Bangladesh University of Engineering and Technology
Electrical & Electronic Engineering

Course No : EEE 414
Course Name : Electrical Service Design

Report on

Electrical service design project

Date of Submission **:**19th February, 2021

Submitted by
Group No – 6

Name & ID:
1606140 – Shakil Ahmed
1606143 – Md. Saklain Morshed
1606164 – Rubayet Binte Kabir
1606187 – Sandip Kollol Dhruba
1606189 – Md. Rohan Islam
1606191 – Asmiya Hasan
1606194 – Md. Sadik Yasir Tauki
1606195 – Prayas Chakma

Table of Contents

List of Figure Captions

CHAPTER 1: DESIGN

FLOOR PLAN (GROUND FLOOR)

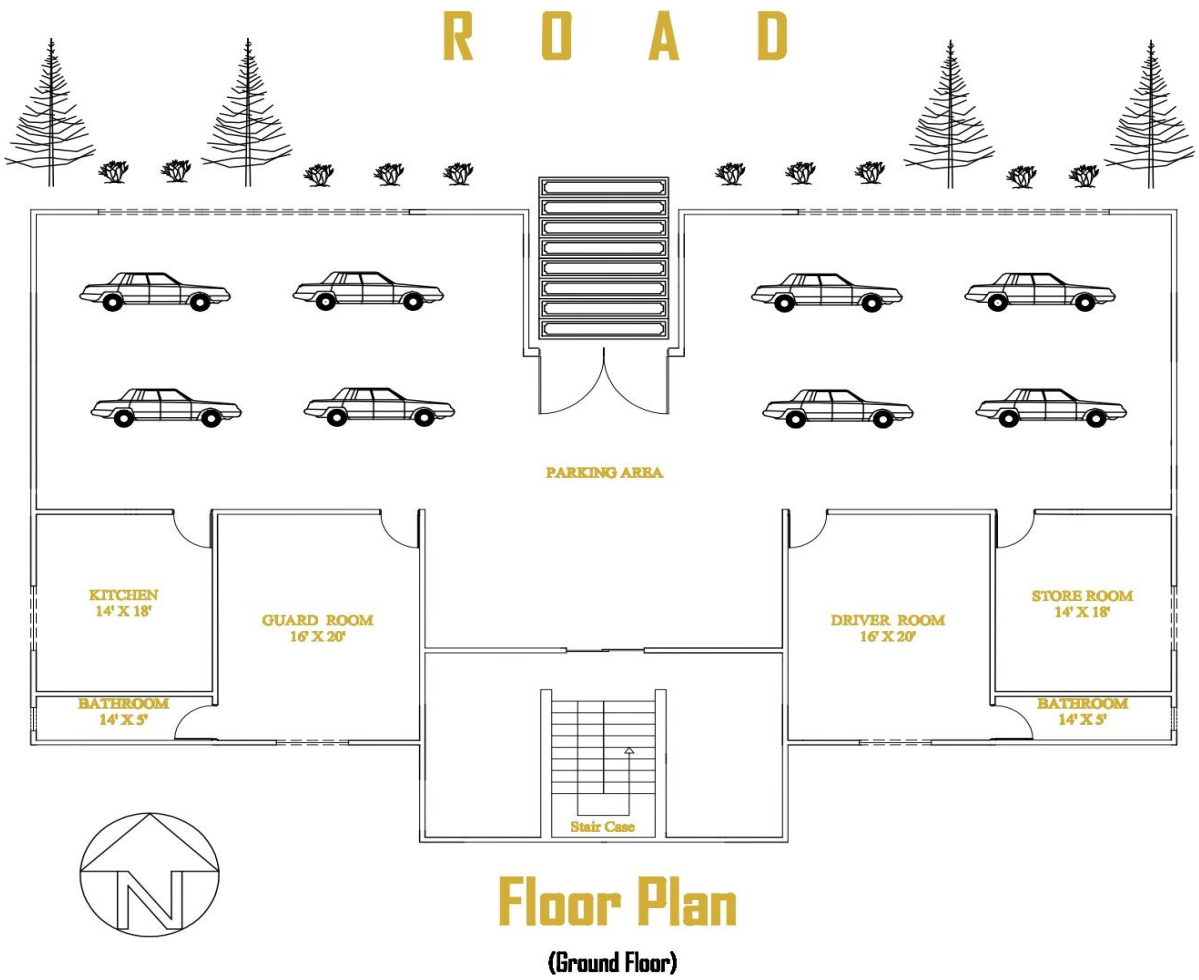


Fig 1.1 Floor Plan (Ground Floor

FLOOR PLAN (1st and 2nd FLOOR)

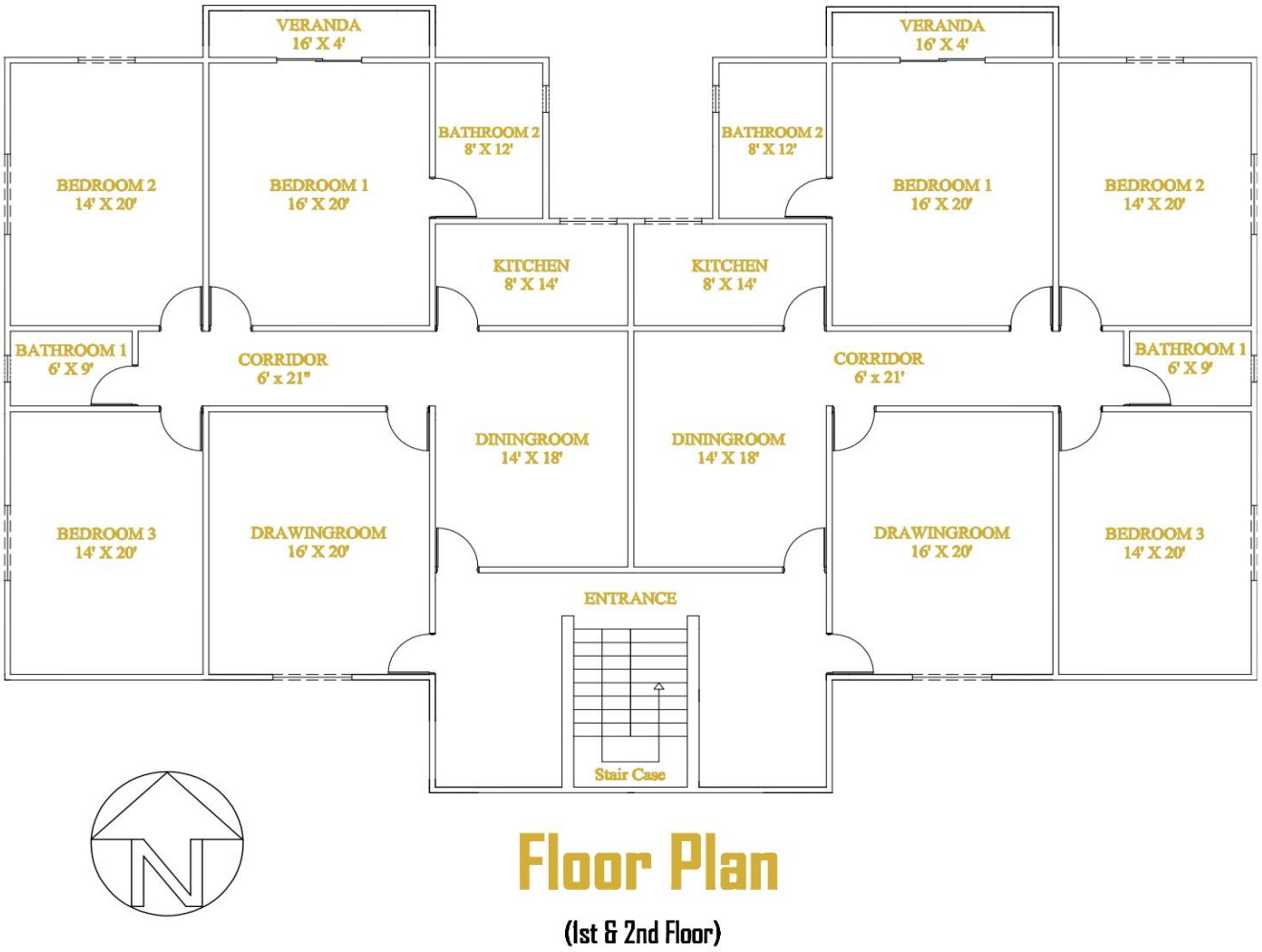


Fig 1.2 Floor Plan (1st and 2nd Floor)

FITTINGS AND FIXTURES LAYOUT (GROUND FLOOR)

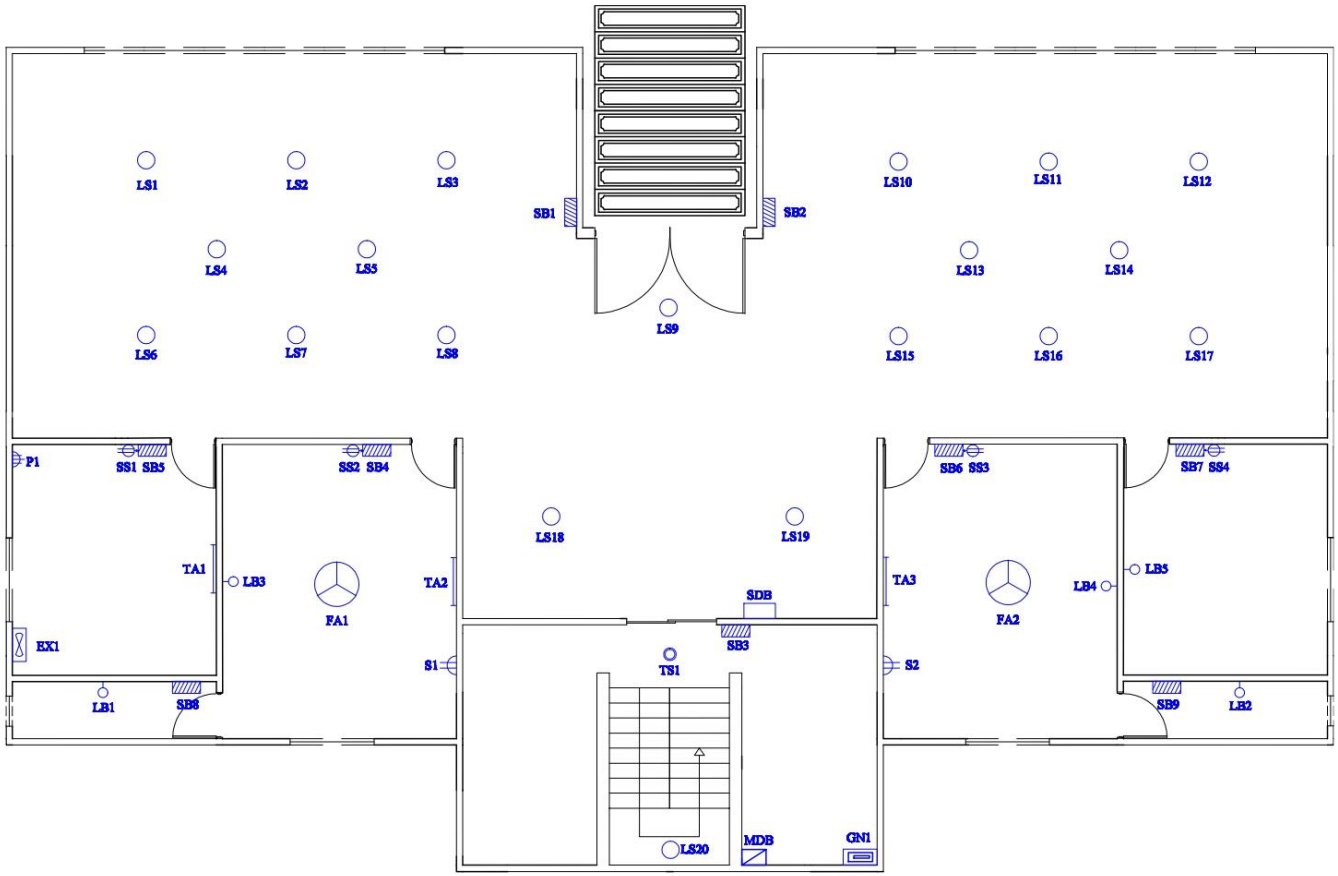


Fig 1.3 Fittings and Fixtures (Ground Floor)

(Ground Floor)

FITTINGS AND FIXTURES LAYOUT (1st and 2nd FLOOR)

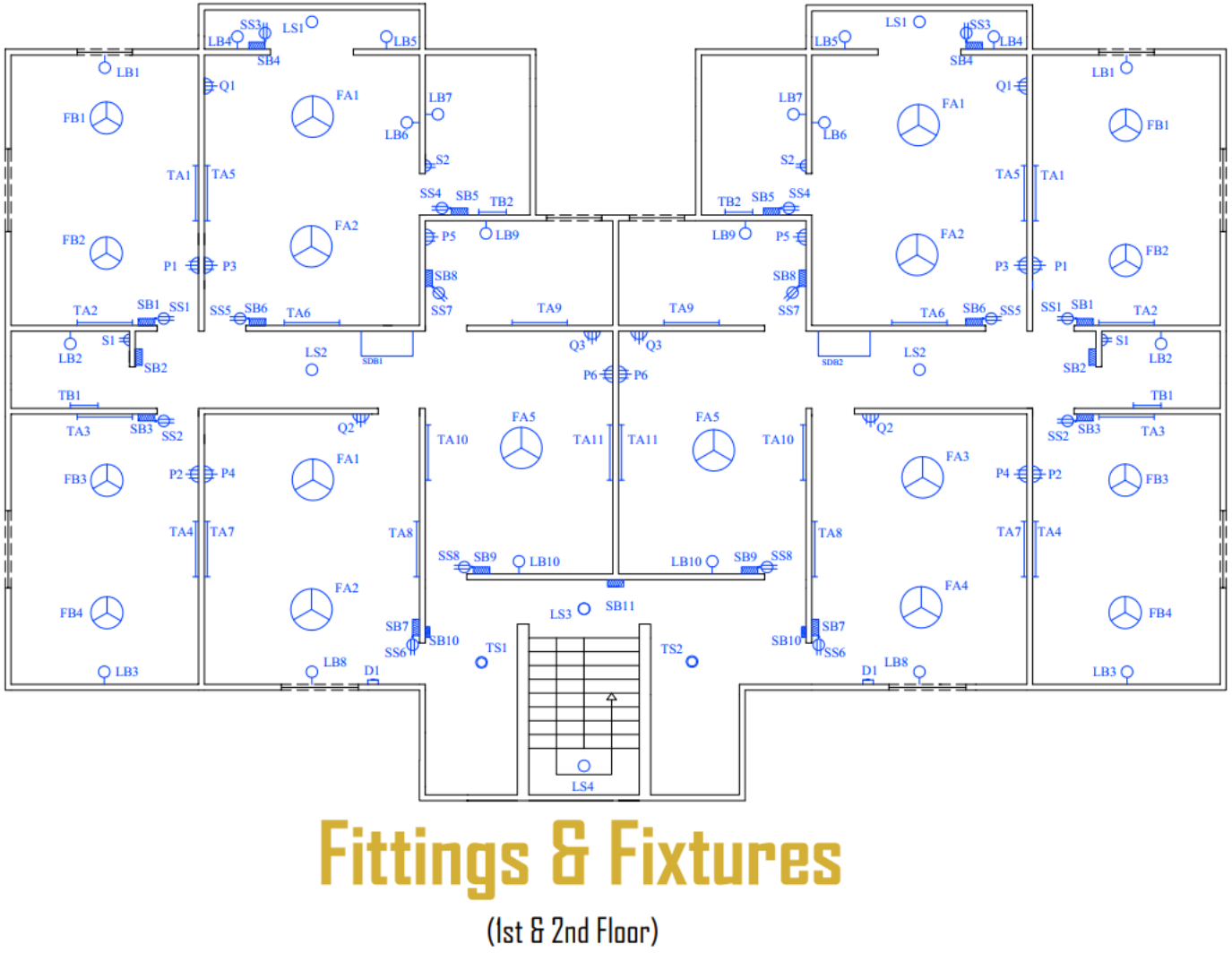
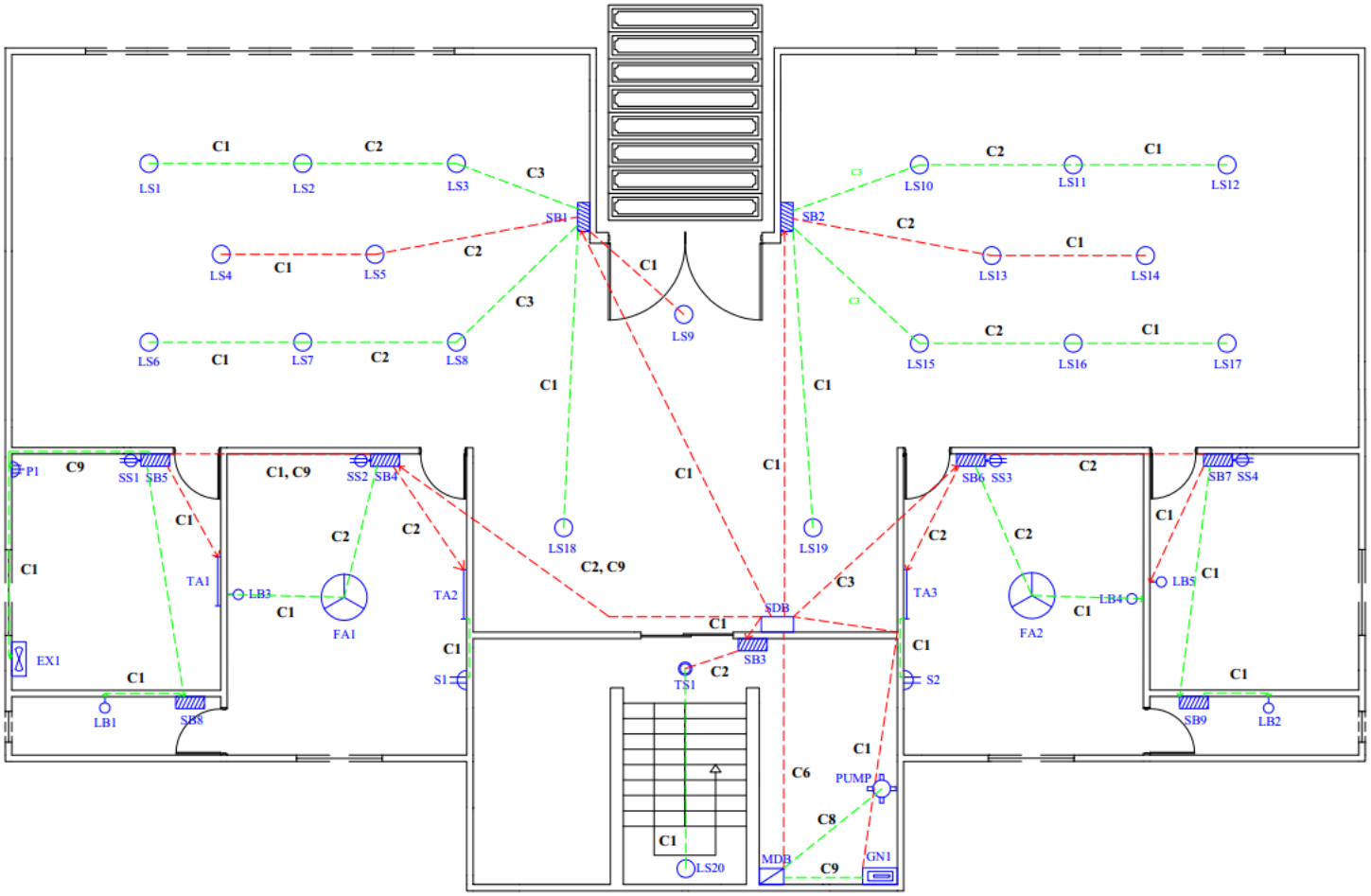


Fig 1.4 Fittings and Fixtures (1st and 2nd Floor)

CONDUIT LAYOUT OF GROUND FLOOR



Conduit

(Ground Floor)

Fig 1.5 Conduit (Ground Floor)

CONDUIT LAYOUT (1st and 2nd FLOOR)

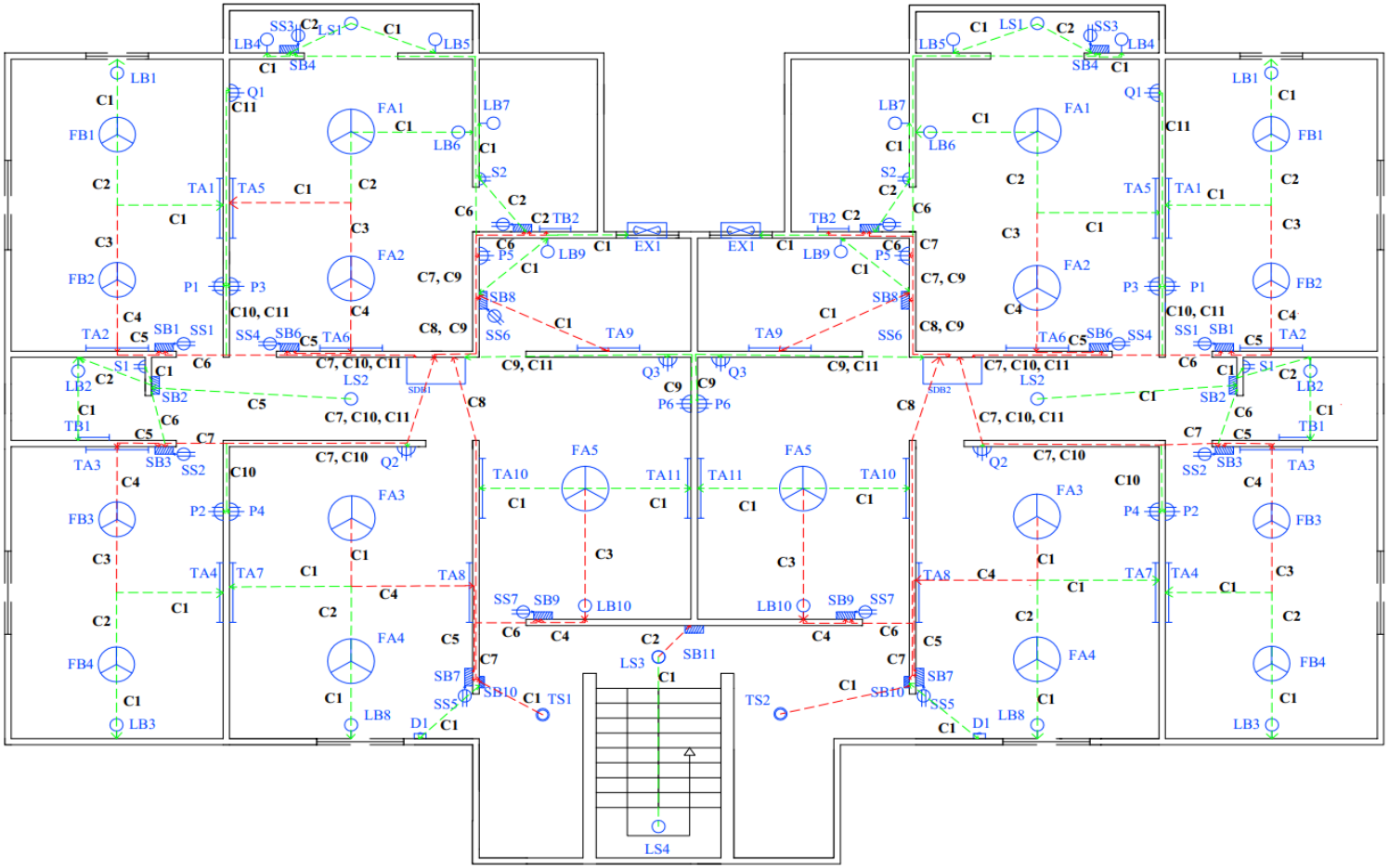


Fig 1.6 Conduit (1st and 2nd Floor)

LEGENDS and CONDUIT SYMBOLS

Legends

Description	Height	Caption	Symbol	
			Fitting & Fixtures	Conduit Layout
4'-40W Wall Mounted Fluroscent Tube Light	Lintel	TA		
2'-20W Wall Mounted Fluroscent Tube Light	Lintel	TB		
60 W Incandescent Light Bracket	Lintel	LB		
23W Energy Bulb	Ceiling	LS		
60W Staircase Light	Ceiling	TS		
36"-56" Sweep Fan	Ceiling	FA		
28"-36" Sweep Fan	Ceiling	FB		
Generator	Floor	GN		
Main Distribution Board	Switchboard	MDB		
12" Exhaust Fan	Lintel	EX		
5A-2 Pin Socket in Switchboard	Switchboard	SS		
5A-2 Pin Socket	Skirting	S		
15A-3 Pin Socket	Skirting	P		
20A-3 Pin Socket	Skirting	Q		
Doorbell	Switchboard	D		
Switcboard	Switchboard	SB		
Sub Distribution Board	Switchboard	SDB		

Conduit Schedules

Name	Cable Size	Conduit Size
C1	2 x 1.5 rm BYM + 1.5 rm BYA	3/4"
C2	4 x 1.5 rm BYM + 1.5 rm BYA	3/4"
C3	6 x 1.5 rm BYM + 1.5 rm BYA	3/4"
C4	8 x 1.5 rm BYM + 1.5 rm BYA	1"
C5	10 x 1.5 rm BYM+ 1.5 rm BYA	1"
C6	2 x 2.5 rm BYM+ 2.5 rm BYA	1"
C7	4 x 2.5 rm BYM + 2.5 rm BYA	1"
C8	6 x 2.5 rm BYM + 2.5 rm BYA	1"
C9	2 x 4 rm BYM + 4 rm BYA	1"
C10	4 x 4 rm BYM + 4 rm BYA	1"
C11	2 x 6 rm BYM + 6 rm BYA	1"

Conduit Symbols

Conduit Type	Symbol
Normal Concealed Conduit	
Normal Concealed Conduit Going Up	
Normal Concealed Conduit Going Down	
Normal+Emergency Concealed Conduit	
Normal+Emergency Concealed Conduit Going Up	
Normal+Emergency Concealed ConduitGoing Down	

CHAPTER 2: ELECTRICAL CONNECTION DIAGRAM

SWITCH BOARD CONNECTION DIAGRAM (GROUND FLOOR)

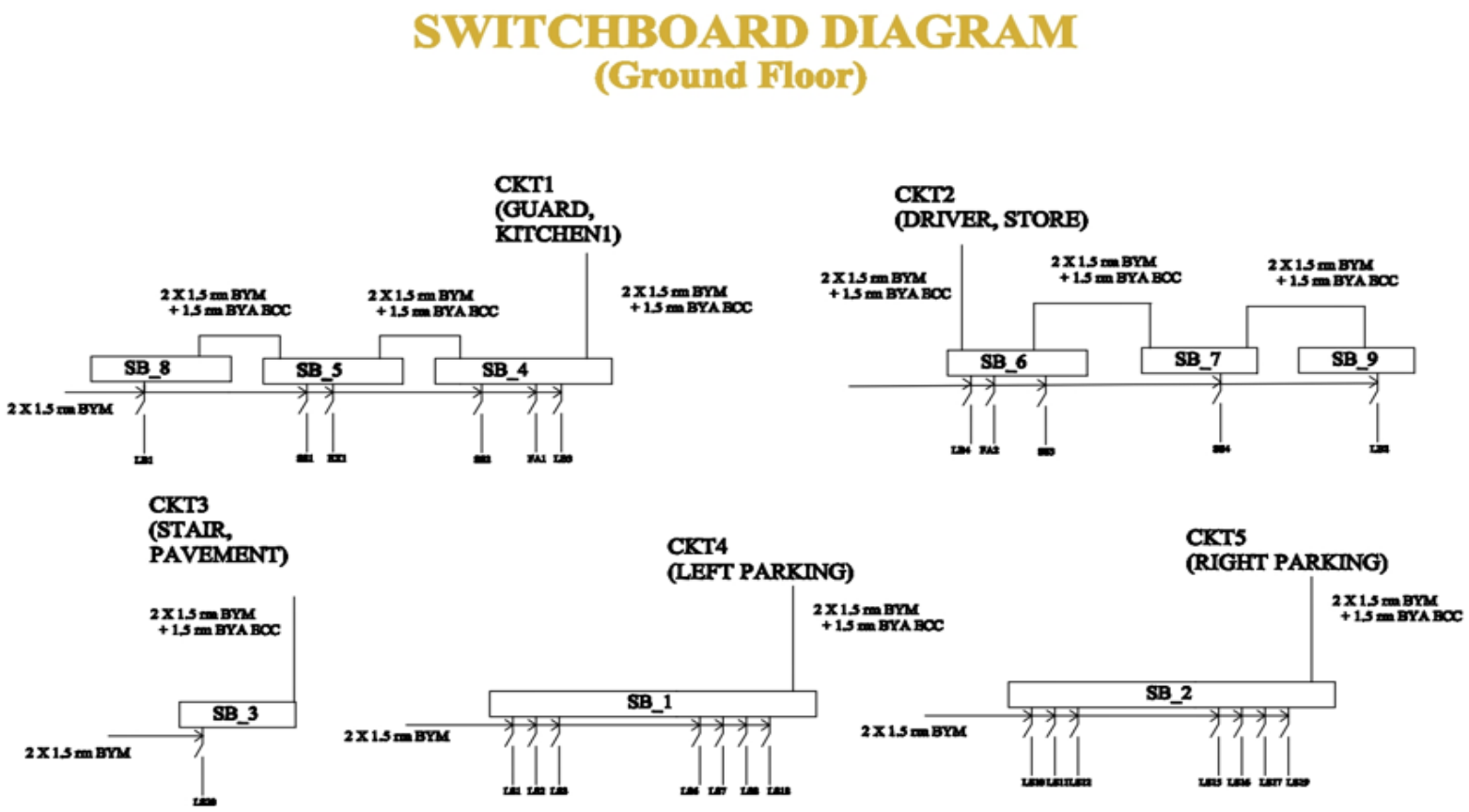


Fig 2.1 Switch Board Connection Diagram (Ground Floor)

SWITCH BOARD CONNECTION DIAGRAM (PER UNIT GENERAL FLOOR)

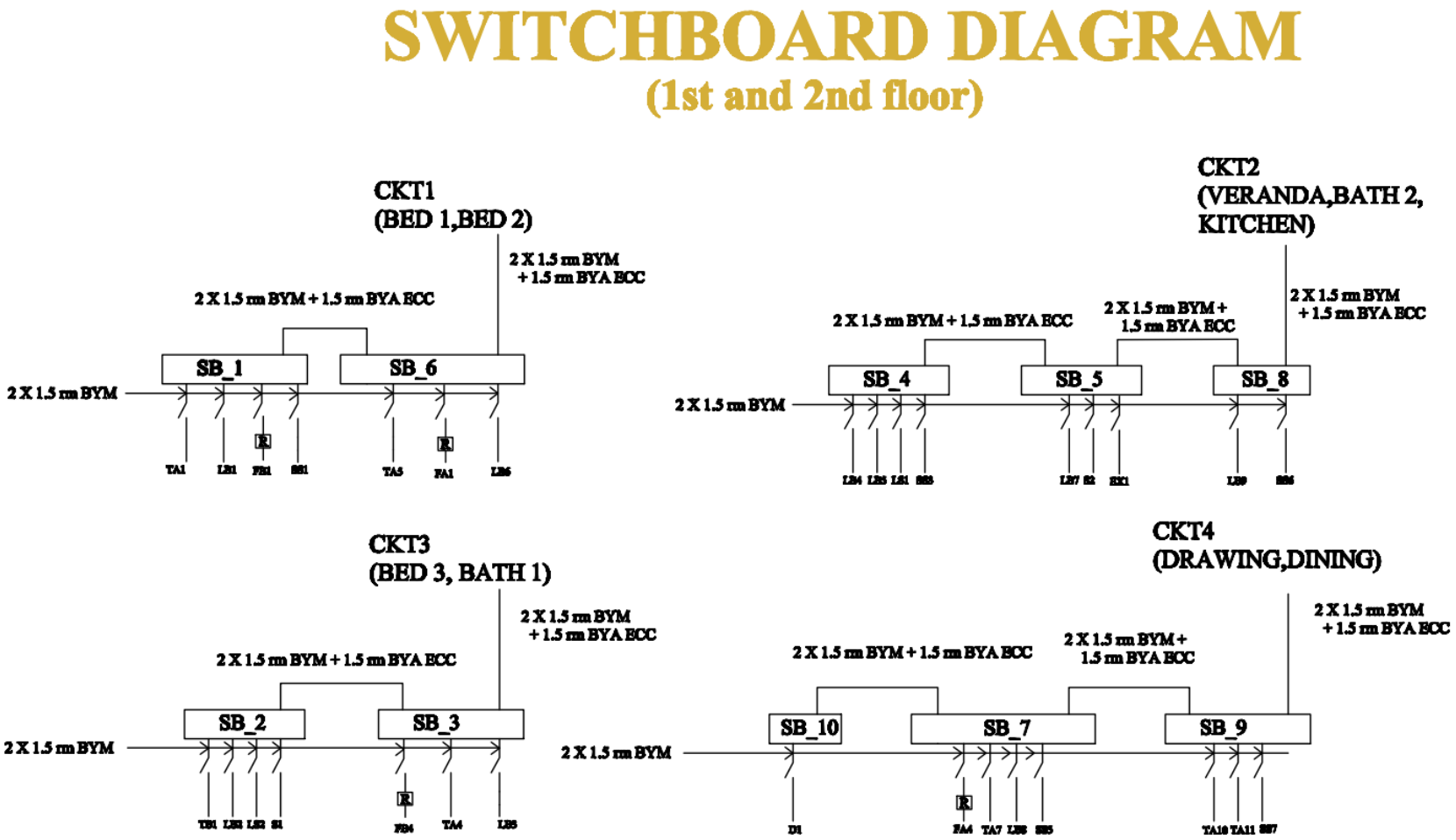


Fig 2.2 Switch Board Connection Diagram (Per Unit General Floor)

SUB DISTRIBUTION BOARD DIAGRAM (GROUND FLOOR)

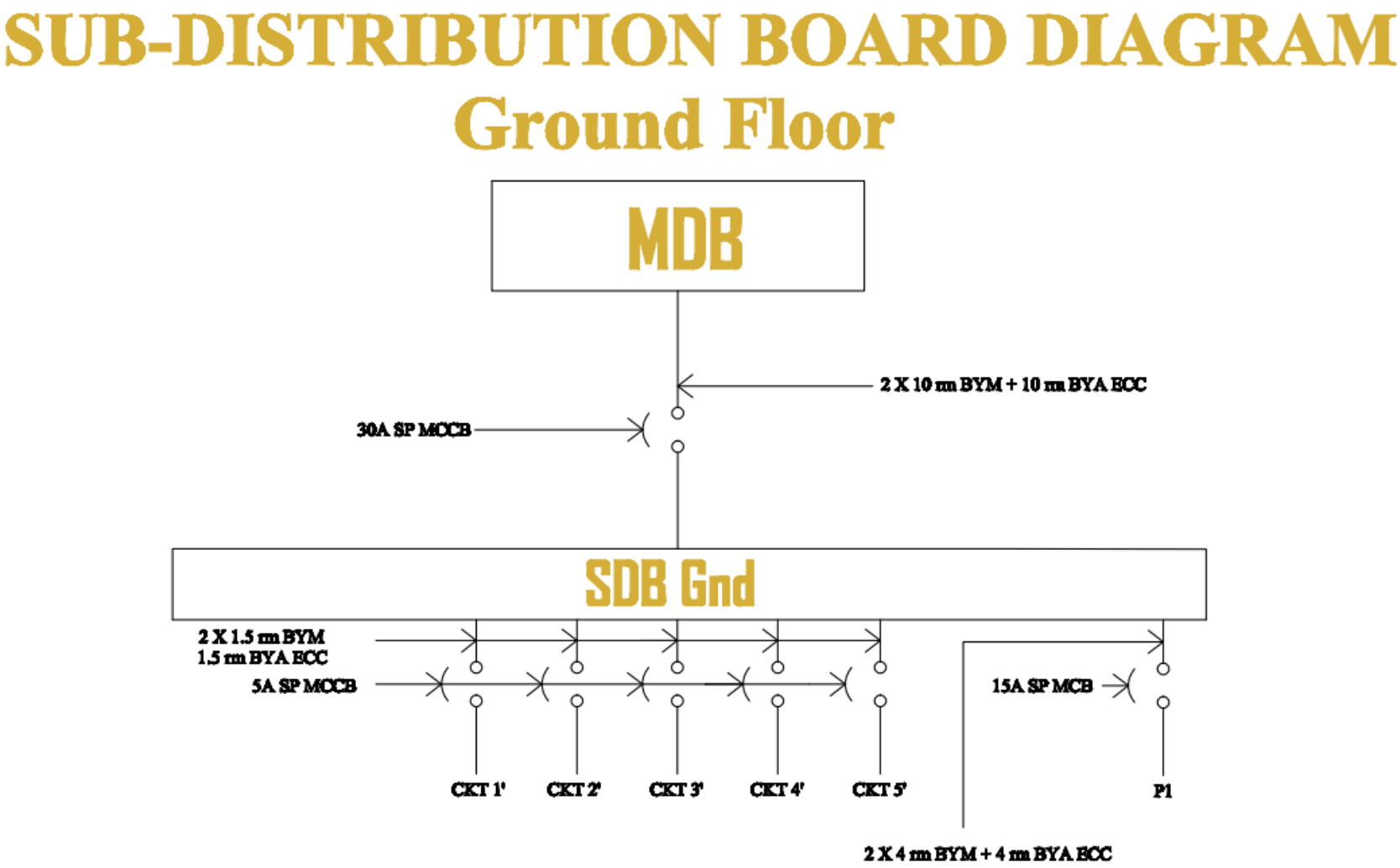


Fig 2.3 Sub-division Board Diagram (Ground Floor)

SUB DISTRIBUTION BOARD DIAGRAM (Per Unit General Floor)

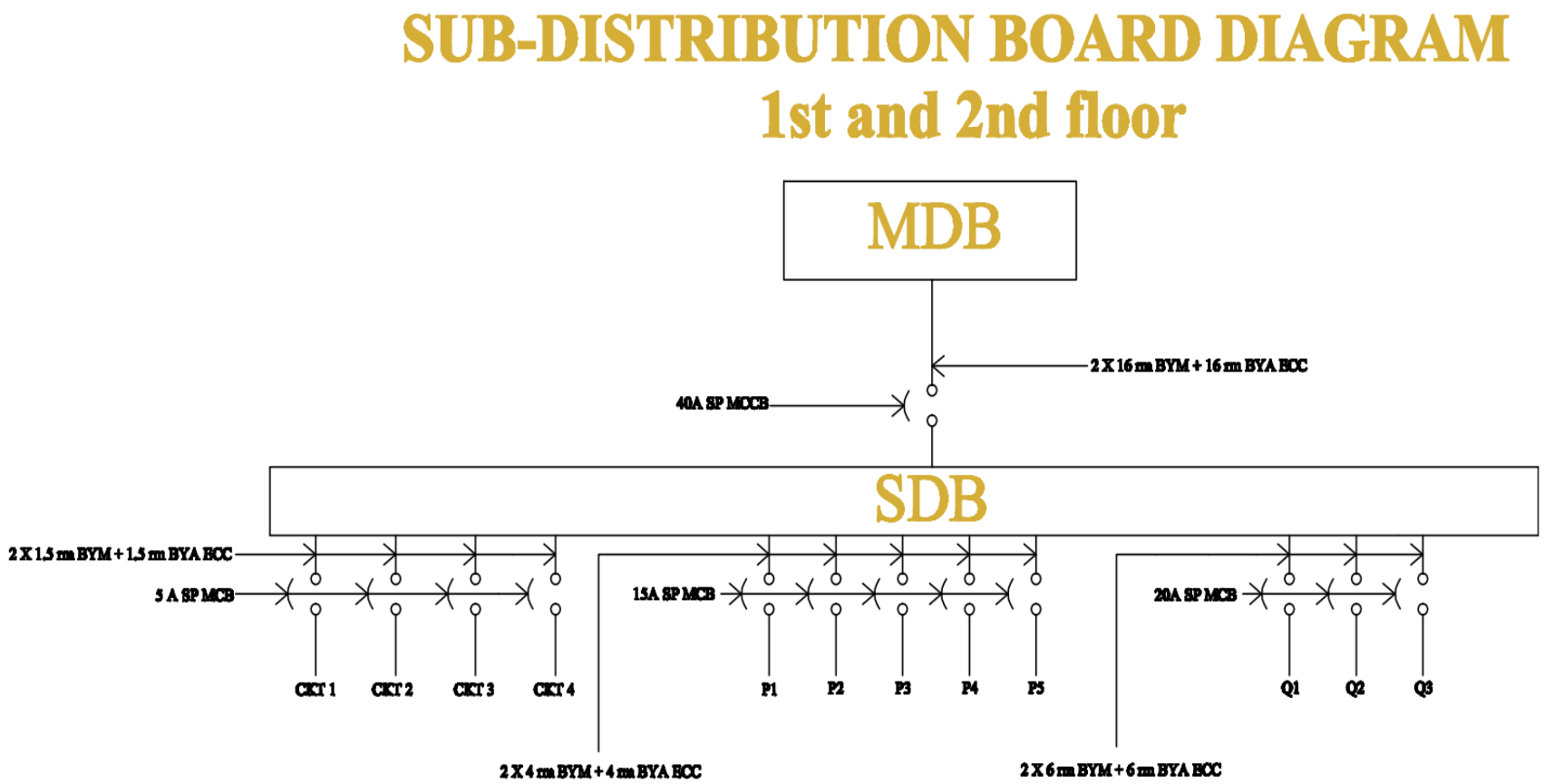


Fig 2.4 Sub-division Board Diagram (Per Unit General Floor)

MAIN DISTRIBUTION BOARD DIAGRAM

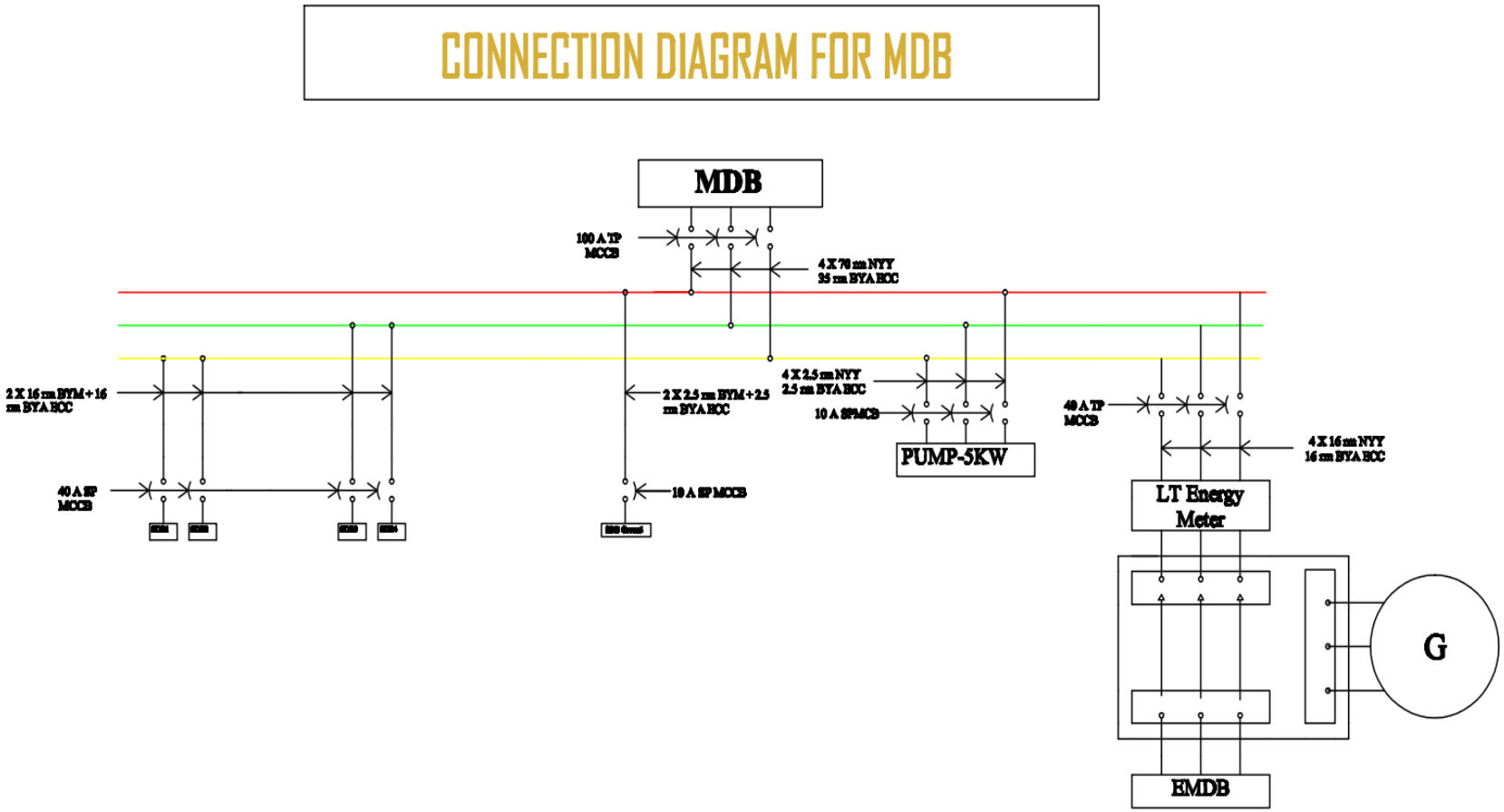


Fig 2.5 Main Distribution Board Diagram

EMERGENCY MAIN DISTRIBUTION BOARD DIAGRAM

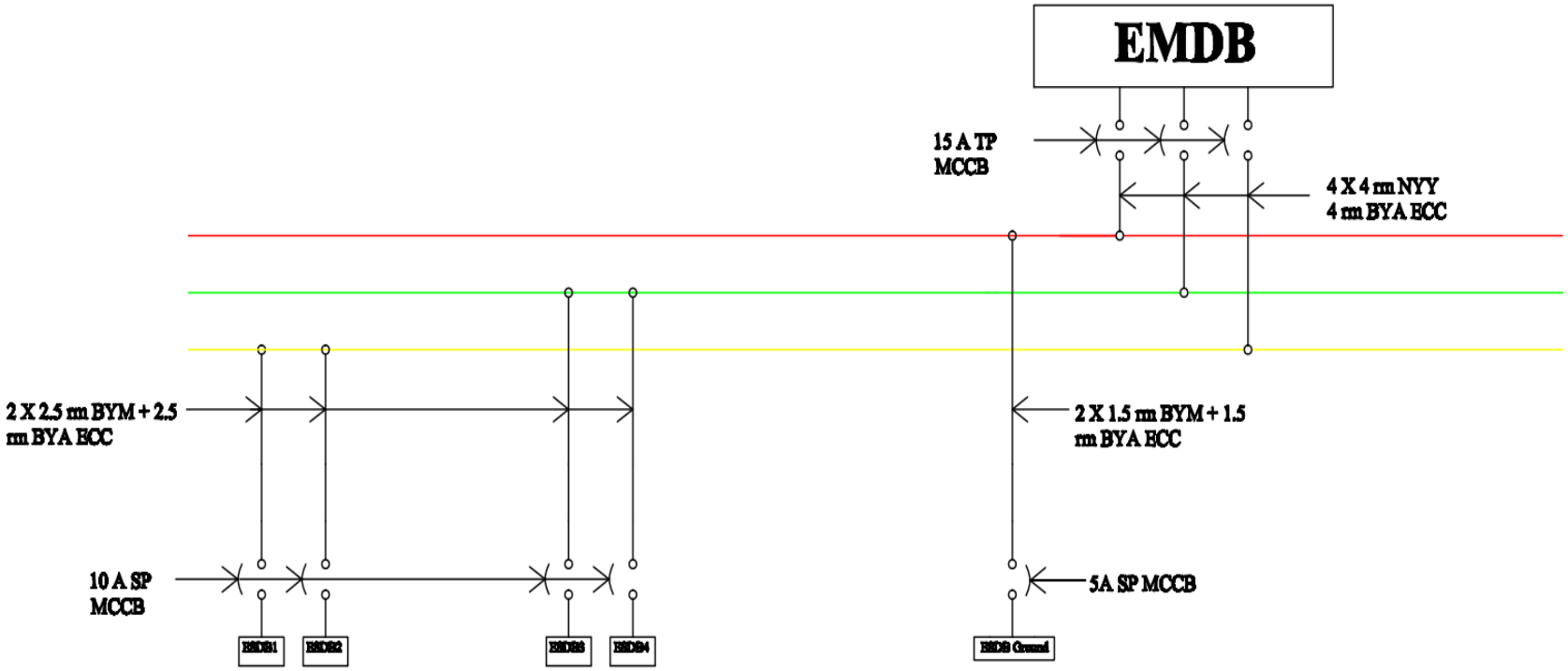


Fig 2.6 Emergency Main Distribution Board Diagram

EMERGENCY SWITCH BOARD DIAGRAM (GROUND FLOOR)

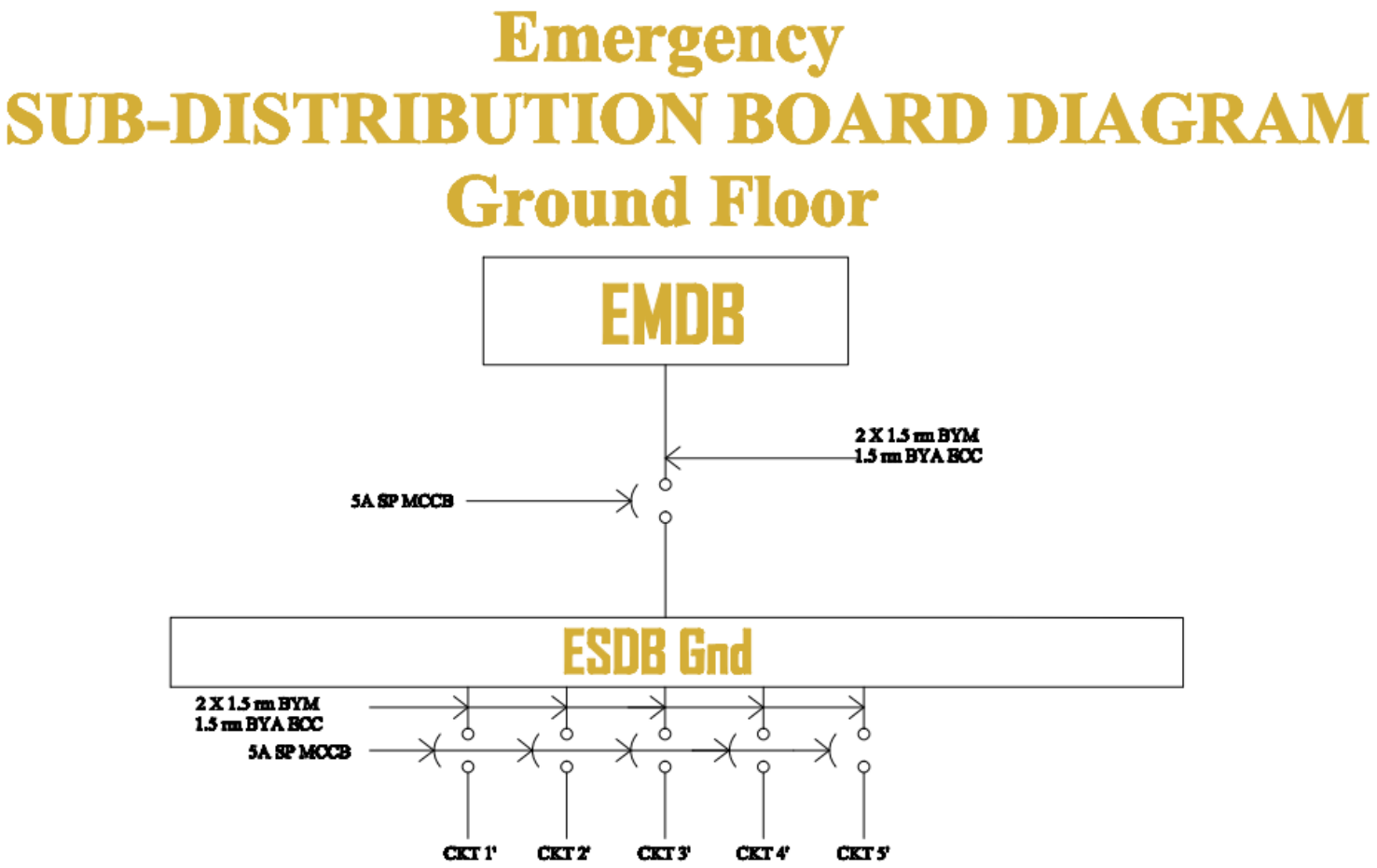


Fig 2.7 Emergency Switch Board Diagram

EMERGENCY SWITCH BOARD DIAGRAM (1st and 2nd FLOOR)

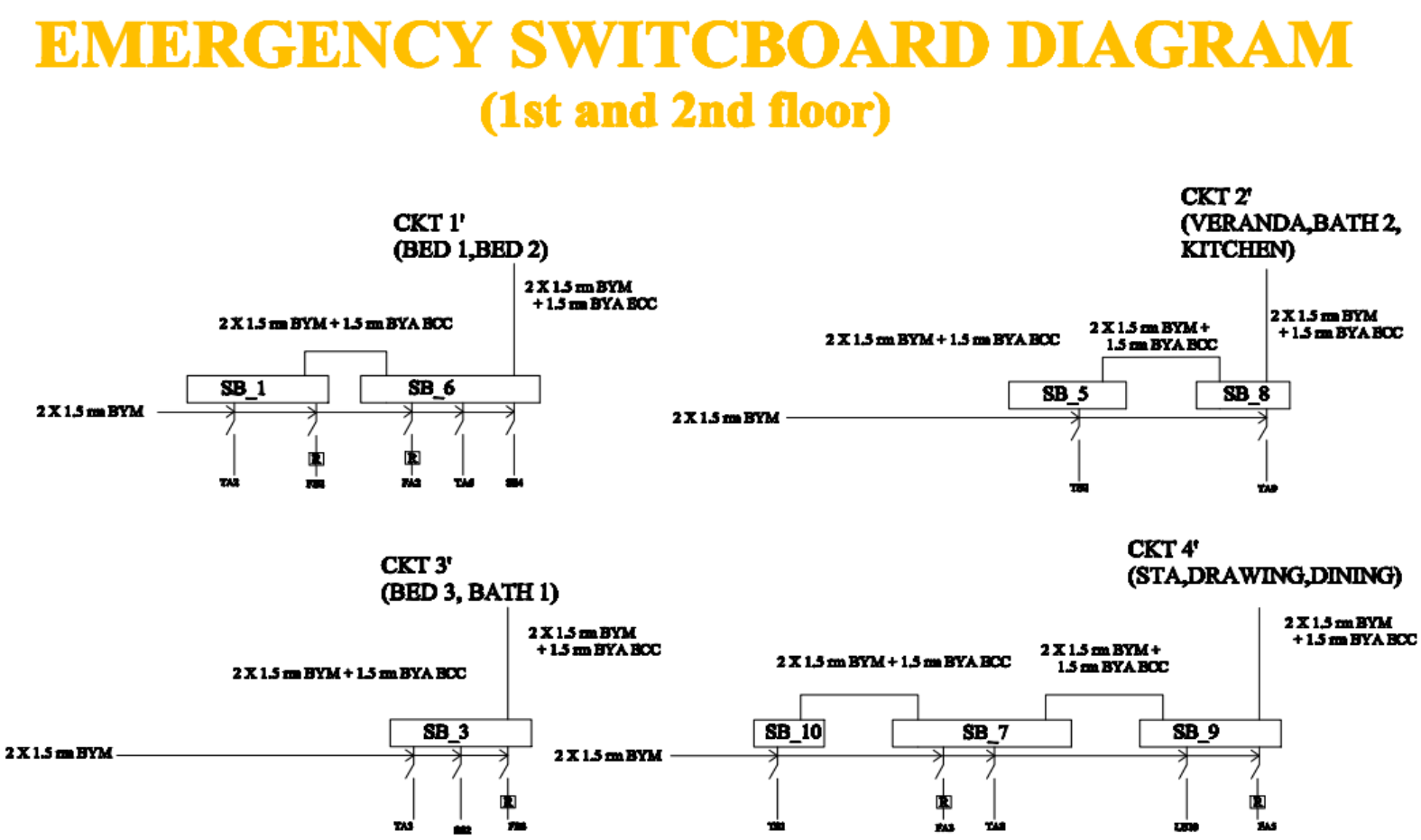


Fig 2.8 Emergency Switch Board Diagram(1st and 2nd Floor)

CHAPTER 3
NUMERICAL CALCULATIONS

Light & fan calculation(Theory)

Formula for Light Bulbs,

$$E=(n*N*F*LLF*UF)/A \quad \text{(Lumen in m2)}$$

E = Illuminance
N = Number of lights
n = Number of lights per illuminate = 1 (by default)
F = lumen of the light bulb = 1250 lumen (20 watt)
LLF = Light loss factor UF = Utilization factor
LLF* UF = 0.72 (0.7 ~0.75)

Formula for Fans,
One 56'' diameter fan is needed every 100 sq ft
Number of Fans =A / 100 (A in sqft) (1 sqft = 0.09290304 m^2)

Light & fan calculation Ground floor

Kitchen/ Store room:

Area,A = 14 * 15 sq ft = 210 sq ft = 19.509638 m^2 E = 80 lumen/ m2
LLF x UF = 0.72
n = 1
Flux = 1250 lumen
From calculation,
Number of lights, N = 1.73419
So, 2 Light Bulbs are needed.
But, to preserve power consumption, 1 LB is set in the store room and 1 TA is set in the kitchen.
Also 1 exhaust fan is set in the kitchen.

Guard/ Driver room:

Area,A = 16 * 20 sq ft = 320 sq ft = 29.7289728 m^2
E = 80 lumen/ m2
LLF x UF = 0.72
n = 1
Flux = 1250 lumen
From calculation,
Number of lights, N = 2.64267
So, 2 Light Bulbs and 1 Tube Light are needed.
But, to preserve power consumption, 1 light bulb(LB) and 1 tube light(TA) are set.
Number of fans = 320/ 100 = 3.2

So, 3 fans are needed, but to preserve power consumption, 1 ceiling fan(FA) is set.

Bathroom:

Area,A = 14 * 5 sq ft = 70 sq ft = 6.5032128 m^2
E = 80 lumen/ m2
LLF x UF = 0.72
n = 1
Flux = 1250 lumen
From calculation,
Number of lights, N = 0.578
So, 1 Light Bulb(LB) is needed.

Parking :

A = (14+16+14+14+16+14)*(20+6+20-20) = 88*26 sq ft = 2288 sqft = 212.562155 m^2
E = 80 lumen/ m2
LLF x UF = 0.72
n = 1
Flux = 1250 lumen
From calculation,
Number of lights, N = 18.89
So, 19 LS are needed.

Satire case:

1 TS and 1 LS are set in the satire case.

Light & fan calculation (1st and 2nd floor)

Bedroom 1 and Drawing room:

Area = 16 * 20 sq ft = 320 sq ft = 29.7289728 m2
E = 100 lumen/ m2
LLF x UF = .72
n = 1
Flux = 1250 lumen

From calculation,
Number of lights, N = 3.3032192
So, we used 2 TA and 1 LB
Number of fans = 320/ 100 = 3.2
To preserve power consumption we have used 2 fans(FA).

Bedroom 2 & Bedroom 3:

Area = 14 *20 sq ft = 280 sq ft = 26.0128512 m2
E = 100 lumen/ m2
LLF x UF = .72
n = 1
Flux = 1250 lumen
From calculation,
Number of lights, N = 2.89
So, we used 2 TA and 1 LB
Number of fans = 280/ 100 = 2.8
2 fans(FB) are set

Dining room:

Area = 14 * 18 sq ft = 252 sq ft = 23.411566 m2
E = 100 lumen/ m2
LLF x UF = .72
n = 1
Flux = 1250 lumen
From calculation,
Number of lights, N = 2.60128
So, we used 2 TA and 1 LB
Number of fans = 252/ 100 = 2.52
1fan(FA) is set to preserve power consumption.

Corridor:

Area = 6* 21 sq ft =126 sq ft = 11.705783 m2
E = 70 lumen/ m^2
LLF x UF = .72
n = 1
Flux = 1250 lumen
From calculation,
Number of lights, N = 0.9104497
We used 1 LS.

Kitchen:

Area = 8*14 sq ft = 112 sq ft = 10.40514 m2
E = 200 lumen/ m2

LLF x UF = .72
n = 1
Flux = 1250 lumen
From calculation,
Number of lights, N = 2.31225
We used 1 TA and 1 LB

Number of fans = 112/ 100 = 1.12
1 exhaust fan is needed.

Toilet 1:

Area = 6*9 sq ft = 54 sq ft = 5.016764 m2
E = 100 lumen/ m2
LLF x UF = .72
n = 1
Flux = 1250 lumen
From calculation,
Number of lights, N = 0.55741824
We used 1 TB and 1 LB, where the extra one is kept for alternative uses**.**

Toilet 2:

Area = 8*12 sq ft =96 sq ft = 8.91869 m2
E = 100 lumen/ m2
LLF x UF = .72
n = 1
Flux = 1250 lumen
From calculation,
Number of lights, N = 0.990965
We used 1 TB and 1 LB, where the extra one is kept for alternative uses**.**.

Veranda:

Area = 16*4 sqft =64 sq ft = 5.94579 m2
E = 70 lumen/ m2
LLF x UF = .72
n = 1
Flux = 1250 lumen
From calculation,
Number of lights, N = 0.46245
Here, though only 1 light is needed, we used 1 LS and 2 LB for decoration purposes.

Staircase: 2 TS and 2 LS are set in the stairecase.

Switchboard Diagram Ground Floor:

CKT 1:
P= LB1+ SS1+ EX1+ SS2+ FA1 +LB3
I =(45 + 60 +100+100+100+60) / (220* 0.8) =2.64 A
(voltage = 220V, PF = 0.8) (I= PV* PF)

CKT 2:
P= LB2+LB4+FA2+SS3+SS4
I =(60+60+100+100+100) / (220* 0.8)=2.38 A

CKT 3:
P= LS20
I =23 / (220* 0.8)=0.13 A

CKT 4:
P= LS1+LS2+LS3+LS6+LS7+LS8+LS18
I =(7*23) / (220* 0.8)=0.91 A

CKT 5:
I =(7*23) / (220* 0.8)=0.91 A

All of the circuits above have current less than 5 A. So, 2 x 1.5rm BYM + 1.5 BYA ECC are used in all of them.

Switchboard Diagram 1st - 2nd floor

CKT 1: SB_1 + SB_6
P = TA1 +FB1 +SS1+ LB1+ TA5+FA1+ LB6
I =(40+ 75 + 100 + 60 + 40 + 100 + 60) / (220* 0.8)=2.6988 A

CKT 2: SB_4 + SB_5 + SB_8
P = LB4+ LB5+ LS1+ SS3+ LB7+ EX1+ S2+ LB9+ SS6
I =(60+ 60 + 23 + 100 + 60 + 45 +100 + 60 + 100)/(220* 0.8) =3.4545 A

CKT 3 : SB_2 + SB_3
P = TB1+ FB2+ LS2+ S1+ FB4+ TA4+ LB3
I =(20 + 75 + 23 + 100 + 75 +40 + 60) / (220* 0.8) = 2.23295 A

CKT 4: SB_10 + SB_7 + SB_9
P = D1+ FA4+ TA7+ LB8+ SS5+ TA10+ TA11+ SS7
I =(50 + 100 + 40 +60 +100 +40 + 40 +100) / (220* 0.8) = 3.0113636 A

All of the circuits above have current less than 5 A. So, 2 x 1.5rm BYM + 1.5 BYA ECC are used in all of them.

Calculation for SDB ground

SDB load = total load ×0.7 + total P socket load × 0.2 + total Q socket load ×0.2
Total load = CKT1+ CKT2+ CKT3+ CKT4+ CKT5
= (465+ 420+ 23+ 161+ 161) W
= 1460 W
P load = 3000 W
Utility load = 5 × 46 = 230 W
SDB load = (1460× 0.7 + 3000× 0.2) W = 1622 W
SDB current = 1622/(220× 0.8) =9.216 A
So, 10 A SP MCCB is needed from SDB to MDB. 2× 2.5rm BYM + 2.5 BYAECC

Calculation for SDB 1st - 2nd floor

Total load = CKT1 + CKT2 + CKT3 + CKT 4 = 475+ 608 + 393 + 530
= 2006
P Load = 3000 w
Q Load = 4000 w

5 P load and 3 Q load

Total load of SDB first floor
= 2006 x 0.7 + 5 x 3000 x 0.2 + 3 x 4000 x 0.2 = 6804.2 w
SDB current = 6804.2 / (220* 0.8) = 38.66A
So, 40A SP MCCB is needed from SDB to MDB.
2 x 16 rm BYM + 16 rm BYA ECC cable are needed.

Emergency Switchboard Diagram Ground Floor

CKT 1':
I =(40+ 40) / (220* 0.8)=0.45 A
CKT 2':
I =(40+ 60) / (220* 0.8)=0.57 A
CKT 3':
P = TS1
I =60 / (220* 0.8)=0.341 A
CKT 4':
P = LS5+ LS4+ LS9
I =(3 * 23) / (220* 0.8)=0.392 A
CKT 5':
P = LS13 + LS14
I =(23 + 23) / (220* 0.8)=0.26 A

All of the circuits above have current less than 5 A. So, 2 x 1.5rm BYM + 1.5 BYA ECC are used in all of them.

Calculation for ESDB ground:

SDB load = total load ×0.7 + total P socket load × 0.2 + total Q socket load ×0.2
Total load = CKT1' + CKT2' + CKT3' + CKT4' + CKT5 '
= (80 + 100 + 60 + 69 + 46) W
= 355 W
SDB load = (355× 0.7) W = 248.5 W
SDB current = 248.5/(220× 0.8) =1.412 A
So, 5 A SP MCCB is needed from ESDB ground to EMDB. 2× 1.5rm BYM + 1.5rm BYAECC

Emergency Switchboard Diagram 1st and 2nd Floor

CKT 1': SB_1 + SB_6
P = TA2+ FB2+ FA2+ TA6 + SS4
I =(40 + 75 + 100 + 40 + 100)/ (220* 0.8)=2.0170 A

CKT 2': SB_5 + SB_8
P = TB2+ TA9
I =(20 + 40)/(220* 0.8) =0.3409 A

CKT 3' : SB_3
P = TA3+ SS2+ FB3
I =(40 + 100 + 75) / (220* 0.8) = 1.22159 A

CKT 4': SB_10 + SB_7 + SB_9
P = TS1+ FA3+ TA8+ LB10 + FA5
I =(60 + 100 + 40 + 60 + 100) / (220* 0.8) = 2.04545 A

All of the circuits above have current less than 5 A. So, 2 x 1.5rm BYM + 1.5 BYA ECC are used in all of them.

Calculation for ESDB 1st and 2nd floor

Total load = CKT1 + CKT2 + CKT3 + CKT 4 = 355 + 60+ 215+ 360 = 990 w
P Load = 3000 w
Q Load = 4000 w

One P load and no Q load.
Total load at ESDB for first floor = 990 x 0.7 + 3000 x 0.2 = 1293 w
ESDB current = 1293 / (220 x 0.8) = 7.35 A

10 A SP MCCB is needed from ESDB to EMDB.
2 x 2.5 rm BYM + 2.5 rm BYA ECC cable are needed.

Calculation for Conduits

Ampere rating, I = PV x pf A
Pf = 0.8 (avg)
Energy Saving bulb = 20 w
Tube Light = 60 w
Ceiling fan = 100 w
Switchboard Socket (max) = 1000 w
Ceiling light = 20 w
Exhaust fan = 45 w

All internal wires are below 5A rating. That's why, 2 x 1.5 rm BYM is used in all internal wiring.

Calculation for EMDB

EMDB load = Total ESDB load x 0.7
Total ESDB load = 4 x ESDB load + ESDB Ground = 4 x 1293 + 248.5 = 5420.5 w
Phase voltage = 220 v
Pf = 0.8
EMDB load = 5420.5 x 0.7 = 3794.35
EMDB current = 3794.5/(3 x 220 x 0.8)= 12.45 A
So, 15A TP MCCB is needed from EMDB to MDB.

A 5kw generator is used to supply the EMDB load.
4 x 4 rm NYY + 4rm BYA ECC is used.

Calculation for MDB

MDB load = (Total SDB + total EMDB + Pump Load) x 0.7
SDB load = 4 x SDB + SDB ground = 4 x 6804.2 + 1622 = 28838.8 w

EMDB Load = 3794.35
Pump Load = 5000w
So, MDB load = (28838.8 + 3794.35 + 5000) x 0.7 = 26343.205 w

MDB current = 26343.205 / (3 x 220 x 0.8) = 86.41 A
100A TP MCCB is required from MDB to the main line.
4 x 70 rm NYY + 70 BYA ECC is used.

Calculations for Transformer

S = 3VI = 3*220*86.41 = 57.0306 kVA

So, 11/0.415 KV, 50 HZ,60 KVA, DYN 11, Oil Immersed Transformer with 4-6% Impedance is needed.

Calculation for minimum load density

According to Rajuk, for Air Conditioned Dwelling abodes 100 W/m^2 should be unit load.

In our Apartment load density is = (Total load)/apartment size in sq m
=(6804.2+1293)/(3808*0.0929) = 22.875 W/m^2