BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING, BUET

Course No : EEE 414
Course Title : Electrical Service Design
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Submitted to

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Objectives

1. Familiarization with Multi-Storied Residential Building Floor-Planning:
    - Gain a comprehensive understanding of the floor-planning process inherent to multi-storied residential buildings.
    - Acquire proficiency in the depiction of architectural layouts and spatial arrangements using AutoCAD.

2. Exploration of Fittings and Fixtures:
    - Investigate the diverse range of fittings and fixtures deployed within each compartment of the residential building.
    - Develop familiarity with the graphical representation of these components in AutoCAD.

3. Systematic Drawing of Conduit Layout:
    - Learn and apply a systematic approach to draft conduit layouts for the building's electrical infrastructure using AutoCAD.
    - Understand the principles of efficient and organized conduit design within the architectural context.

4. Switchboard Connection Drawing:
    - Gain proficiency in illustrating switchboard connections, including emergency scenarios, using AutoCAD.
    - Explore the symbology and graphical representation of electrical connections within switchboards.

5. Calculation and Placement of Electrical Components:
    - Understand the methodologies involved in calculating and placing essential electrical components in switchboard diagrams.
    - Incorporate AutoCAD tools to accurately represent components such as circuit breakers, transformers, and generators with specified ratings.

6. Electrical Designing Procedure for Lightning Protection:
    - Comprehend the procedural aspects of electrical design pertaining to lightning protection systems.
    - Apply AutoCAD for the graphical representation of lightning protection components and their strategic placement within the building.

Design Steps

1. Architectural Floor Planning for a Six-Stored Building:
    - Initiated the project by meticulously creating detailed floor plans for both the ground floor and typical floors of a Six-stored residential building.
    - Employed AutoCAD for the accurate representation of architectural elements, ensuring a comprehensive understanding of spatial layouts.

2. Integration of Fittings and Fixtures on Each Floor:
    - Systematically incorporated a variety of fittings and fixtures for each floor, paying close attention to functionality and aesthetic considerations.
    - Utilized AutoCAD to visually depict the placement and arrangement of these components within the building's compartments.

3. Strategic Conduit Layout Planning for Each Floor:
    - Executed a meticulous planning phase for the conduit layout on each floor, emphasizing a systematic and organized approach.
    - Applied AutoCAD tools to ensure precision in the graphical representation of conduit systems, aligning with electrical design requirements.

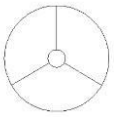
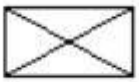
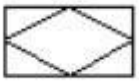
4. Elaborate Switchboard and Distribution Board Diagrams:
    - Illustrated detailed switchboard and distribution board diagrams, encompassing regular as well as emergency scenarios.
    - Employed AutoCAD to create comprehensive visualizations of the electrical connections, emphasizing clarity and adherence to design specifications.

5. Thorough Design of Lightning Protection System (LPS):
    - Undertook a comprehensive approach to design the Lightning Protection System (LPS) for the building.
    - Utilized AutoCAD for the graphical representation of the lightning protection components, ensuring a robust and strategically positioned system.

Fittings and Fixtures

Fixture Legends

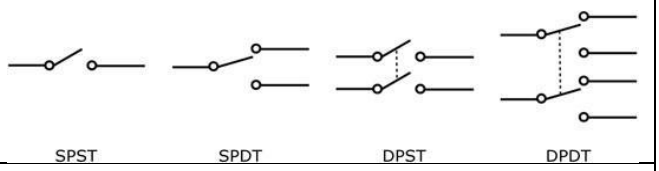
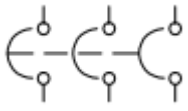
Below, we outline the diverse types of fixtures utilized in the project, accompanied by details on their strategic placement and corresponding symbols.

Description	Height	Caption	Symbol
Wall Mounted Light	Lintel	LL	
Ceiling Light	Ceiling	CL	
Wall Mounted Tube Light	Lintel	TL	
Ceiling Mounted Tube Light	Ceiling		
Fan (56” diameter)	Ceiling	F	
Switch Board	Mid wall	SB	
Sub Distribution Board	Mid wall	SDB	
Main Distribution Board	Mid wall	MDB	
Exhaust Fan (8” diameter)	Lintel	E	
2 Pin Socket	Mid wall	SS	

2 Pin TV Socket	Lower	TS	
Antenna Socket	Skirting	T	
3 Pin Socket 20A	Lintel	S	

Switchboard Legends

The types of different components used in switchboard diagrams along with their symbol are presented below:

Description	Symbol
Switch	
Energy Meter	
SPDT Two Way Switch for Automatic Transfer	
Fan Regulator	
Single Pole Circuit Breaker (SP MCCB)	
Triple Pole Circuit Breaker (TP MCCB)	

Delta to Wye Transformer	
Power Factor Improvement (PFI) Plant	
Generator	G

Calculation

Light Requirement

Let,
Room length = L (in meters)
Room width = W (in meters) N =
Number of lights required

E = Luminance level required (lux). This parameter will vary depending on the type of room (e.g. bedroom, kitchen)

F = Average luminous flux from each light source (lumen)

UF = Utilization factor (allowance for light distribution of the luminaire and the room surfaces)

MF = Maintenance factor (allowance for reduced light output due to deterioration)

Then, following is the equation used to calculate the number of lights required [1]:

$$N = \frac{E * L * W}{F * UF * MF}$$

The following table shows the required luminance values for each room.

Room Type	E (lux)
Dining Space	100
Living Room	70
Kitchen	200
M. Bedroom	70
Bedroom	70
G. Bedroom	70
Veranda	50
Store Room	50
Bathroom	100
Garage	100
Guard Room	70

The average luminous flux for each room is assumed to be 1250 lumen at 20W. The maintenance factor, MF is taken as 0.8, that is 20% of the light is assumed tobe deteriorated due to dust, aging etc.

Calculation of Utilization Factor:

To calculate the utilization factor, we first need to calculate the room index.Room index is defined by the following formula:

$$\text{Room Index } = \frac{L * W}{Mounting\ Height * (L + W)}$$

Mounting height = Luminaire height – Work plane height = 9 ft – 3 ft = 6 ft = 1.828 meter

We also need to know the surface reflectance of ceiling (C), wall (W) and floor

(F) of the room. Typically, they are chosen as C = 0.7, W = 0.5 and F = 0.2.

Table 1: Utilisation Factors

Room reflectances			Room index								
C	W	F	0.75	1.00	1.25	1.50	2.00	2.50	3.00	4.00	5.00
0.7	0.5	0.2	NA	0.61	0.65	0.67	0.70	0.71	0.73	0.74	0.75

From the tabular data shown above, we can readily determine the utilization factor for a particular room index for the given C, W and F values.

Fan Requirement:

The number of fans required; M is determined by the following formula [1]:

$$M = \frac{L(in\ feet) * W(in\ feet)}{100}$$

Apartment 1:

❖ Calculations for Bedroom 1:

Length = 11'5" = 3.48 m
Width = 9' = 2.745 m
Area, A = 102.75 sq. feet = 9.55 m^2
Room Index = 0.838
UF = 0.7155
Illuminance, E = 100 lumen/m2
Total Illuminance, (N*F) = 1667.67 lumen.
So, we will install 1 18W LED light bulb and 20W CFL bulb.
Number of fans = 1.02
So, we will install 1 fan for our room.

❖ Calculations for Master Bedroom:

Length = 10' = 3.05m m
Width = 9'10" = 3 m
Area, A = 98.33 sq. feet = 9.135m^2
Room Index = 0.82
UF = 0.71
Illuminance, E = 100 lumen/m2
Total Illuminance, (N*F) = 1607.22 lumen.
So, we will install 1 18W LED light bulb and 20W CFL bulb.
Number of fans = 0.98
So, we will install 1 fan for our master bedroom.

❖ Calculations for Living room:

Length = 12'11" = 3.939 m
Width = 9'3" = 2.82 m
Area, A = 119.47 sq. feet = 11.099 m^2
Room Index = 0.898
UF = 0.739
Illuminance, E = 150 lumen/m2
Total Illuminance, (N*F) = 2815.15 lumen.
So, we will install 1 24W LED light bulb and 20W CFL bulb.
Number of fans = 1.19
So, we will install 1 fan for living room.

❖ Calculations for Dining Room:

Length = 9'1" = 2.77 m
Width = 14'1" = 4.29 m
Area, A = 127.92 sq. feet = 11.88 m^2
Room Index = 0.92
UF = 0.7481

Illuminance, E = 150 lumen/m2
Total Illuminance, (N*F) = 2978.66 lumen.
So, we will install 1 24W LED light bulb and 20W CFL bulb.
Number of fans = 1.27
So, we will install 1 fan for dining room.

❖ Calculations for Kitchen:

Length = 8’ = 2.44 m
Width = 8’2” = 2.49 m
Area, A = 65.33 sq. feet = 6.06 m^2
Room Index = 0.67
UF = 0.6368
Illuminance, E = 160 lumen/m2
Total Illuminance, (N*F) = 1906.3 lumen.
So, we will install 1 18W LED light bulb and 20W CFL bulb.
Number of fans = 0
So, we will install 0 fan for our kitchen.

❖ Calculations for Toilet-1:

Length = 4’= 1.22 m
Width = 8’2” = 2.49 m
Area, A = 32.66 sq. feet = 3.03 m^2
Room Index = 0.44
UF = 0.5237
Illuminance, E = 100 lumen/m2
Total Illuminance, (N*F) = 724.37 lumen.
So, we will install 1 10W LED light bulb.

❖ Calculations for Toilet-2:

Length = 4’4” = 1.32 m
Width = 5’5” = 1.65 m
Area, A = 23.47 sq. feet = 2,18 m^2
Room Index = 0.4
UF = 0.5006
Illuminance, E = 100 lumen/m2
Total Illuminance, (N*F) = 544.5 lumen.
So, we will install 1 6W LED light bulb.

❖ Calculation for Veranda:

Length = 8’4” = 2.54 m
Width = 3’ = 0.915 m
Area, A = 25 sq. feet = 2.32 m^2
Room Index = 0.36
UF = 0.4838
Illuminance, E = 70 lumen/m2

Total Illuminance, (N*F) = 420 lumen.
So, we will install 1 6W LED light bulb.

Apartment 2:

❖ Calculations for Bedroom 1:

Length = 11'5" = 3.48 m
Width = 9' = 2.745 m
Area, A = 102.75 sq. feet = 9.55 m^2
Room Index = 0.838
UF = 0.7155
Illuminance, E = 100 lumen/m2
Total Illuminance, (N*F) = 1667.67 lumen.
So, we will install 1 18W LED light bulb and 20W CFL bulb.
Number of fans = 1.02
So, we will install 1 fan for our room.

❖ Calculations for Master Bedroom:

Length = 10' = 3.05m m
Width = 9'10" = 3 m
Area, A = 98.33 sq. feet = 9.135m^2
Room Index = 0.82
UF = 0.71
Illuminance, E = 100 lumen/m2
Total Illuminance, (N*F) = 1607.22 lumen.
So, we will install 1 18W LED light bulb and 20W CFL bulb.
Number of fans = 0.98
So, we will install 1 fan for our master bedroom.

❖ Calculations for Living room:

Length = 12'11" = 3.939 m
Width = 9'3" = 2.82 m
Area, A = 119.47 sq. feet = 11.099 m^2
Room Index = 0.898
UF = 0.739
Illuminance, E = 150 lumen/m2
Total Illuminance, (N*F) = 2815.15 lumen.
So, we will install 1 24W LED light bulb and 20W CFL bulb.
Number of fans = 1.19
So, we will install 1 fan for living room.

❖ Calculations for Dining Room:

Length = 9'1" = 2.77 m
Width = 14'1" = 4.29 m
Area, A = 127.92 sq. feet = 11.88 m^2
Room Index = 0.92

UF = 0.7481
Illuminance, E = 150 lumen/m2
Total Illuminance, (N*F) = 2978.66 lumen.
So, we will install 1 24W LED light bulb and 20W CFL bulb.
Number of fans = 1.27
So, we will install 1 fan for dining room.

❖ Calculations for Kitchen:

Length = 8’ = 2.44 m
Width = 8’2” = 2.49 m
Area, A = 65.33 sq. feet = 6.06 m^2
Room Index = 0.67
UF = 0.6368
Illuminance, E = 160 lumen/m2
Total Illuminance, (N*F) = 1906.3 lumen.
So, we will install 1 18W LED light bulb and 20W CFL bulb.
Number of fans = 0
So, we will install 0 fan for our kitchen.

❖ Calculations for Toilet-1:

Length = 4’= 1.22 m
Width = 8’2” = 2.49 m
Area, A = 32.66 sq. feet = 3.03 m^2
Room Index = 0.44
UF = 0.5237
Illuminance, E = 100 lumen/m2
Total Illuminance, (N*F) = 724.37 lumen.
So, we will install 1 10W LED light bulb.

❖ Calculations for Toilet-2:

Length = 4’4” = 1.32 m
Width = 5’5” = 1.65 m
Area, A = 23.47 sq. feet = 2,18 m^2
Room Index = 0.4
UF = 0.5006
Illuminance, E = 100 lumen/m2
Total Illuminance, (N*F) = 544.5 lumen.
So, we will install 1 6W LED light bulb.

❖ Calculation for Veranda:

Length = 8’4” = 2.54 m
Width = 3’ = 0.915 m
Area, A = 25 sq. feet = 2.32 m^2
Room Index = 0.36
UF = 0.4838

Illuminance, E = 70 lumen/m2
Total Illuminance, (N*F) = 420 lumen.
So, we will install 1 6W LED light bulb.

Apartment 3:

❖ Calculations for Bedroom 1:

Length = 11'7" = 3.53 m
Width = 8'4" = 2.54 m
Area, A = 96.52 sq. feet = 8.96 m^2
Room Index = 0.80
UF = 0.7031
Illuminance, E = 100 lumen/m2
Total Illuminance, (N*F) = 1594.31 lumen.
So, we will install 1 18W LED light bulb and 20W CFL bulb.
Number of fans = 0.96
So, we will install 1 fan for our room.

❖ Calculations for Master Bedroom:

Length = 11'1" = 3.38 m
Width = 10" = 3.05 m
Area, A = 110.83 sq. feet = 10.29 m^2
Room Index = 0.876
UF = 0.7305
Illuminance, E = 100 lumen/m2
Total Illuminance, (N*F) = 1761.93 lumen.
So, we will install 1 18W LED light bulb and 20W CFL bulb.
Number of fans = 1.1083
So, we will install 1 fan for our master bedroom.

❖ Calculations for Living room:

Length = 12'1" = 3.68 m
Width = 11'9" = 3.58 m
Area, A = 141.97 sq. feet = 13.19 m^2
Room Index = 0.99
UF = 0.7771
Illuminance, E = 150 lumen/m2
Total Illuminance, (N*F) = 3182.57 lumen.
So, we will install 1 24W LED light bulb and 20W CFL bulb.
Number of fans = 1.49
So, we will install 2 fans for our living room.

❖ Calculations for Dining Room:

Length = 9’5” = 2.87 m
Width = 13’7” = 4.14 m
Area, A = 127.9 sq. feet = 11.88 m^2
Room Index = 0.92
UF = 0.7508
Illuminance, E = 150 lumen/m2
Total Illuminance, (N*F) = 2967.63 lumen.
So, we will install 1 24W LED light bulb and 20W CFL bulb.
Number of fans = 1.27
So, we will install 1 fan for dining room.

❖ Calculations for Kitchen:

Length = 6’7” = 2 m
Width = 7’6” = 2.28 m
Area, A = 49.37 sq. feet = 4.58 m^2
Room Index = 0.58
UF = 0.5922
Illuminance, E = 160 lumen/m2
Total Illuminance, (N*F) = 1549.16 lumen.
So, we will install 1 18W LED light bulb and 20W CFL bulb.

❖ Calculations for Toilet-1:

Length = 5’6” = 1.67 m
Width = 4’ = 1.22 m
Area, A = 22 sq. feet = 2.04 m^2
Room Index = 0.38
UF = 0.493
Illuminance, E = 100 lumen/m2
Total Illuminance, (N*F) = 518.22 lumen.
So, we will install 1 6W LED light bulb.

❖ Calculations for Toilet-2:

Length = 8’ = 2.44 m
Width = 4’2” = 1.27 m
Area, A = 33.33 sq. feet = 3.09m^2
Room Index = 0.45
UF = 0.5283
Illuminance, E = 100 lumen/m2
Total Illuminance, (N*F) = 732.72 lumen.
So, we will install 1 10W LED light bulb.

❖ Calculation for Veranda:

Length = 13’ = 3.96 m
Width = 3’ = 0.915 m
Area, A = 39 sq. feet = 3.62 m^2
Room Index = 0.406

UF = 0.5031
Illuminance, E = 70 lumen/m2
Total Illuminance, (N*F) = 30.15 lumen.
So, we will install 1 6W LED light bulb.

Apartment 4:

❖ Calculations for Bedroom 1:

Length =9'9" = 2.97 m
Width = 11'5" = 3.48 m
Area, A = 111.31 sq. feet = 10.34 m^2
Room Index = 0.87
UF = 0.7306
Illuminance, E = 100 lumen/m2
Total Illuminance, (N*F) = 1769.31 lumen.
So, we will install 1 18W LED light bulb and 20W CFL bulb.
Number of fans = 1.11
So, we will install 1 fan for our room.

❖ Calculations for Master Bedroom:

Length = 10'9" = 3.27 m
Width = 10" = 3.05 m
Area, A = 107.5 sq. feet = 9.98 m^2
Room Index = 0.86
UF = 0.7254
Illuminance, E = 100 lumen/m2
Total Illuminance, (N*F) = 1720.96 lumen.
So, we will install 1 18W LED light bulb and 20W CFL bulb.
Number of fans = 1.075
So, we will install 1 fan for our master bedroom.

❖ Calculations for Living room:

Length = 12'2" = 3.71 m
Width = 5'4" = 1.62 m
Area, A = 64.8 sq. feet = 6.02 m^2
Room Index = 0.61
UF = 0.609
Illuminance, E = 150 lumen/m2
Total Illuminance, (N*F) = 1856.02 lumen.
So, we will install 1 18W LED light bulb and 20W CFL bulb.
Number of fans = 0.64
So, we will install 1fan for our living room.

❖ Calculations for Dining Room:

Length = 9'5" = 2.87 m
Width = 13'7" = 4.14 m
Area, A = 127.9 sq. feet = 11.88 m^2
Room Index = 0.92
UF = 0.7508
Illuminance, E = 150 lumen/m2
Total Illuminance, (N*F) = 2967.63 lumen.
So, we will install 1 24W LED light bulb and 20W CFL bulb.
Number of fans = 1.27
So, we will install 1 fan for dining room.

❖ Calculations for Kitchen:

Length = 6'7" = 2 m
Width = 7'6" = 2.28 m
Area, A = 49.37 sq. feet = 4.58 m^2
Room Index = 0.58
UF = 0.5922
Illuminance, E = 160 lumen/m2
Total Illuminance, (N*F) = 1549.16 lumen.
So, we will install 1 18W LED light bulb and 20W CFL bulb.

❖ Calculations for Toilet-1:

Length = 5'6" = 1.67 m
Width = 4' = 1.22 m
Area, A = 22 sq. feet = 2.04 m^2
Room Index = 0.38
UF = 0.493
Illuminance, E = 100 lumen/m2
Total Illuminance, (N*F) = 518.22 lumen.
So, we will install 1 6W LED light bulb.

❖ Calculations for Toilet-2:

Length = 8' = 2.44 m
Width = 4'2" = 1.27 m
Area, A = 33.33 sq. feet = 3.09m^2
Room Index = 0.45
UF = 0.5283
Illuminance, E = 100 lumen/m2
Total Illuminance, (N*F) = 732.72 lumen.
So, we will install 1 10W LED light bulb.

❖ Calculation for Veranda:

Length = 13’ = 3.96 m
Width = 3’ = 0.915 m
Area, A = 39 sq. feet = 3.62 m^2
Room Index = 0.406
UF = 0.5031
Illuminance, E = 70 lumen/m2
Total Illuminance, (N*F) = 30.15 lumen.
So, we will install 1 6W LED light bulb.

Layout of 6 storied building:

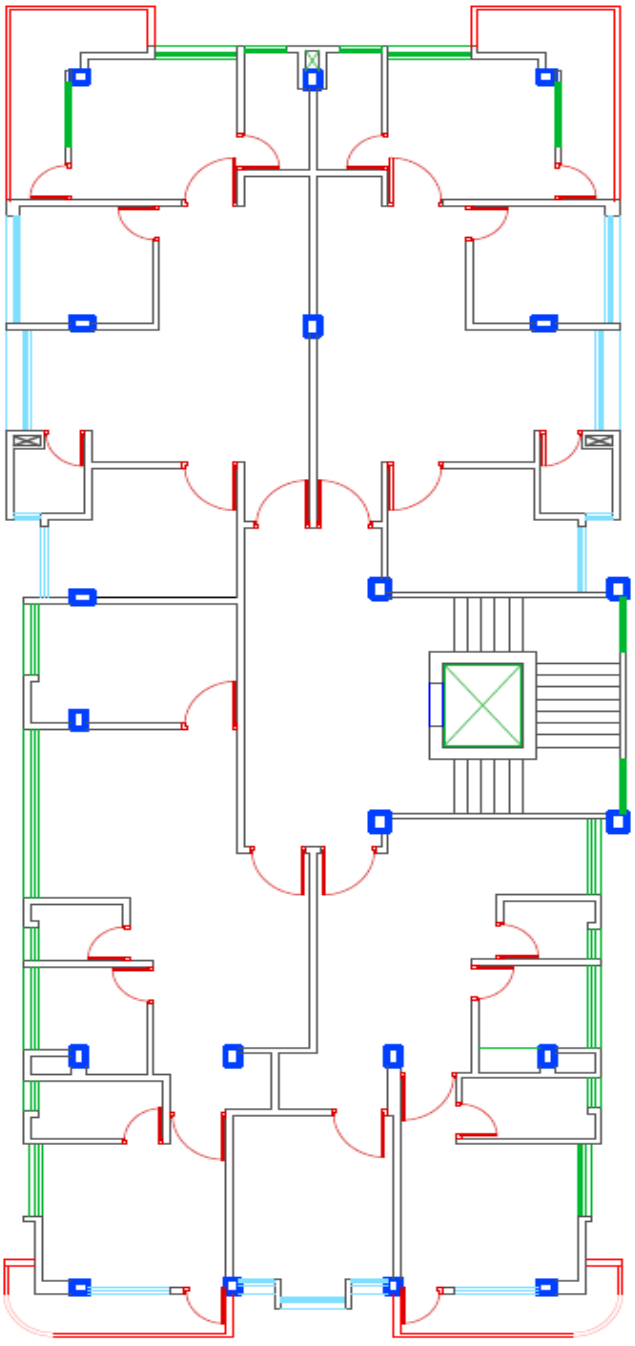


Fig: Layout of first floor

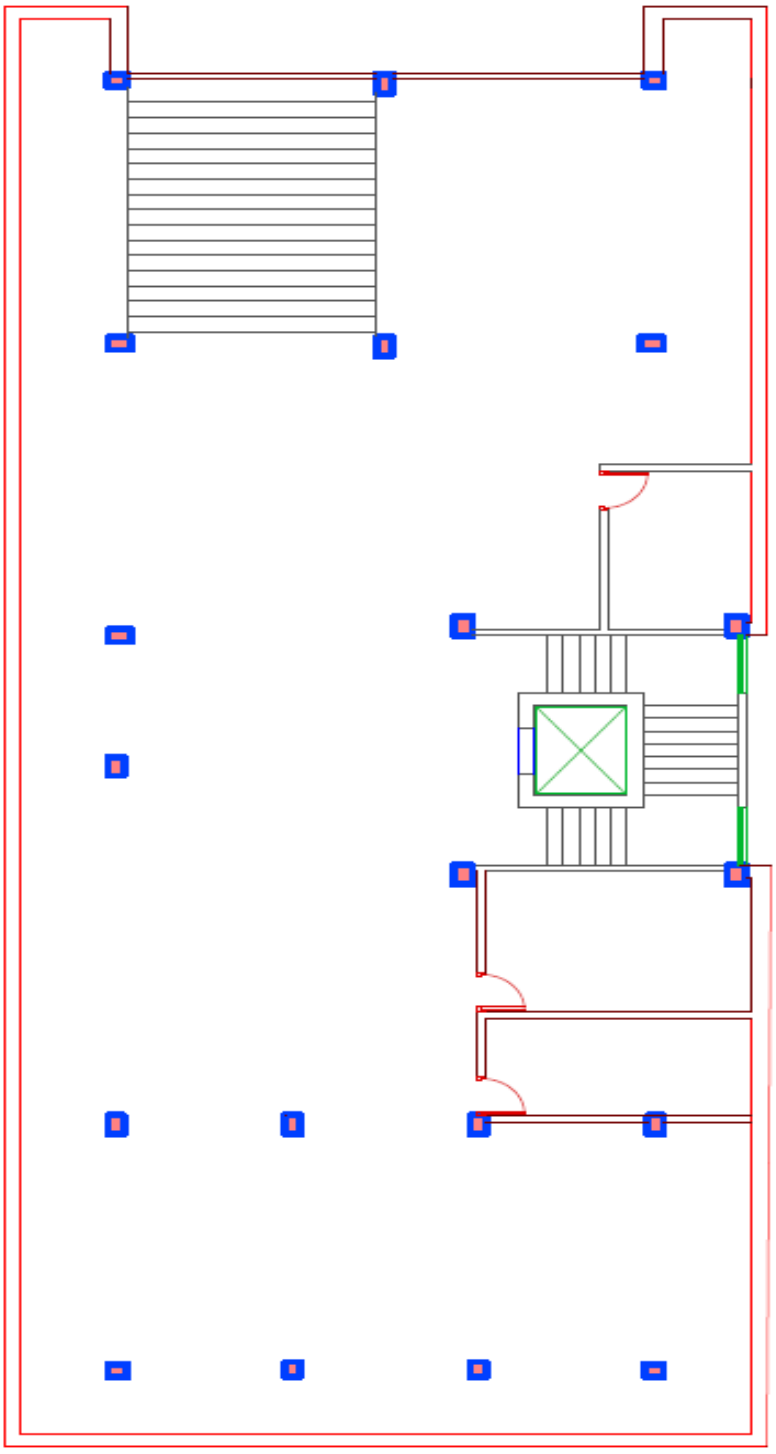


Fig: Ground floor

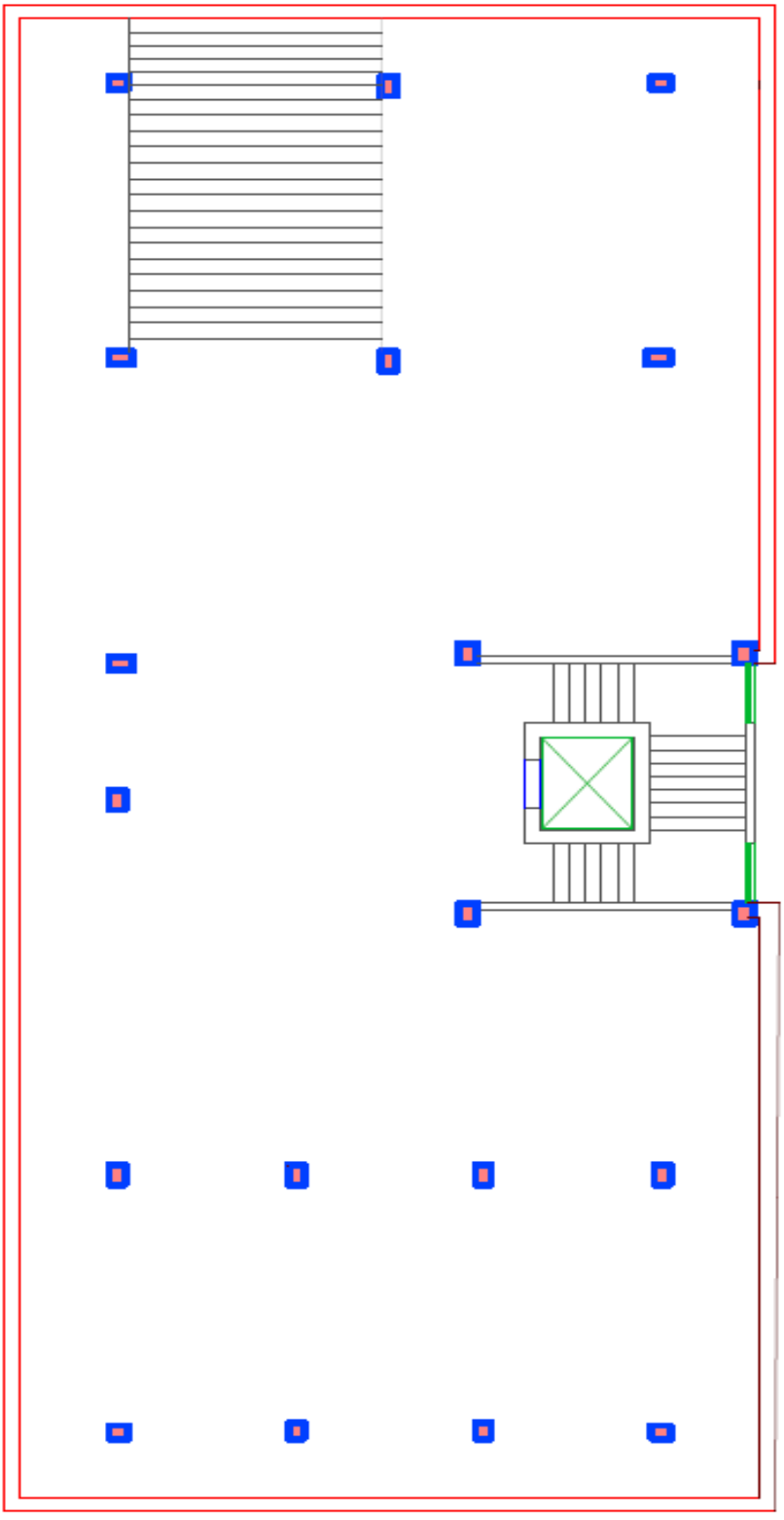


Fig: Basement

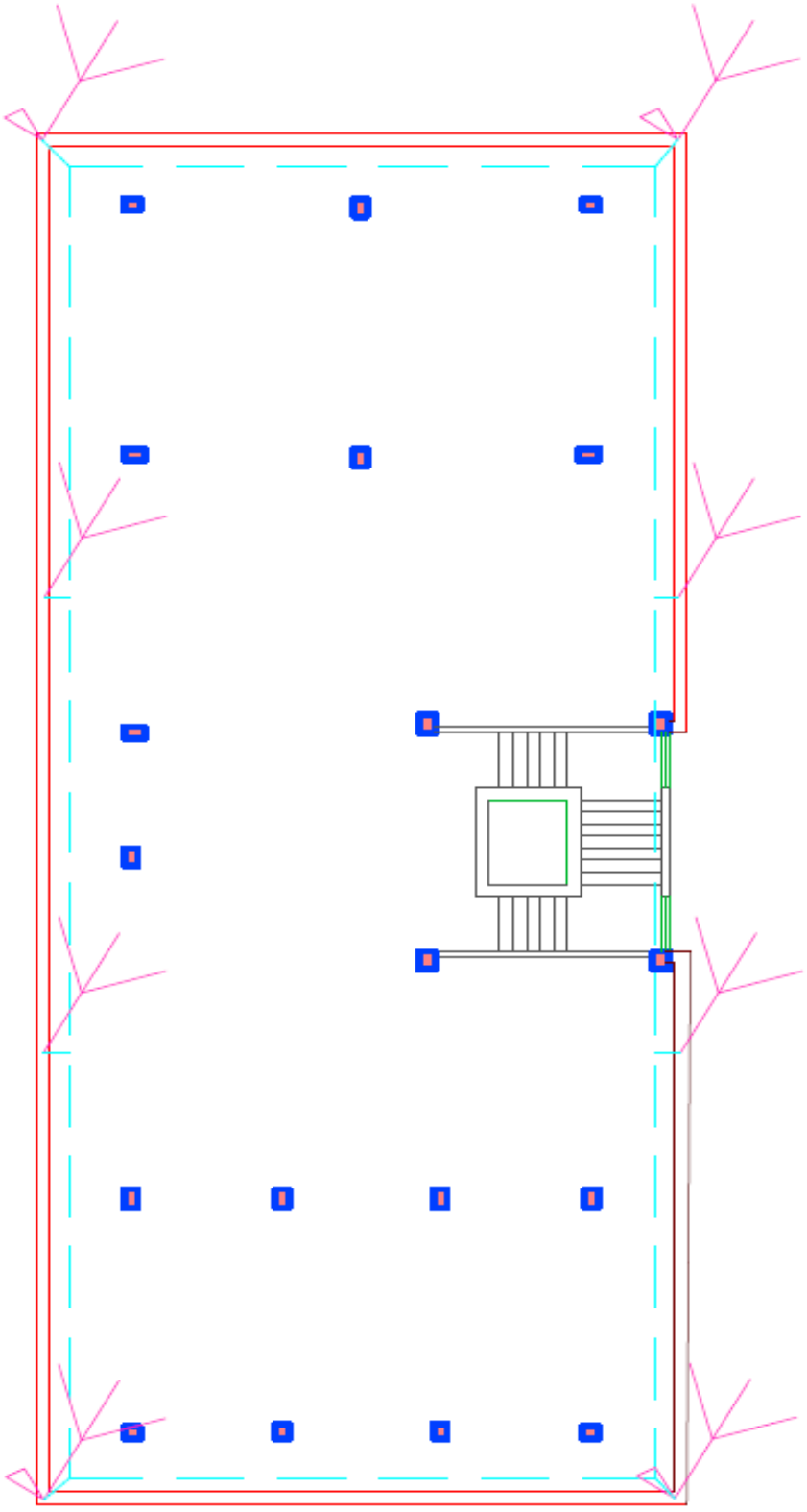


Fig: Rooftop

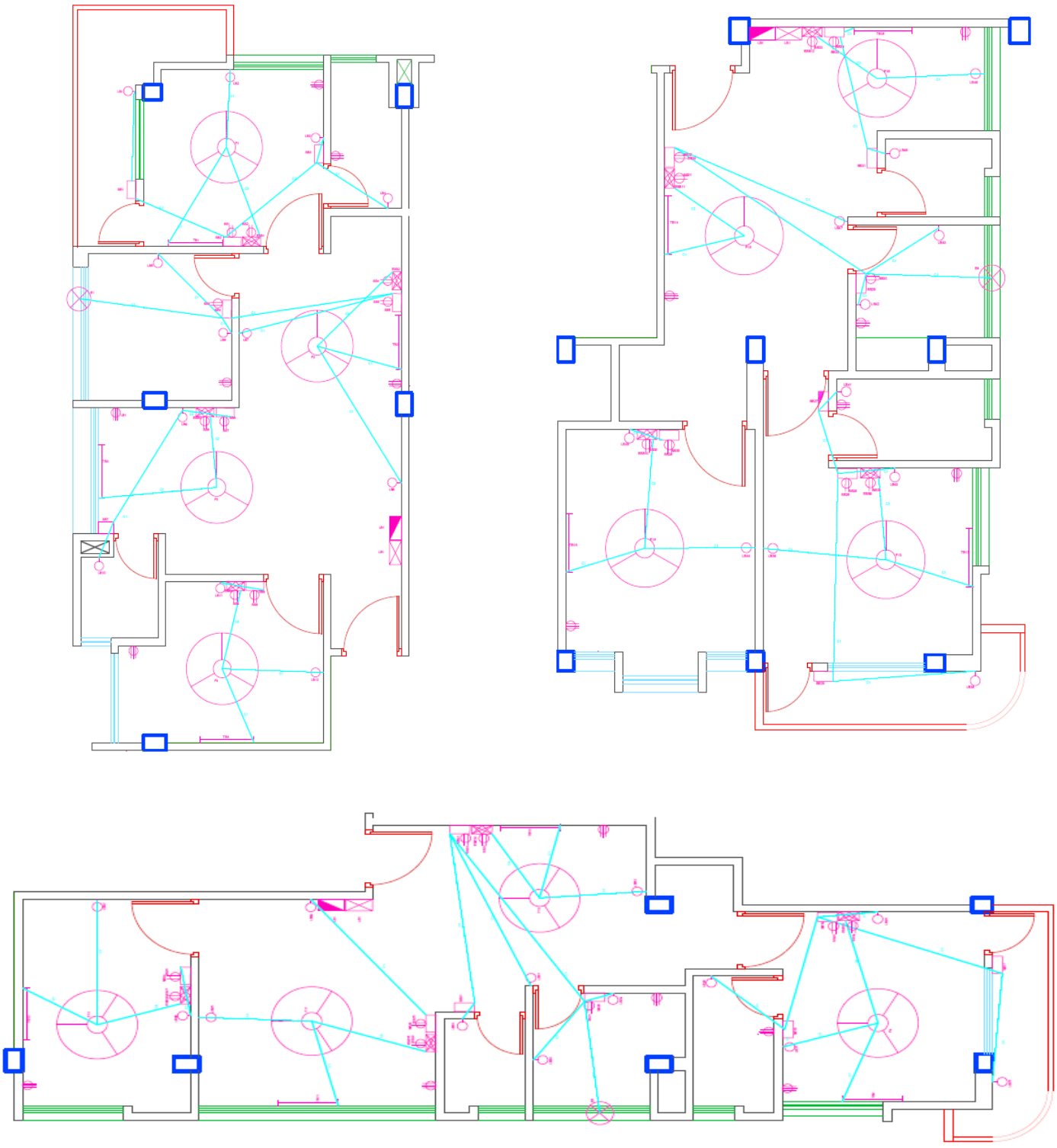


Fig: fittings with conduit connection of Appartment 1 & 2 (top left), 3(top right) , 4(bottom)

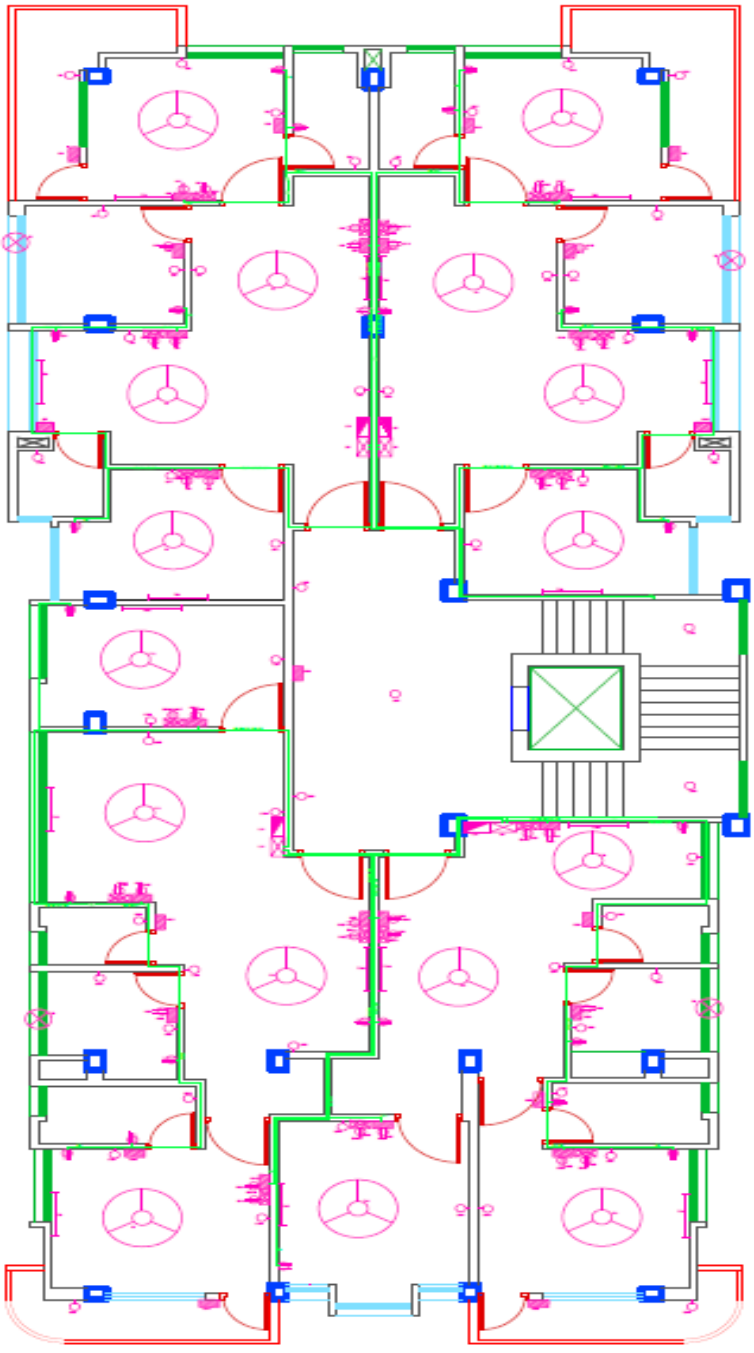


Fig: Complete layout with fitting with SDB

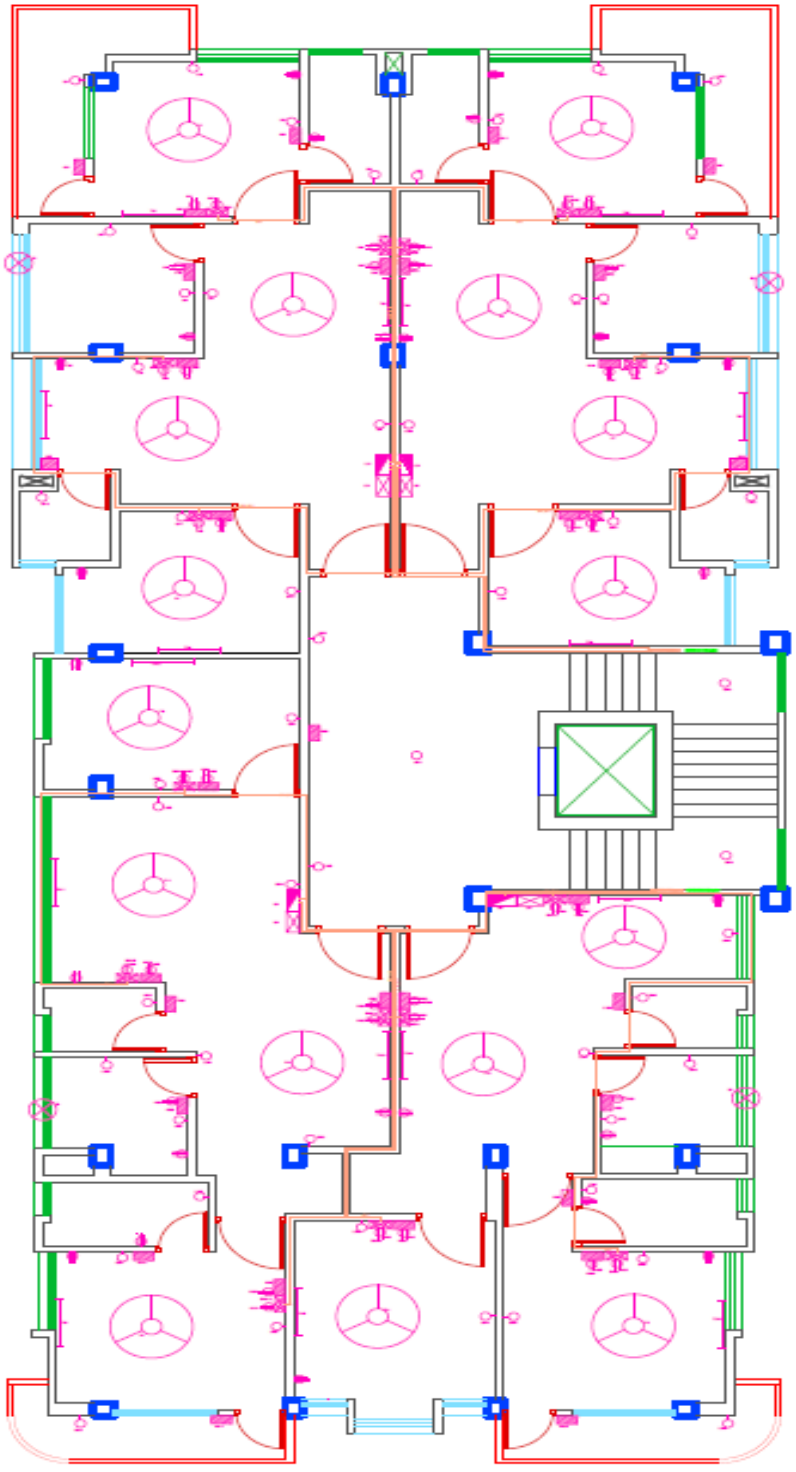


Fig: Complete layout with fitting with ESDB

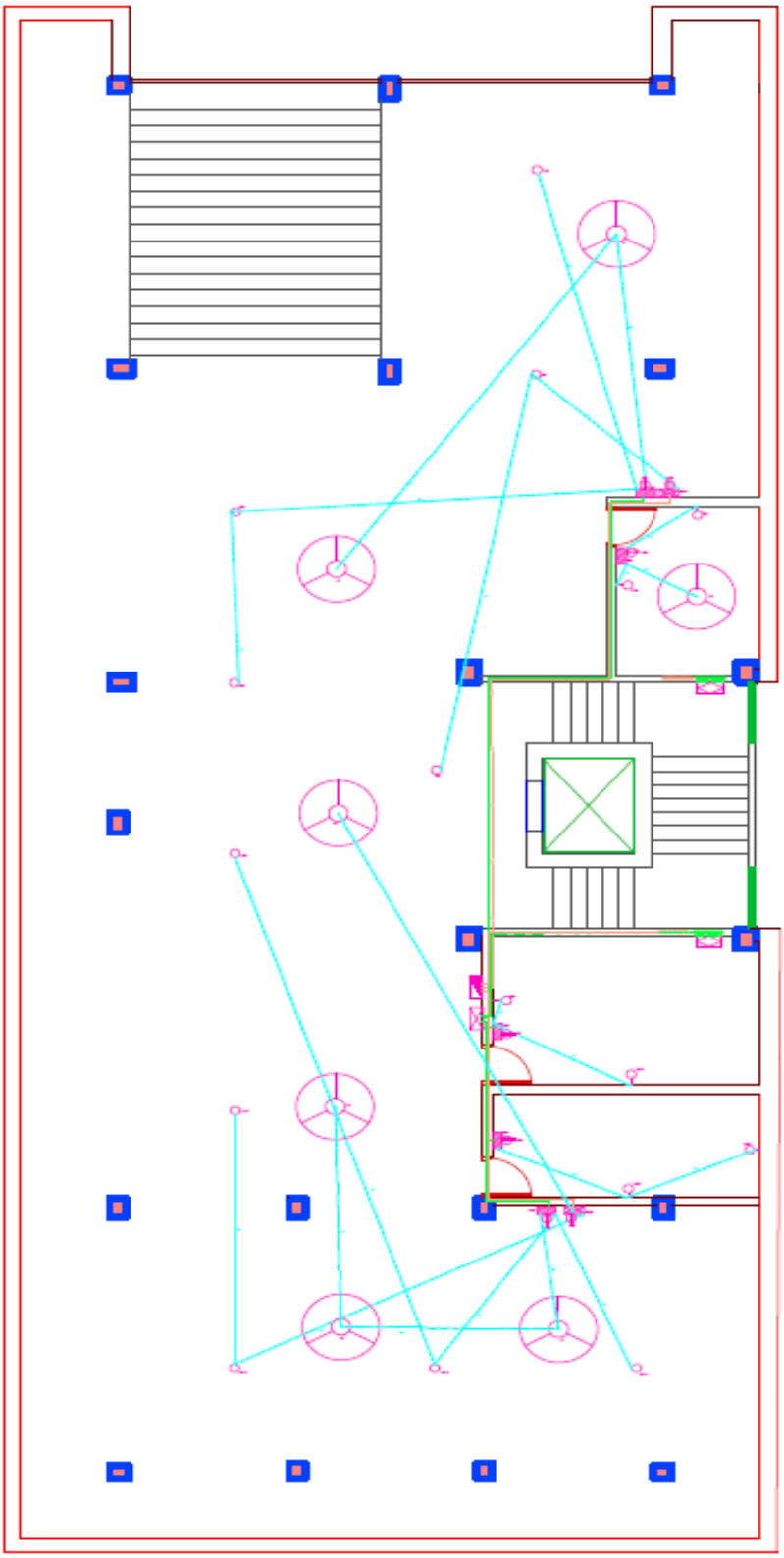


Fig: Ground floor wiring with fitting

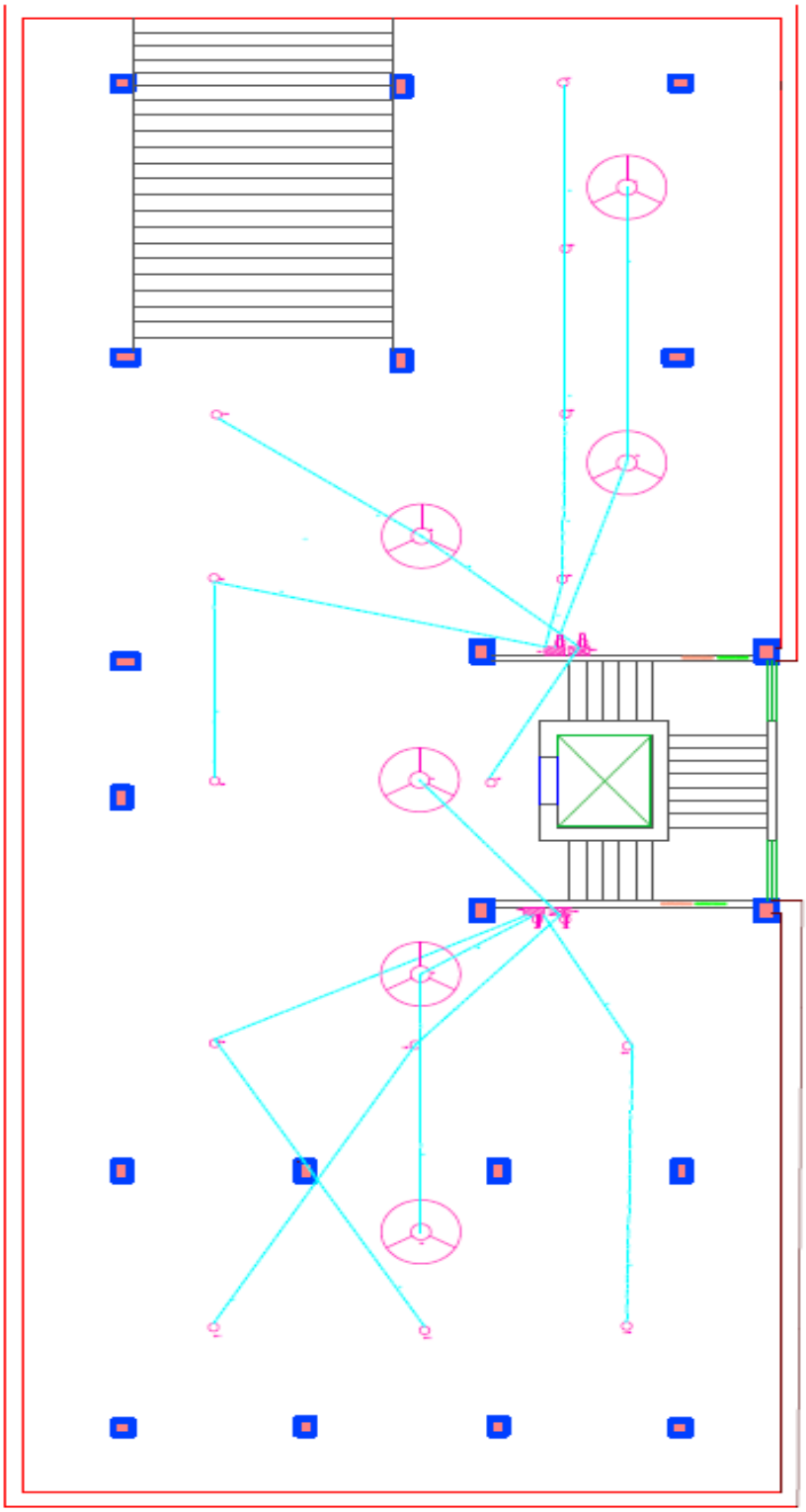


Fig: Basement floor wiring with fitting

Apartment:1

(1) kitchen :

❖ **SB:**

- Light ---> 18 W *2 = 36 W
- SB Socket ---> 100 W *1 = 100 W

Total Load = 136 W

$$I = \frac{136}{220 \times 0.7} = 0.88A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

(2) Dining

❖ **SB:**

- Socket (Table height) ---> 100 W *1 = 100 W
- Light Bulb ---> 24 W *1 = 24 W

Total Load = 124 W

$$I = \frac{124}{220 \times 0.7} = 0.81A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

❖ **ESB:**

- Tube Light ---> 20 W *1 = 20 W
- Light bulb ---> 24 W *1 = 24 W
- Fan ---> 100 W *1 = 100 W
- SB Socket ---> 100 W *1 = 100 W

Total Load = 244 W

$$I = \frac{244}{220 \times 0.7} = 1.4A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

(3) Drawing -

SB:

- Light Bulb ---> 24 W *1 = 24 W
- SB Socket ---> 100 W *1 = 100 W

Total Load = 124 W

$$I = \frac{124}{220 \times 0.7} = 0.81A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

❖ **ESB:**

- Tube Light ---> 20 W *1 = 20 W
- Fan ---> 100 W *1 = 100 W
- SB Socket ---> 100 W *1 = 100 W

Total Load = 220 W

$$I = \frac{220}{220 \times 0.7} = 1.43A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used

Toilet-2

❖ **SB:**

- Light Bulb ---> 6 W *1 = 6 W

Total Load = 6 W

$$I = \frac{6}{220 \times 0.7}$$

$$= .04 \text{ A}$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used

(4) Bedroom –

SB:

- Light Bulb ---> 18 W *1 = 18 W
- SB Socket ---> 100 W *1 = 100 W

Total Load = 118 W

$$I = \frac{118}{220 \times 0.7} = 0.77A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

❖ **ESB:**

- Light Bulb ---> 18 W *1 = 18 W
- Fan ---> 100 W *1 = 100 W
- SB Socket ---> 100 W *1 = 100 W
- Tube Light ---> 20W * 1 = 20 W

Total Load = 238 W

$$I = \frac{238}{220 \times 0.7} = 1.55A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

(3) Master Bedroom

SB:

- Light Bulb ---> 18 W *1 = 18 W
- SB Socket ---> 100 W *1 = 100 W

Total Load = 118 W

$$I = \frac{118}{220 \times 0.7} = 0.77A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

❖ **ESB:**

- Tube Light ---> 20 W *1 = 20 W
- Light Bulb ---> 18 W *1 = 18 W
- Fan ---> 100 W *1 = 100 W
- SB Socket ---> 100 W *1 = 100 W

Total Load = 238 W

$$I = \frac{238}{220 \times 0.7} = 1.55A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

Toilet-1

❖ **SB:**

- Light Bulb ---> 10 W *1 = 10 W

Total Load = 10 W

$$I = \frac{10}{220 \times 0.7}$$

$$= 0.06 \text{ A}$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used

Balcony

❖ **SB:**

- Light Bulb ---> 6 W *1 = 6 W

Total Load = 6 W

$$I = \frac{6}{220 \times 0.7}$$

$$=0.04A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used

Apartment:2

(5) kitchen :

❖ **SB:**

- Light ---> 18 W *2 = 36 W
- SB Socket ---> 100 W *1 = 100 W

Total Load = 136 W

$$I = \frac{136}{220 \times 0.7} = 0.88A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

(6) Dining

❖ **SB:**

- Socket (Table height) ---> 100 W *1 = 100 W
- Light Bulb ---> 24 W *1 = 24 W

Total Load = 124 W

$$I = \frac{124}{220 \times 0.7} = 0.81A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

❖ **ESB:**

- Tube Light ---> 20 W *1 = 20 W
- Light bulb ---> 24 W *1 = 24 W
- Fan ---> 100 W *1 = 100 W
- SB Socket ---> 100 W *1 = 100 W

Total Load = 244 W

$$I = \frac{244}{220 \times 0.7} = 1.4A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

(7) Drawing -

SB:

- Light Bulb ---> 24 W *1 = 24 W
- SB Socket ---> 100 W *1 = 100 W

Total Load = 124 W

$$I = \frac{124}{220 \times 0.7} = 0.81A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

❖ **ESB:**

- Tube Light ---> 20 W *1 = 20 W
- Fan ---> 100 W *1 = 100 W
- SB Socket ---> 100 W *1 = 100 W

Total Load = 220 W

$$I = \frac{220}{220 \times 0.7} = 1.43A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used

Toilet-2

❖ **SB:**

- Light Bulb ---> 6 W *1 = 6 W

Total Load = 6 W

$$I = \frac{6}{220 \times 0.7}$$

$$= .04 \text{ A}$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used

(8) Bedroom –

SB:

- Light Bulb ---> 18 W *1 = 18 W
- SB Socket ---> 100 W *1 = 100 W

Total Load = 118 W

$$I = \frac{118}{220 \times 0.7} = 0.77A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

❖ **ESB:**

- Light Bulb ---> 18 W *1 = 18 W
- Fan ---> 100 W *1 = 100 W
- SB Socket ---> 100 W *1 = 100 W
- Tube Light ---> 20W * 1 = 20 W

Total Load = 238 W

$$I = \frac{238}{220 \times 0.7} = 1.55A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

(4) Master Bedroom

SB:

- Light Bulb ---> 18 W *1 = 18 W
- SB Socket ---> 100 W *1 = 100 W

Total Load = 118 W

$$I = \frac{118}{220 \times 0.7} = 0.77A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

❖ **ESB:**

- Tube Light ---> 20 W *1 = 20 W
- Light Bulb ---> 18 W *1 = 18 W
- Fan ---> 100 W *1 = 100 W
- SB Socket ---> 100 W *1 = 100 W

Total Load = 238 W

$$I = \frac{238}{220 \times 0.7} = 1.55A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

Toilet-1

❖ **SB:**

- Light Bulb ---> 10 W *1 = 10 W

Total Load = 10 W

$$I = \frac{10}{220 \times 0.7}$$

$$= 0.06 \text{ A}$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used

Balcony

❖ **SB:**

- Light Bulb ---> 6 W *1 = 6 W

Total Load = 6 W

$$I = \frac{6}{220 \times 0.7}$$

$$=0.04A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used

Apartment-3:

(9) kitchen :

❖ **SB:**

- Light ---> 18 W *2 = 36 W
- SB Socket ---> 100 W *1 = 100 W

Total Load = 136 W

$$I = \frac{136}{220 \times 0.7} = 0.88A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

(10) Dining

❖ **SB:**

- Socket (Table height) ---> 100 W *1 = 100 W
- Light Bulb ---> 24 W *1 = 24 W

Total Load = 124 W

$$I = \frac{124}{220 \times 0.7} = 0.81A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

❖ **ESB:**

- Tube Light ---> 20 W *1 = 20 W
- Light bulb ---> 24 W *1 = 24 W
- Fan ---> 100 W *1 = 100 W
- SB Socket ---> 100 W *1 = 100 W

Total Load = 244 W

$$I = \frac{244}{220 \times 0.7} = 1.58A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

(11) Drawing -

SB:

- Light Bulb ---> 24 W *1 = 24 W
- SB Socket ---> 100 W *1 = 100 W

Total Load = 124 W

$$I = \frac{124}{220 \times 0.7} = 0.81A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

❖ **ESB:**

- Tube Light ---> 20 W *1 = 20 W
- Fan ---> 100 W *1 = 100 W
- SB Socket ---> 100 W *1 = 100 W

Total Load = 220 W

$$I = \frac{220}{220 \times 0.7} = 1.43A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

Toilet-2

❖ **SB:**

- Light Bulb ---> 6 W *1 = 6 W

Total Load = 6 W

$$I = \frac{6}{220 \times 0.7}$$

$$= 0..04 \text{ A}$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used

(12) Bedroom –

SB:

- Light Bulb ---> 18 W *1 = 18 W
- SB Socket ---> 100 W *1 = 100 W

Total Load = 118 W

$$I = \frac{118}{220 \times 0.7} = 0.77A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

❖ **ESB:**

- Light Bulb ---> 18 W *1 = 18 W
- Fan ---> 100 W *1 = 100 W
- SB Socket ---> 100 W *1 = 100 W
- Tube Light ---> 20W * 1 = 20 W

Total Load = 238 W

$$I = \frac{238}{220 \times 0.7} = 1.55A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

(5) Master Bedroom

SB:

- Light Bulb ---> 18 W *1 = 18 W
- SB Socket ---> 100 W *1 = 100 W

Total Load = 118 W

$$I = \frac{118}{220 \times 0.7} = 0.77A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

❖ **ESB:**

- Tube Light ---> 20 W *1 = 20 W
- Light Bulb ---> 18 W *1 = 18 W
- Fan ---> 100 W *1 = 100 W
- SB Socket ---> 100 W *1 = 100 W

Total Load = 238 W

$$I = \frac{238}{220 \times 0.7} = 1.55A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

Toilet-1

❖ **SB:**

- Light Bulb ---> 10 W *1 = 10 W

Total Load = 10 W

$$I = \frac{10}{220 \times 0.7}$$

$$= 0.06 \text{ A}$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used

Balcony

❖ **SB:**

- Light Bulb ---> 6 W *1 = 6 W

Total Load = 6 W

$$I = \frac{6}{220 \times 0.7}$$

$$= 0.04 \text{ A}$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used

Apartment:4

(13) kitchen :

❖ **SB:**

- Light ---> 18 W *2 = 36 W
- SB Socket ---> 100 W *1 = 100 W

Total Load = 136 W

$$I = \frac{136}{220 \times .7} = 0.88A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

(14) Dining

❖ **SB:**

- Socket (Table height) ---> 100 W *1 = 100 W
- Light Bulb ---> 24 W *1 = 24 W

Total Load = 124 W

$$I = \frac{124}{220 \times .7} = 0.81A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

❖ **ESB:**

- Tube Light ---> 20 W *1 = 20 W
- Fan ---> 100 W *1 = 100 W
- SB Socket ---> 100 W *1 = 100 W

Total Load = 220 W

$$I = \frac{220}{220 \times .7} = 1.43A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

(15) Drawing -

SB:

- SB Socket ---> 100 W *1 = 100 W
- Tube Light ---> 20 W *1 = 20 W

Total Load = 120 W

$$I = \frac{120}{220 \times 0.7} = 0.78A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

❖ ESB:

- Fan ---> 100 W *1 = 100 W
- SB Socket ---> 100 W *1 = 100 W
- Light Bulb ---> 24 W *1 = 24 W

Total Load = 244 W

$$I = \frac{244}{220 \times .7} = 1.58A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

Toilet-2

❖ SB:

- Light Bulb ---> 6 W *1 = 6 W

Total Load = 6 W

$$I = \frac{6}{220 \times 0.7}$$

$$= 0.04 \text{ A}$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used

(16) Bedroom –

SB:

- Light Bulb ---> 18 W *1 = 18 W
- SB Socket ---> 100 W *1 = 100 W

Total Load = 118 W

$$I = \frac{118}{220 \times 0.7} = 0.77A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

❖ **ESB:**

- Light Bulb ---> 18 W *1 = 18 W
- Fan ---> 100 W *1 = 100 W
- SB Socket ---> 100 W *1 = 100 W
- Tube Light ---> 20W * 1 = 20 W

Total Load = 238 W

$$I = \frac{238}{220 \times 0.7} = 1.55A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

(6) Master Bedroom

SB:

- Light Bulb ---> 18 W *1 = 18 W
- SB Socket ---> 100 W *1 = 100 W

Total Load = 118 W

$$I = \frac{118}{220 \times 0.7} = 0.77A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

❖ **ESB:**

- Tube Light ---> 20 W *1 = 20 W
- Light Bulb ---> 18 W *1 = 18 W
- Fan ---> 100 W *1 = 100 W
- SB Socket ---> 100 W *1 = 100 W

Total Load = 238 W

$$I = \frac{238}{220 \times 0.7} = 1.55A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

Toilet-1

❖ **SB:**

- Light Bulb ---> 10 W *1 = 10 W

Total Load = 10 W

$$I = \frac{10}{220 \times 0.7}$$

$$= 0.06 \text{ A}$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used

Balcony

❖ **SB:**

- Light Bulb ---> 6 W *1 = 6 W

Total Load = 6 W

$$I = \frac{6}{220 \times .7} = 0.04A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

Calculations for Sub-distribution Boards (First Floor)

(1) SDB1

Total Load=136+124+124+6+118+118+10+6

=642W

P Load = (3000 + 3000 + 3000 + 3000 +3000+3000) W

= 18000 W

SDB Load = Total Load × 0.7 + P Load × 0.5
= (642 × 0.7 + 18000 × 0.5) W
= 9450 W

SDB Current $I = \frac{9450}{220 \times .7} = 61.36A$

So, 65A SP MCCB is needed from MDB to SDB3

(2) ESDB1

Total Load=244+220+238+238

=940W

P Load = 0 W

Q Load= 0W

SDB Load = Total Load × 0.7 + P Load × 0.5 + Q Load × 0.3
= (940 × 0.7 +0 × 0.5 +0 × 0.3) W
= 658 W

SDB Current $I = \frac{658}{220 \times .7} = 4.27A$

So, 10A SP MCCB is needed from MDB to SDB3

(3)SDB2

Total Load=136+124+124+6+118+118+10+6

=642W

P Load = (3000 + 3000 + 3000 + 3000 +3000+3000) W

= 18000 W

SDB Load = Total Load × 0.7 + P Load × 0.5
= (642 × 0.7 + 18000 × 0.5) W
= 9450 W

SDB Current $I = \frac{9750}{220 \times .7} = 61.36A$

So, 65A SP MCCB is needed from MDB to SDB3

(4)ESDB2

Total Load=244+220+238+238

=940W

P Load = 0 W

Q Load= 0W

SDB Load = Total Load × 0.7 + P Load × 0.5 + Q Load × 0.3
= (940 × 0.7 +0 × 0.5 +0 × 0.3) W
= 658 W

SDB Current $I = \frac{658}{220 \times .7} = 4.27A$

So, 10A SP MCCB is needed from MDB to SDB3

(5)SDB3

Total Load=136+124+124+6+118+118+10+6

=642W

P Load = (3000 + 3000 + 3000 + 3000 +3000+3000) W

= 18000 W

SDB Load = Total Load × 0.7 + P Load × 0.5
= (642 × 0.7 + 18000 × 0.5) W
= 9450 W

SDB Current $I = \frac{9450}{220 \times .7} = 61.36A$

So, 65A SP MCCB is needed from MDB to SDB3

(6)ESDB3

Total Load=244+220+238+238

=940W

P Load = 0 W

Q Load= 0W

SDB Load = Total Load × 0.7 + P Load × 0.5 + Q Load × 0.3
= (940 × 0.7 +0 × 0.5 +0 × 0.3) W
= 658 W

SDB Current $I = \frac{658}{220 \times .7} = 4.27A$

So, 10A SP MCCB is needed from MDB to SDB3

(5)SDB3

Total Load=136+124+120+6+118+118+10+6

=638W

P Load = (3000 + 3000 + 3000 + 3000 +3000+3000) W

= 18000 W

SDB Load = Total Load × 0.7 + P Load × 0.5
= (638 × 0.7 + 18000 × 0.5) W
= 9448 W

SDB Current $I = \frac{9448}{220 \times .7} = 61.34A$

So, 65A SP MCCB is needed from MDB to SDB3

(6)ESDB3

Total Load=244+220+238+238

=940W

P Load = 0 W

Q Load= 0W

SDB Load = Total Load × 0.7 + P Load × 0.5 + Q Load × 0.3
= (940 × 0.7 +0 × 0.5 +0 × 0.3) W
= 658 W

SDB Current $I = \frac{658}{220 \times .7} = 4.27A$

So, 10A SP MCCB is needed from MDB to SDB3

Ground Floor

(1) Parking :

❖ **SB:**

- Light ---> 20 W *3 = 60 W
- SB Socket ---> 100 W *1 = 100 W
- Fan ---> 100 W *2 = 200 W

.....

Total Load = 360 W

$$I = \frac{360}{220 \times .7} = 2.34A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

❖ **ESB:**

- Light Bulb ---> 20 W *2 = 40 W
- SB Socket ---> 100 W *1 =100 W

.....

Total Load = 140 W

$$I = \frac{140}{220 \times .7} = 0.91A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

❖ **SB:**

- Light ---> 20 W *3 = 60 W
- SB Socket ---> 100 W *1 = 100 W
- Fan ---> 100 W *3 = 300 W

.....

Total Load = 460 W

$$I = \frac{460}{220 \times .7} = 2.98A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

❖ **ESB:**

- Light Bulb ---> 20 W *2 = 40 W
- Fan ---> 100 W *1 =100 W
- SB Socket ---> 100W*1 =100W

.....

Total Load = 240 W

$$I = \frac{240}{220 \times .7} = 1.56A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

(2) Guard Room :

❖ **SB:**

- Light ---> 20 W *2 = 40 W
- SB Socket ---> 100 W *1 = 100 W
- Fan ---> 100 W *1 = 100 W

.....

Total Load = 240 W

$$I = \frac{240}{220 \times .7} = 1.56A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

(3) Transformer Room :

❖ **SB:**

- Light ---> 20 W *2 = 40 W
- SB Socket ---> 100 W *1 = 100W

.....

Total Load = 140 W

$$I = \frac{140}{220 \times .7} = 0.91A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

(4) Generator Room :

❖ **SB:**

- Light ---> 20 W *2 = 40 W
- SB Socket ---> 100 W *1 = 100W

.....

Total Load = 140 W

$$I = \frac{140}{220 \times .7} = 0.91A$$

Calculations for Sub-distribution Boards (Ground Floor)

(1)SDB1

Total Load=360+460+140+140

=1100W

SDB Load = Total Load × 0.7 + P Load × 0.5
= (1100 × 0.7 + 0 × 0.5) W
= 770 W

SDB Current $I = \frac{770}{220 \times .7} = 5A$

So, 65A SP MCCB is needed from MDB to SDB3

(2)ESDB1

Total Load=240+140

=380W

P Load = 0 W

SDB Load = Total Load × 0.7 + P Load × 0.5
= (380 × 0.7 +0 × 0.5) W
= 266 W

SDB Current $I = \frac{266}{220 \times .7} = 1.72A$

So, 65A SP MCCB is needed from MDB to SDB3

Underground

(5) Parking :

❖ **SB:**

- Light ---> 20 W *6 = 120 W
- SB Socket ---> 100 W *1 = 100 W
- Fan ---> 100 W *2 = 200 W

.....

Total Load = 420 W

$$I = \frac{420}{220 \times .7} = 2.72A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

❖ **ESB:**

- Light Bulb ---> 20 W *2 = 40 W
- SB Socket ---> 100 W *1 =100 W
- Fan ---> 100 W *1 =100 W

.....

Total Load = 240 W

$$I = \frac{240}{220 \times .7} = 1.56A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

❖ **SB:**

- Light ---> 20 W *4 = 80 W
- SB Socket ---> 100 W *1 = 100 W
- Fan ---> 100 W *2 = 200 W

.....

Total Load = 380 W

$$I = \frac{380}{220 \times .7} = 2.47A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

❖ **ESB:**

- Light Bulb ---> 20 W *2 = 40 W
- Fan ---> 100 W *1 =100 W
- SB Socket ---> 100W*1 =100W

.....

Total Load = 240 W

$$I = \frac{240}{220 \times .7} = 0.04A$$

So, 2x1.5 rm BYM + 1.5 BYC ECC are used.

Calculations for Sub-distribution Boards (Underground)

(1)SDB1

Total Load=420+380

=800W

SDB Load = Total Load × 0.7 + P Load × 0.5
= (800 × 0.7 + 0 × 0.5) W
= 560 W

SDB Current $I = \frac{560}{220 \times .7} = 3.63A$

So, 10A SP MCCB is needed from MDB to SDB3

(2)ESDB1

Total Load=240+240

=480W

P Load = 0 W

SDB Load = Total Load × 0.7 + P Load × 0.5
= (480 × 0.7 +0 × 0.5) W
= 336 W

SDB Current $I = \frac{336}{220 \times .7} = 2.18A$

So, 5A SP MCCB is needed from MDB to SDB3

Calculations for Main Distribution Boards

(1)EMDB

8 person Elevator Load=5000W

$$I = \frac{5000}{3 \times 220 \times .7} = 10.822A$$

So, 15A SP MCCB is needed from Elevator to EMDB

Total Load = (336+(658+658+658+658) × 5+266+5000)× 0.7W

= 13134 W

EMDB Current, $I = \frac{13134}{3 \times 220 \times .7} = 28.4286A$ (according to sir's lecture)

So, 30A TP MCCB is needed from MDB TO EMDB

A 15kW or 20 KVA Generator is used to supply the EMDB load through an ATS.Generator room dimension will be 25 sqm.

(2)MDB

Total SDB Load = (9750×20+560+770) W
= 196330 W

Pump Load = 2500 W

So, 10A TP MCCB is needed from PUMP TO MDB

MDB Load = Total SDB Load × 0.7 + (EMDB Load + Pump Load) × 0.7

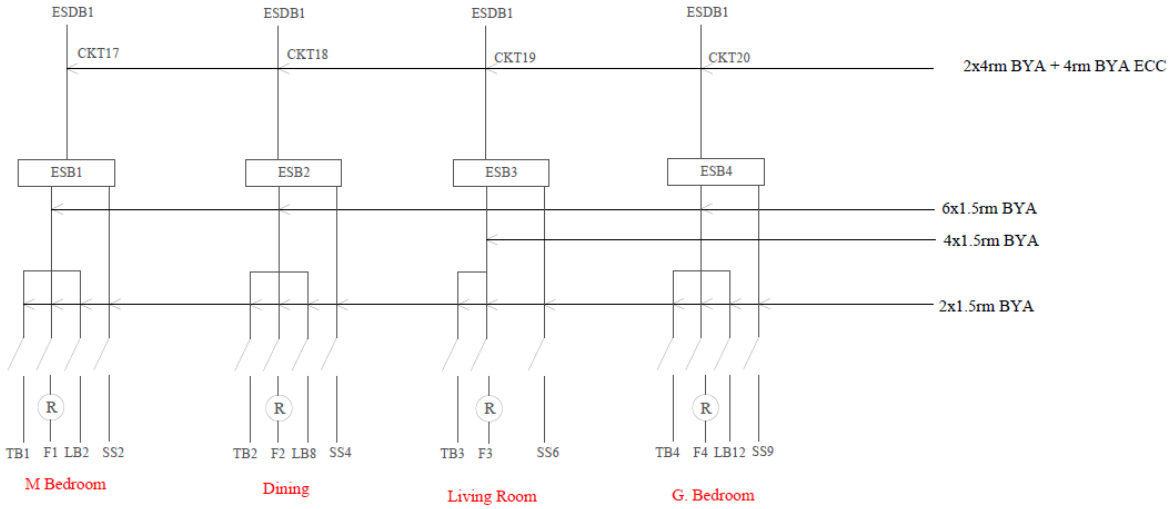
= 196330 × 0.7 + (13134+112+ 2500) × 0.7 W
= 148453 W

MDB Current, $I = \frac{148453}{3\times220\times.7} = 321.3272A$
So, 60A TP MCCB is needed from Main Line to MDB.

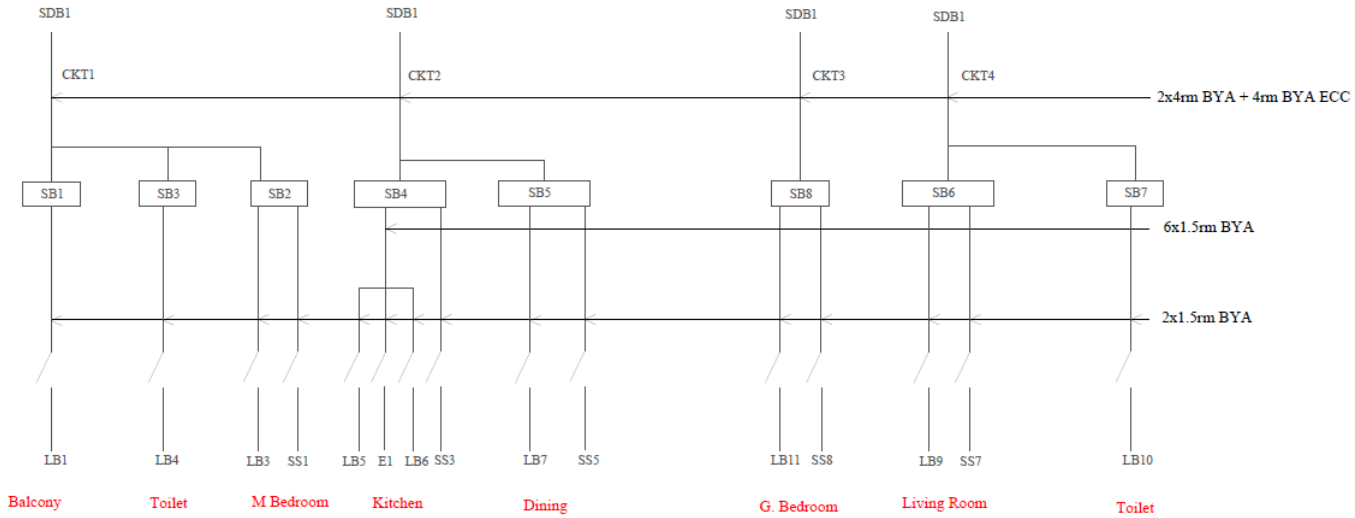
Switchboard diagram

(1)Apartment-01

ESDB:



SDB:



(2)Apartment-02

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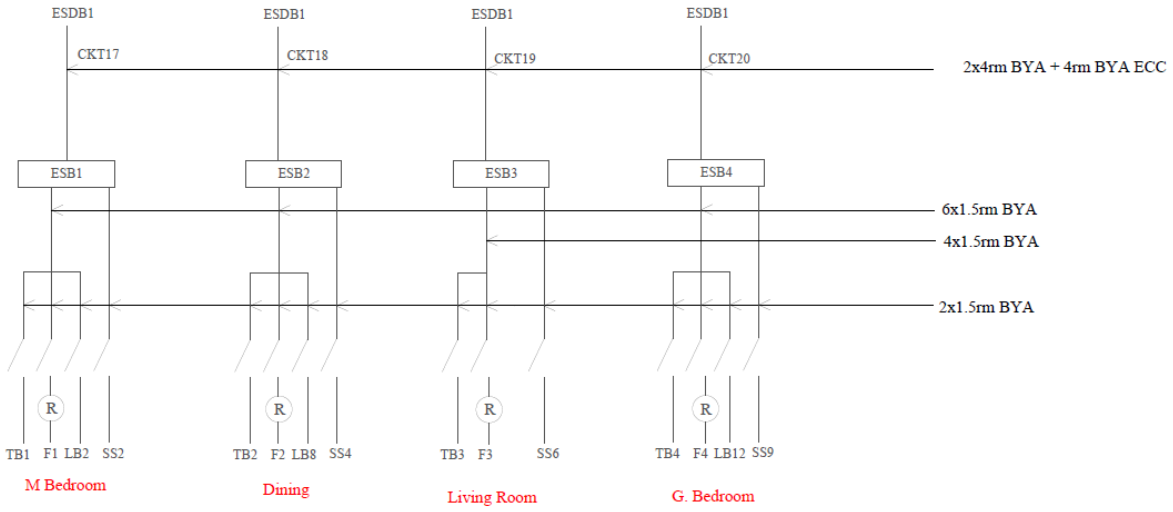

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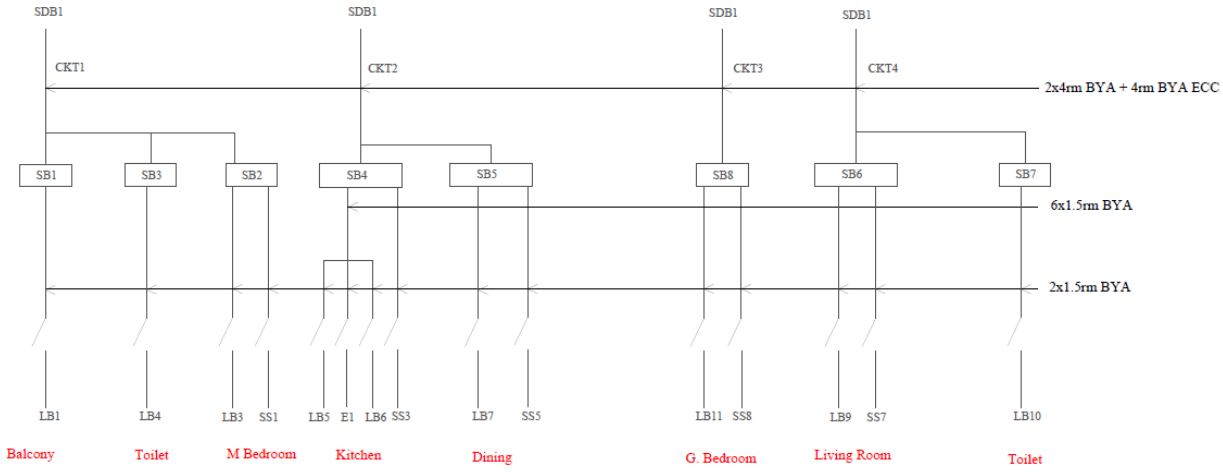

(3)Apartment-03

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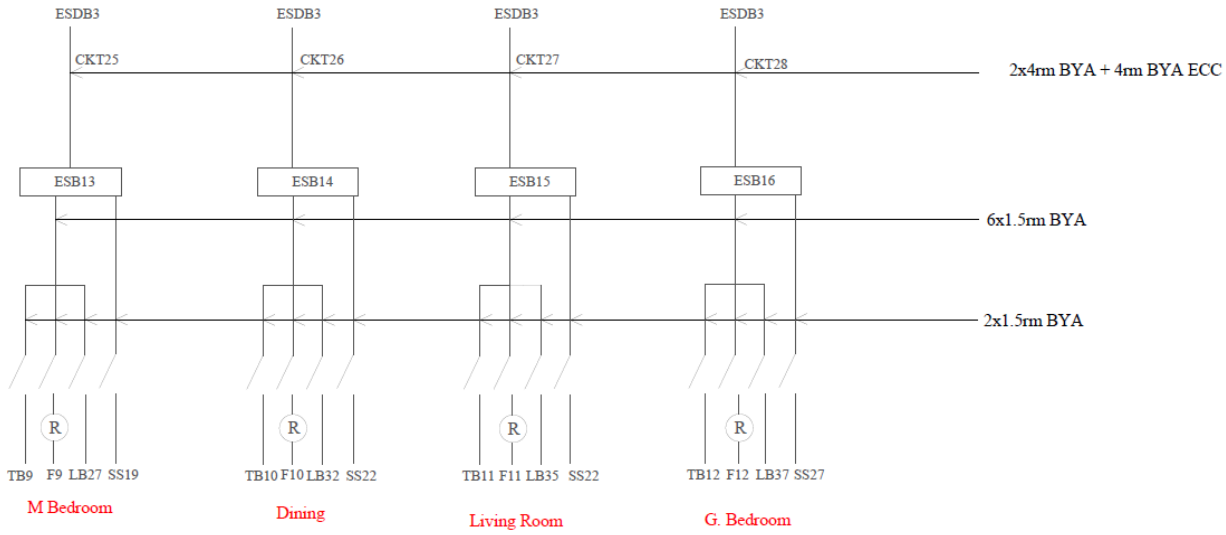

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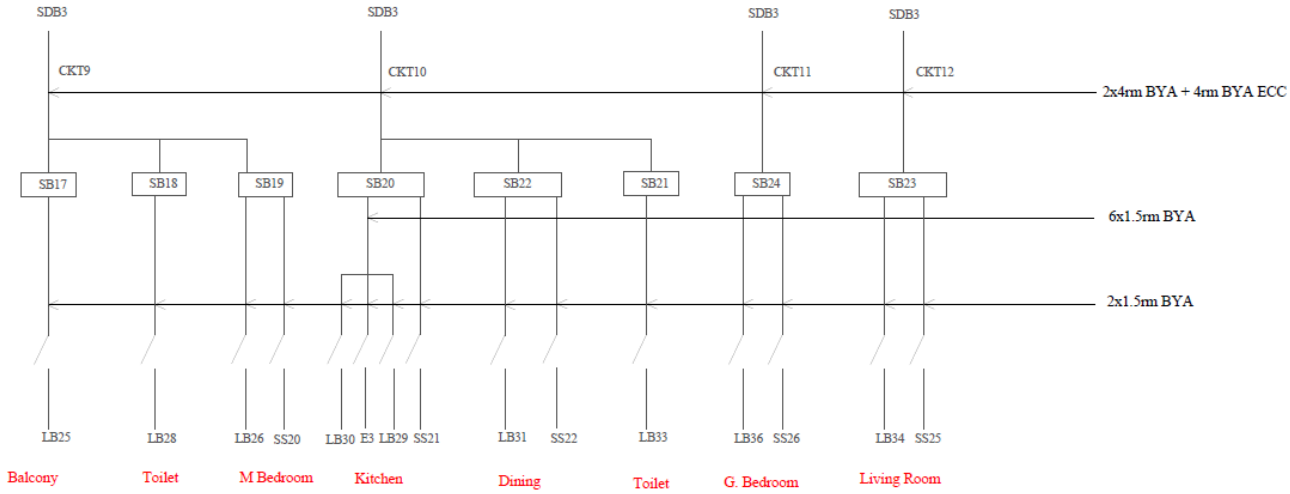
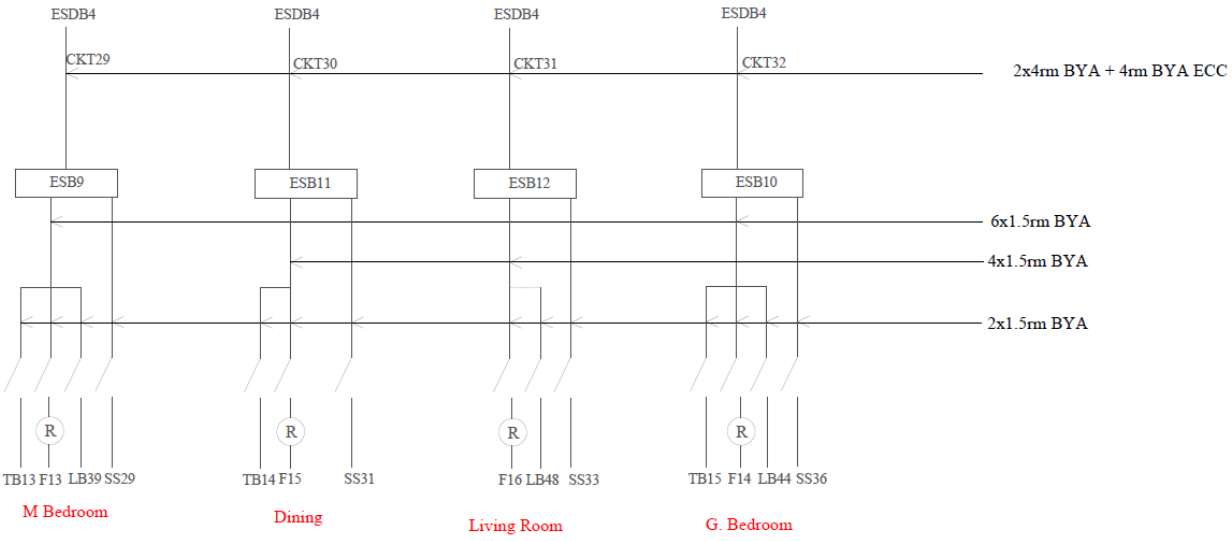


(4)Apartment-04

ESDB:



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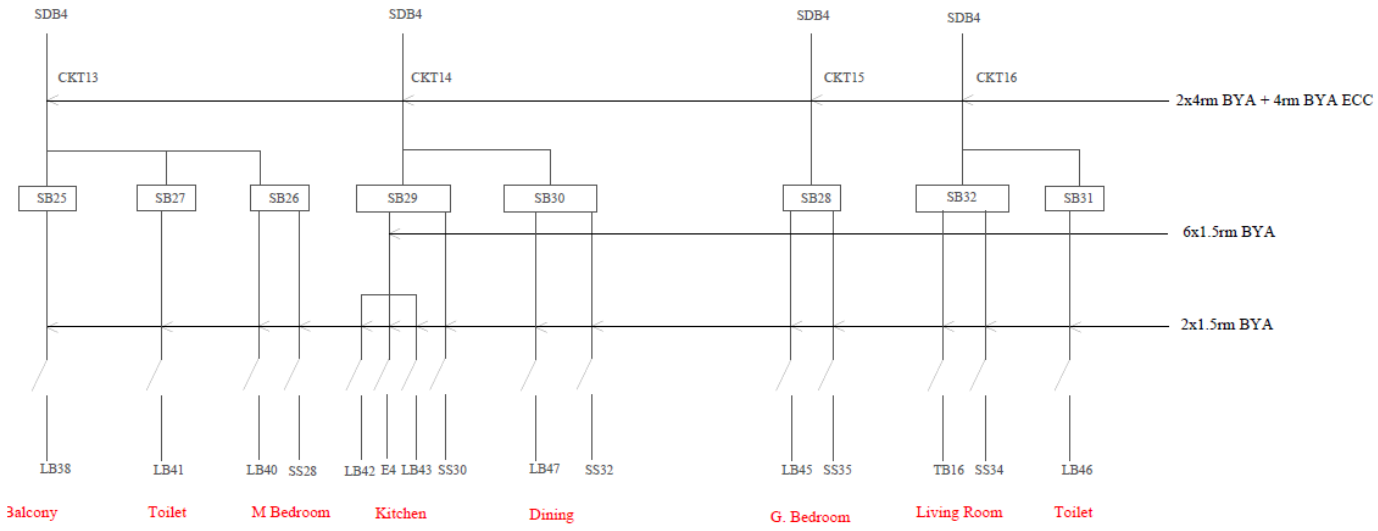
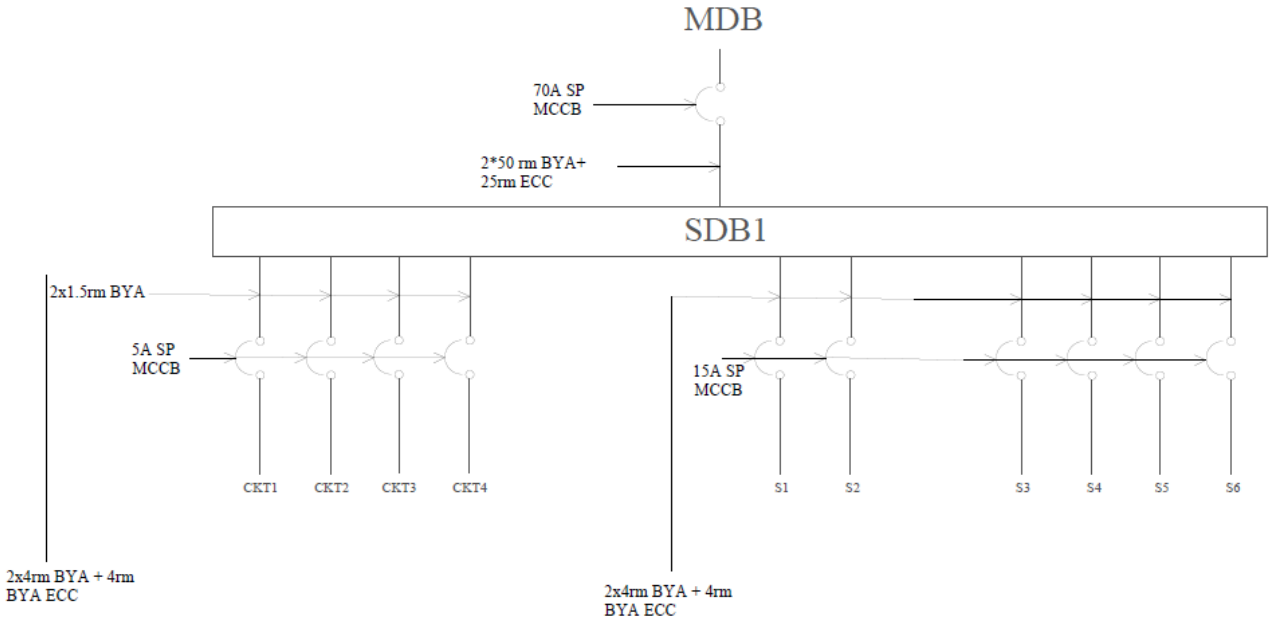
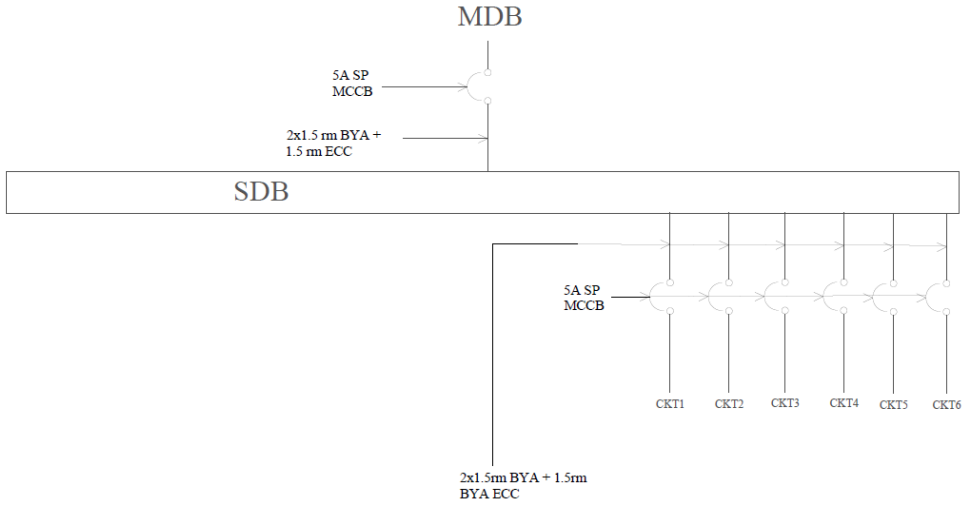


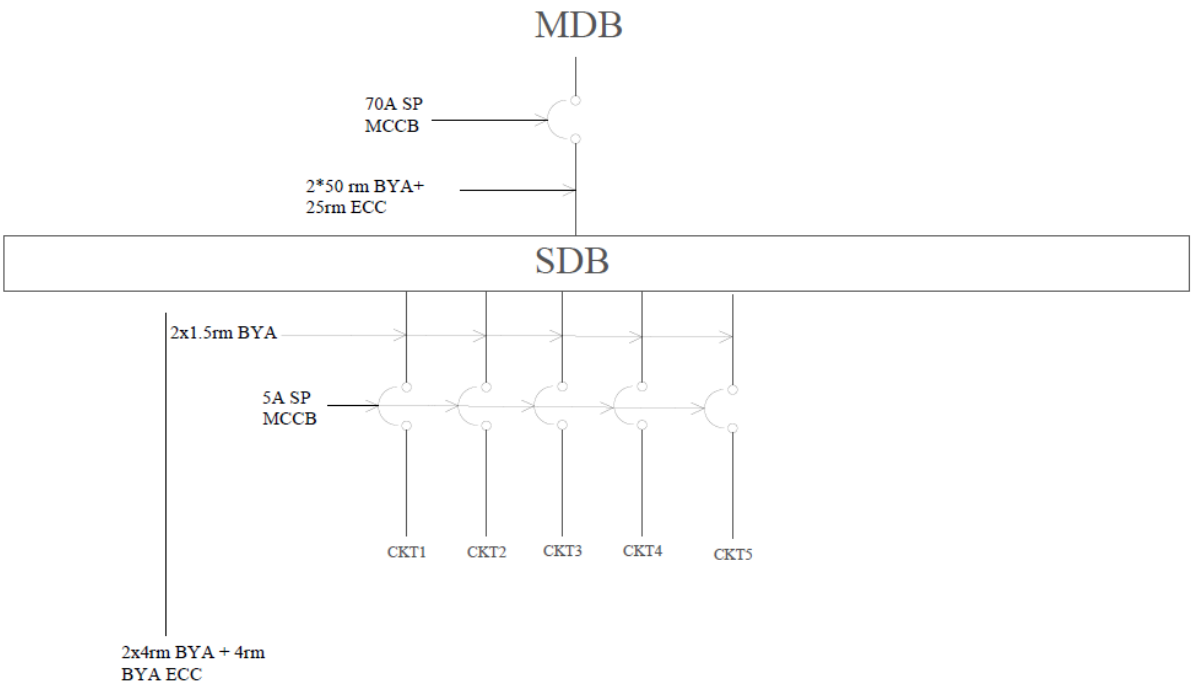
Default Unit SDB Diagram



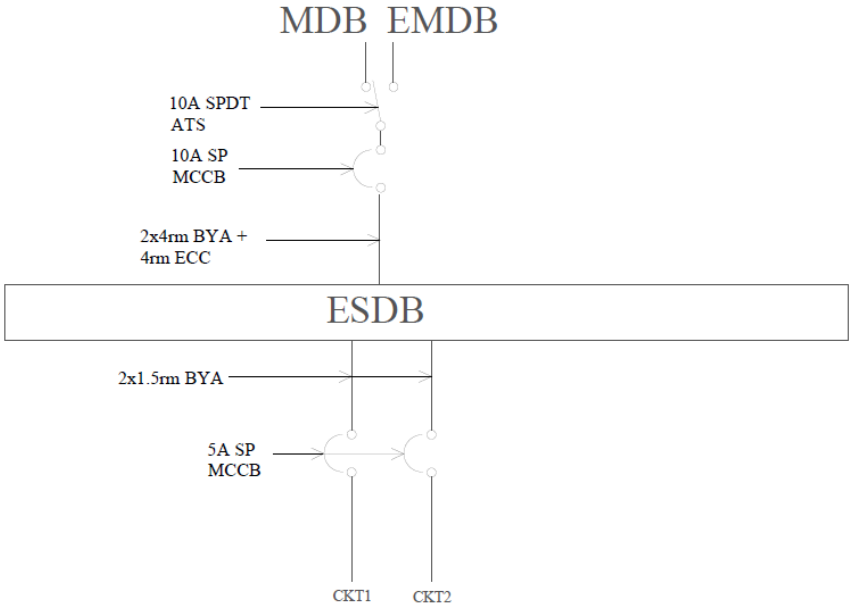
Staircase light SDB Diagram



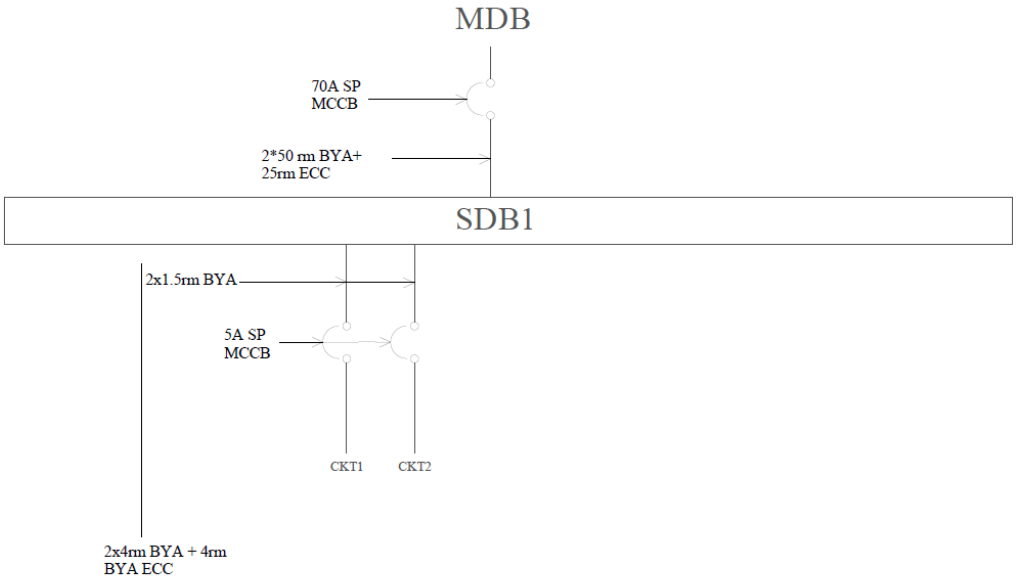
Ground Floor SDB Diagram



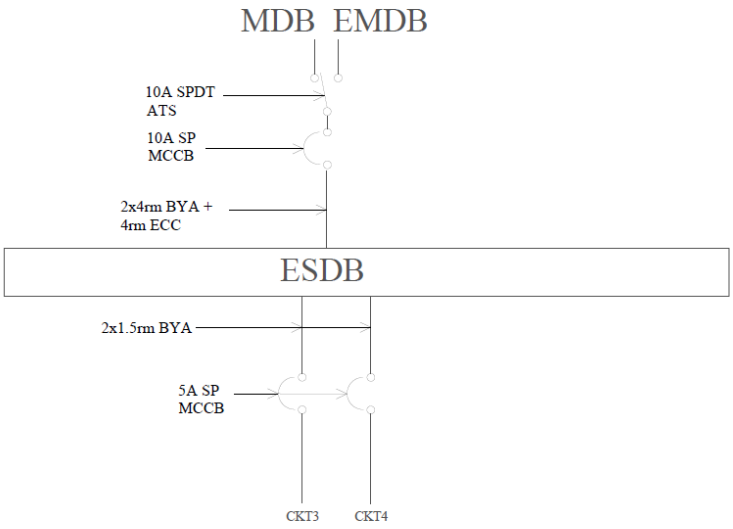
Ground Floor ESDB Diagram



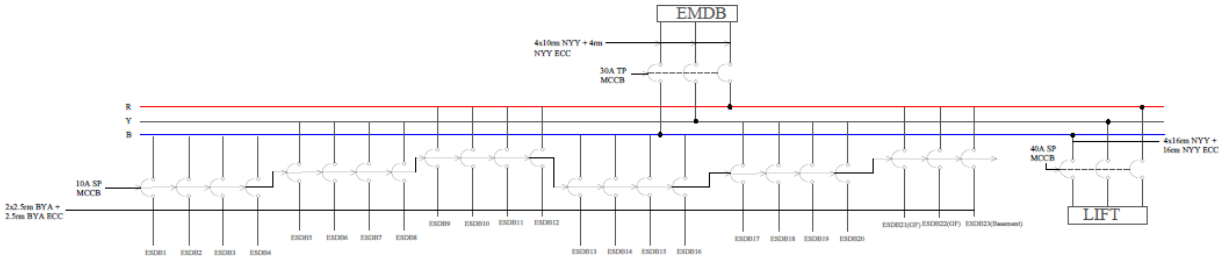
Basement SDB Diagram



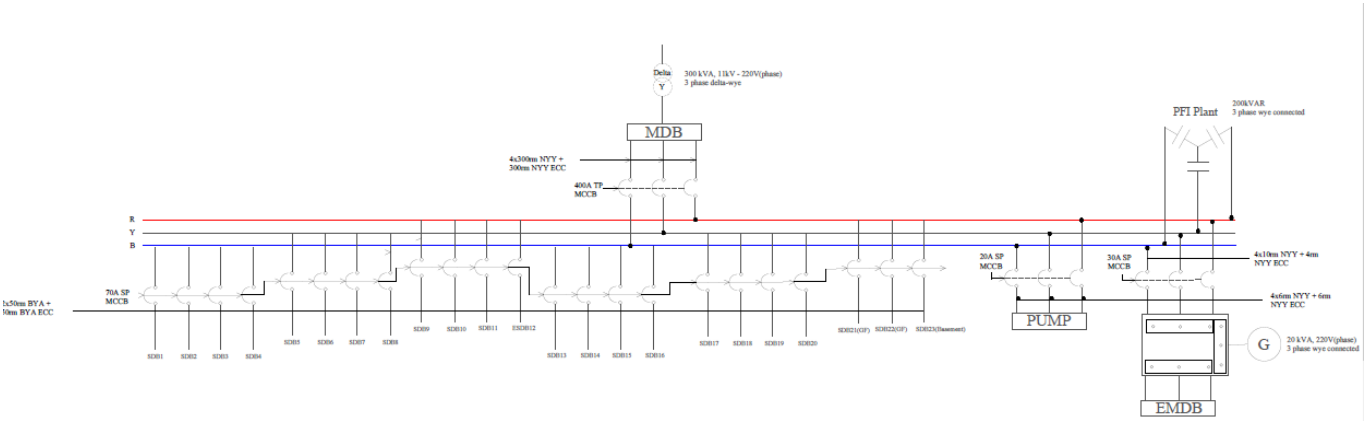
Basement ESDB Diagram



EMDB Connection Diagram



MDB Connection Diagram



Calculation of PFI Plant:

Cosx = 0.7

Sinx = 0.714

Q= 3VIsinx = ptanx = 151.422 kVar

I = Q/2Vsinx = 482 A

So, 500A TP MCCB is req. from PFIto MDB

Calculation of Transformers:

S= 3VI = 3*220*321.3272 A = 212.075 kVA
So, 11/0.415 kV, 50 Hz, 300 kVA, DYN 11, Oil Immersed Transformer with 4-6% impedence is needed.
Transformer room dimension will be 48 sqm.

Lighting Protection System:

Total area=313 sqm
Length=90ft
Width=40ft
Lighting arrestor in length =(90/25)
=4
Lighting arrestor in length =(40/25)
=2
Earth down conductor =1(for 80 sqm)+(313-80)/100
=1+3
=4

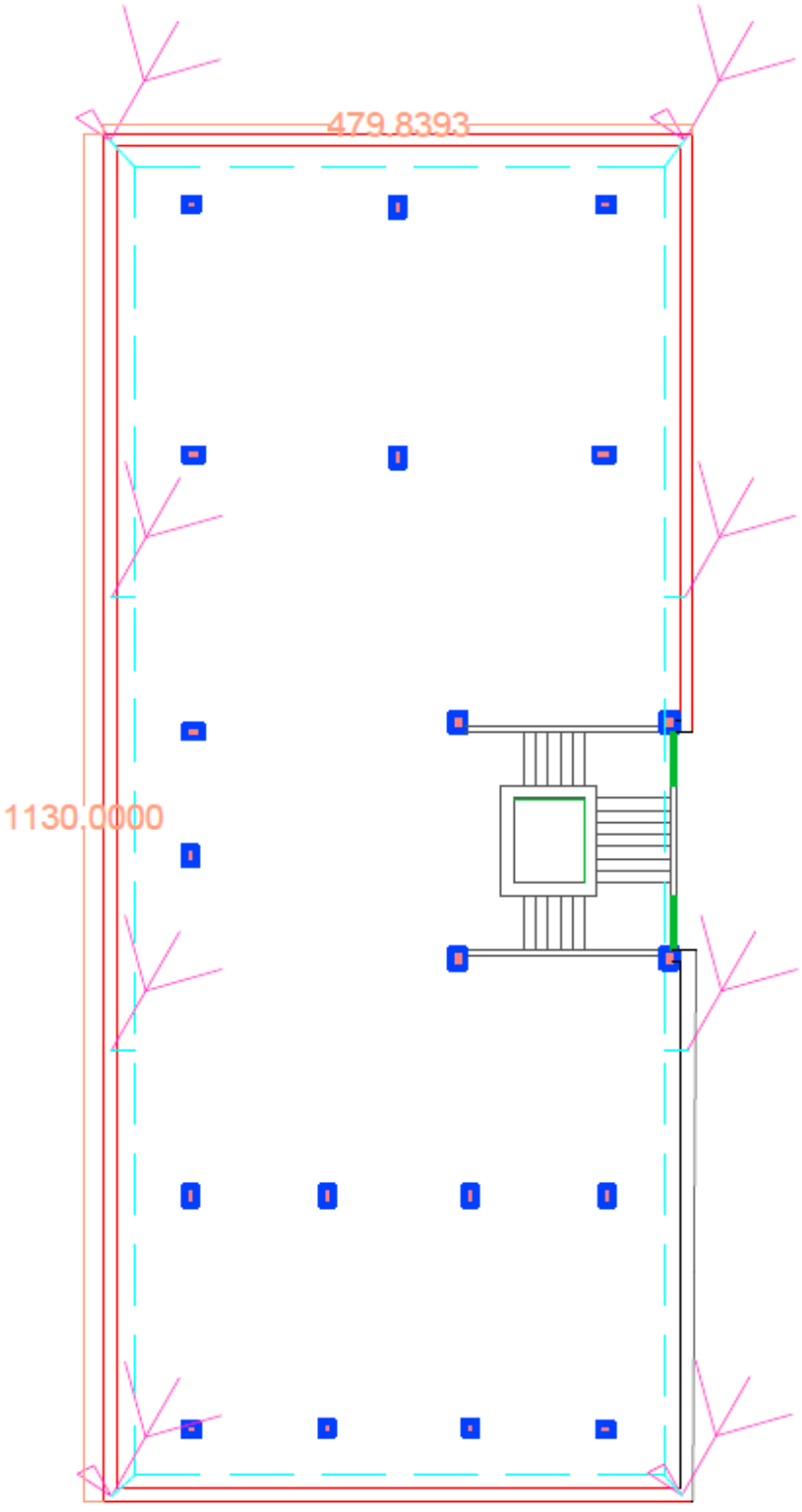


Fig: Lighting Arrestor at rooftop