EEE 414 ELECTRICAL SERVICES AND DESIGN PROJECT

Group 4

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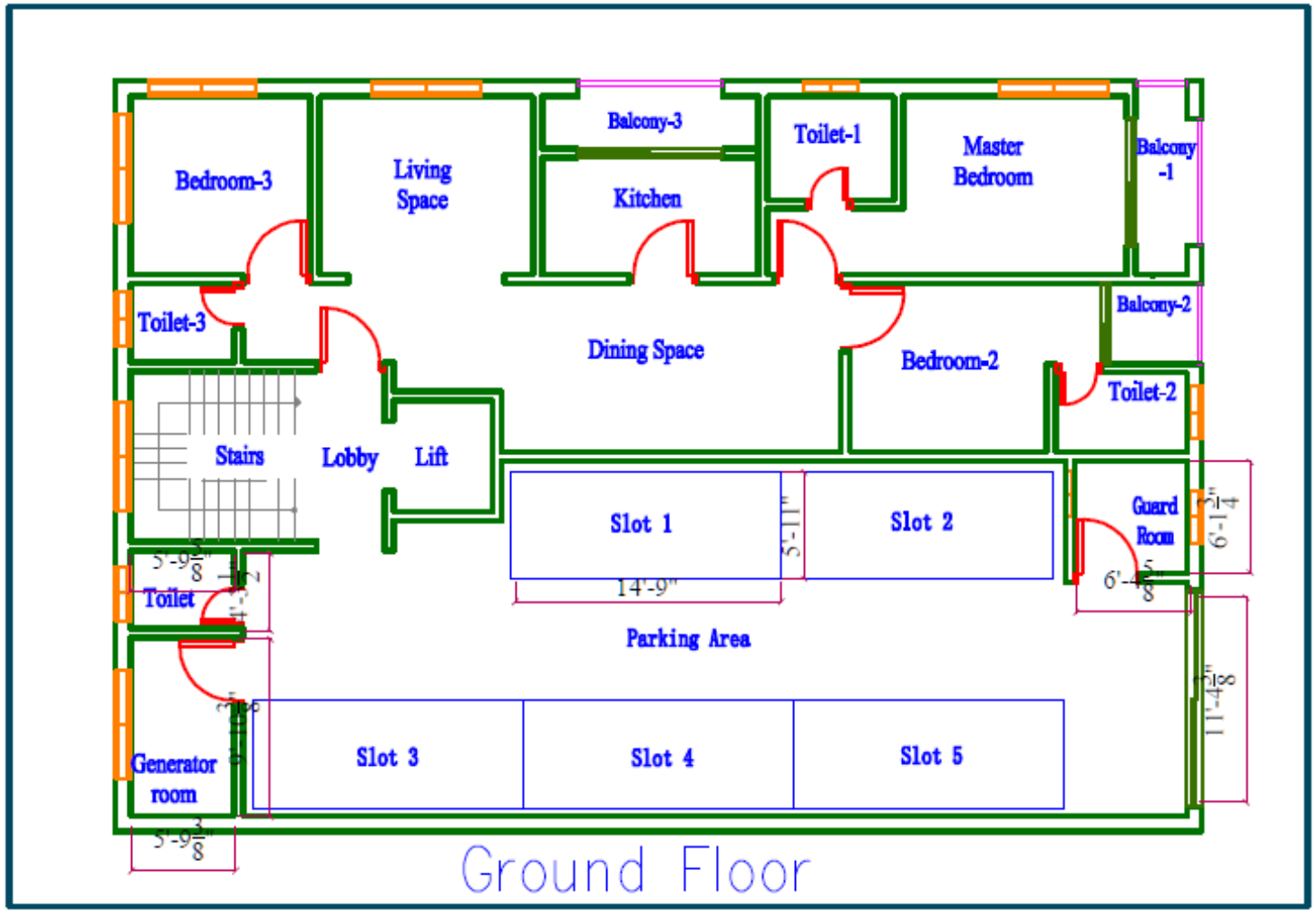
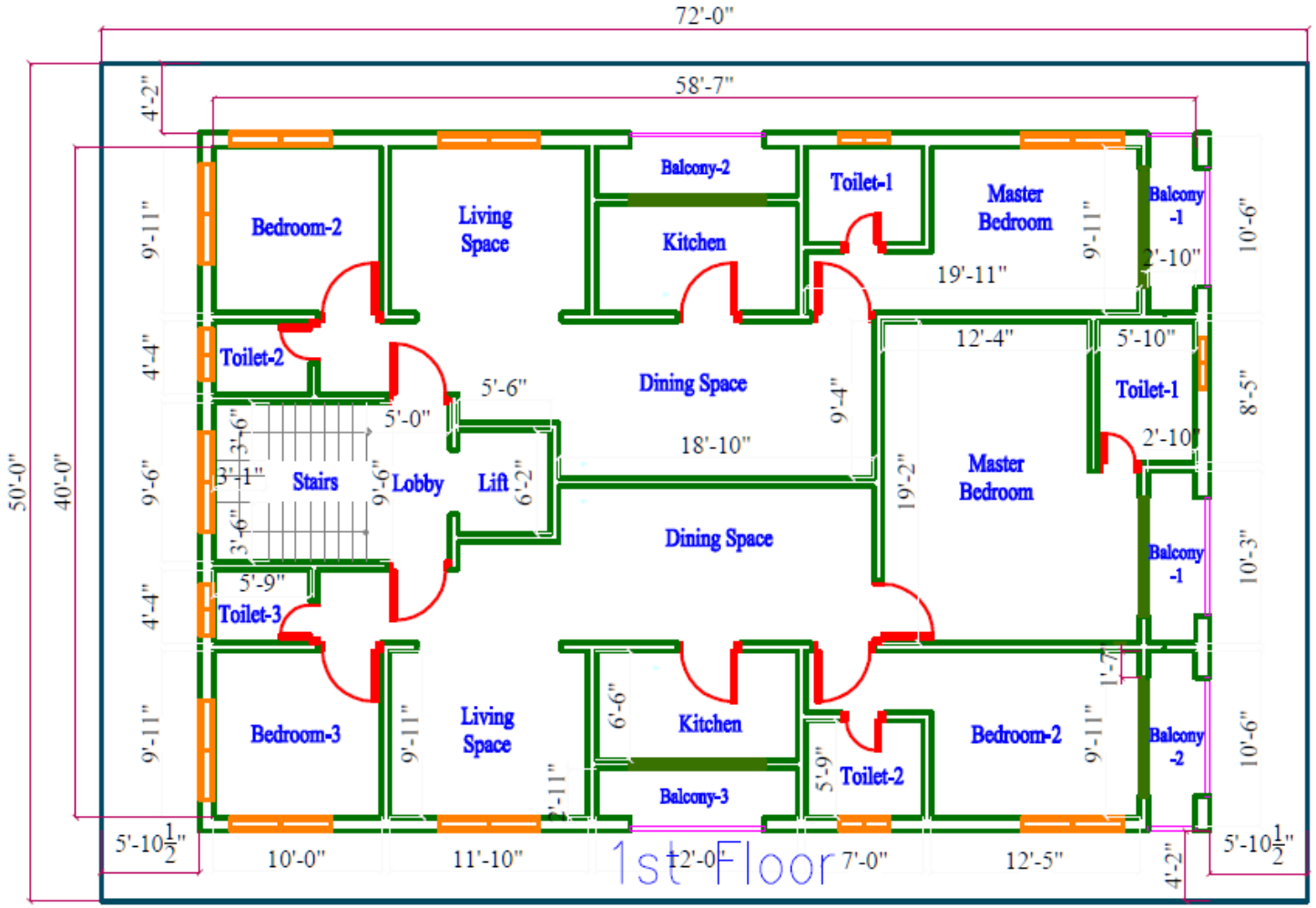
FLOOR PLAN
(GROUND FLOOR)

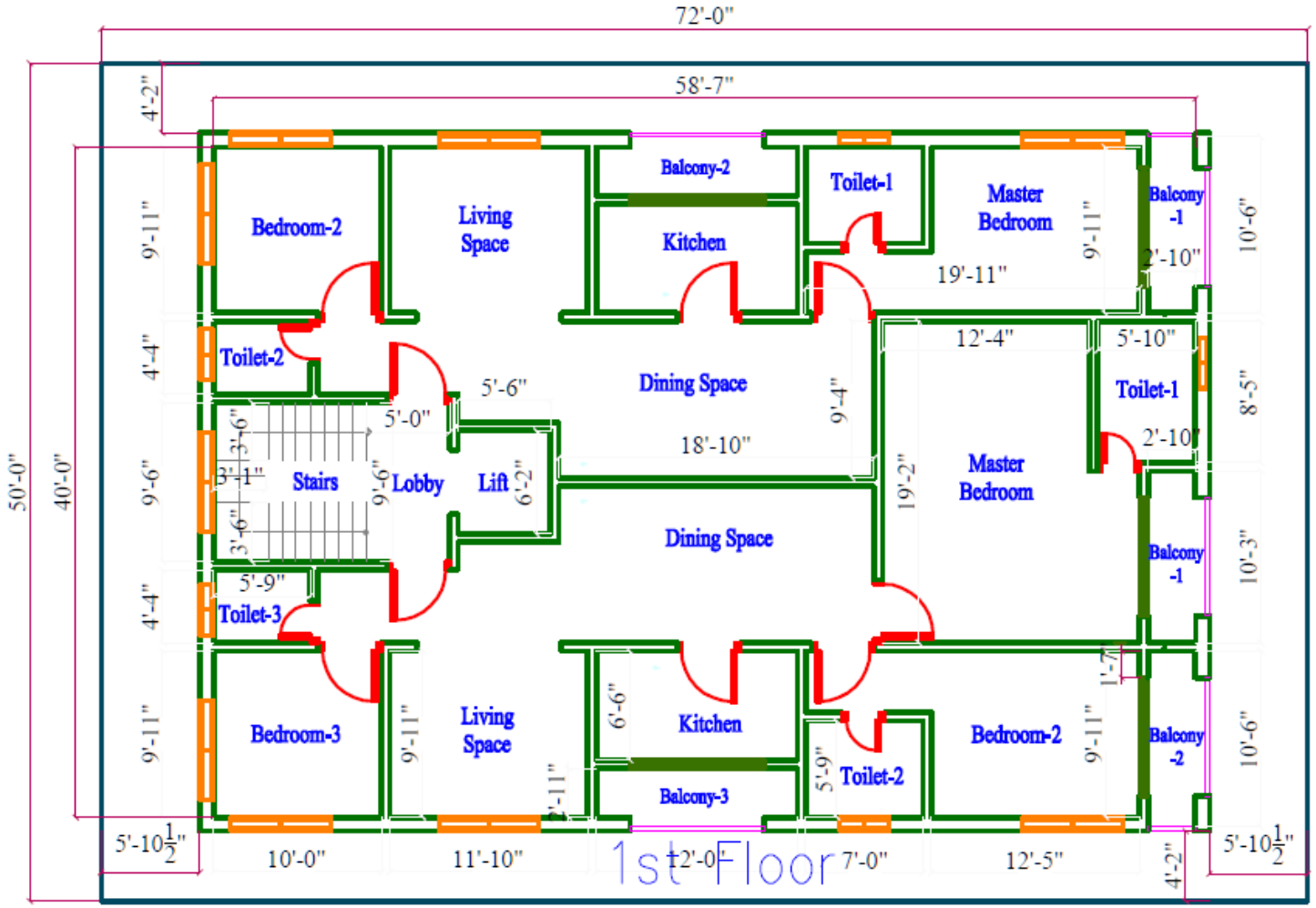


FLOOR PLAN
(FIRST FLOOR)



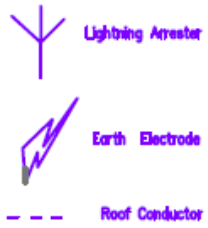
FLOOR PLAN

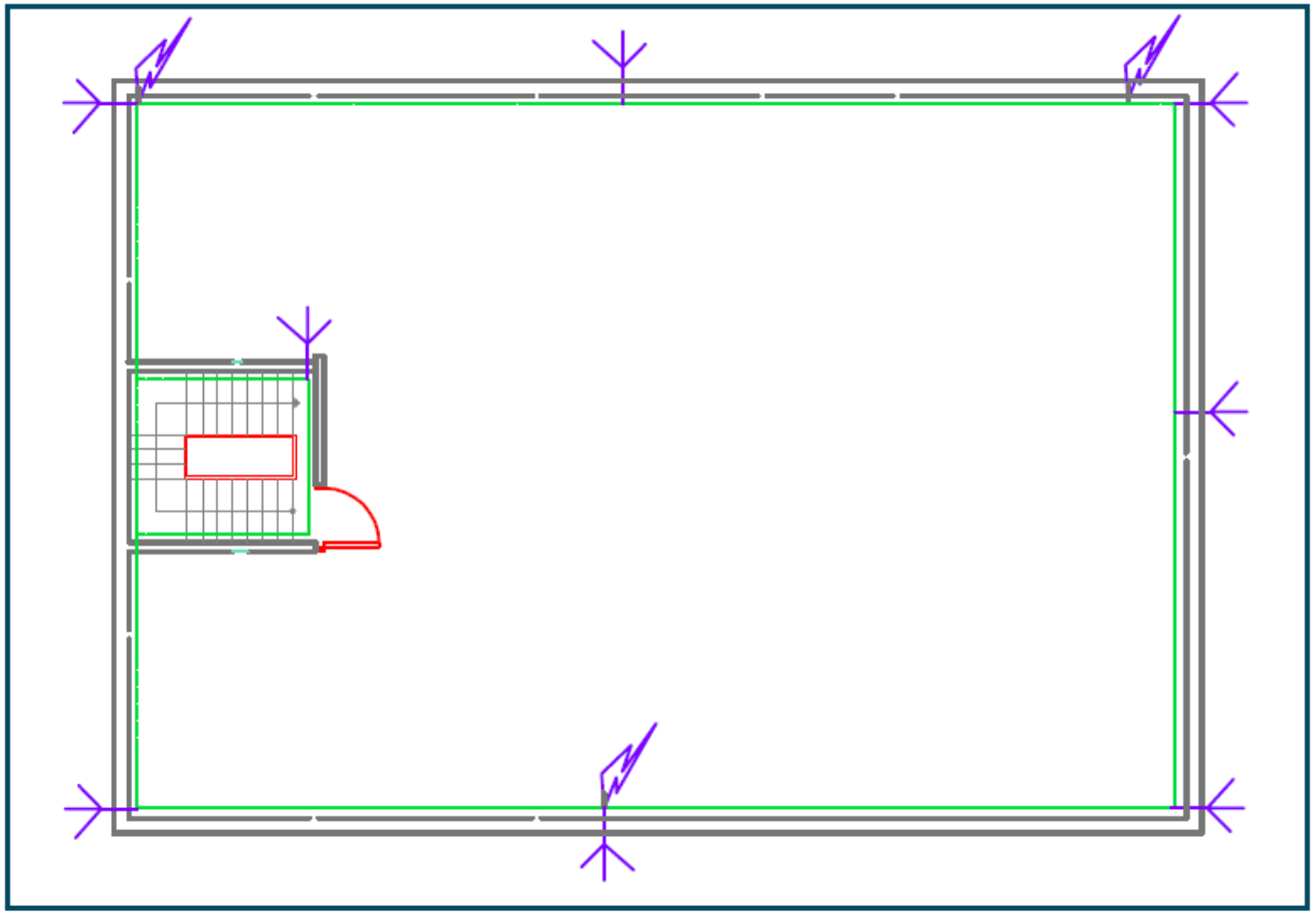
(SECOND TO FIFTH FLOOR)



FLOOR PLAN

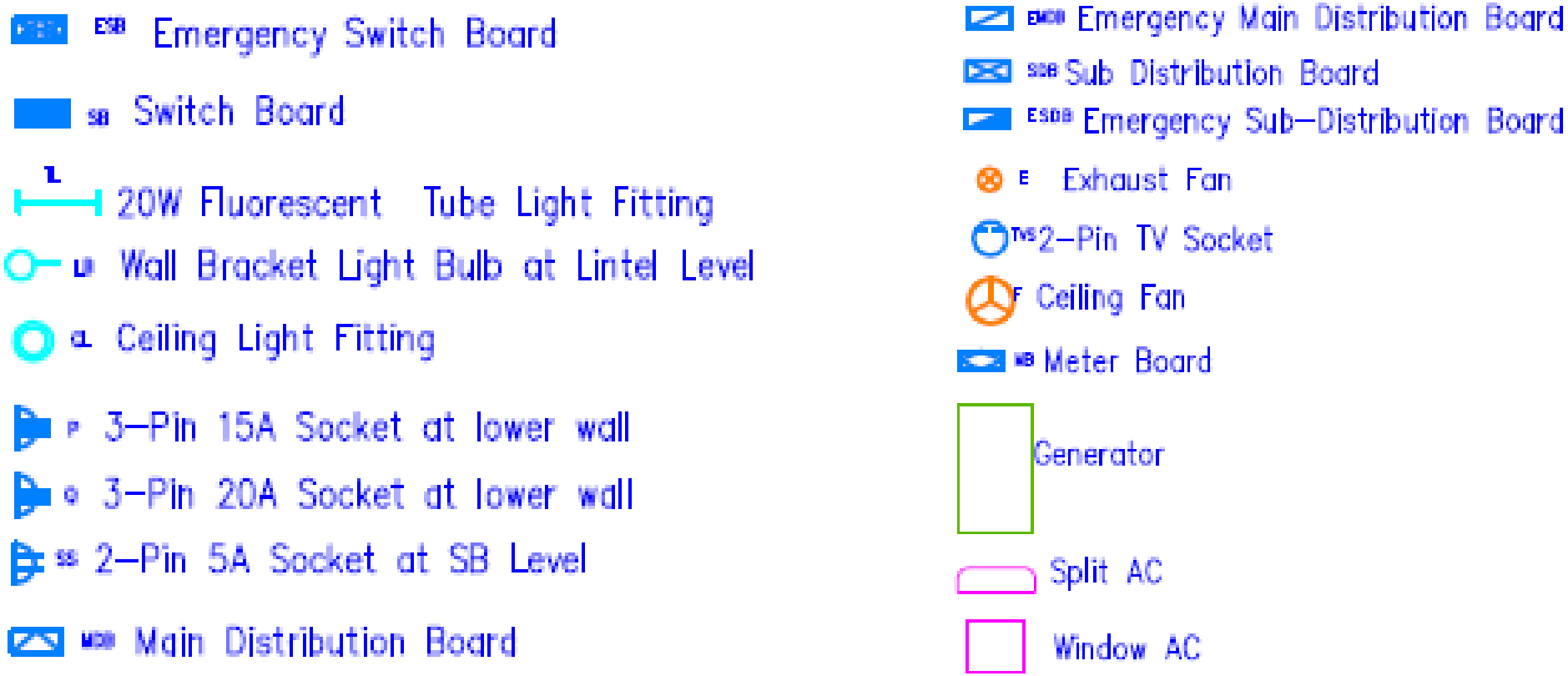
ROOF





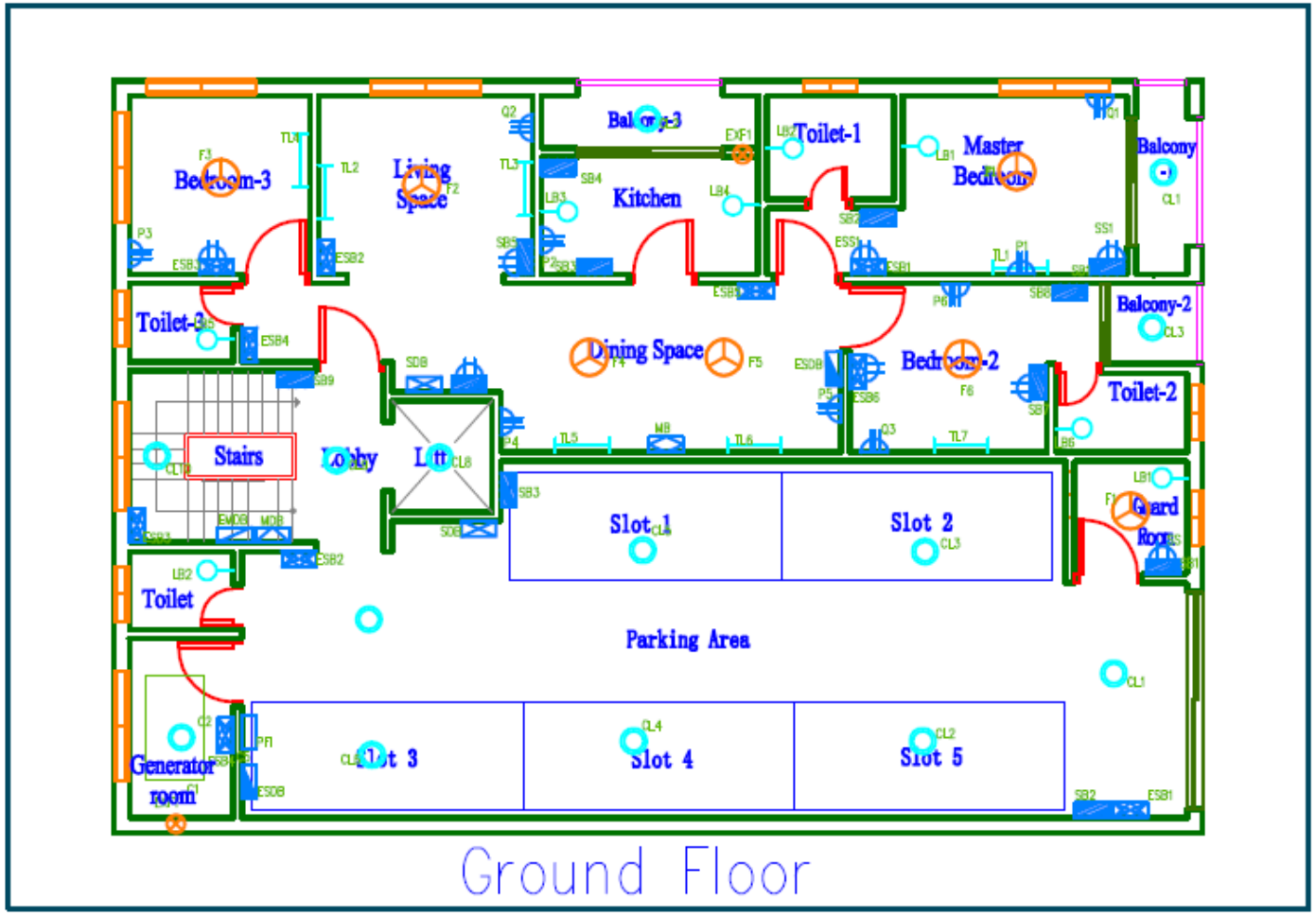
FIXTURES AND FITTINGS

LEGENDS



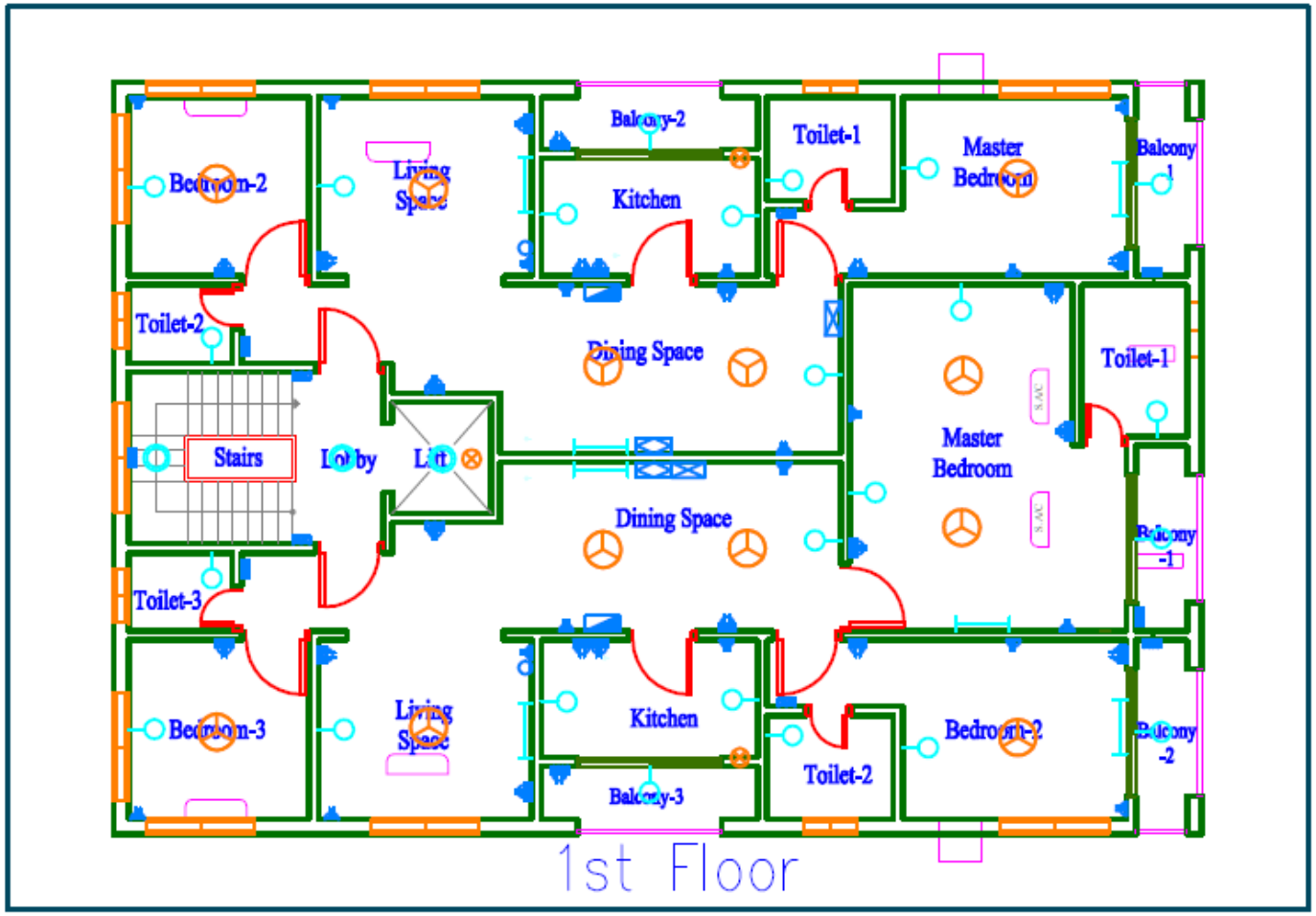
FIXTURES AND FITTINGS

IN LAYOUTS



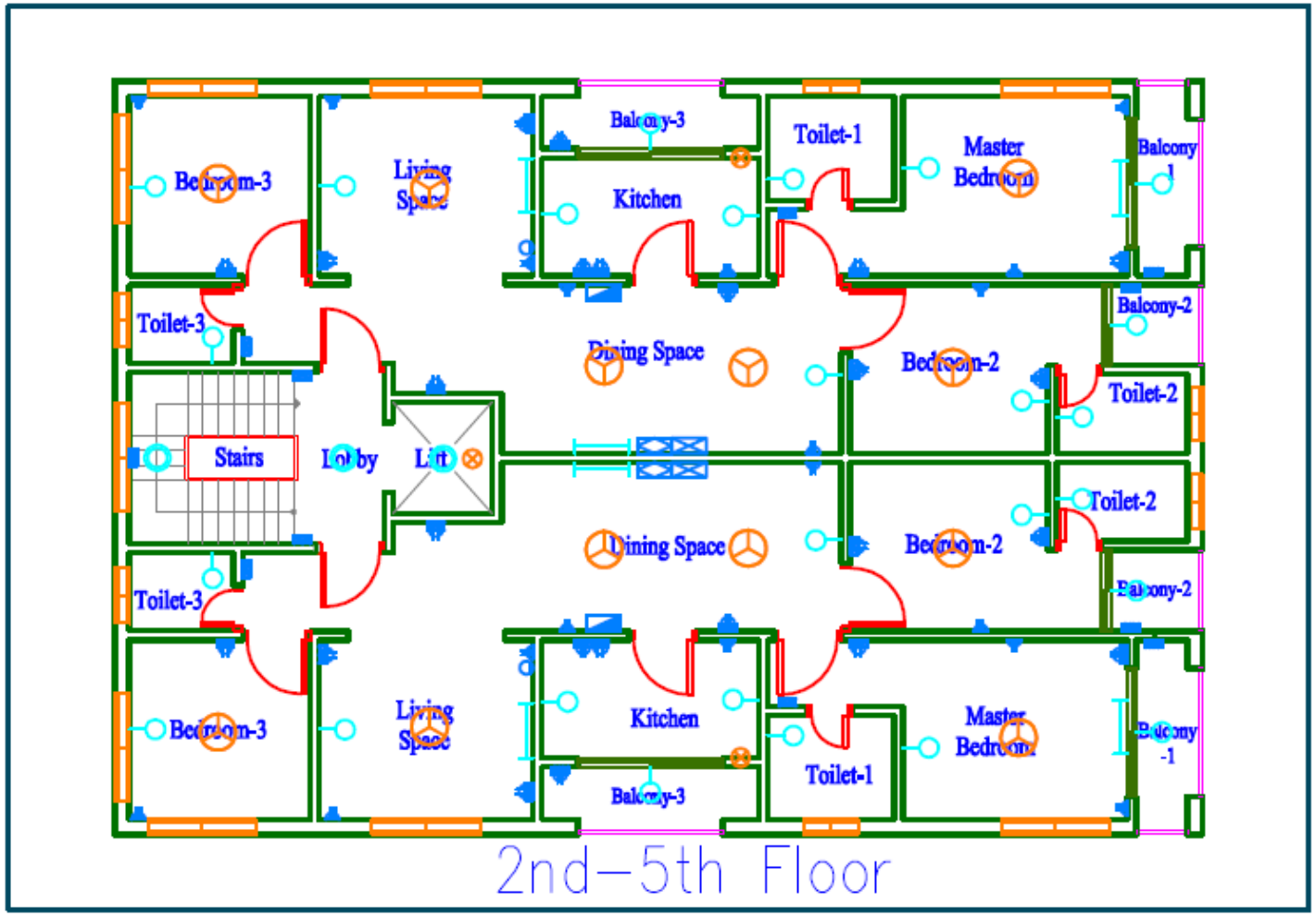
FIXTURES AND FITTINGS

IN LAYOUTS



FIXTURES AND FITTINGS

IN LAYOUTS



CALCULATION OF FITTINGS

$$Number\ of\ Lights, N = \frac{E \times A(m^2)}{n \times F \times UF \times LLF}$$

Assumptions:

Number of lights per illuminaire, n = 1

Flux, F = 1800 Lumen (20W energy saving bulb and fluorescent tube light)

Utilization factor and light loss factor, UF = found from table using room index

Light loss factor, LLF = 0.9

Reflectance:

Ceiling = 0.3

Walls = 0.5

Floor = 0.2

$$\text{Room Index} = \frac{Length * Width}{Mounting\ Height * (Length + Height)}$$

$$Number\ of\ Fans, N = \frac{A(sqft)}{100}$$

Diameter of fan = 56”

Second Floor:

Room	E (Lumen/ m^2)	Length	Width	Room index	Utilization factor	Number of Lights	Number of lights rounded	Number of Fans
Master Bedroom	100	12'5"	9'11"	0.840237687	0.35	1.220195409	2	1
Bedroom-2	100	10'11"	9'4"	0.76680823	0.31	1.009684002	1	1
Bedroom-3	100	10'	9'11"	0.758811715	0.305	0.982707712	1	1
Living Space	150	11'10"	9'11"	0.822239847	0.34	1.744306189	2	1
Dining Space	100	18'10"	9'4"	0.951072189	0.36	1.741897591	2	2
Kitchen	160	12'	6'6"	0.642551351	0.2	1.236725268	2	1
Toilet-1	100	7'	5'9"	0.481105882	0.15	0.398863718	1	0
Toilet-2	100	7'3"	4'4.5"	0.415822581	0.12	0.314321952	1	0
Toilet-3	100	5'9"	4'4"	0.376591736	0.11	0.246915635	1	0
Balcony-1	70	10'6"	2'10"	0.3400425	0.1	0.20636862	1	0
Balcony-2	70	4'10"	4'5.5"	0.353435874	0.15	0.157686	1	0
Balcony-3	70	12'	2'11"	0.357586592	0.17	0.2477987	1	0

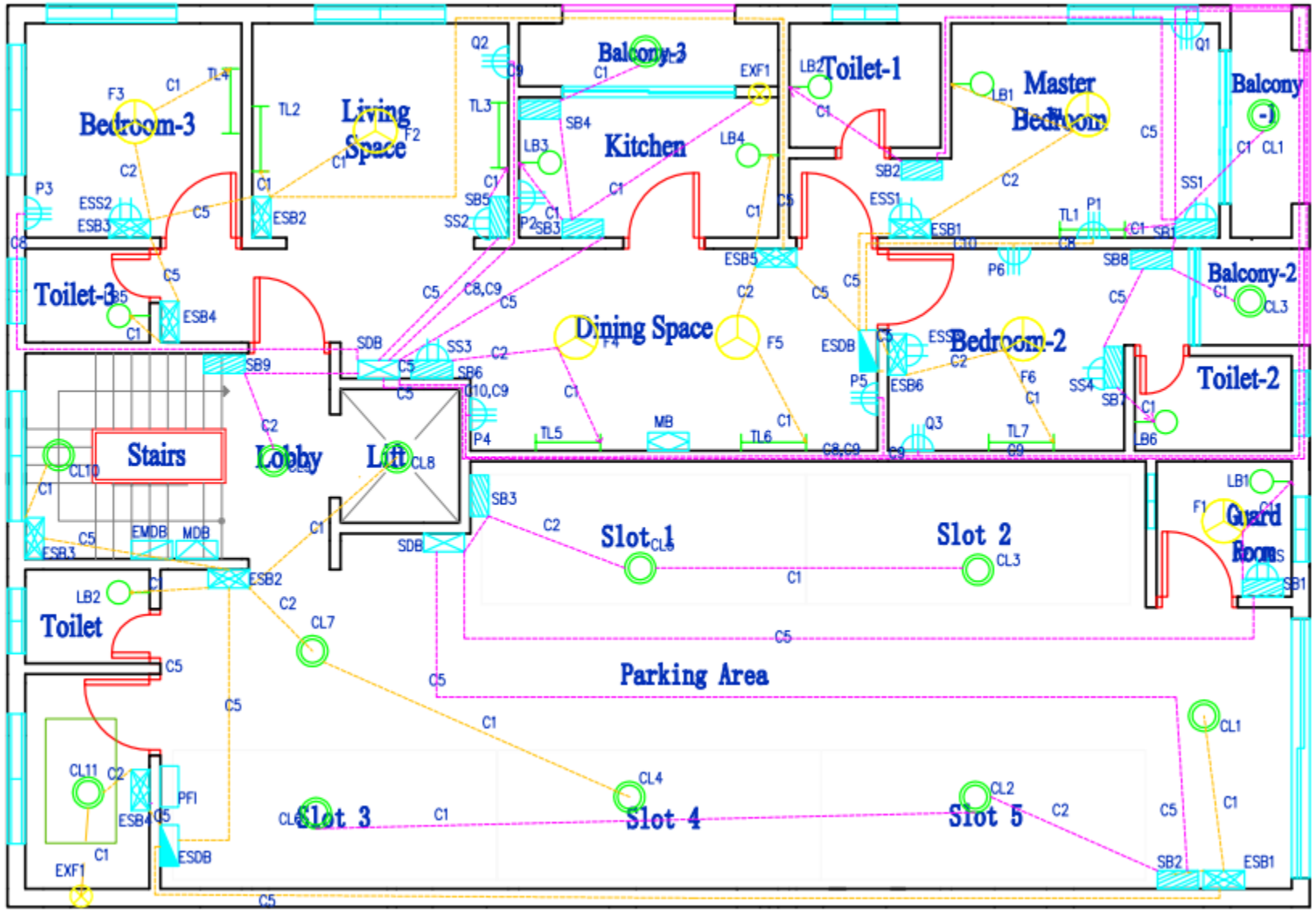
First Floor (Owner's Bigger Unit):

Room	E (Lumen/ m^2)	Length	Width	Room index	Utilization factor	Number of Lights	Number of lights rounded	Number of Fans
Master Bedroom	100	19'2"	12'4"	1.143672	0.39	3.475981	3	2.363889
Toilet-1	100	8'5"	5'10"	0.525082	0.175	1.608918	1	
Balcony-1	70	10'3"	2'10"	0.338289	0.1	1.165828	1	

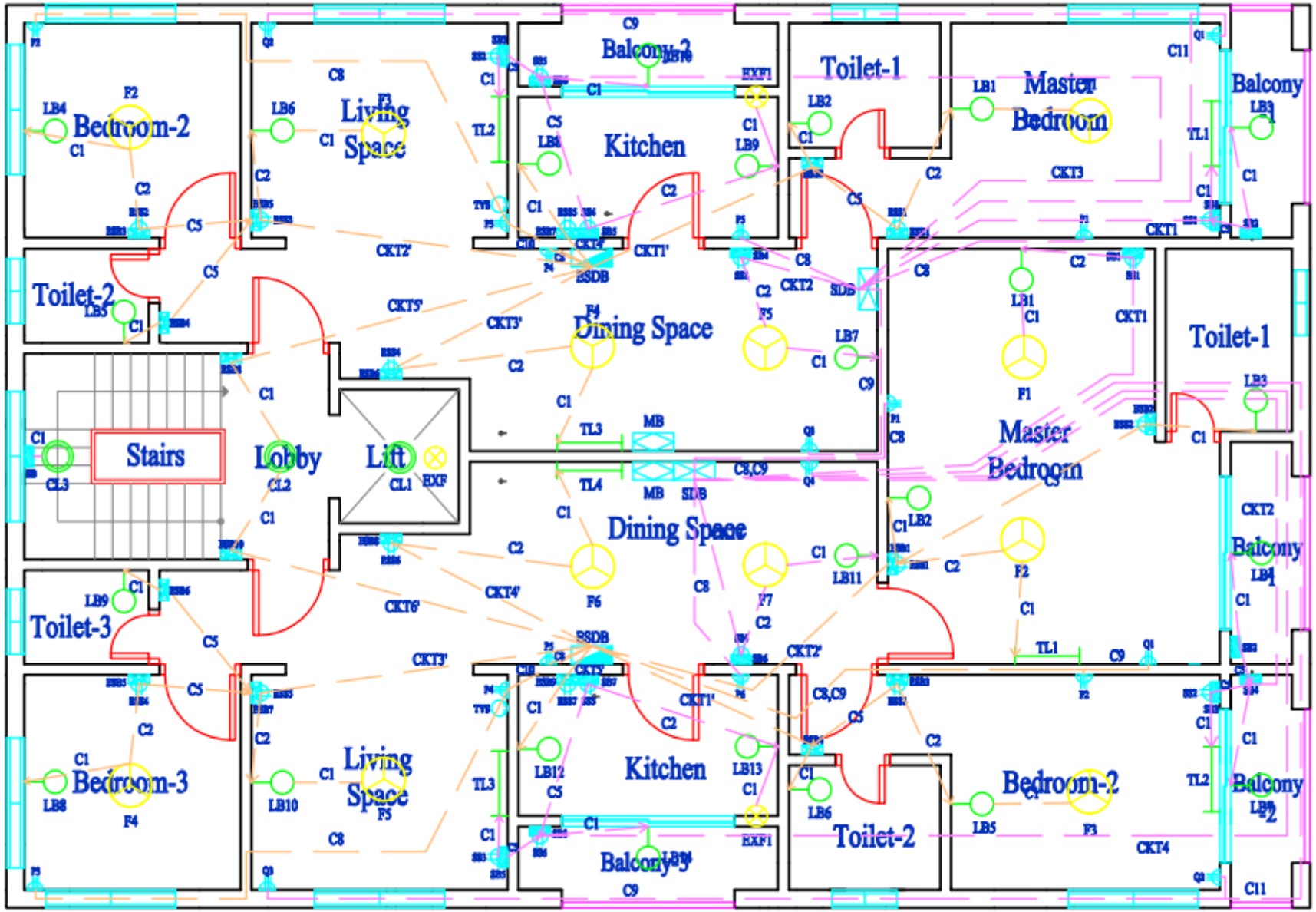
Ground Floor:

Room	E (Lumen/ m^2)	Length	Width	Room index	Utilization factor	Number of Lights	Number of lights rounded	Number of Fans
Guard Room	100	6'3"	6'3"	0.47625	0.15	1.493426	1	1
Toilet	100	5'9"	4'4"	0.376592	0.11	1.299009	1	
Generator Room	70	9'11"	5'9"	0.554679	0.19	1.204739	1	1
Parking Area	70	52'4"	19'9"	2.185222	0.54	7.683599	7	
Common space								
Stairs	80	9'6"	9'1"	0.707669	0.28	0.684097	1	
Lobby	80	9'6"	5'	0.499241	0.17	0.376567	1	
Lift	80	6'2"	5'6"	0.443049	0.13	0.268882	1	1

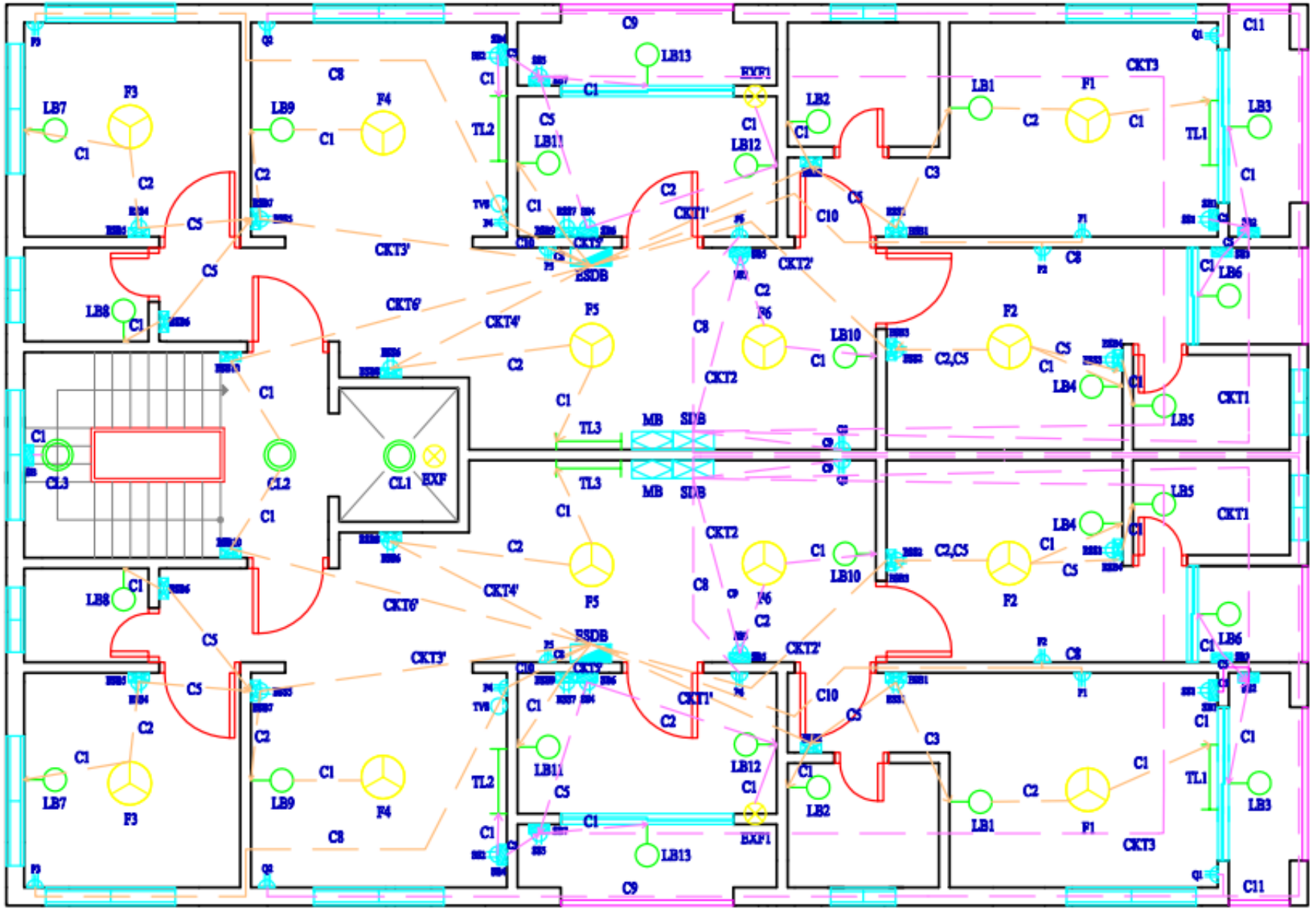
CONDUIT (GROUND FLOOR)



CONDUIT (FIRST FLOOR)



CONDUIT (SECOND TO FIFTH FLOOR)



CALCULATION FOR CONDUITS

Formula:

$$Ampere\ Rating, I = \frac{P}{V \times pf}\ A$$

Assumptions:

Voltage, V = 220 V

Power factor, pf = 0.7

Light Bulb (LB) = 20 W

Tube Light (TL) = 20 W

Ceiling Light (CL) = 20 W

Ceiling Fan (F) = 100 W

Exhaust Fan (EXF) = 60 W

Switchboard Socket (SS) = 100 W

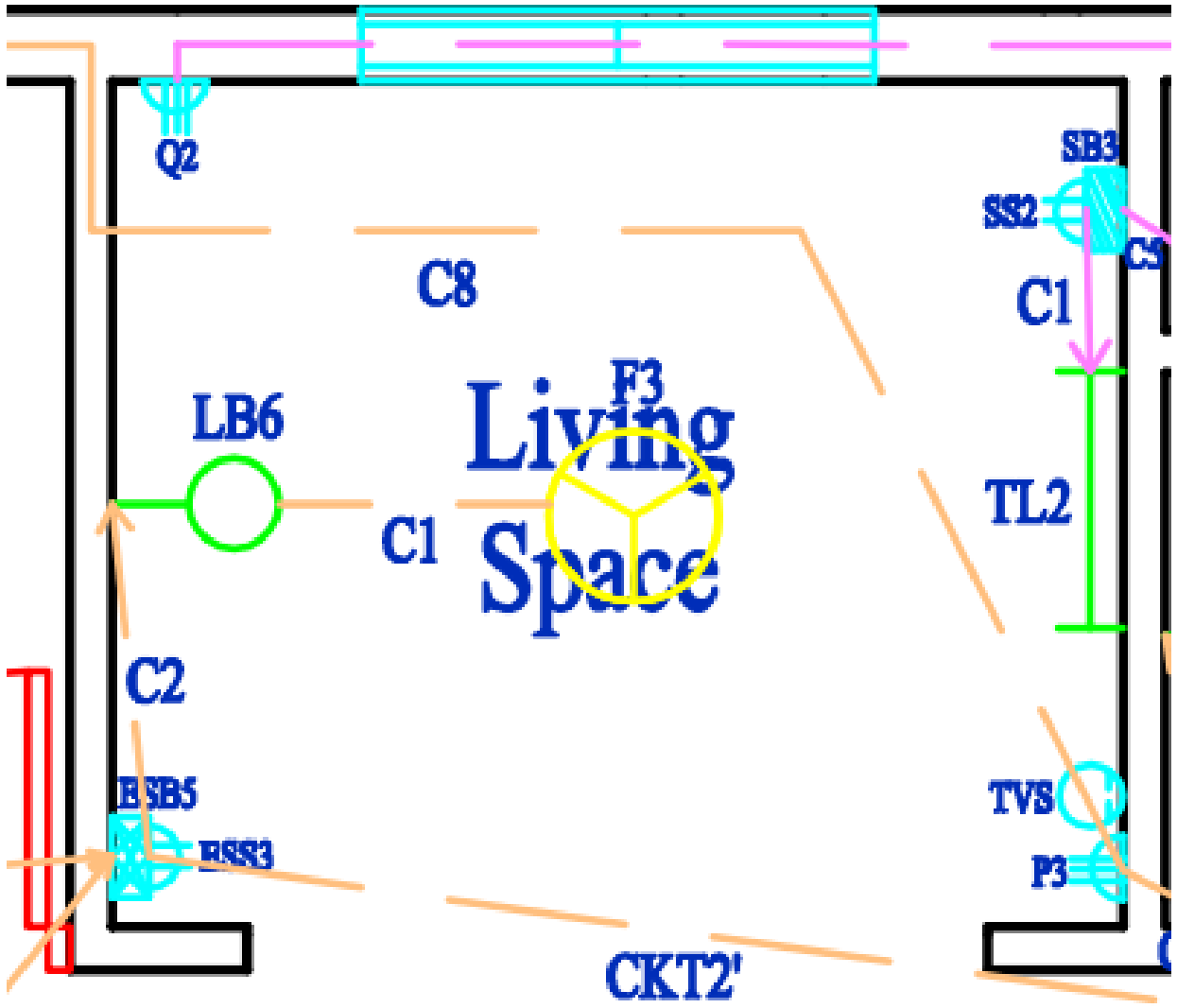
Emergency Switchboard Socket (ESS) = 100 W

It is seen that, all Internal wires are below 5 A rating so 2x1.5 rm BYM is used in all internal wiring.

LEGENDS FOR CONDUITS

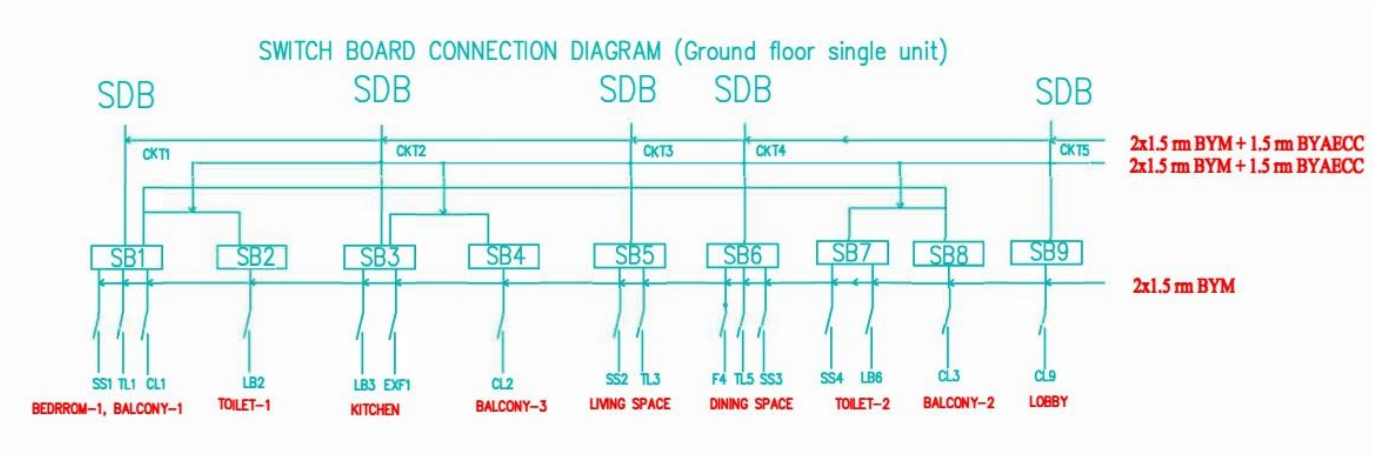
Symbol	Containing Power Cable
C1	2x1.5 rm BYM
C2	4x1.5 rm BYM
C3	6x1.5 rm BYM
C4	8x1.5 rm BYM
C5	2x1.5 rm BYM+1.5 rm BYAECC
C8	2x4 rm BYM + 4 rm BYAECC
C9	2x6 rm BYM + 6 rm BYAECC
C10	4x4 rm BYM + 2x4 rm BYAECC
C11	4x6 rm BYM + 2x6 rm BYAECC
C12	2x 16 rm BYM + 16 rm BYA ECC

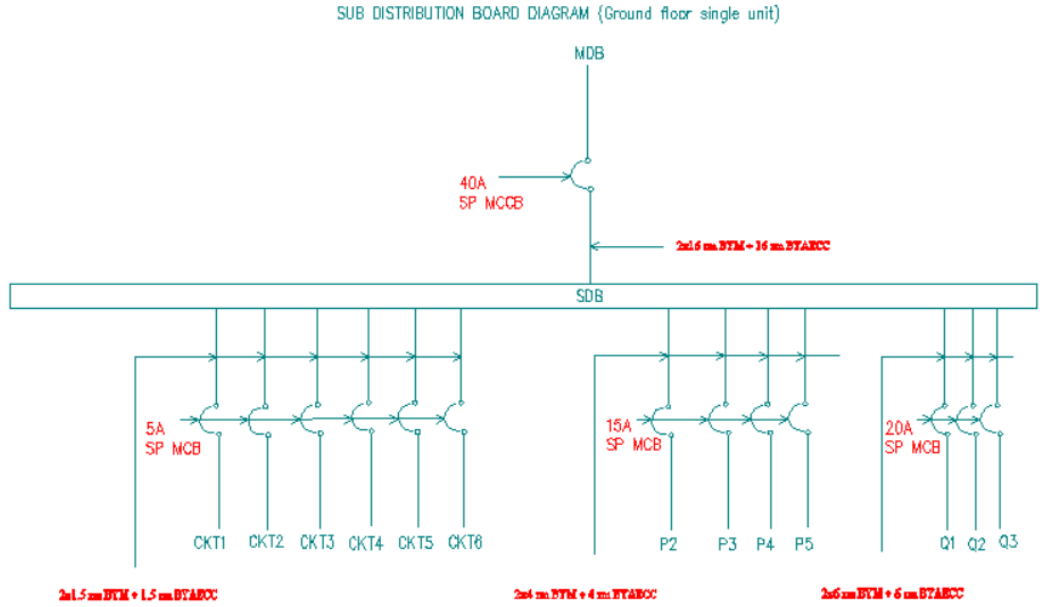
CONDUIT



SWITCHBOARD CONNECTION DIAGRAM

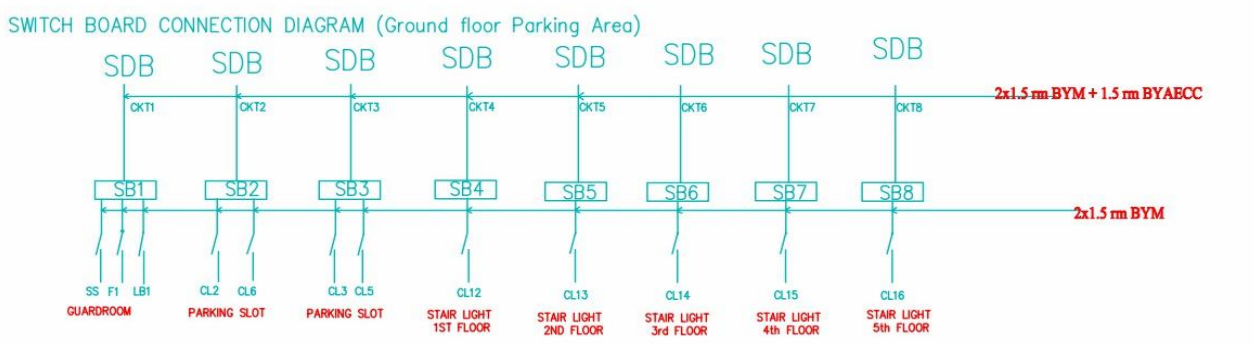
(GROUND FLOOR SINGLE UNIT)

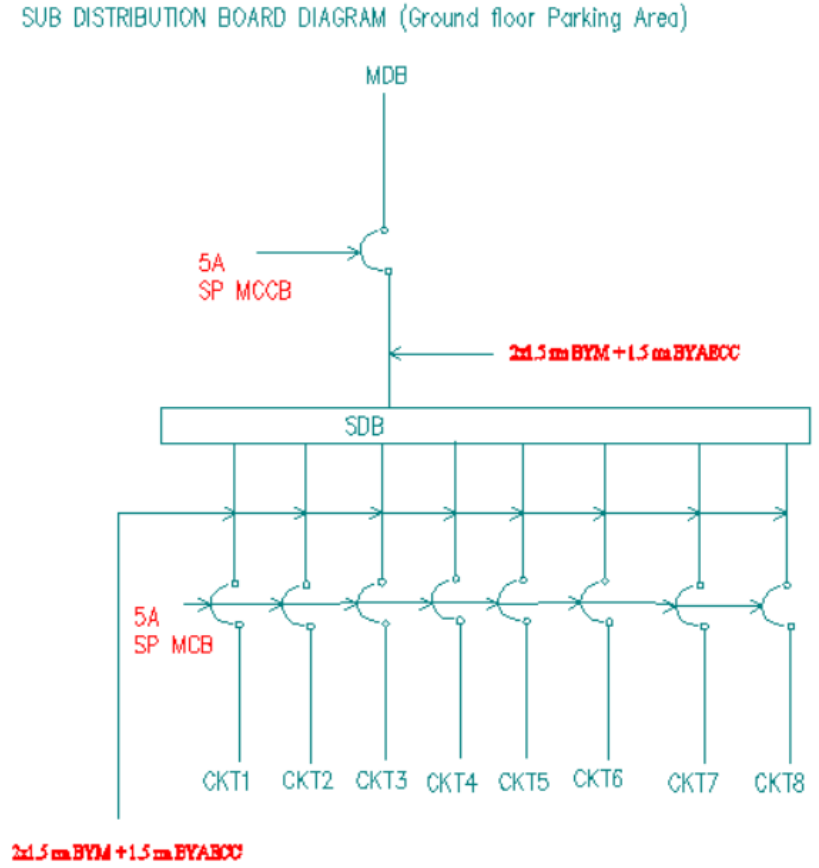




SWITCHBOARD CONNECTION DIAGRAM

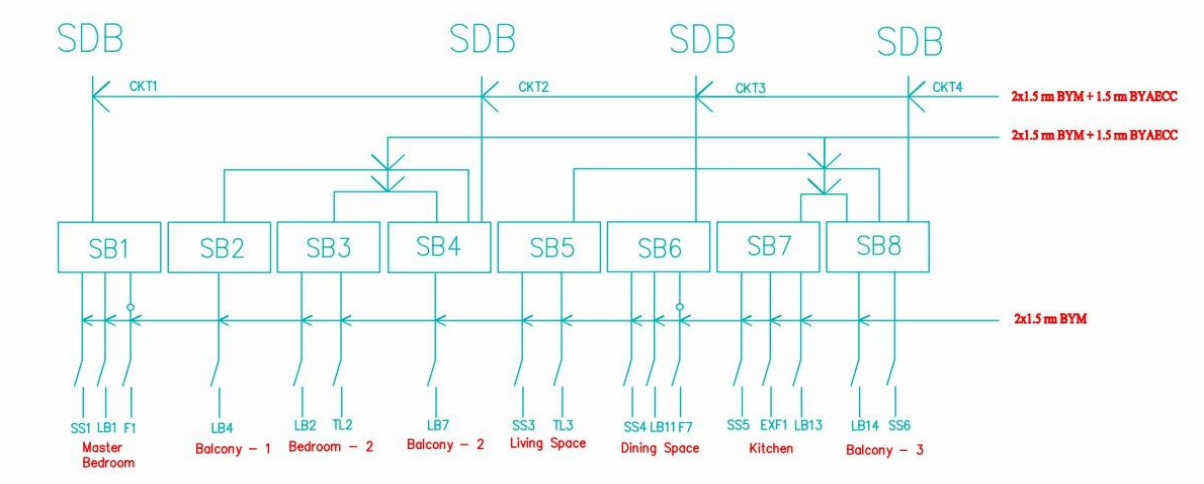
(GROUND FLOOR PARKING AREA)

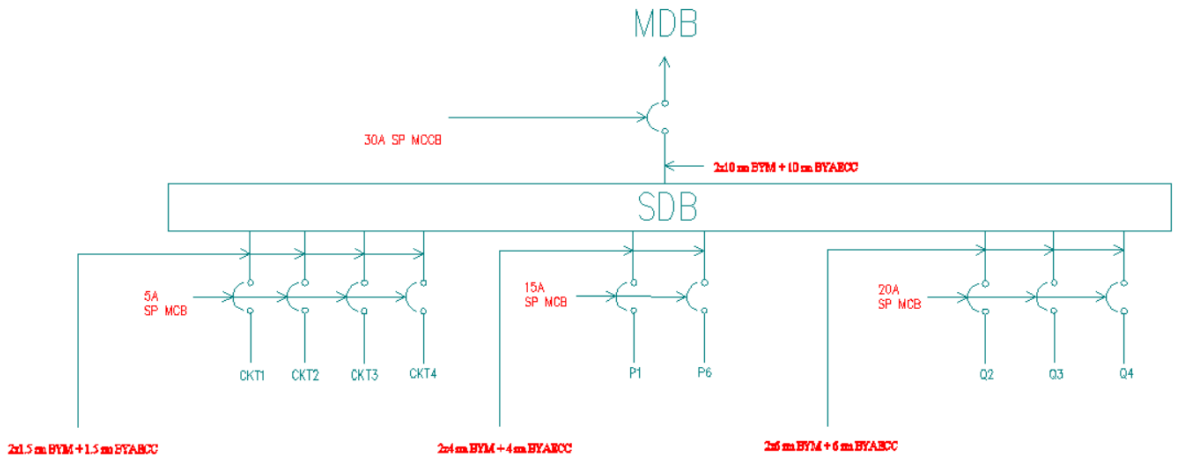




SWITCHBOARD CONNECTION DIAGRAM

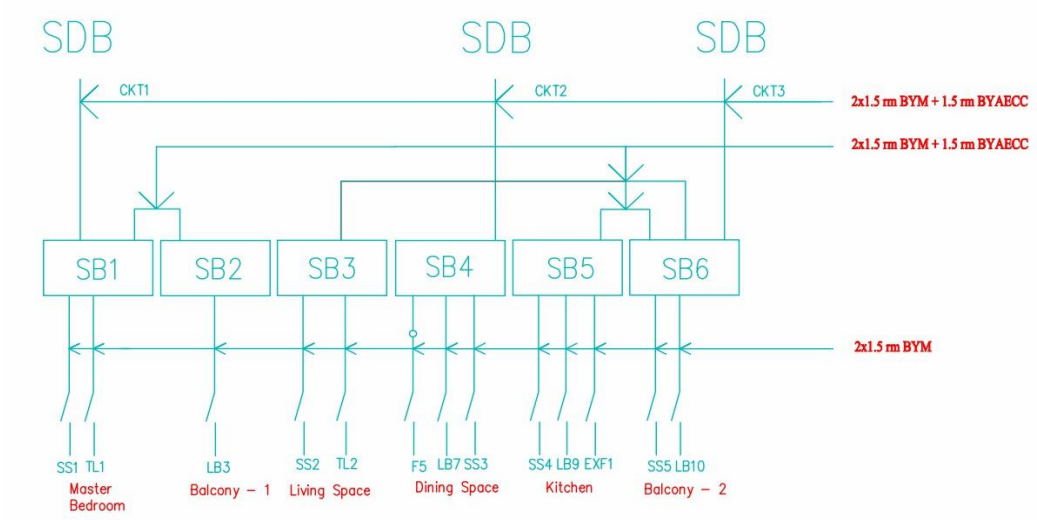
(1ST FLOOR (OWNER'S BIGGER UNIT))

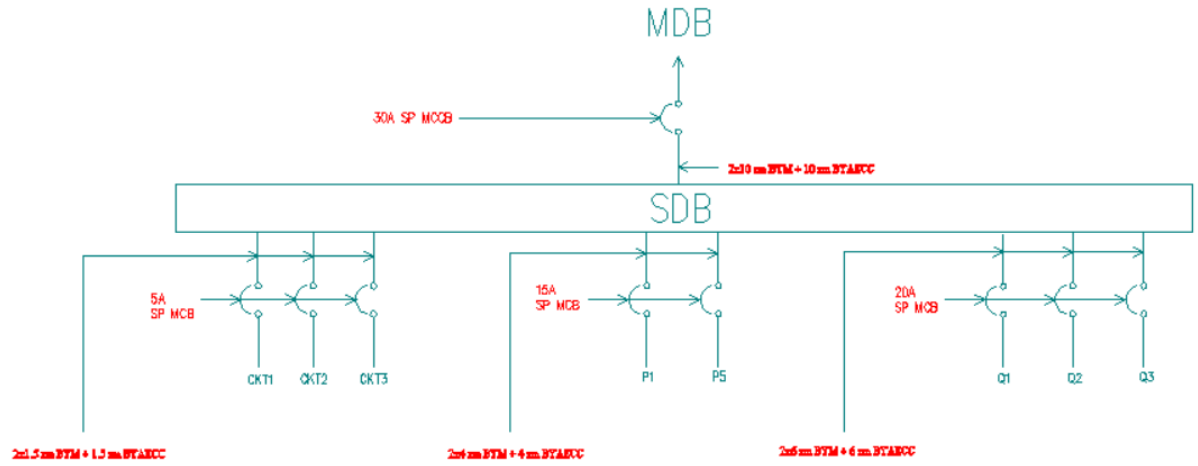




SWITCHBOARD CONNECTION DIAGRAM

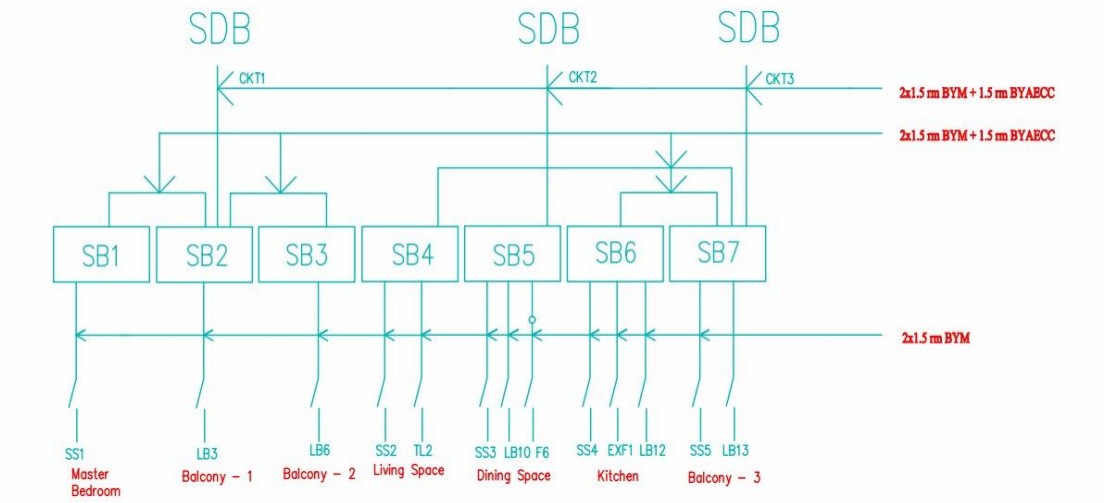
(1ST FLOOR (SMALLER UNIT))

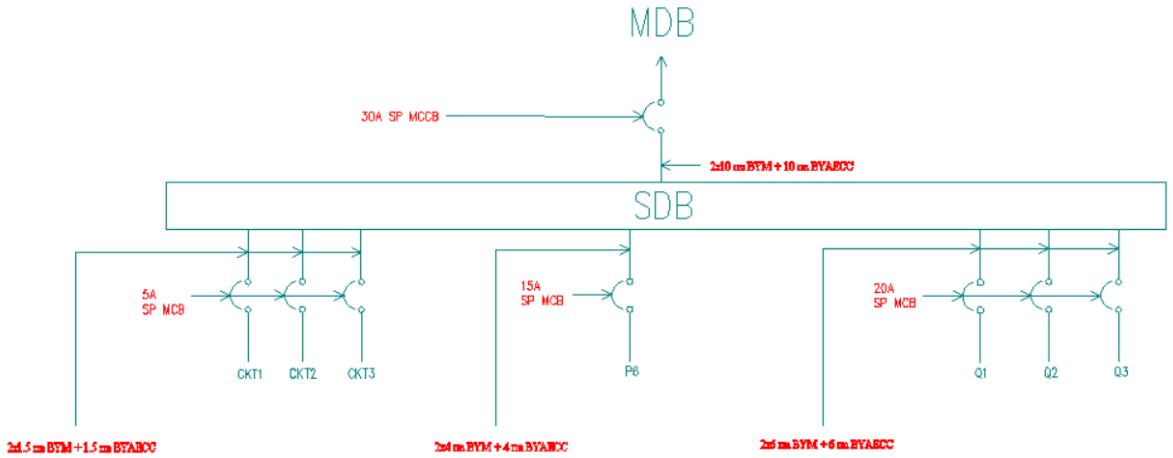




SWITCHBOARD CONNECTION DIAGRAM

(2ND TO 5TH FLOOR TYPICAL UNIT)





CALCULATION FOR SDB

Formula:

SDB load = Total load x 0.7 + Total P socket load x 0.2 + Total Q socket load x 0.2

$$SDB\ current = \frac{SDB\ load}{Voltage\ \times pf}$$

Assumptions:

P load = 3000 W

Q load = 4000 W

Voltage = 220 V

Power factor, pf = 0.7

SAMPLE CALCULATION FOR SDB

Ground Floor (Single Unit):

Sub-Distribution Board (SDB):

Total load = CKT1 load + CKT2 load + CKT3 load + CKT4 load + CKT5 load

CKT1 load = 100 + 20 + 20 + 20 + 140 = 300 W

CKT2 load = 20 + 60 + 20 = 100 W

CKT3 load = 100 + 20 = 120 W

CKT4 load = 100 + 20 + 100 = 220 W

CKT5 load = 20 W

Total load = 760 W

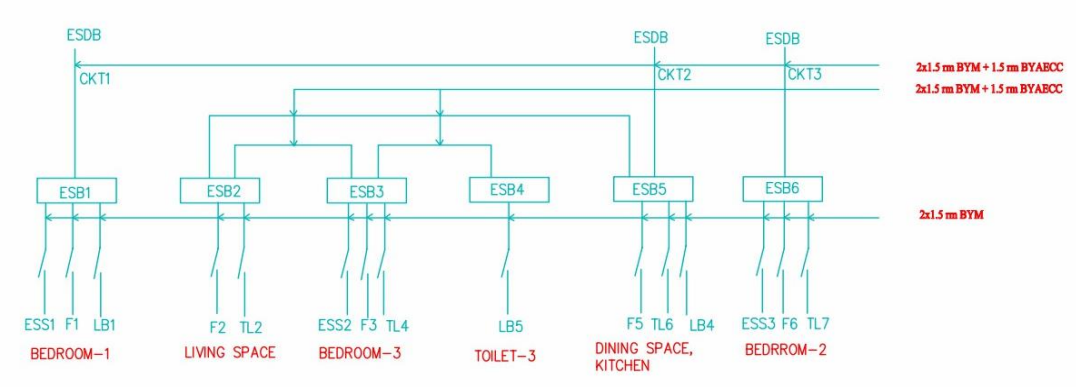
SDB load = 760 x 0.7 + 4 x 3000 x 0.2 + 3 x 4000 x 0.2 = 5332 W

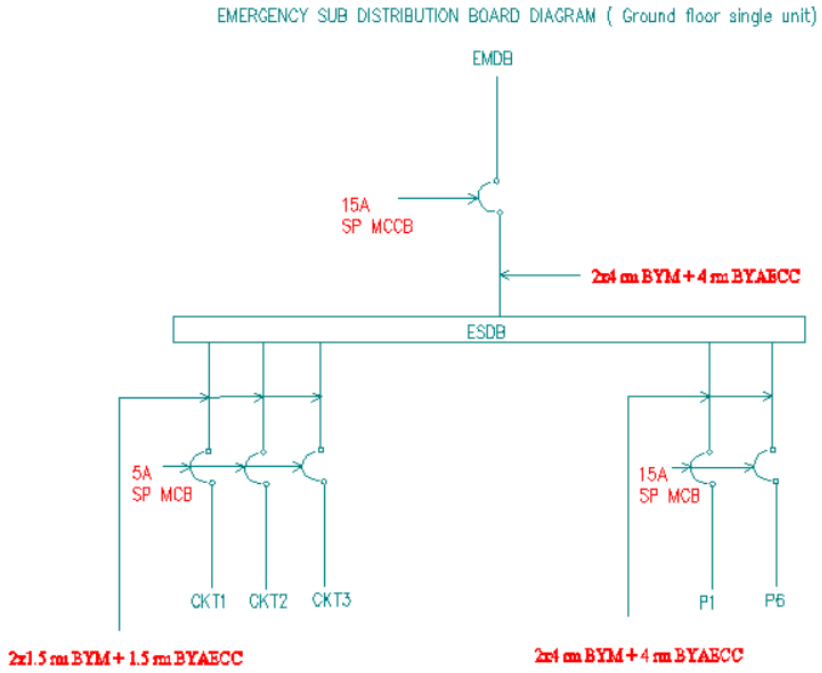
$$SDB\ current = \frac{5332}{220\ \times 0.7} = 34.62\ A$$

So, 40 A SP MCCB is needed from SDB to MDB

SWITCHBOARD CONNECTION DIAGRAM

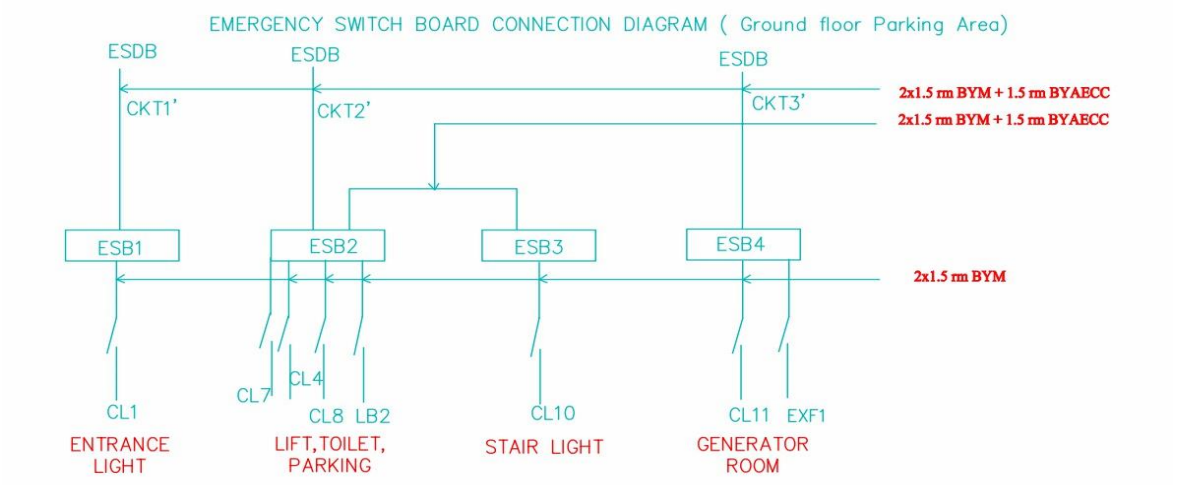
EMERGENCY SWITCHBOARD OF GROUND FLOOR SINGLE UNIT

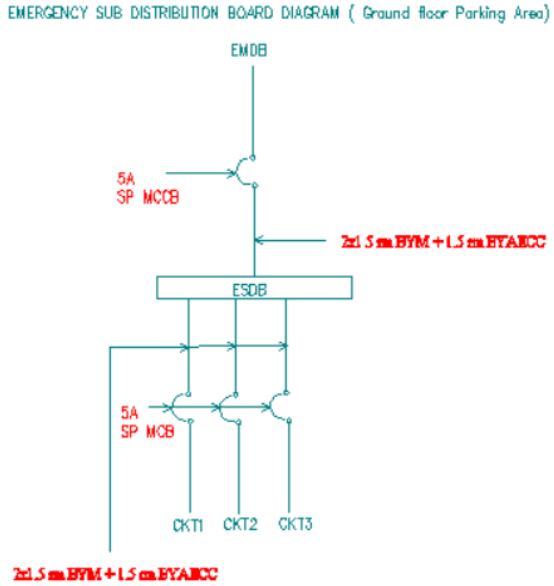




SWITCHBOARD CONNECTION DIAGRAM

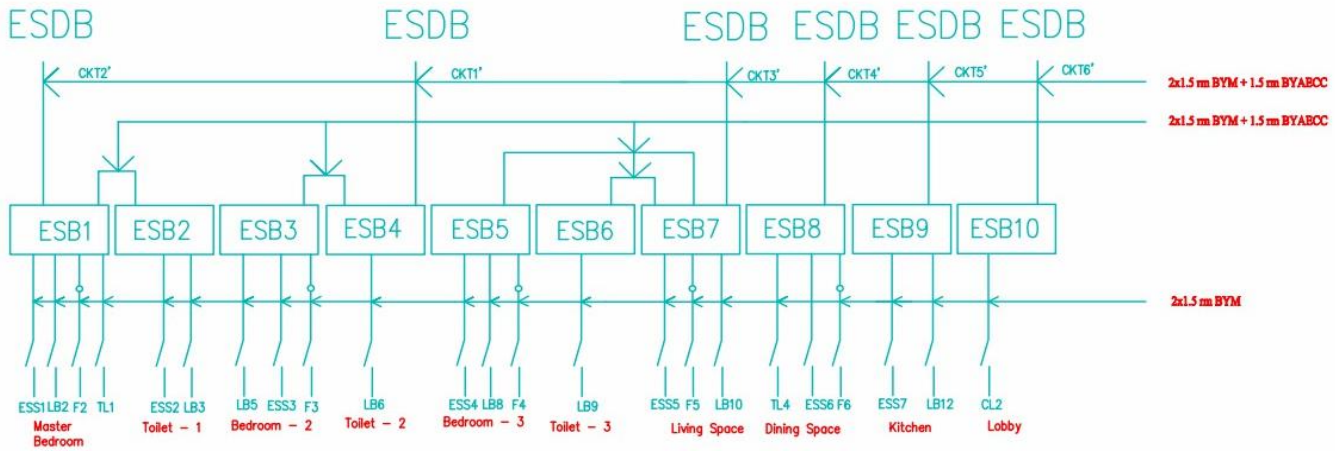
EMERGENCY SWITCHBOARD OF GROUND FLOOR PARKING AREA

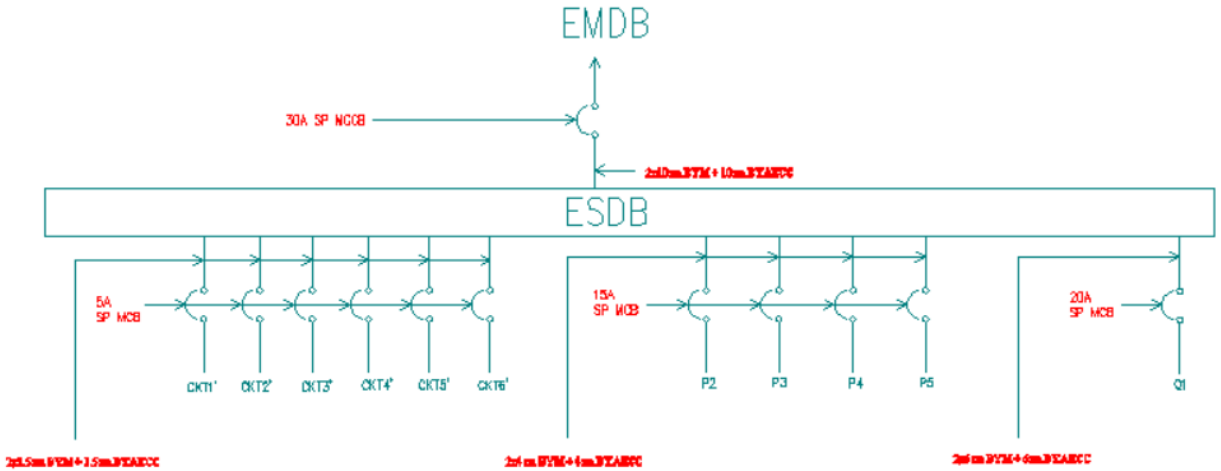




SWITCHBOARD CONNECTION DIAGRAM

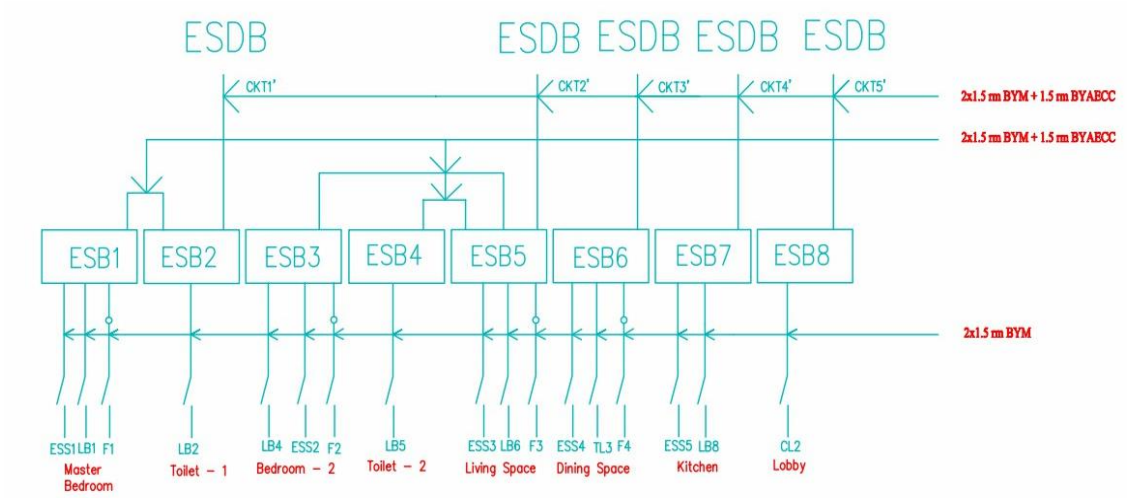
EMERGENCY SWITCHBOARD OF 1ST FLOOR (OWNER'S BIGGER UNIT)

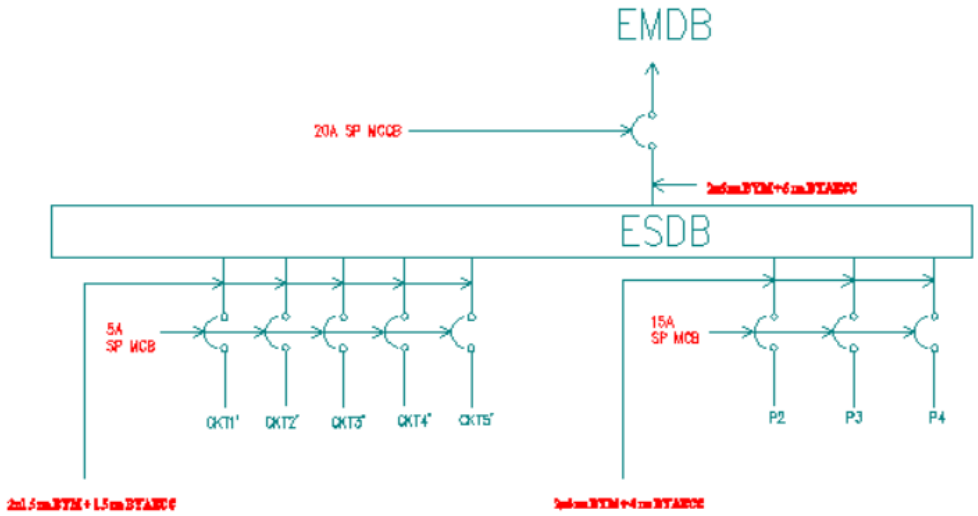




SWITCHBOARD CONNECTION DIAGRAM

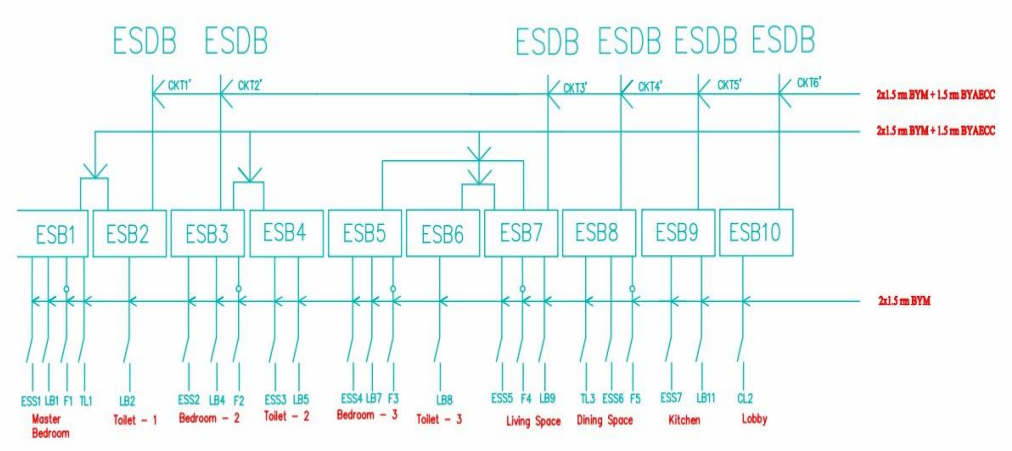
EMERGENCY SWITCHBOARD OF 1ST FLOOR (SMALLER UNIT)

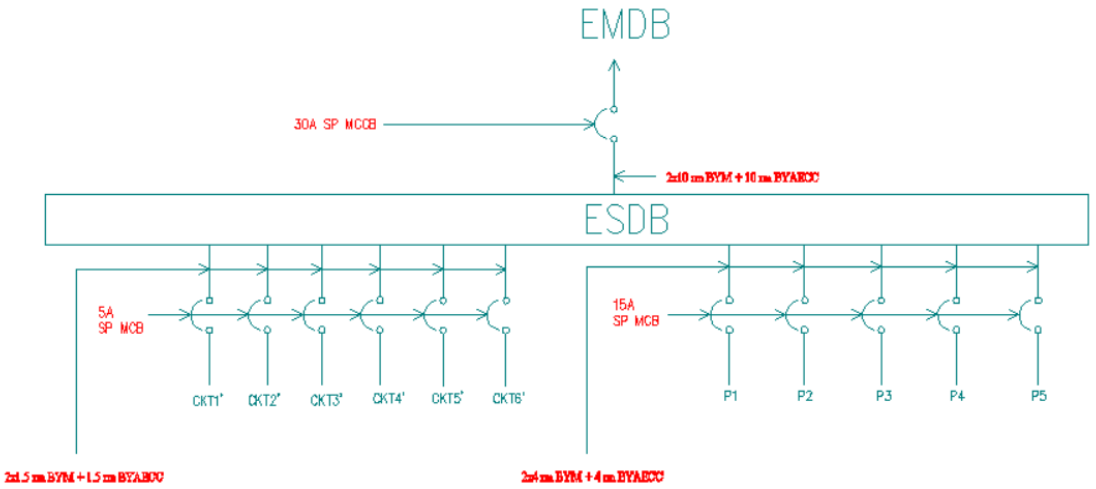




SWITCHBOARD CONNECTION DIAGRAM

EMERGENCY SWITCHBOARD OF 2ND FLOOR TYPICAL UNIT





SAMPLE CALCULATION FOR EMERGENCY SWITCHBOARDS(ESDB)

Formula:

ESDB load = Total load x 0.7 + Total P socket load x 0.2 + Total Q socket load x 0.2

$$ESDB\ current = \frac{ESDB\ load}{Voltage\ \times pf}$$

Assumptions:

P load = 3000 W

Q load = 4000 W

Voltage = 220 V

Power factor, pf = 0.7

SAMPLE CALCULATION FOR EMERGENCY SWITCHBOARDS

Emergency Sub-Distribution Board (ESDB):

Total load = CKT1' load + CKT2' load + CKT3' load + CKT4' load + CKT5' load + CKT6' load

CKT1' load = 220 + 20 = 240 W

CKT2' load = 120 + 100 + 100 + 20 + 20 = 360 W

CKT3' load = 220 + 20 + 100 + 100 + 20 = 460 W

CKT4' load = 100 + 100 + 20 = 220 W

CKT5' load = 100 + 20 = 120 W

CKT6' load = 20 W

Total load = 1420 W

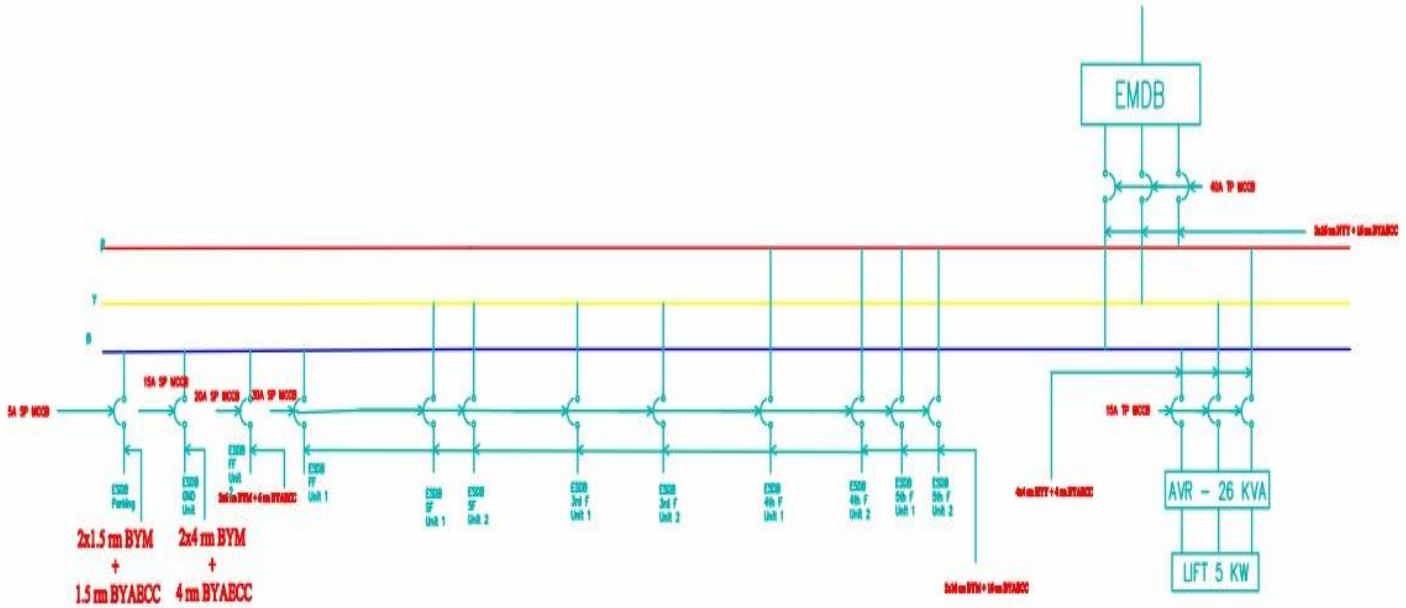
ESDB load = 1420 x 0.7 + 4 x 3000 x 0.2 + 1 x 4000 x 0.2 = 4194 W

$$ESDB\ current = \frac{4194}{220 \times 0.7} = 27.234\ A$$

So, 30 A SP MCCB is needed from ESDB to EMDB

SWITCHBOARD CONNECTION DIAGRAM

EMERGENCY MAIN DISTRIBUTION BOARD



CALCULATION FOR EMERGENCY DISRIBUTION BOARD

- **Calculations for EMDB:**

  EMDB Load = Total ESDB Load x 0.7 + Lift Load x 0.7

Total ESDB Load = ESDB_Gnd_unit + ESDB_Parking + ESDB_FF_unit1 + ESDB_FF_unit2 + ESDB_SF x 8

= 1858 + 140 + 4194 + 2542 + 3980 x 8

= 40574 W

EMDB Current = $\frac{EMDB\ Load}{\sqrt{3} * Line\ Voltage * pf}$

Phase Voltage = 220 V

Line Voltage = $\sqrt{3}$ * 220 V = 381.05 V

Power Factor, pf = 0.7

Lift Load = 5000 W

EMDB Load = 40574 x 0.7 + 5000 x 0.7= 31901.8 W

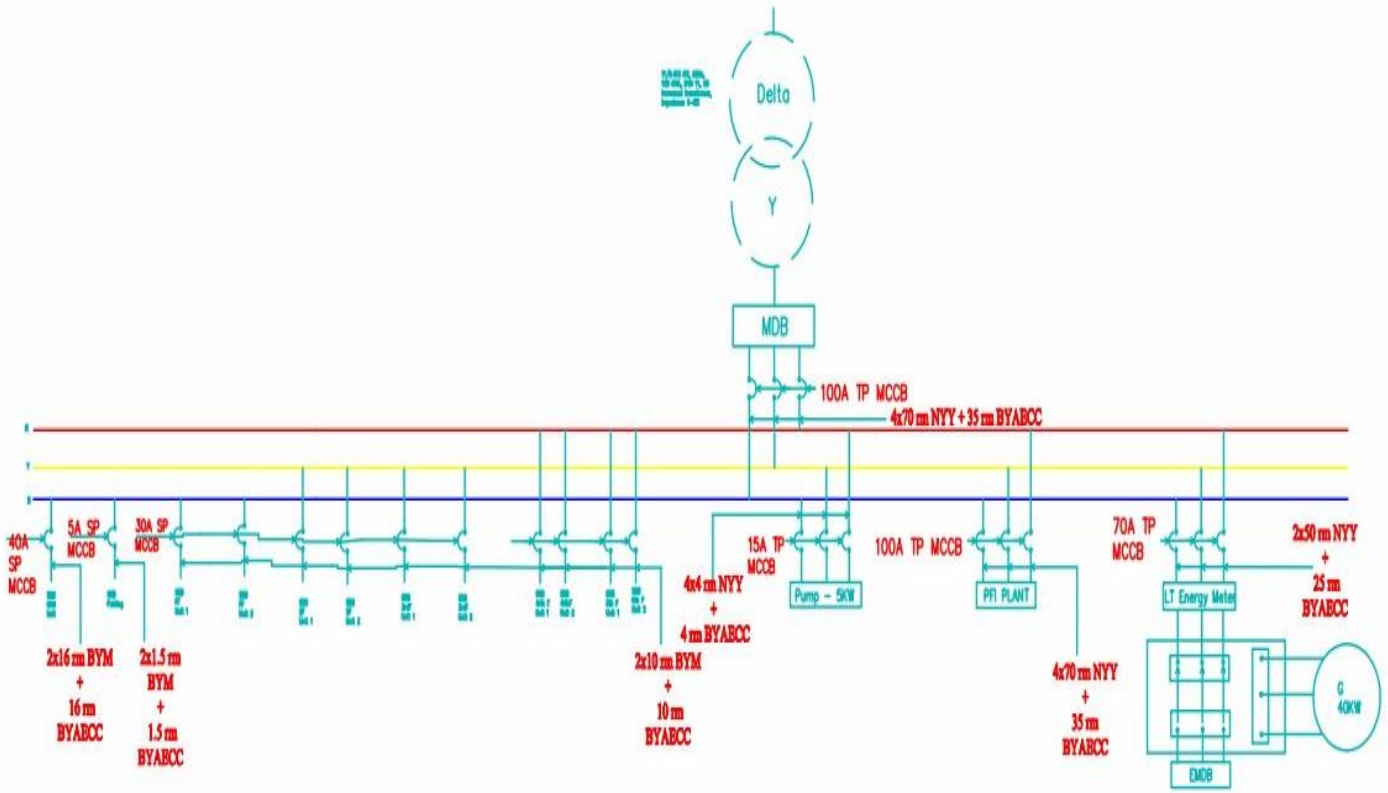
$EMDB\ current = \frac{31901.8}{\sqrt{3} \times 381.05 \times 0.7} = 69.05\ A$

So, 70 A TP MCCB 2x50 rm NYY + 25 rm BYAECC is needed from EMDB to MDB

A 40 KW Generator is used to supply the EMDB Load through an ATS.

SWITCHBOARD CONNECTION DIAGRAM

MAIN DISTRIBUTION BOARD



CALCULATION FOR MAIN DISRIBUTION BOARD

Calculations for MDB

MDB load = Total SDB load x 0.7 + (EMDB load + Pump load) x 0.7

Total SDB load = SDB_Gnd_unit + SDB_Parking + SDB_FF_unit1 + SDB_FF_unit2

+ SDB_SF_unit x 2

= 5332 + 280 + 4314 + 4146 +3546 x 8

= 42440 W

$$MDB\ current = \frac{MDB\ Load}{\sqrt{3} * Line\ Voltage * pf}$$

Phase Voltage = 220 V

Line Voltage = $\sqrt{3}$ x 220 V = 381.05 V

Power Factor, pf = 0.95 (Due to PFI plant)

Total SDB load = 42440 W

EMDB load = 31901.8 W

Pump load = 5000 W

MDB load = 42440 x 0.7 + (31901.8 + 5000) x 0.7 = 55539.26 W

$$MDB\ current = \frac{55539.26}{\sqrt{3} \times 381.05 \times 0.95} = 88.58\ A$$

So, 100 A TP MCCB 4x70 rm NYY + 35 rm BYAECC is needed from MDB to Main Line

CALCULATION FOR PFI PLANT

$cos\theta = 0.7, sin\theta = \sqrt{1-(cos\theta)^2} = 0.714$

$Q = 3VIsin\theta = Ptan\theta = 56.66\ KVAR$

After pf improvement $\sin\theta = 1$

$$I = \frac{Q}{3 \times V \times sin\theta} = 85.85\ A$$

So, 100A TP MCCB 4x70 rm NYY + 35 rm is needed from PFI to MDB

SAMPLE CALCULATION FOR MINIMUM LOAD DENSITY

Ground Floor (Single Unit):

$$Load\ density = \frac{Total\ load}{Apartment\ size\ in\ meter^2} = \frac{5332+1858}{1255 \times 0.3048^2} = 61.667\ W/m^2$$

LIGHTNING PROTECTION

Index	Index Figure	Description	Index Value
A	Use of Structure	Houses and similar buildings	2
B	Type of Construction	Reinforced concrete with non-metal roof	2
C	Consequential effects	Ordinary domestic(not containing valuable materials)	2
D	Degree of Isolation	Structure located in an area with a few other structures of similar height	5
E	Type of Terrain	Flat terrain at any level	2
F	Height of Structure	(6(floor)+1)×10′(floor height)3.281(convert to meter)=21.34(6floor+1)×10′floor height3.281convert to meter=21.34	8
G	No. of thunderstorm days per year	Over 21	21
		Total	42

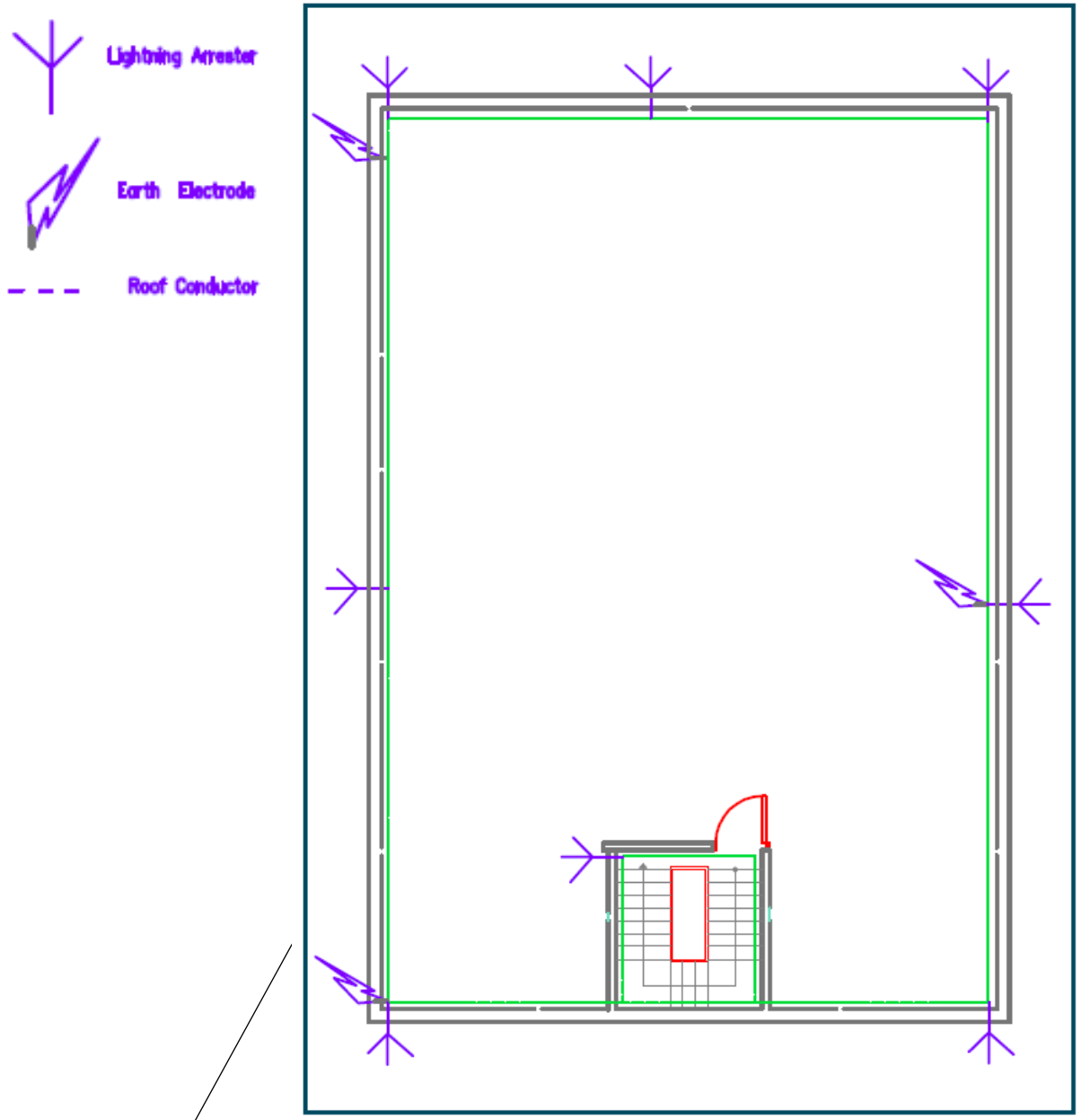
TOTAL INDEX NUMBER IS 42 WHICH IS HIGHER THAN 40. SO LIGHTNING PROTECTION IS ESSENTIAL.

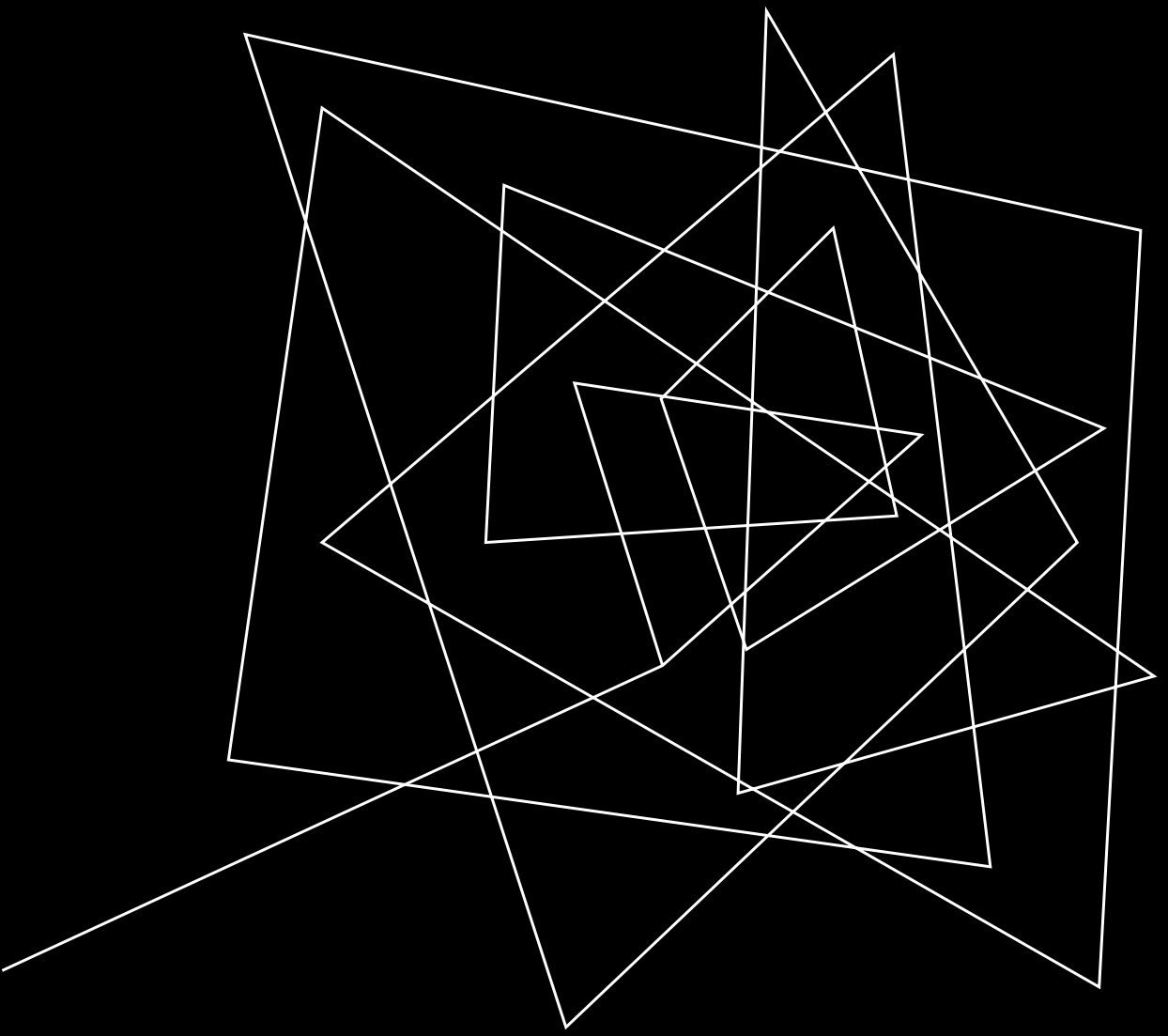
LPS DESIGN PARAMETERS

Lightning Arrester
Rod Height = 2 m
Roof Perimeter = 2 x (41.67’ + 61.83’) = 207 ft
Here, 8 lightning arresters have been placed, 25ft distance apart.

Down Conductor:
Total Area = 41.67’ x 61.83’ = 2576.45 sq. ft. = 239.36 sq. m
Number of down conductors – 1 conductor for first 180 sq. M
(239.36 - 80) /100 = 1.59 ≈ 2 extra conductors
We have used total 3 down conductors with ground electrodes.
Earth termination resistance of ground electrodes – less than 10 ohms

Roof Conductors:
Roof conductors are placed 6” away from the roof railing connecting all the lightning arrestors to the down conductors.





THANK YOU