Bangladesh University of Engineering and Technology

DEPERTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Course - EEE-414 (Electrical Services Design Laboratory)

Electrical Services Design Project

Submitted to

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Submitted By

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Project Objective:

The objective of this project is-

➢ to get acquainted with the floor-planning of a typical multi-storied residential building.

➢ to familiarize yourself with various fittings and fixtures used in each compartment of the building.

➢ to learn how to systematically draw the conduit layout of the building.

➢ to understand and draw the switchboard connections (including emergency)

➢ to calculate and place appropriate components in the switchboard diagrams (e.g. circuit breaker, transformer, generator of particular ratings)

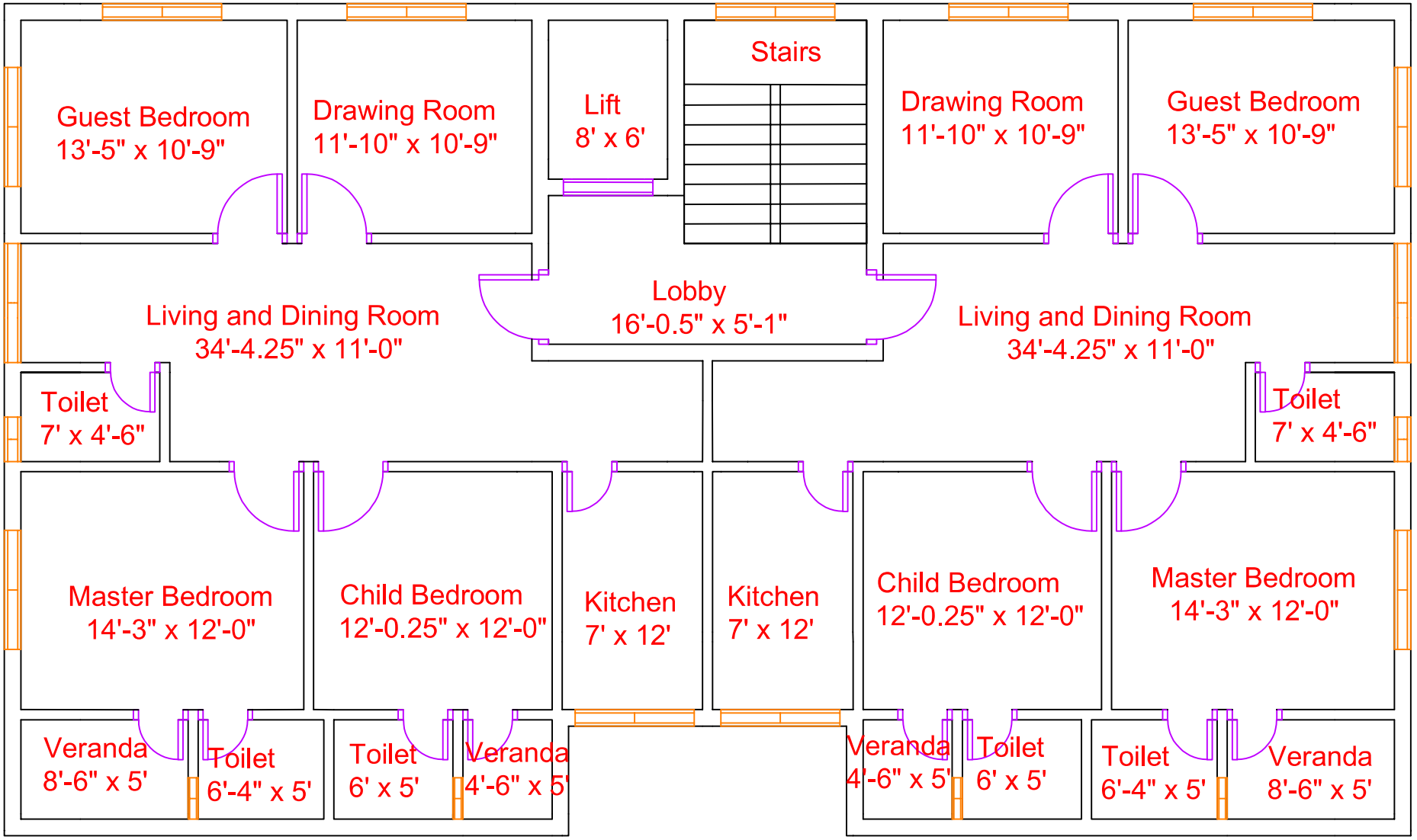
➢ to learn the electrical designing procedure of a lightning protection system.

Design Steps

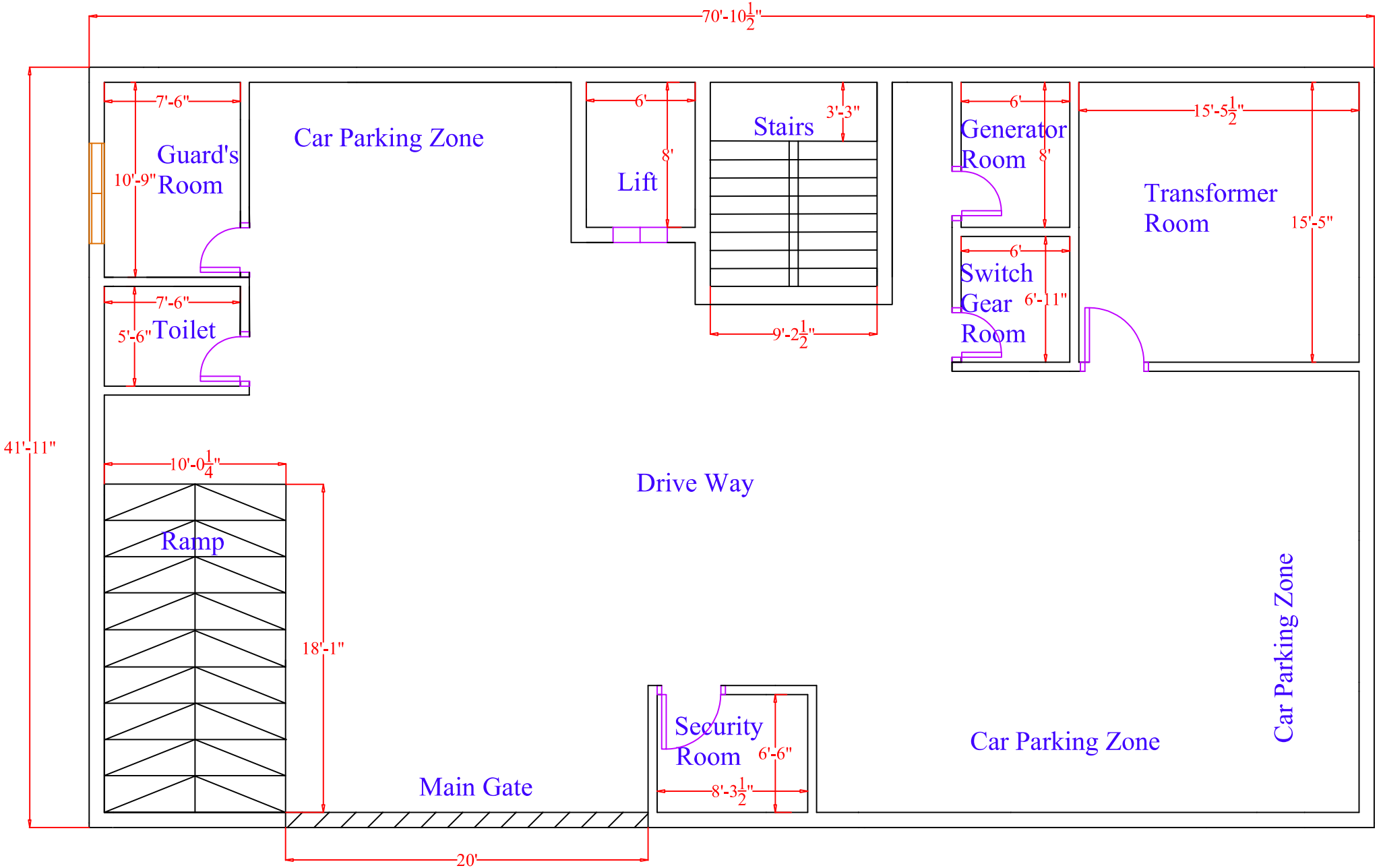
The project was carried out according to the following design steps:

1. Ground floor and typical floor plan of a three-story building
2. Fittings and fixtures for each floor
3. Conduit layout planning for each floor
4. Switchboard and distribution board diagram
5. Lightening protection system (LPS) design

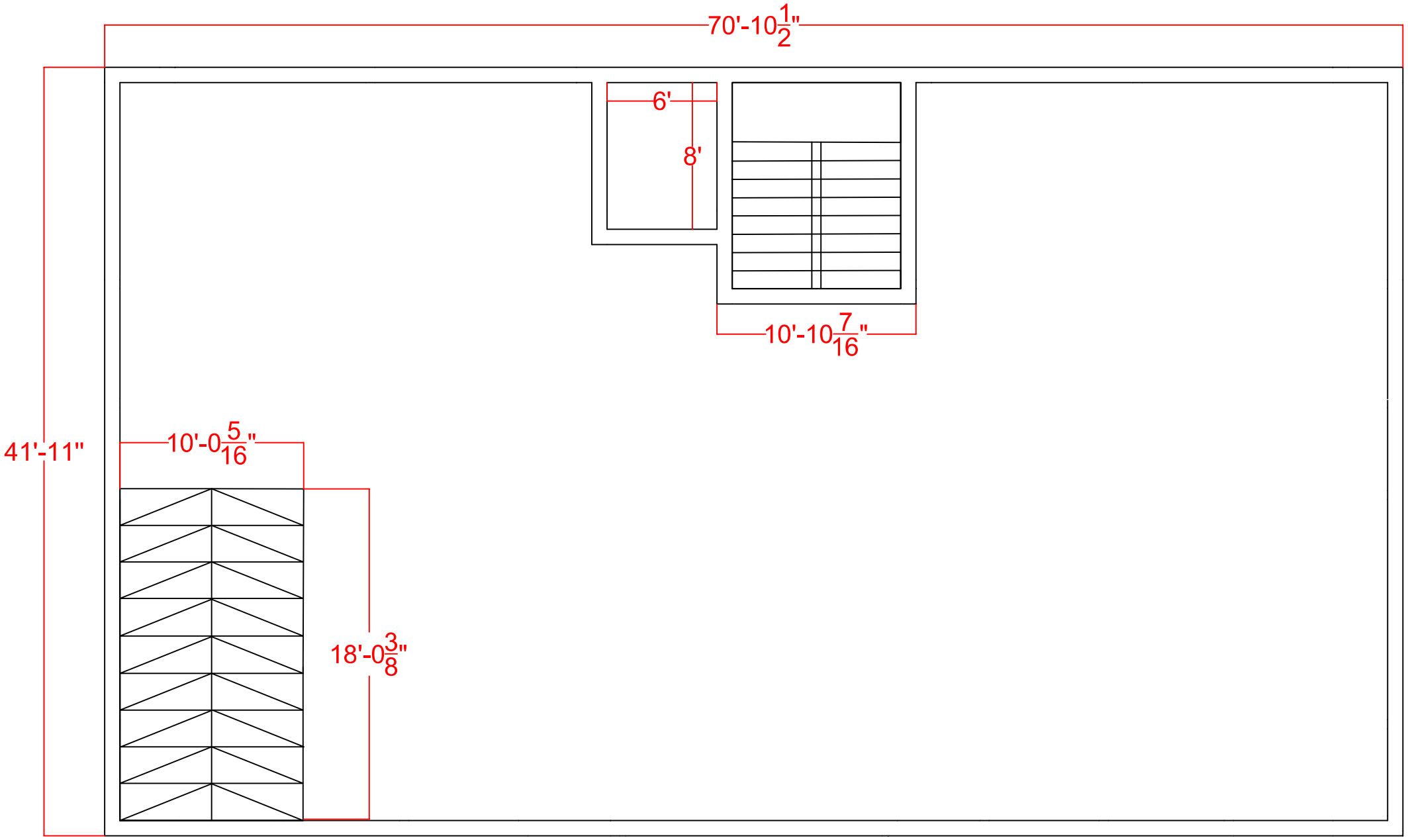
COMMON FLOOR LAYOUT



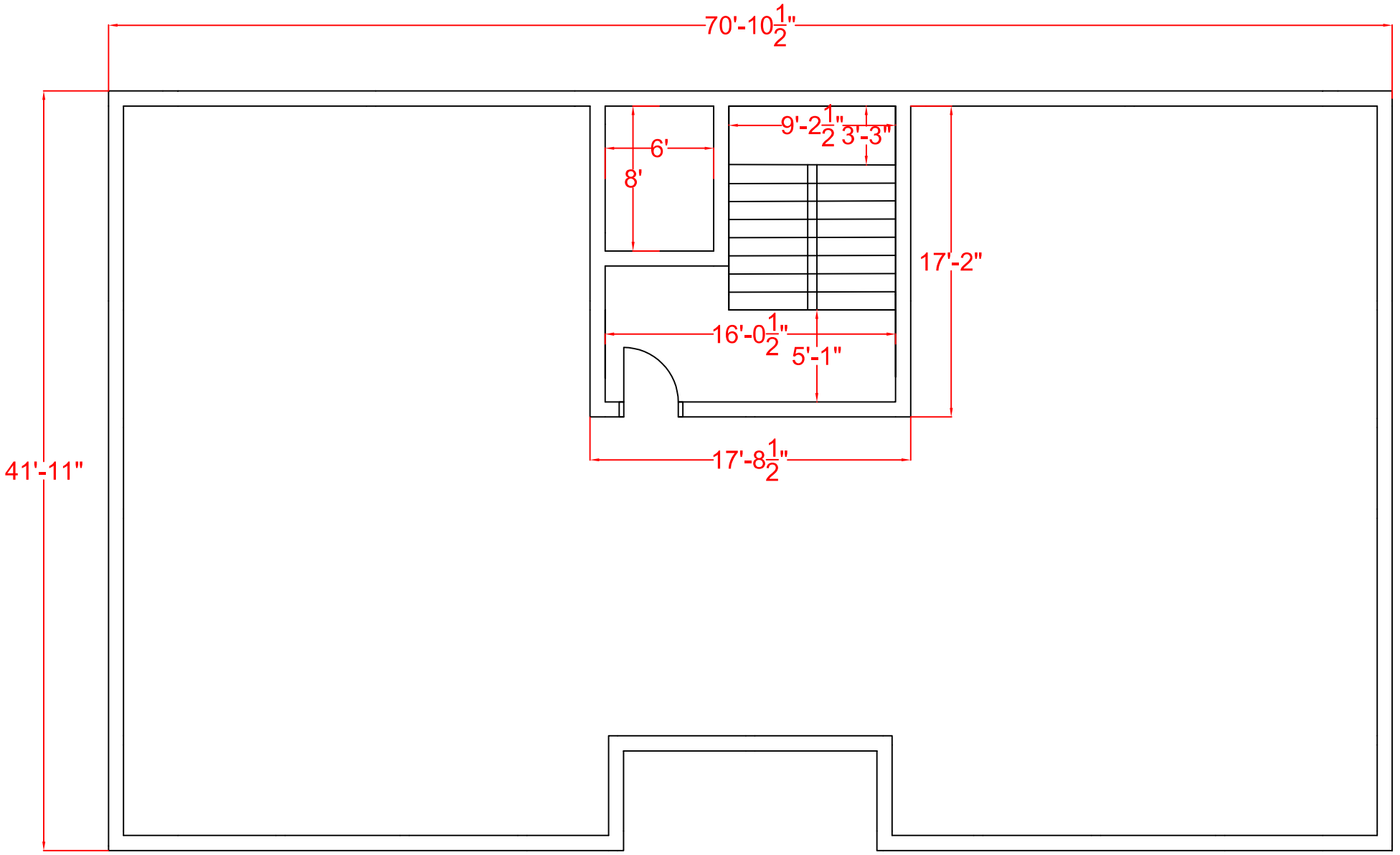
Ground Dimensions



Basement Dimensions



Roof Dimensions



FORMULAE AND DATA

Light Calculation:

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

$$\text{Total Lumen} = \sum N_i * F_i = \frac{E * L * W}{UF * LLF}$$

where,

L = Length (m), W = Width (m), N_i = Number of light Bulbs of i-th kind Light Source (nos)

F_i = Luminous Flux of i-th kind Light Source (lumen), LLF = Light Loss Factor (Taken 0.9)

E = Luminance Level (lux) for that room

UF = Utilization Factor from the Room Index calculated taking typical (C, W, F) = (0.7,0.5,0.2)

C, W, F = Values for Surface Reflectance for Ceiling, Wall and Floor respectively

Mounting Height = 2 m (Taken)

Note, for simplicity, we have taken UF = 0.7 for all cases (RI not needed)

Fan Calculation:

$$Number\ of\ Fans = \frac{L*W\ (in\ sq.feet)}{100}$$

Charts:

UTILIZATION FACTOR CHART (UF)

Utilization factor											
Room Reflectance			Room Index								
Ceiling	Wall	Floor	0.75	1	1.25	1.5	2	2.5	3	4	5
0.7	0.5	0.2	0.43	0.49	0.55	0.6	0.66	0.71	0.75	0.8	0.83

LUMNIMOUS FLUX CHART (F_i)

Light Type	Symbol	Watt Rating (W)	Lumen Rating (Lumen)
LED Bulb	LLA	12	1200
	LLB	18	1800
LED Tube	TLA	20	1800
	TLB	40	3600
Ceiling Light	CLA	12	1200
	CLB	18	1800

LUMINANCE LEVEL CHART (E)

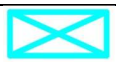
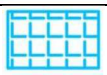
Room Type	Luminance Level (Lux)
Drawing Room	80
Guest Bedroom	70
Master Bedroom	70
Child Bedroom	70
Living and Dining Room (Outer Portion)	50
Living and Dining Room (Center Portion)	70
Living and Dining Room (Inner Portion)	50
Toilet (Living and Dining Room)	100
Toilet (Master Bedroom)	100
Toilet (Child Bedroom)	100
Veranda (Master Bedroom)	50
Veranda (Child Bedroom)	50
Kitchen	200
Lobby	70
Stairs	100
Lift Lobby	70
Security Room	50
Guard's Room	50
Driver's Waiting	50
Generator	50
Garage (Parking + Driveway)	200
Toilet (Ground Floor)	100

Other Appliances Power Rating:

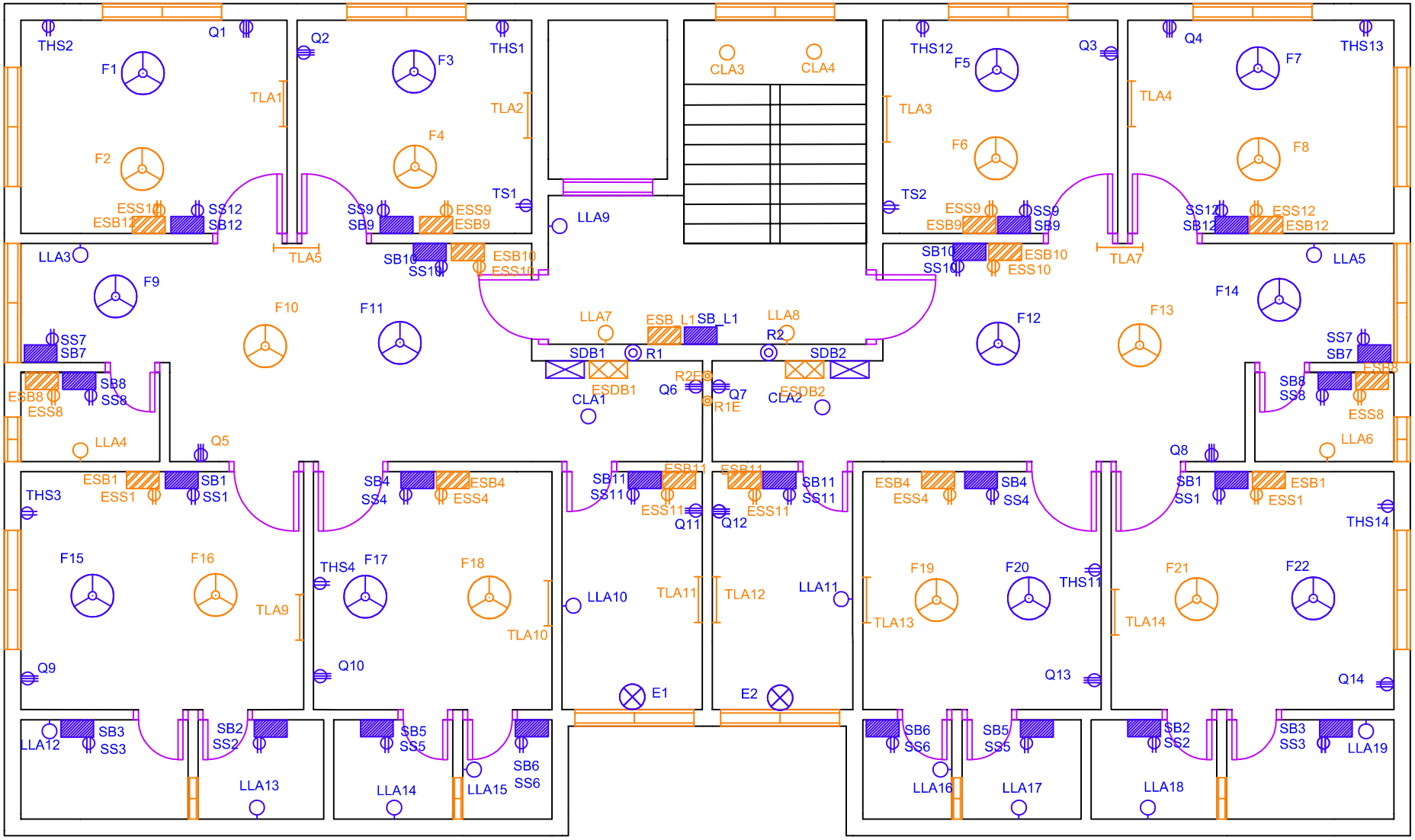
Fan	100 W
2-pin Socket (SB/TV)	100 W
Exhaust Fan	40 W
3-pin P Load (Fridge, PC, Iron)	3000 W
3-pin Q Load (AC)	4000 W
Pump Load	2500 W

FITTINGS AND FIXTURES CALCULATIONS

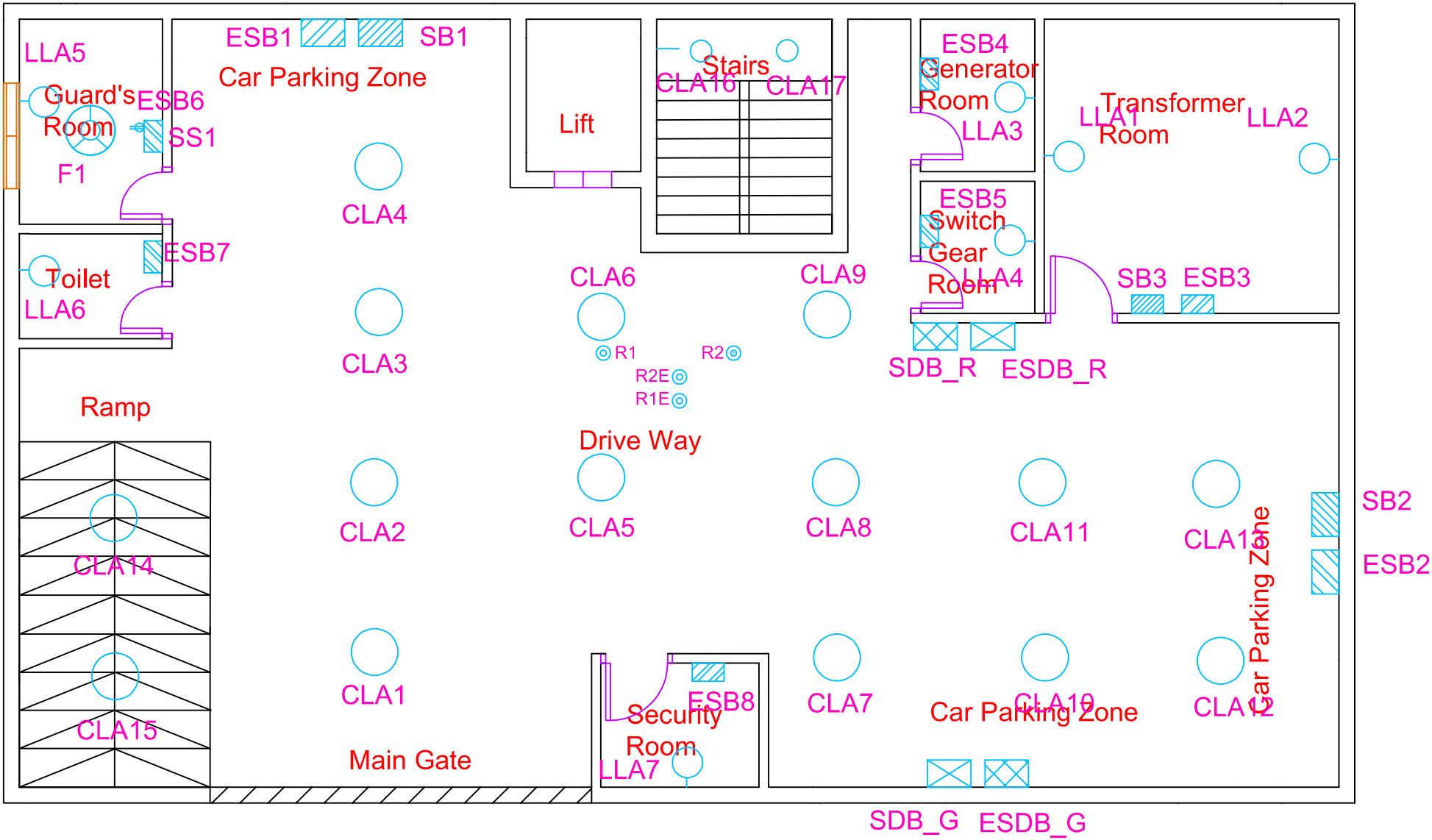
						Fittings and Fixtures Calculations							
	Room Type	**Length (ft)**	**Width (ft)**	**Area (sq.ft)**	**Length (m)**	**Width (m)**	**Area (sq.m)**	**Room Index**	**Utilization Factor (UF)**	**Luminance Level (E)**	**Total Lumen**	**Assigned Lights and Types**	**Number of Fans**
	Drawing Room	11.833	10.750	127.205	3.6067	3.2766	11.818	0.8584	0.7	80.00	1500.66133	1 TLA	2
	Guest Bedroom	13.417	10.750	144.230	4.08941	3.2766	13.399	0.9095	0.7	70.00	1488.81793	1 TLA	2
	Master Bedroom	14.250	12.000	171.000	4.3434	3.6576	15.886	0.9928	0.7	70.00	1765.15776	1 TLA	2
	Child Bedroom	12.271	12.000	147.252	3.7402	3.6576	13.68	0.9246	0.7	70.00	1520.01761	1 TLA	2
	Living and Dining Room (Outer)	7.500	6.000	45.000	2.286	1.8288	4.1806	0.508	0.7	50.00	331.796571	XXX	NA
	Living and Dining Room (Center)	18.250	11.000	200.750	5.5626	3.3528	18.65	1.046	0.7	70.00	2072.25392	1 LLA, 1 TLA, 1 CLA	3
	Living and Dining Room (Inner)	8.604	5.000	43.020	2.6225	1.524	3.9967	0.4819	0.7	50.00	317.197522	XXX	NA
	Toilet (Living and Dining Room)	7.000	4.500	31.500	2.1336	1.3716	2.9264	0.4174	0.7	100.00	464.5152	1 LLA	NA
	Toilet (Master Bedroom)	6.330	6.000	37.980	1.92938	1.8288	3.5285	0.4694	0.7	100.00	560.072613	1 LLA	NA
	Toilet (Child Bedroom)	6.000	6.000	36.000	1.8288	1.8288	3.3445	0.4572	0.7	100.00	530.874514	1 LLA	NA
	Veranda (Master Bedroom)	6.417	6.000	38.500	1.95581	1.8288	3.5768	0.4725	0.7	50.00	283.871875	1 LLA	NA
	Veranda (Child Bedroom)	4.500	4.000	18.000	1.3716	1.2192	1.6723	0.3227	0.7	50.00	132.718629	1 LLA	NA
Common Floor	Kitchen	7.083	12.000	84.996	2.1589	3.6576	7.8964	0.6788	0.7	200.00	2506.78946	1 LLA, 1 TLA	NA
	Lobby	16.042	7.500	120.313	4.88951	2.286	11.177	0.7789	0.7	70.00	1241.93558	2 LLA	NA
	Stairs	9.208	11.250	103.593	2.80669	3.429	9.6241	0.7717	0.7	100.00	1527.64118	2 CLA	NA
Lobby	Lift Lobby	6.000	8.000	48.000	1.8288	2.4384	4.4593	0.5225	0.7	70.00	495.48288	1 LLA	NA
	Security Room	8.292	6.500	53.896	2.5273	1.9812	5.0071	0.5553	0.7	50.00	397.387838	1 LLA	NA
	Guard's Room	7.500	10.750	80.625	2.286	3.2766	7.4903	0.6733	0.7	50	594.468857	1 LLA	1
	Generator	6.000	8.000	48.000	1.8288	2.4384	4.4593	0.5225	0.7	50	353.916343	1 LLA	NA
	Garage (Parking + Driveway)			2296.774			213.38		0.7	50	16934.7086	15 CLA	NA
	Toilet (Ground Floor)	7.500	5.500	41.250	2.286	1.6764	3.8323	0.4836	0.7	50.00	304.146857	1 LLA	NA
	Transformer	15.458	15.417	238.316	4.7117	4.699	22.14	1.1763	0.7	50.00	1757.16494	2 LLA	NA
Ground	Switchgear Room	6.000	6.917	41.500	1.8288	2.1082	3.8555	0.4896	0.7	50.00	305.990171	1 LLA	NA
Basement	Garage (Parking + Driveway)			2520.545			234.17		0.7	50.00	18584.6285	15 CLA	NA
Roof				Considering the inner and outer area								6 LLA, 2 CLA	NA

Description	Height	Caption	Symbol
Wall Mounted Light	Lintel	LLA	
Ceiling Light	Ceiling	CLA	
Wall Mounted Tube Light	Lintel	TLA	
Fan (56” diameter)	Ceiling	F	
Switch Board	Mid wall	SB	
Sub Distribution Board	Mid wall	SB	
Main Distribution Board	Mid wall	MDB	
Emergency Main Distribution Board	Mid wall	EMDB	
Emergency Switch Board	Mid wall	ESB	
Emergency Sub Distribution Board	Mid Wall	ESDB	
Exhaust Fan (8” diameter)	Lintel	Ex	
2 Pin Socket/TV Socket	Mid Wall	SS/TSS	
3 Pin Socket	Lintel	Q	
Riser	Ceiling	R	

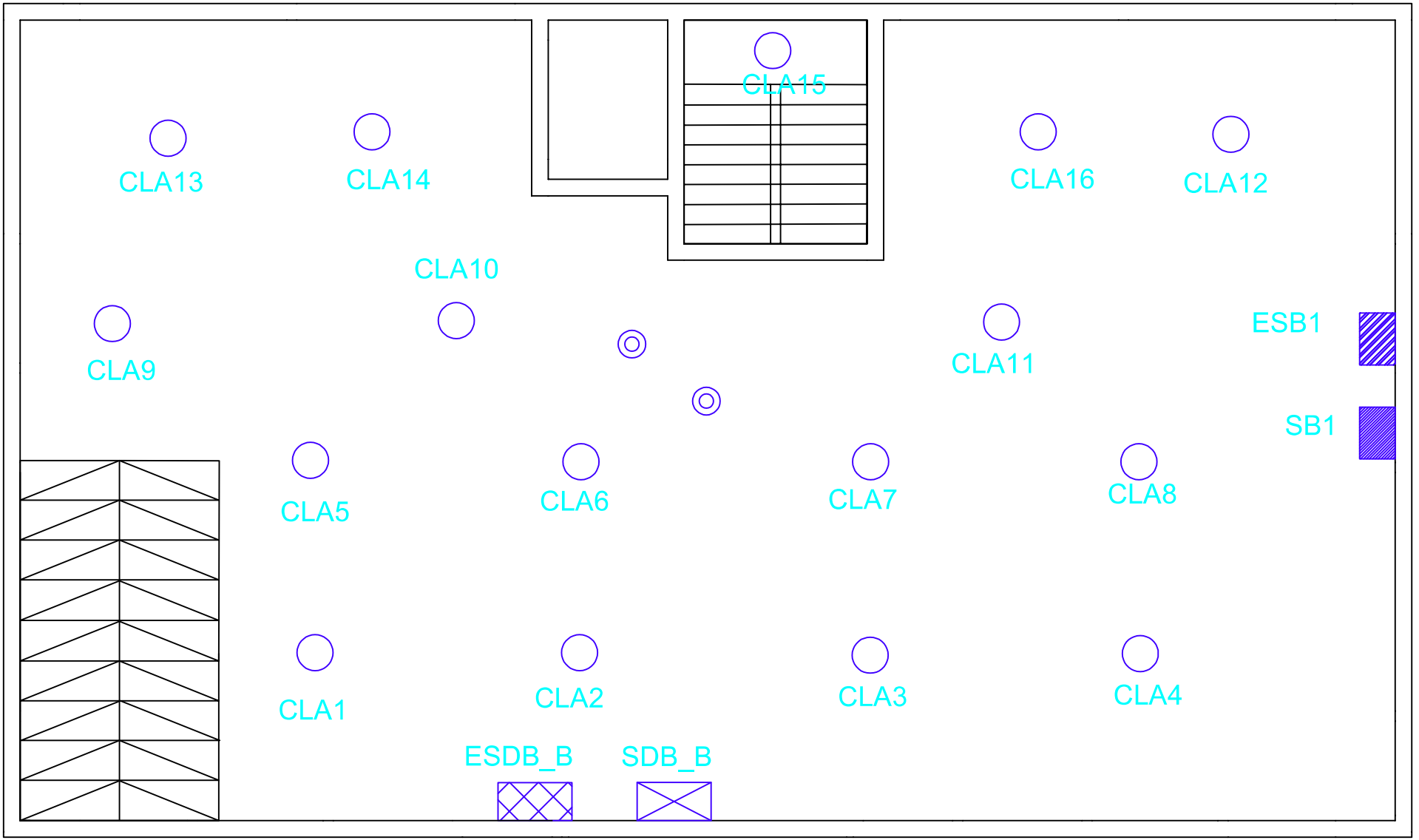
COMMON FLOOR FIXTURES AND FITTINGS



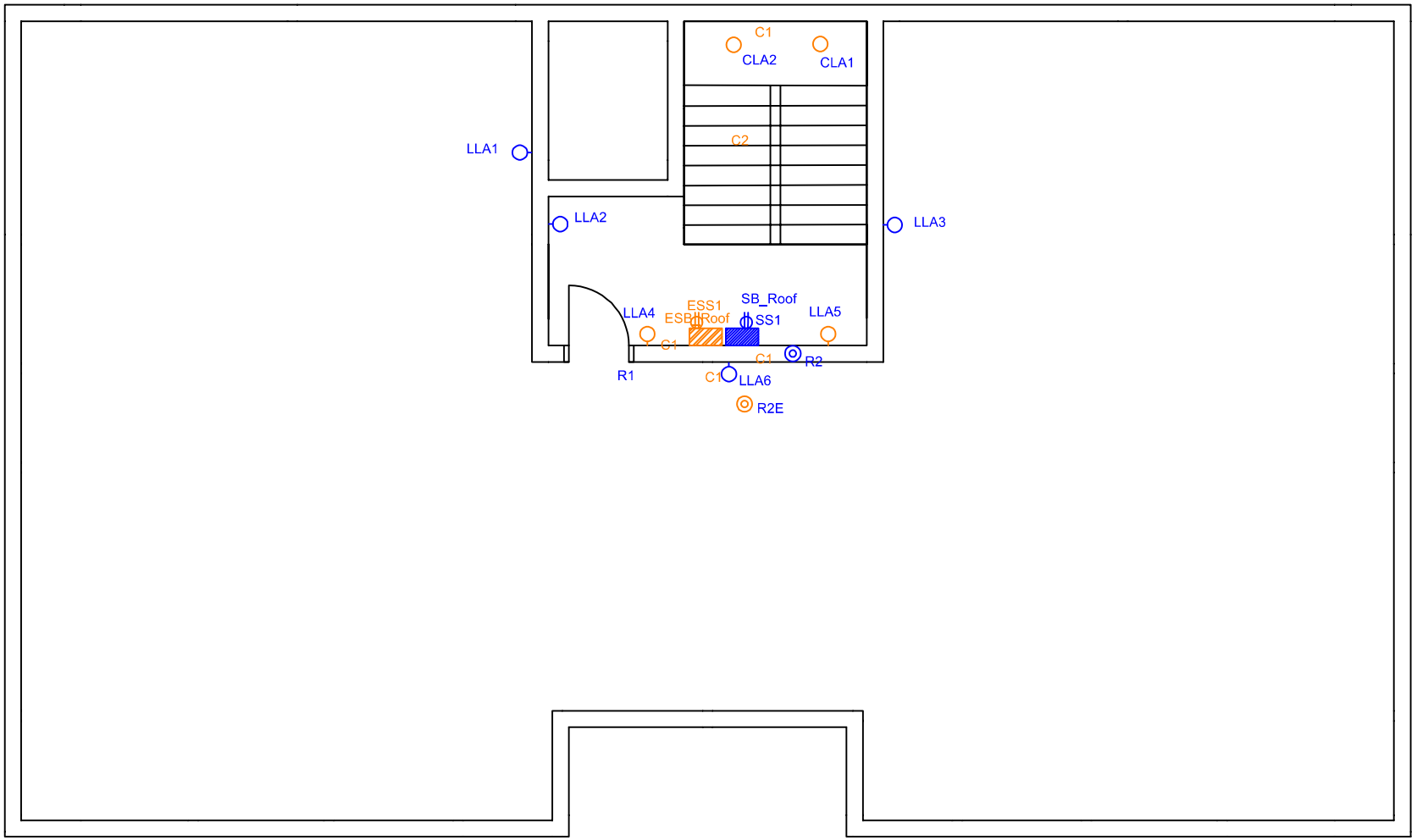
GROUND FLOOR FIXTURES AND FITTINGS



BASEMENT FITTINGS AND FIXTURES



ROOF FITTINGS AND FIXTURES



Power Calculations: *(Number of P/Q Load for an ESB must be 0)*

Current Rating of any appliance, I = Power Rating / (V*pf), V =220V, pf = 0.7

Current Rating of any SB/ESB, I = Total Power Rating for that SB / (V*pf), V =220V, pf = 0.7

Power Rating of an SDB/ESDB = 0.7*Total SB/ESB Load+0.5*Total P Load+0.3*Total Q Load

Current Rating of an SDB/ESDB = Power Rating for that SDB / (V*pf), V =220V, pf = 0.7

Power Rating of EMDB = 0.7*(Total ESDB Rating + Lift Load)

Power Rating for MDB = 0.7*Total SDB Rating + 0.7*(Pump Load + Total EMDB Rating)

Current Rating for MDB = Power Rating of an MDB / (3*V*pf), V = 220, pf = 0.7

Generator Rating = Power Rating of EMDB

Transformer Rating (VA) = 3*V*Current Rating of MDB

A	B	C	D	E	F		G	H	I		J	
					a'	b'			a"	b"	a"'	B"'
3/0.029	1.5	5	16	10	6	10		27	27	22	16	20
7/0.029	2.5	10	16	10	4	7		16	36	30	22	28
7/0.036	4	15	14	10	3	5	1	10	47	39	30	37
7/0.044	6	20	14	10	2	4	1	6.8	59	50	38	47
7/0.052	10	30	10	10	1	2	1.5	4	78	68	52	63
7/0.064	16	40	10	10		1	1.5	2.6	100	94	70	85
19/0.052	25	50	6	6		1	2	1.6	130	125	91	110
19/0.064	35	60	6	6			2	1.2	155	160	112	136
19/0.072	50	70	6	6			2	0.93	185	195	136	164
19/0.083	70	100	1/0	1/0			2	0.65	225	245	173	207
37/0.072	95	120	1/0	1/0			2.5	0.48	270	300	216	253
37/0.083	120	150	1/0	1/0			2.5	0.4	310	350	244	291
37/0.093	150	200	1/0	1/0			3	0.34	350	405		333
37/0.130	185	250	3/0	3/0			3.5	0.29	390	460		381
61/0.093	240	300	3/0	3/0			4	0.24	450	555		452
61/0.103	300	425	3/0	3/0			4	0.22	515	640		526
91/0.093	400	585	3/0	3/0			6	0.2	586	770		639
91/0.103	500	685	3/0	3/0			6	0.18	680	900		752
127/0.103	630	800	3/0	3/0			6	0.17	800	1030		855

A : Single core cable construction diameter, inch .... as per Imperial Standard Size :B.S.S (old).

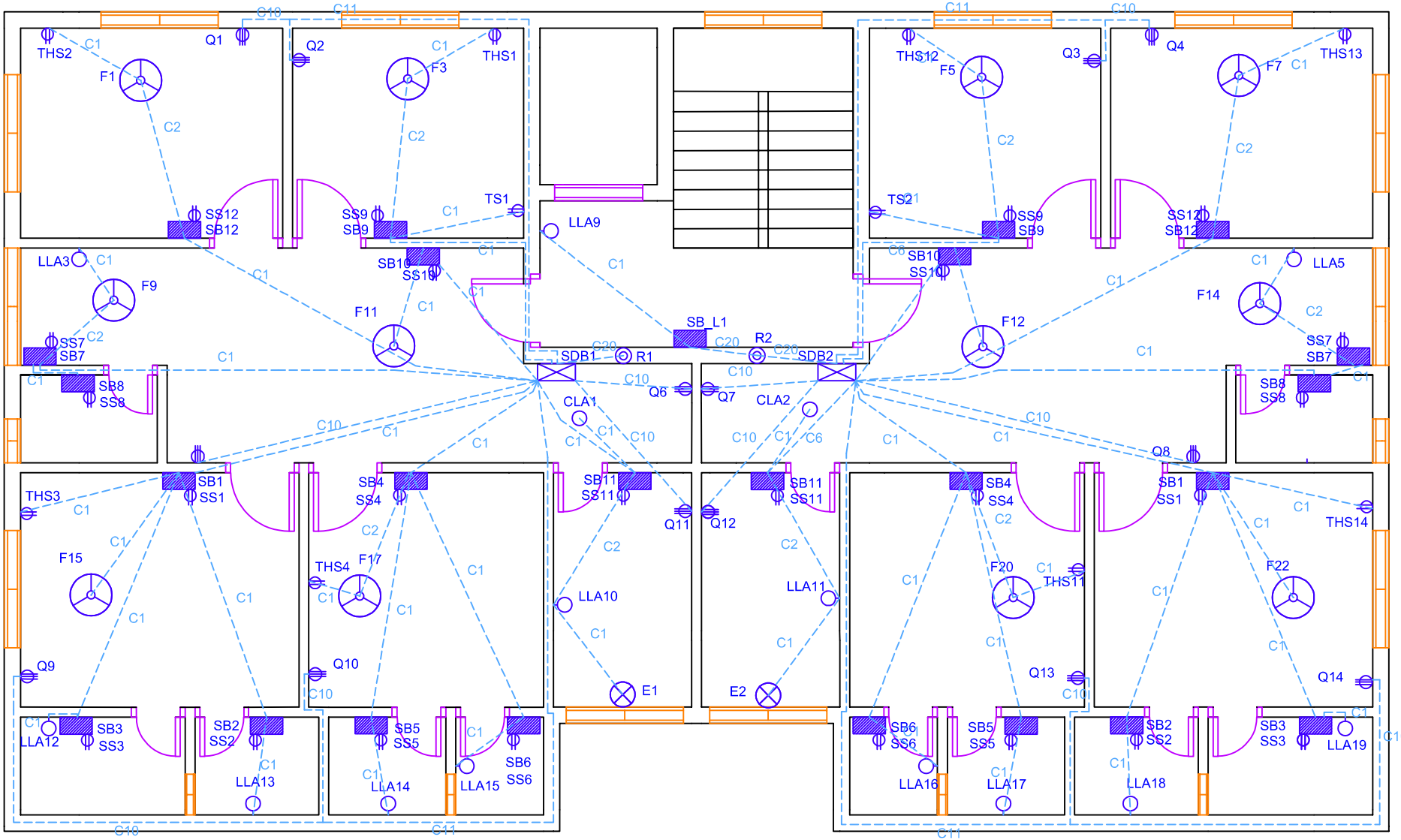
B : Single core cable construction area, mm² .... as per Metric Standard Size : VDE.

C : CB designed current rating amps.

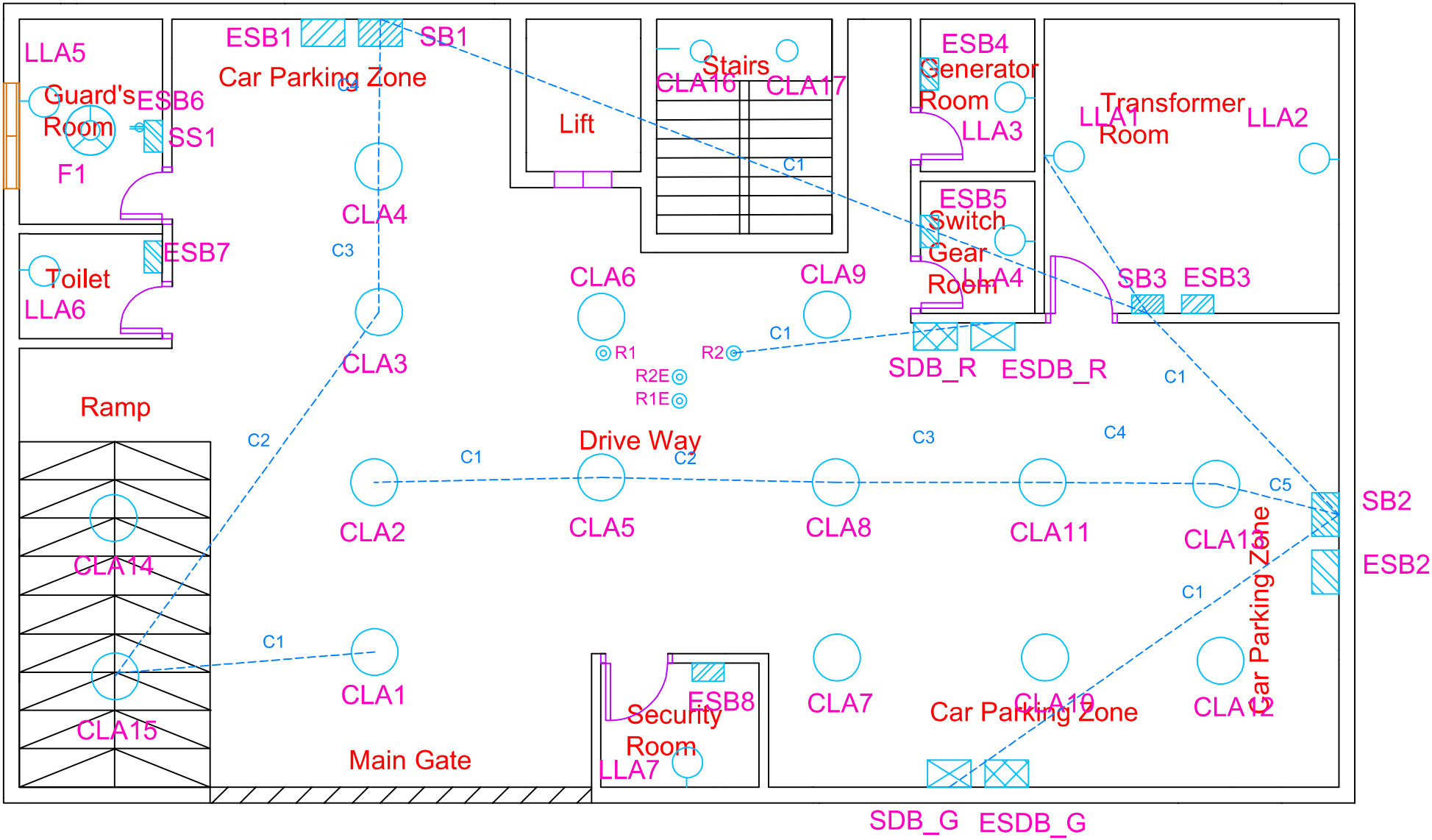
Legend for Conduit:

Symbol	Wire Rating(rm)	Current Rating
C1	2 x 1.5 BYM	5A
C2	4 x 1.5 BYM	5A
C3	6 x 1.5 BYM	5A
C4	8 x 1.5 BYM	5A
C5	10 x 1.5 BYM	5A
C6	2 x 2.5 BYM + 2.5 BYA ECC	10A
C7	4 x 2.5 BYM + 2.5 BYA ECC	10A
C8	2 x 4 BYM + 4 BYA ECC	15A
C10	2 x 6 BYM + 6 BYA ECC	20A
C11	4 x 6 BYM + 6 BYA ECC	20A
C15	2 x 70 BYM + 70 BYA ECC	80A

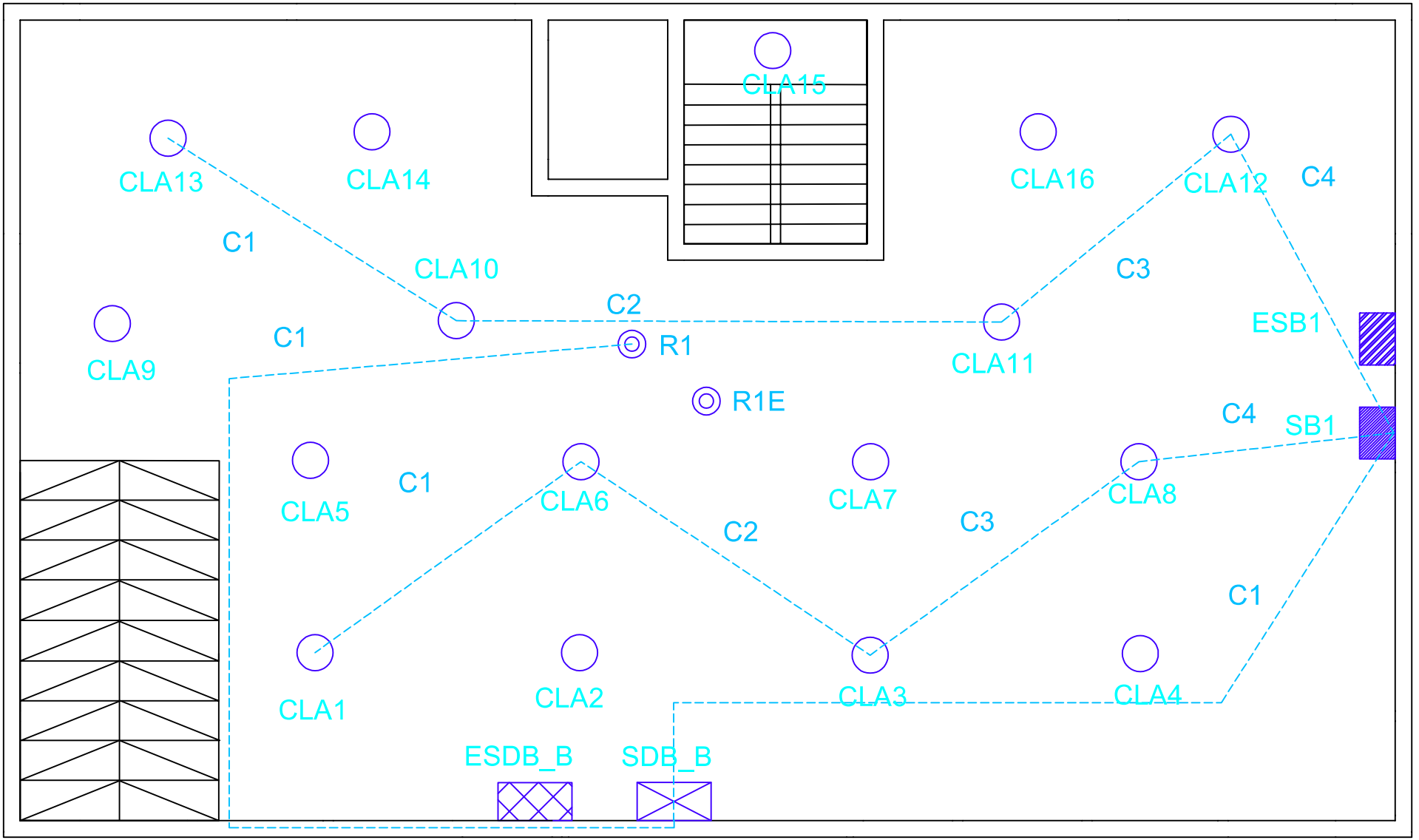
COMMON FLOOR MAIN CONDUIT



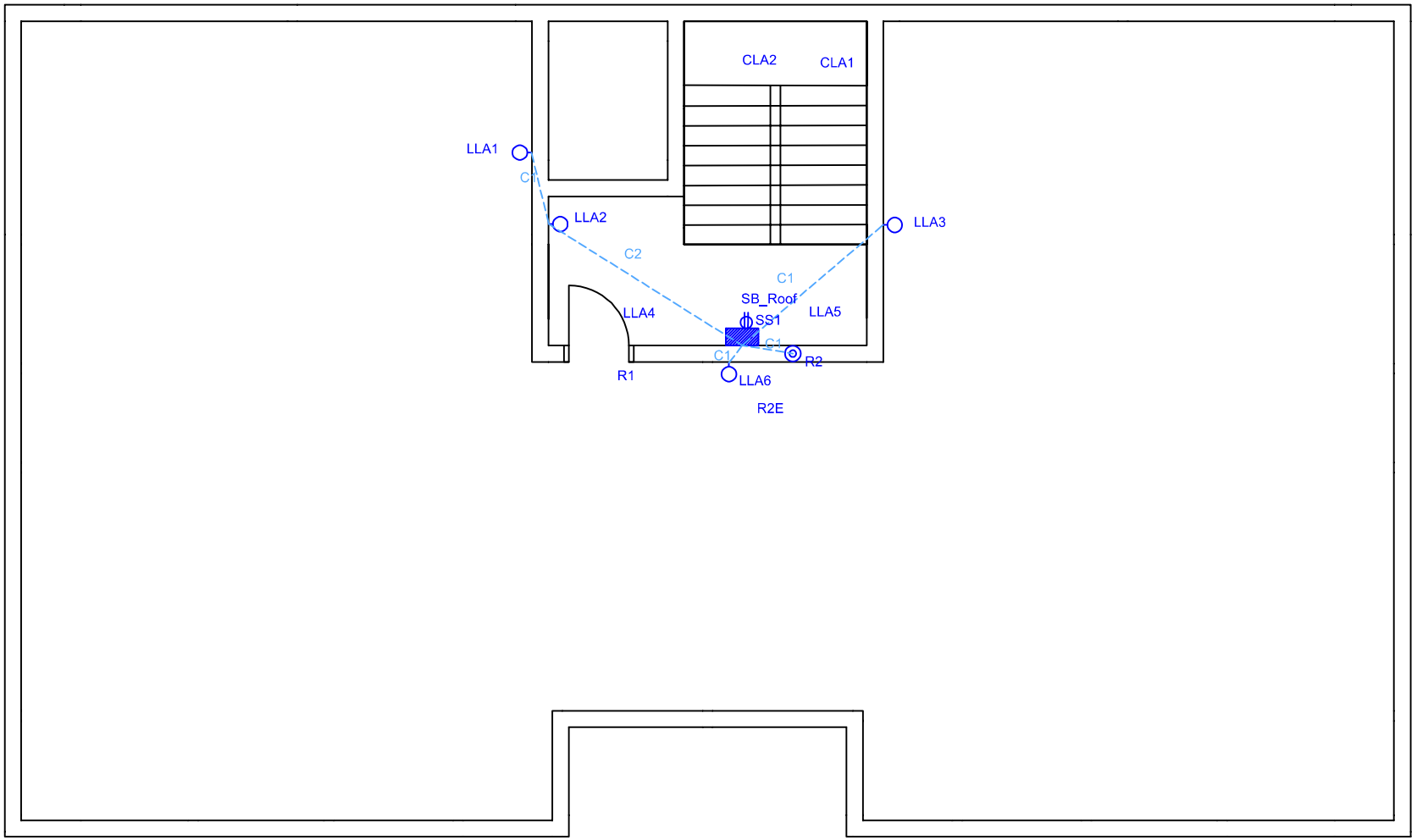
GROUND FLOOR MAIN CONDUIT



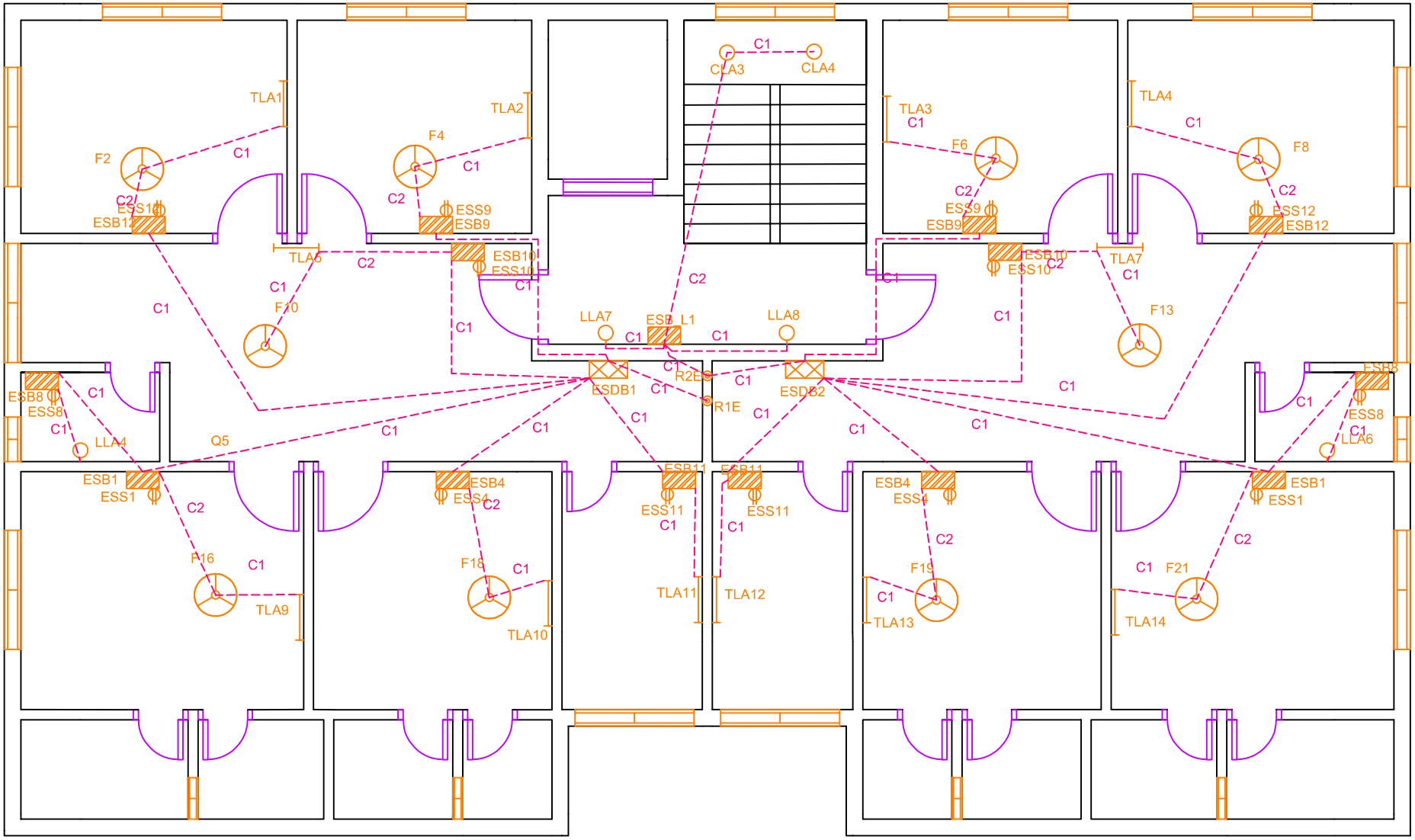
BASEMENT MAIN CONDUIT



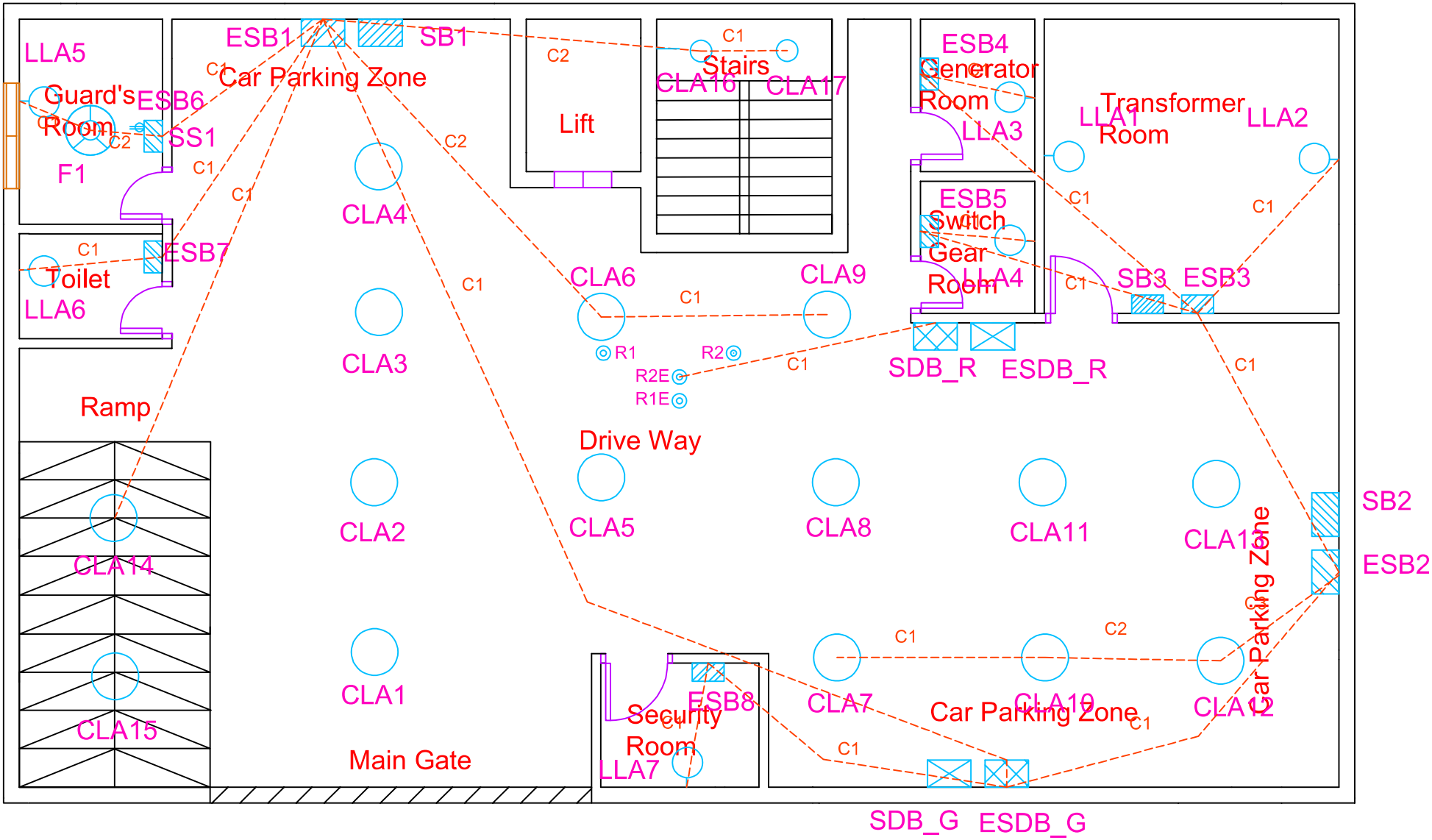
ROOF MAIN CONDUIT



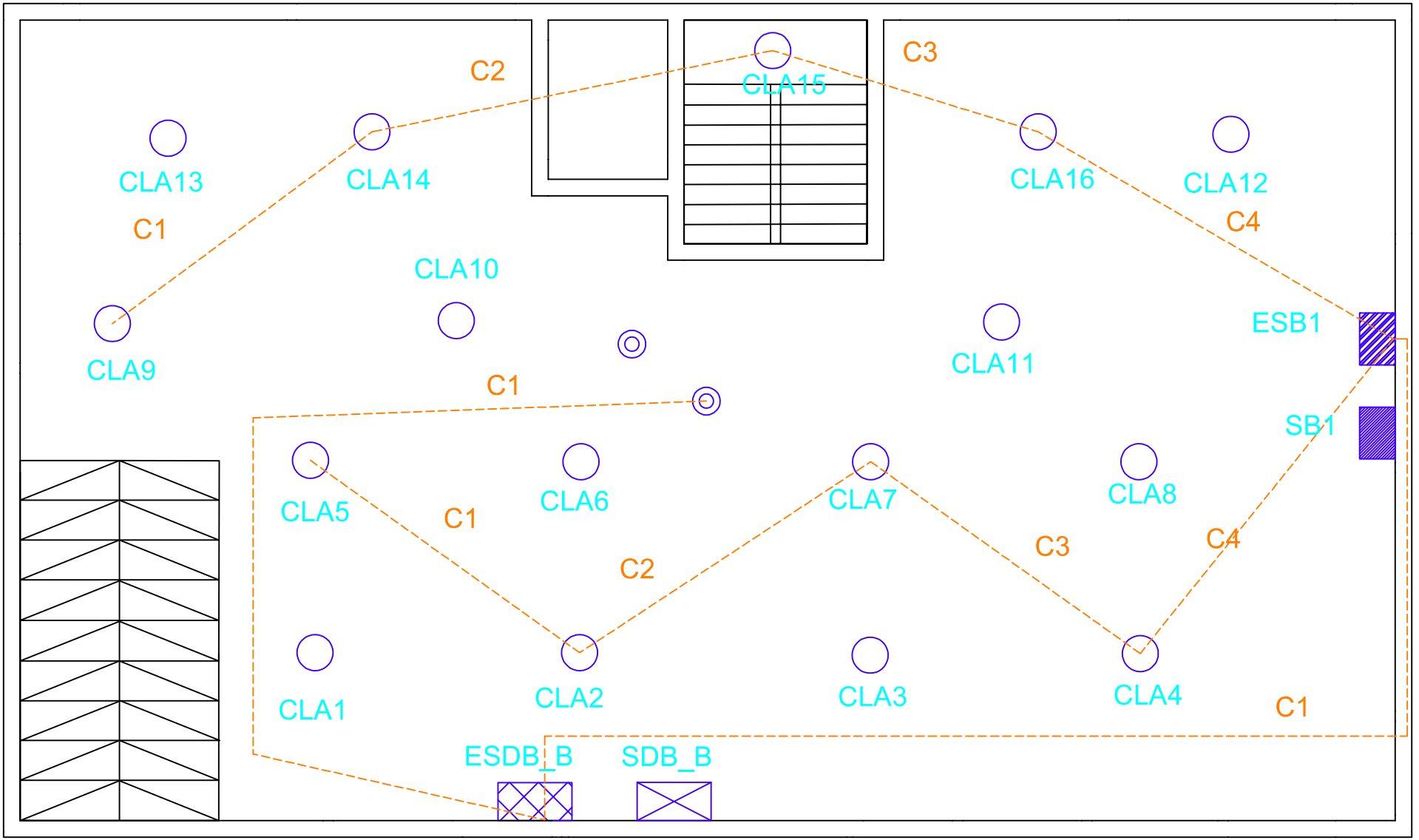
COMMON FLOOR EMERGENCY CONDUIT



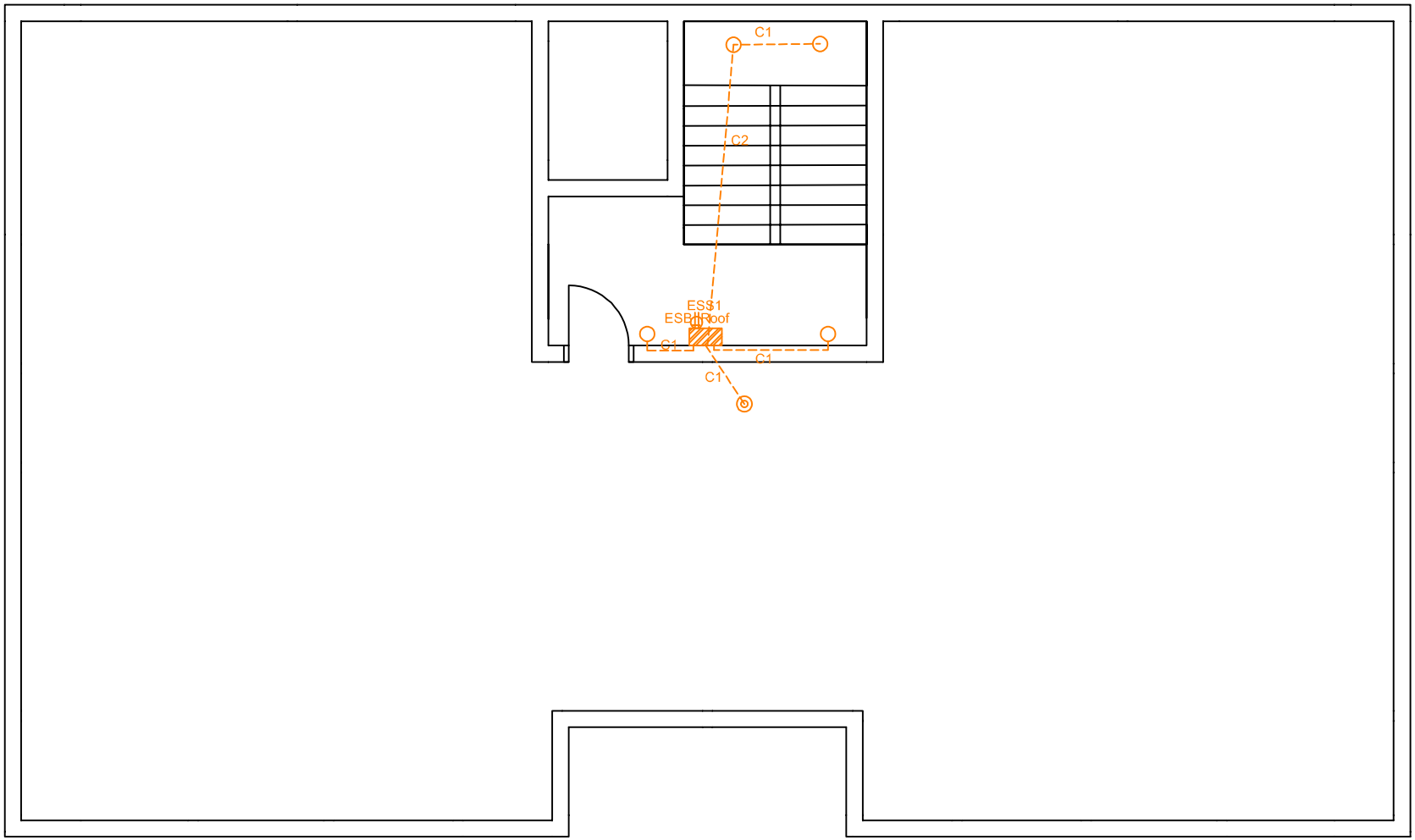
GROUND FLOOR EMERGENCY CONDUIT



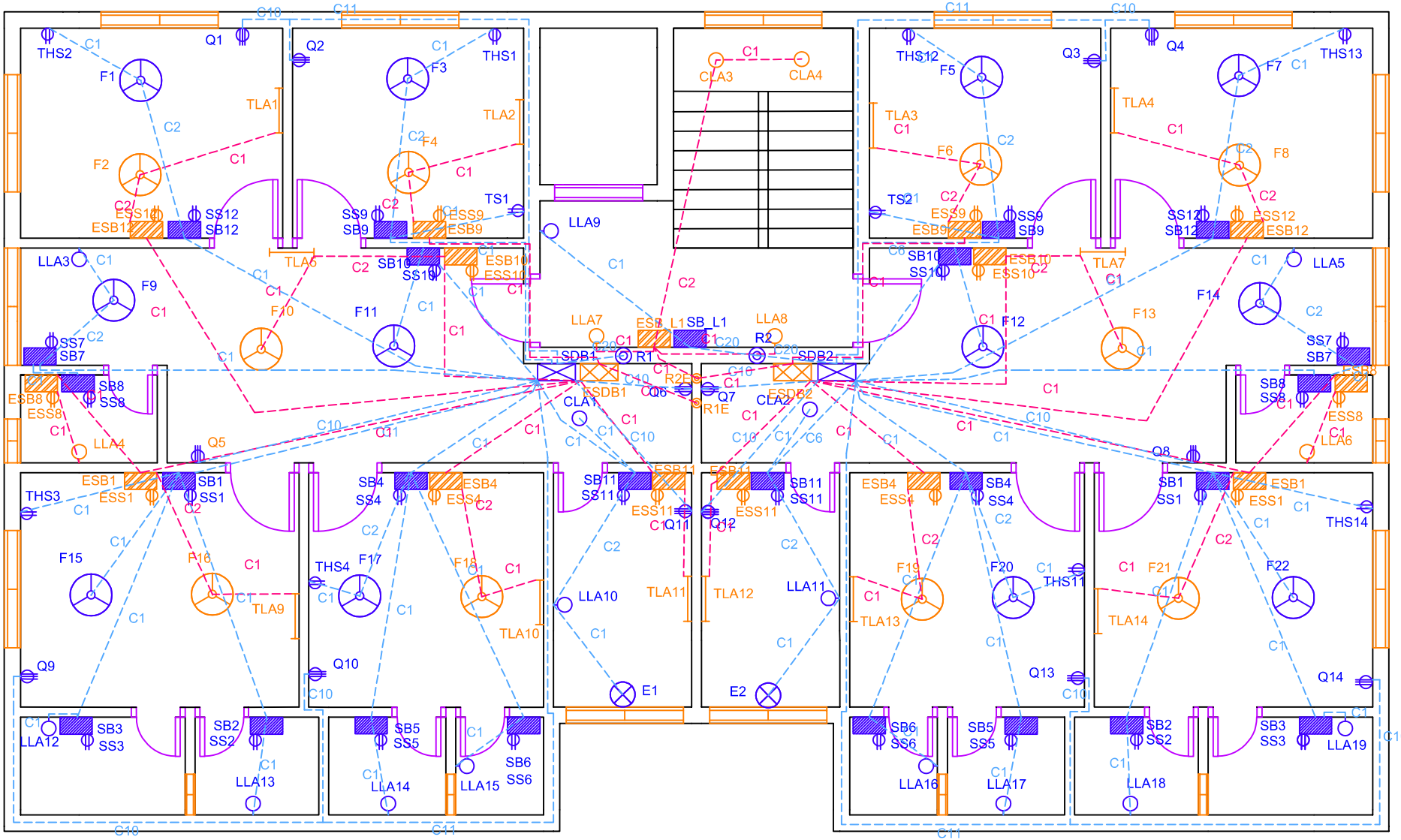
BASEMENT EMERGENCY CONDUIT



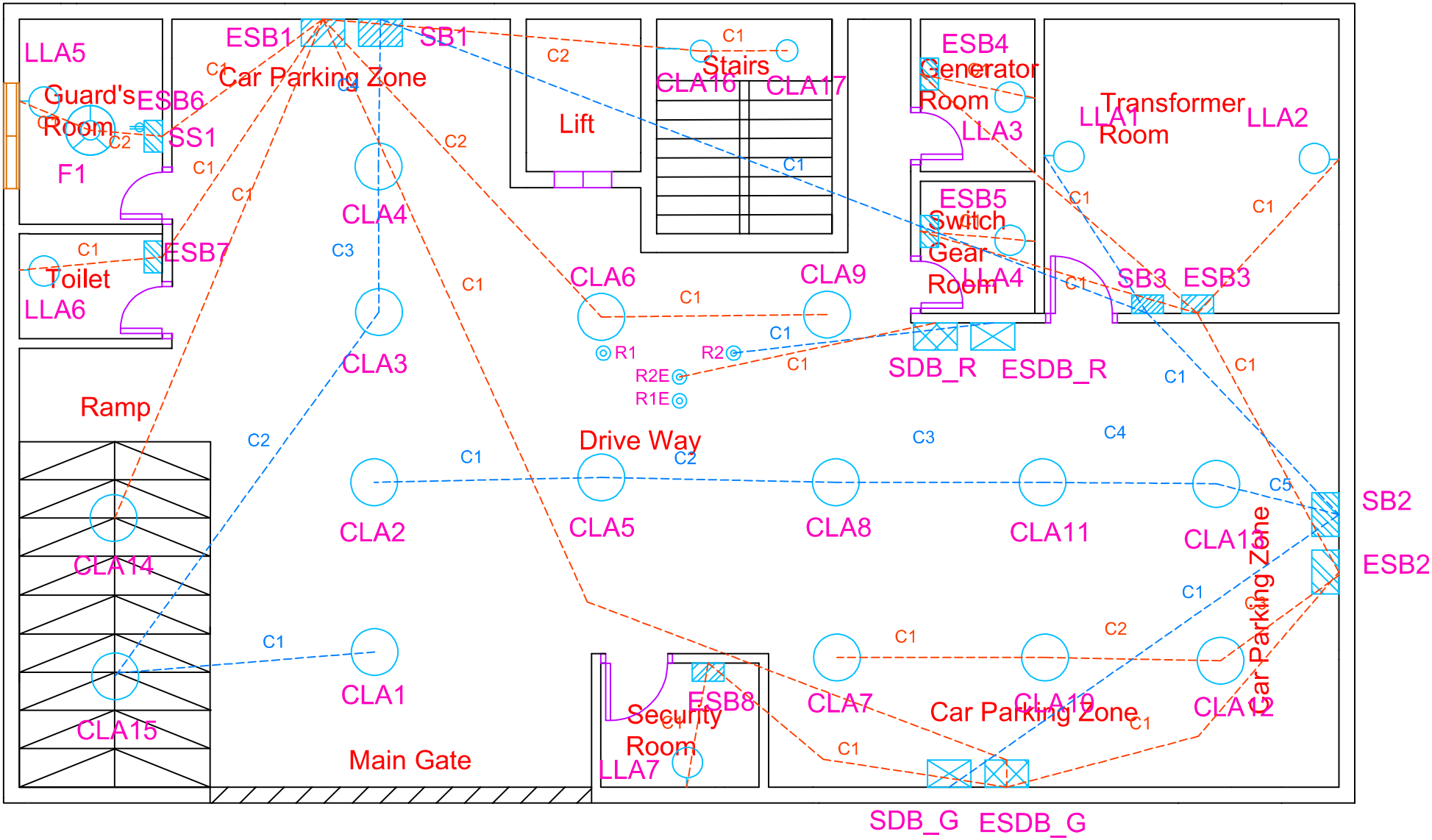
ROOF EMERGENCY CONDUIT



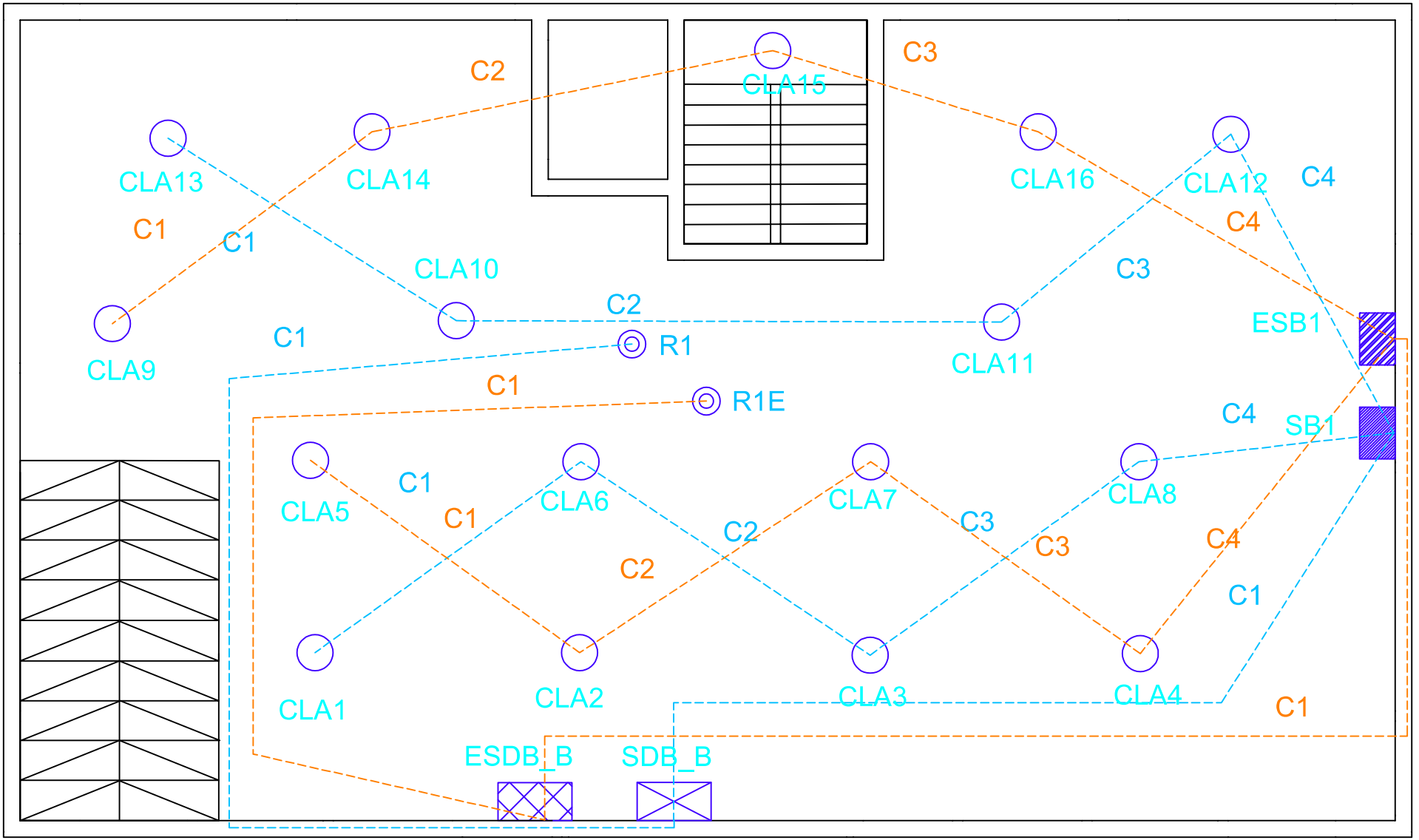
COMMON FLOOR CONDUIT



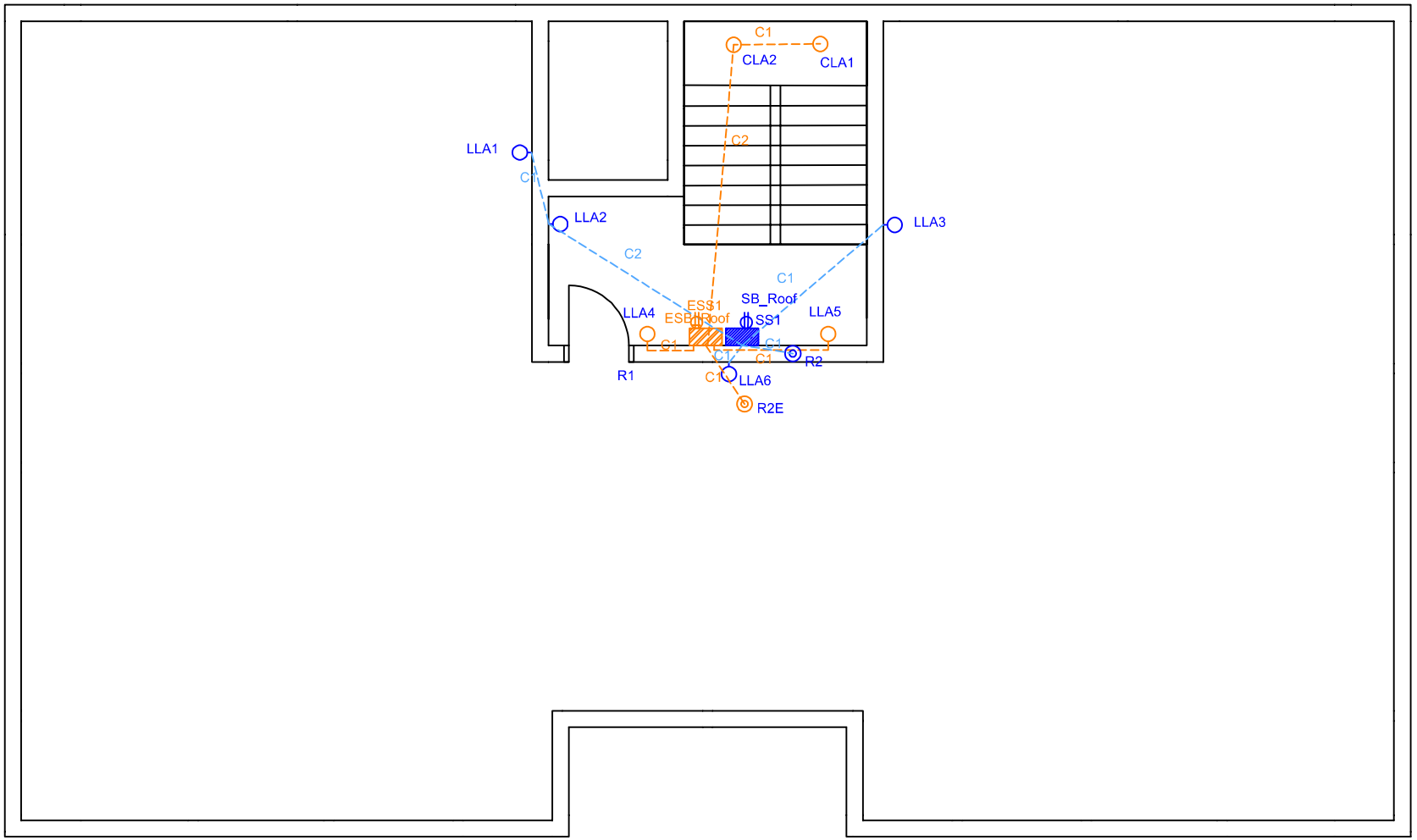
GROUND FLOOR CONDUIT



BASEMENT CONDUIT



ROOF CONDUIT



Power Calculations

Common Unit

SB:

DRAWING ROOM	**SB9**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
Fan	1	100	100	0.649350649
SB Socket	1	100	100	0.649350649
Table H Socket	1	100	100	0.649350649
TV Socket	1	100	100	0.649350649
		Total-->	400	2.597402597

GUEST BEDROOM	**SB12**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
Fan	1	100	100	0.649350649
SB Socket	1	100	100	0.649350649
Table H Socket	1	100	100	0.649350649
		Total-->	300	1.948051948

MASTER BEDROOM	**SB1**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
Fan	1	100	100	0.649350649
SB Socket	1	100	100	0.649350649
Table H Socket	1	100	100	0.649350649
		Total-->	300	1.948051948

CHILD BEDROOM	**SB4**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
Fan	1	100	100	0.649350649
SB Socket	1	100	100	0.649350649
Table H Socket	1	100	100	0.649350649
		Total-->	300	1.948051948

LIVING AND DINING ROOM Part 1	**SB7**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
LLA	1	12	12	0.077922078
SB Socket	1	100	100	0.649350649
Fan	1	100	100	0.649350649
		Total-->	212	1.376623377
LIVING AND DINING ROOM Part 2	**SB10**			
SB Socket	1	100	100	0.649350649
Fan	1	100	100	0.649350649
		Total-->	200	1.298701299

TOILET (LIVING AND DINING ROOM)	**SB8**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
SB Socket	1	100	100	0.649350649
		Total-->	100	0.649350649

TOILET (MASTER BEDROOM)	**SB2**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
LLA	1	12	12	0.077922078
SB Socket	1	100	100	0.649350649
		Total-->	112	0.727272727

TOILET (CHILD BEDROOM)	**SB5**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
LLA	1	12	12	0.077922078
SB Socket	1	100	100	0.649350649
		Total-->	112	0.727272727

VERANDA (MASTER BEDROOM)	**SB3**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
LLA	1	12	12	0.077922078
SB Socket	1	100	100	0.649350649
		Total-->	112	0.727272727

VERANDA (CHILD BEDROOM)	**SB6**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
LLA	1	12	12	0.077922078
SB Socket	1	100	100	0.649350649
		Total-->	112	0.727272727

KITCHEN	**SB11**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
LLA	1	12	12	0.077922078
SB Socket	1	100	100	0.649350649
CLA (in L&D)	1	12	12	0.077922078
Exhaust Fan	1	40	40	0.25974026
		Total-->	164	1.064935065

SDB:

Common Floor SDB per unit					
Room Name	**Switch Borad**	**Circuit No**	**Current Rating**	**Load**	**ckt Current Rating**
MASTER BEDROOM	SB1	ckt1	1.948	300	3.402597403
TOILET (MASTER BEDROOM)	SB2		0.727	112	
VERANDA (MASTER BEDROOM)	SB3		0.727	112	
CHILD BEDROOM	SB4	ckt2	1.948	300	3.402597403
TOILET (CHILD BEDROOM)	SB5		0.727	112	
VERANDA (CHILD BEDROOM)	SB6		0.727	112	
LIVING AND DINING ROOM Part 1	SB7	ckt3	1.377	212	2.025974026
TOILET (LIVING AND DINING ROOM)	SB8		0.649	100	
DRAWING ROOM	SB9	ckt4	2.597	400	2.597402597
LIVING AND DINING ROOM Part 2	SB10	ckt5	1.299	200	1.298701299
KITCHEN	SB11	ckt6	1.065	164	1.064935065
GUEST BEDROOM	SB12	ckt7	1.948	300	1.948051948
	Nos	**P Rating**	**Current Rating**	**Load**	
P load	7	3000	19.48	21000	

Total P Load --->	**21000**
Total SB Load --->	**1900**
Total Load --->	**11830**
Current Rating --->	**76.81818182**

ESB:

DRAWING ROOM	**ESB9**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
TLA	1	20	20	0.12987013
Fan	1	100	100	0.649350649
SB Socket	1	100	100	0.649350649
		Total--->	220	1.428571429

GUEST BEDROOM	**ESB4**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
TLA	1	20	20	0.12987013
Fan	1	100	100	0.649350649
SB Socket	1	100	100	0.649350649
		Total--->	220	1.428571429

MASTER BEDROOM	**ESB1**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
TLA	1	20	20	0.12987013
Fan	1	100	100	0.649350649
SB Socket	1	100	100	0.649350649
		Total-->	220	1.428571429

CHILD BEDROOM	**ESB12**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
TLA	1	20	20	0.12987013
Fan	1	100	100	0.649350649
SB Socket	1	100	100	0.649350649
		Total-->	220	1.428571429

LIVING AND DRAWING ROOM	**ESB10**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
TLA	1	20	20	0.12987013
Fan	1	100	100	0.649350649
SB Socket	1	100	100	0.649350649
		Total-->	120	0.779220779

TOILET (LIVING AND DRAWING ROOM)	**ESB8**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
LLA	1	12	12	0.077922078
SB Socket	1	100	100	0.649350649
		Total-->	112	0.727272727

ESDB:

Common Floor ESDB per unit					
Room Name	**Switch Borad**	**Circuit No**	**Power**	**Current Rating**	**ckt Current Rating**
TOILET (LIVING AND DRAWING ROOM)	ESB8	ckt1	112	0.727272727	2.155844156
MASTER BEDROOM	ESB1		220	1.428571429	
GUEST BEDROOM	ESB4	ckt2	220	1.428571429	1.428571429
DRAWING ROOM	ESB9	ckt3	220	1.428571429	1.428571429
CHILD BEDROOM	ESB12	ckt4	220	1.428571429	1.428571429
KITCHEN	ESB11	ckt5	20	0.12987013	0.12987013
LIVING AND DRAWING ROOM	ESB10	ckt6	120	0.779220779	0.779220779

Total ESB Load -->	**1132**
Total P Load -->	**0**
Total Load -->	**792.4**
Current Rating -->	**5.1454545**

Ground Floor:

SB:

TRANSFORMER	**SB3**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
LLA	1	12	12	0.077922078
		Total -->	**12**	**0.077922078**

GARAGE (PARKING + DRIVEWAY)	**SB2**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
CLA	5	12	60	0.38961039
		Total -->	60	0.38961039

GARAGE (PARKING + DRIVEWAY)	**SB1**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
CLA	4	12	48	0.311688312
		Total -->	48	0.311688312

SDB:

Room Name	Switch Borad	Circuit No	Current Rating	Power	ckt Current Rating
TRANSFORMER	SB3	ckt1	0.078	12	0.779220779
GARAGE (PARKING + DRIVEWAY)	SB2		0.39	60	
GARAGE (PARKING + DRIVEWAY)	SB1		0.312	48	

Total P Load -->	0
Total SB Load -->	120
Total Load -->	84
Total Current Rating ->	0.545454545

ESB:

SWITCHGEAR ROOM	**ESB5**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
LLA	1	12	12	0.077922078
		Total -->	**12**	**0.077922078**

TRANSFORMER	**ESB3**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
LLA	1	12	12	0.077922078
		Total -->	**12**	**0.077922078**

SECURITY ROOM	**ESB8**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
LLA	1	12	12	0.077922078
		Total -->	12	0.077922078

GENERATOR	**ESB4**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
LLA	1	12	12	0.077922078
		Total -->	**12**	**0.077922078**

GARAGE (PARKING + DRIVEWAY)	**ESB1**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
CLA	3	12	36	0.233766234
		Total -->	**36**	**0.233766234**

GUARD'S ROOM	**ESB6**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
LLA	1	12	12	0.077922078
Fan	1	100	100	0.649350649
SB Socket	1	100	100	0.649350649
		Total -->	212	1.376623377

TOILET (GUARD'S ROOM)	**ESB7**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
LLA	1	12	12	0.077922078
		Total -->	12	0.077922078

GARAGE (PARKING + DRIVEWAY)	**ESB2**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
CLA	3	12	36	0.233766234
		Total -->	**36**	**0.233766234**

ESDB:

Room Name	**Switch Borad**	**Circuit No**	**Current Rating**	**Power**	**ckt Current Rating**
GARAGE (PARKING + DRIVEWAY)	ESB1	ckt1	0.234	36	1.688311688
GUARD'S ROOM	ESB6		1.377	212	
TOILET (GUARD'S ROOM)	ESB7		0.078	12	
TRANSFORMER	ESB3	ckt2	0.078	12	0.467532468

SWITCHGEAR ROOM	ESB5		0.078	12	
GENERATOR	ESB4		0.078	12	
GARAGE (PARKING + DRIVEWAY)	ESB2		0.234	36	
SECURITY ROOM	ESB8	ckt3	0.078	12	0.077922078

Total P Load -->	**0**
Total SB Load -->	**332**
Total Load -->	**232.4**
Total Current Rating ->	**1.509090909**

Basement:

SB:

GARAGE (PARKING + DRIVEWAY)		**SB1**		
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
CLA	8	12	96	0.623376623
		Total-->	96	0.623376623

SDB:

Ground Floor SDB					
Room Name	**Switch Borad**	**Circuit No**	**Current Rating**	**Load**	**ckt Current Rating**
GARAGE (PARKING + DRIVEWAY)	SB1	ckt1	0.623	96	0.623376623

Total P Load -->	**0**
Total SB Load -->	**96**
Total Load -->	**67.2**
Total Current Rating ->	**0.436363636**

ESB:

GARAGE (PARKING + DRIVEWAY)		**ESB1**		
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
CLA	7	12	84	0.545454545
		Total-->	84	0.545454545

ESDB:

Room Name	**Switch Borad**	**Circuit No**	**Current Rating**	**Load**	**ckt Current Rating**
GARAGE (PARKING + DRIVEWAY)	ESB1	ckt1	0.545	84	0.545454545

Total P Load -->	0
Total SB Load -->	84
Total Load -->	58.8
Total Current Rating ->	0.381818182

Roof, Lobby and Stairs:

SB:

ROOF	**SB_ROOF**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
LLA	4	12	48	0.311688312
SB Socket	1	100	100	0.649350649
		Total-->	148	0.961038961

MAIN FLOOR (SB)				
LOBBY	**SB_L1**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
LLA	1	12	12	0.077922078
		Total-->	**12**	**0.077922078**

SDB:

Room Name	Switch Borad	Circuit No	Current Rating	Load	ckt Current Rating
ROOF	SB_ROOF	ckt10	0.961	148	0.961038961
LOBBY	SB_L1	cktx	0.078	12	0.077922078

Number of Floors	9
x = 1,2,…9	

Total P Load -->	0
Total SB Load -->	256
Total Load -->	179.2
Total Current Rating ->	1.163636364

ESB:

ROOF	**ESB_ROOF**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
LLA	2	12	24	0.155844156
CLA	2	12	24	0.155844156
SB Socket	1	100	100	0.649350649
		Total-->	148	0.961038961

MAIN FLOOR (ESB)				
STAIRS	**ESB_L1**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
CLA	2	12	24	0.155844156
		Total-->	**24**	**0.155844156**

LIFT LOBBY	**ESB_L1 (cont.)**			
Appliances	**Quantity**	**Power per head**	**Power**	**Current Rating**
LLA	2	12	24	0.155844156
		Total-->	**24**	**0.155844156**

ESDB:

Room Name	Switch Borad	Circuit No	Current Rating	Load	ckt Current Rating
ROOF	ESB_ROOF	ckt10'	0.961	148	0.961038961
LIFT LOBBY	ESB_L1	cktx'	0.312	48	0.311688312

Number of Floors	9
x = 1,2,…9	

Total P Load -->	0
Total ESB Load -->	580
Total Load -->	406
Total Curent Rating ->	2.636363636

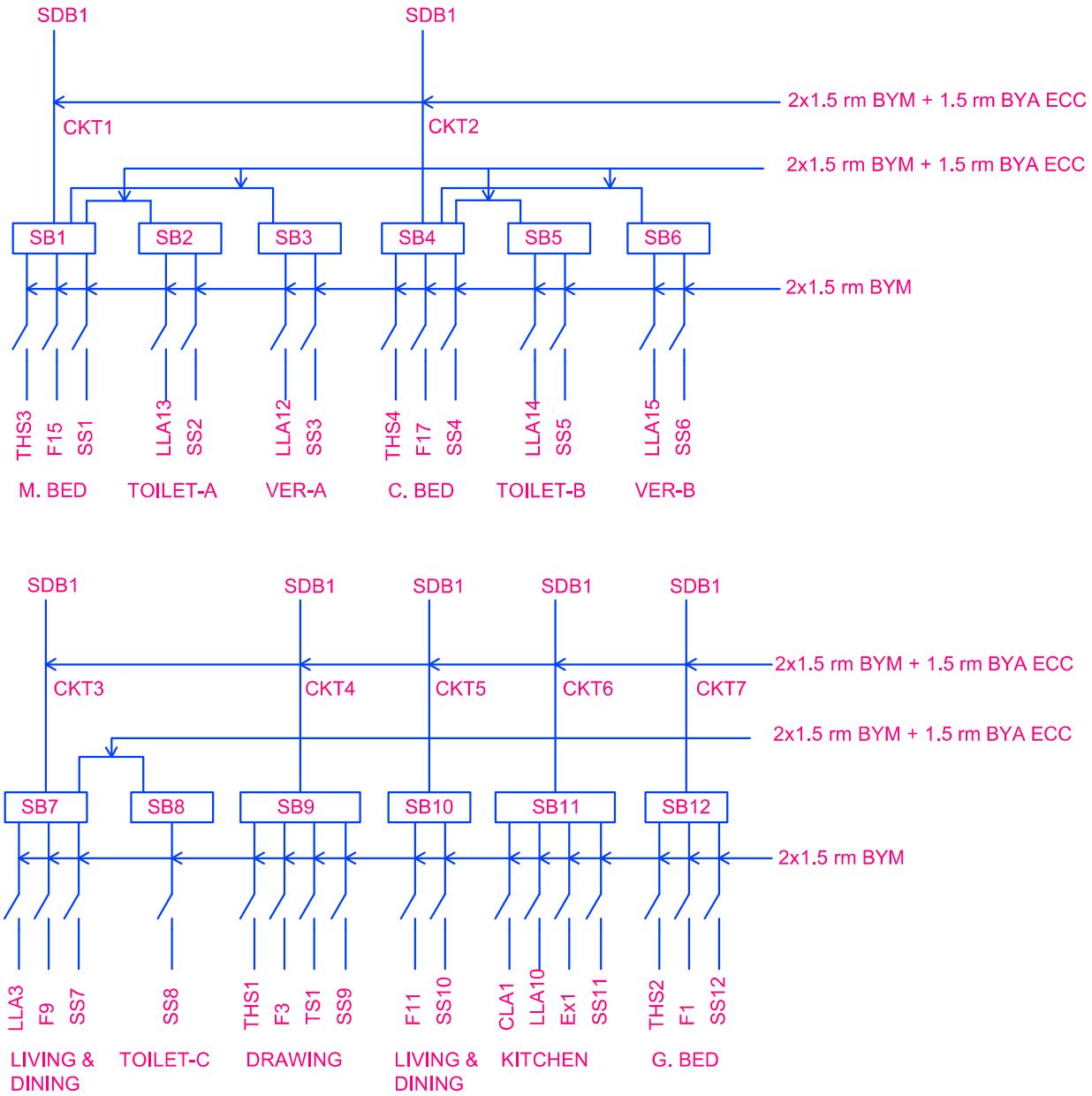
MDB Calculations:

		Nos	Power Rating	Current Rating	Total Power
COMMON FLOOR	**SDB**	18	11830	76.81818182	212940
	ESDB	18	792.4	5.145454545	14263.2
GROUND	**SDB**	1	84	0.545454545	84
	ESDB	1	232.4	1.509090909	232.4
BASEMENT	**SDB**	1	67.2	0.436363636	67.2
	ESDB	1	58.8	0.381818182	58.8
PUMP		1	5000		5000
ROOF, LOBBY, STAIRS	**SDB**	1	179.2	1.163636364	179.2
	ESDB	1	406	2.636363636	406

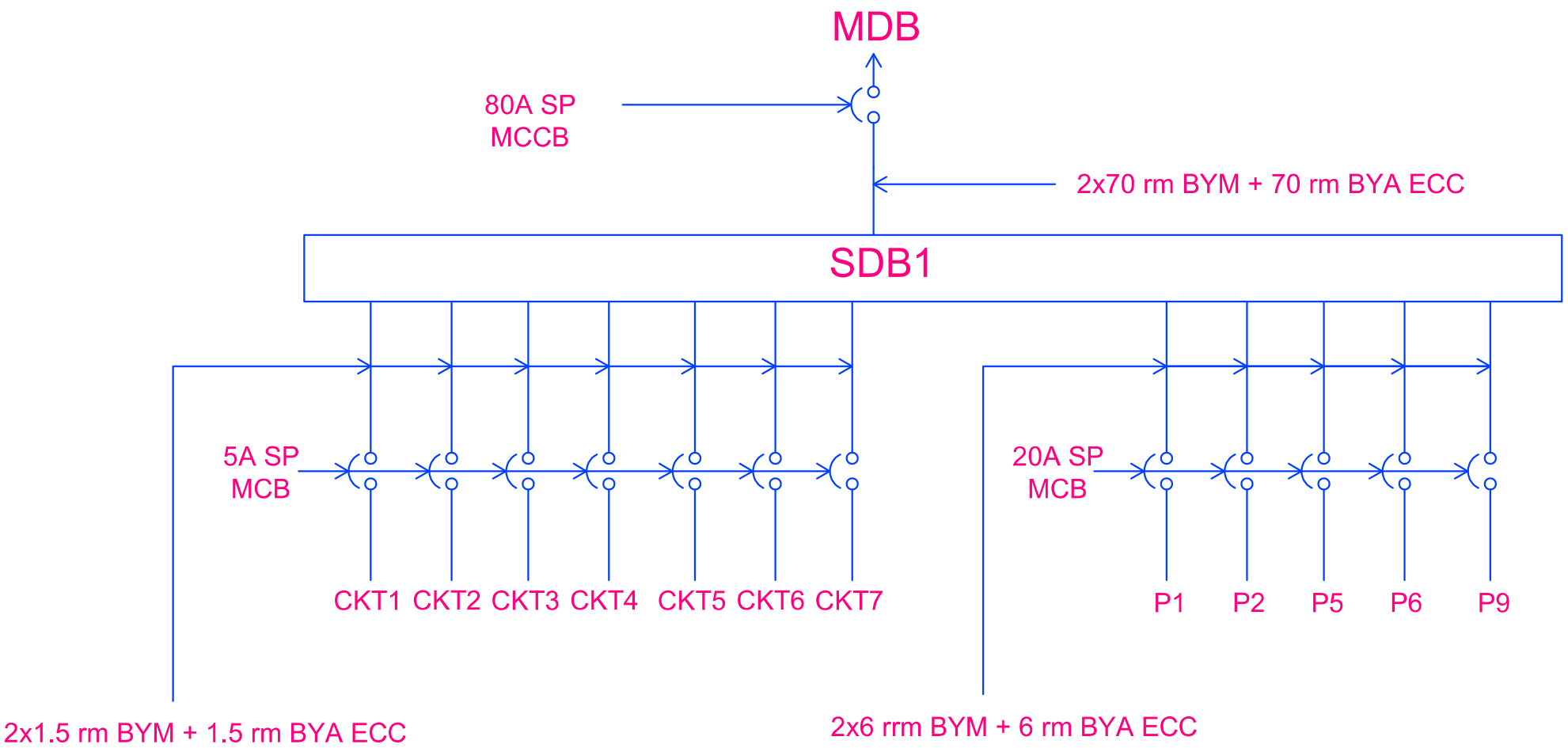
Number of Floors	**9**
Number of Units	**2**

	Power	Current
Total SDB	**213270.4**	**461.624**
Total ESDB	14977.2	32.414
Lift Load	18000	38.96103896
Total EMDB Load	23084.04	49.96545455
Total Pump Load	5000	10.82251082
Total MDB Load	168948.108	365.6885455
Generator Load (W)	23084.04	49.96545455
Transformer (VA)	241354.44	365.6885455

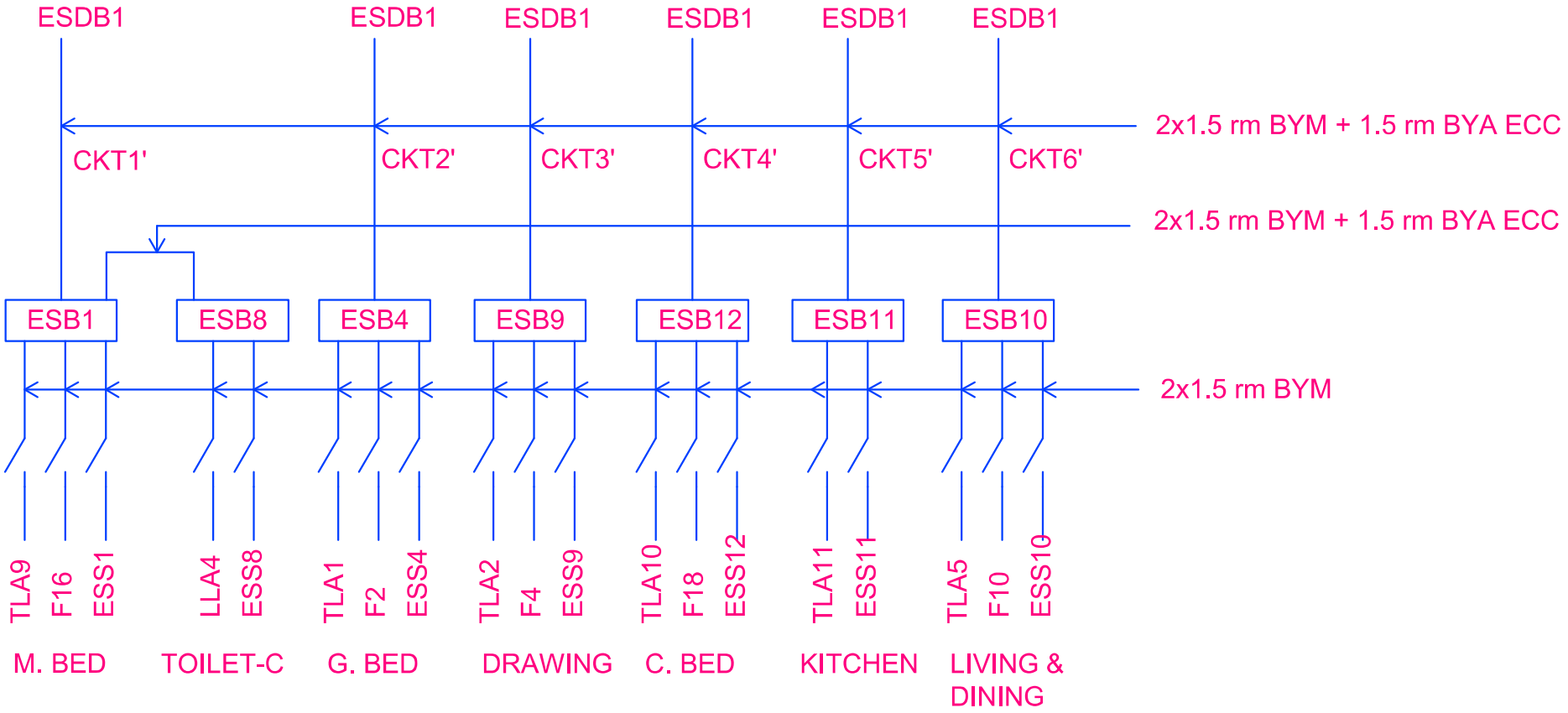
Switch Board Connection Diagram of Common Unit



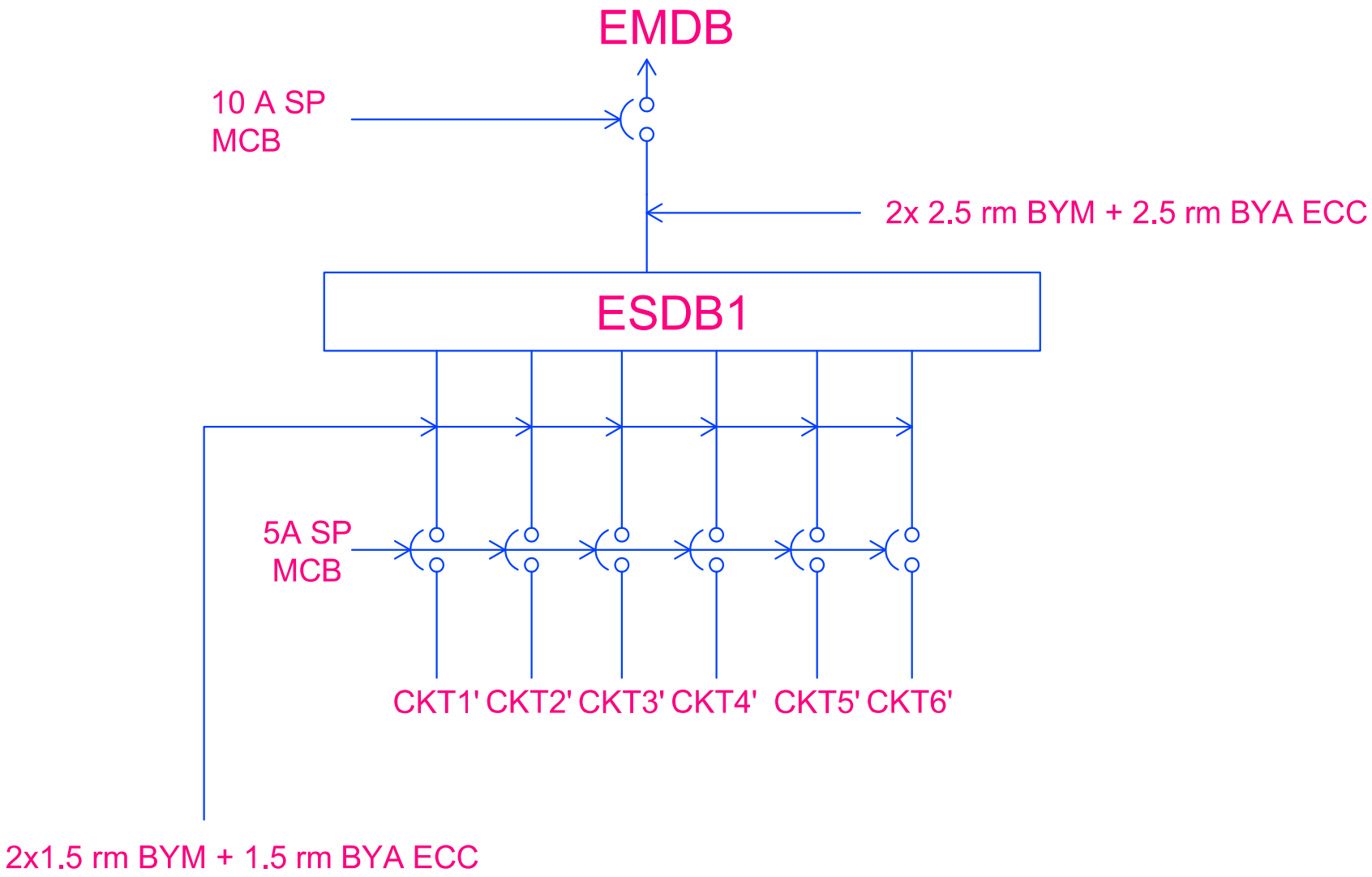
SDB Connection Diagram for Common Unit



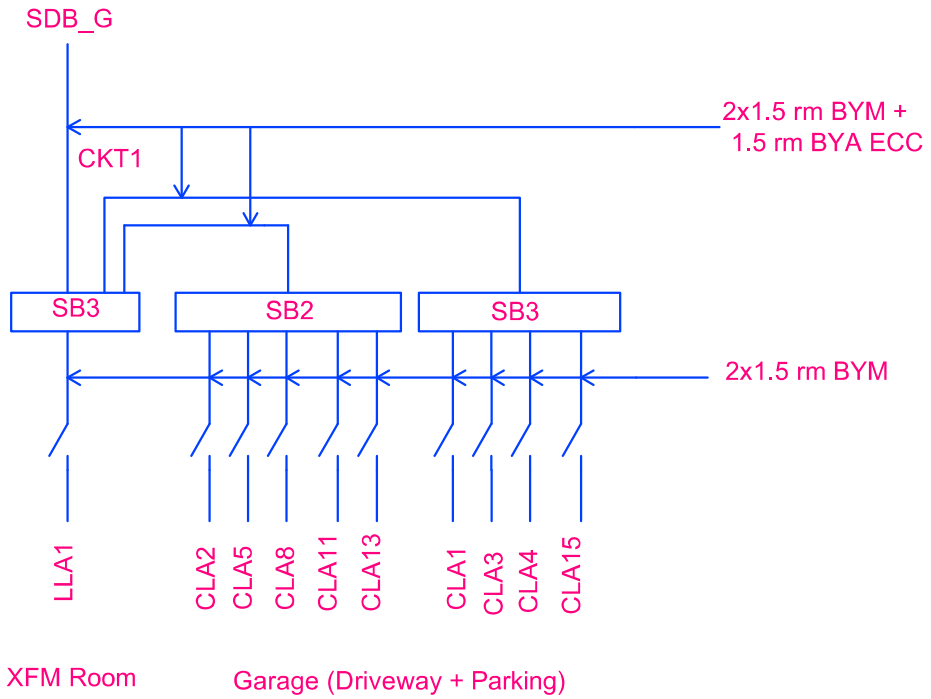
Emergency Switch Board Connection Diagram of Common Unit



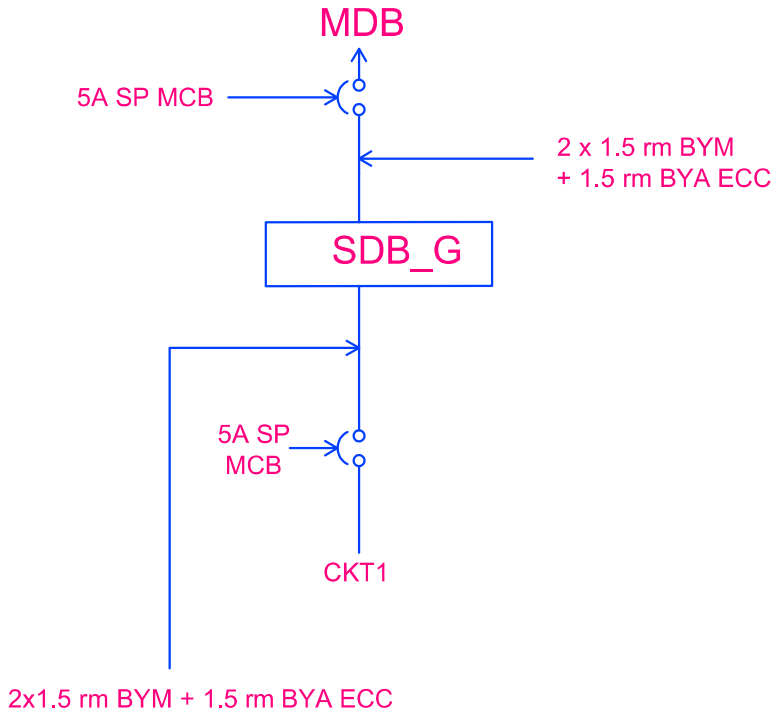
ESDB Connection Diagram for Common Unit



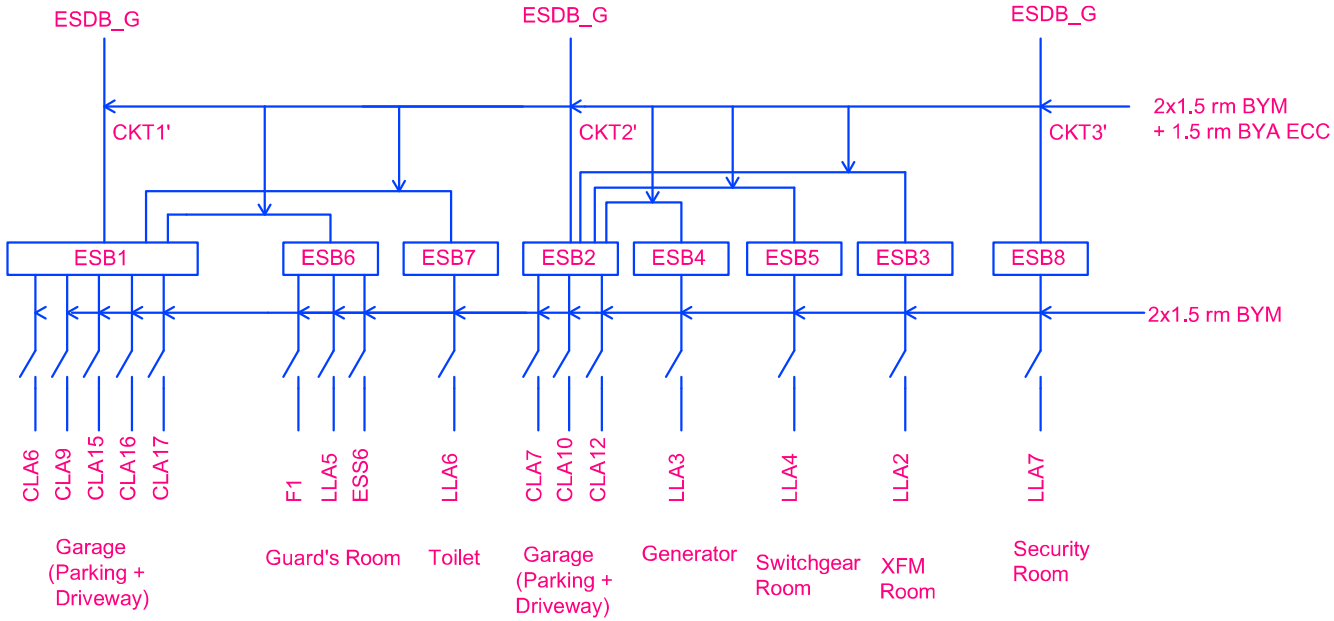
SB Connection Diagram of Ground



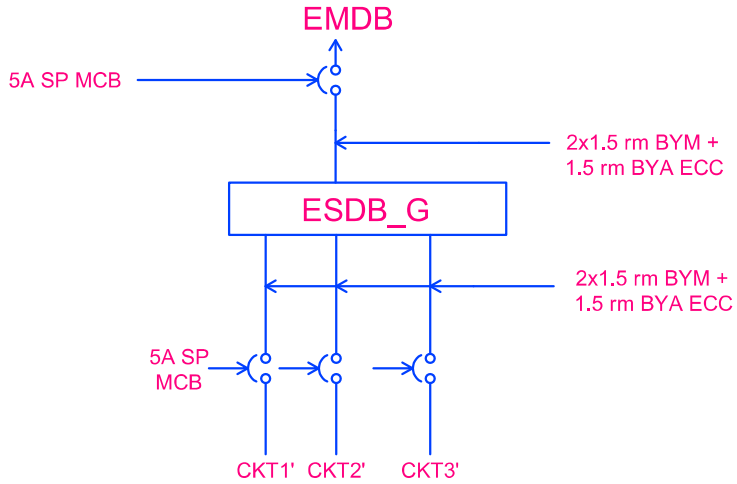
SDB Connection Diagram for Ground



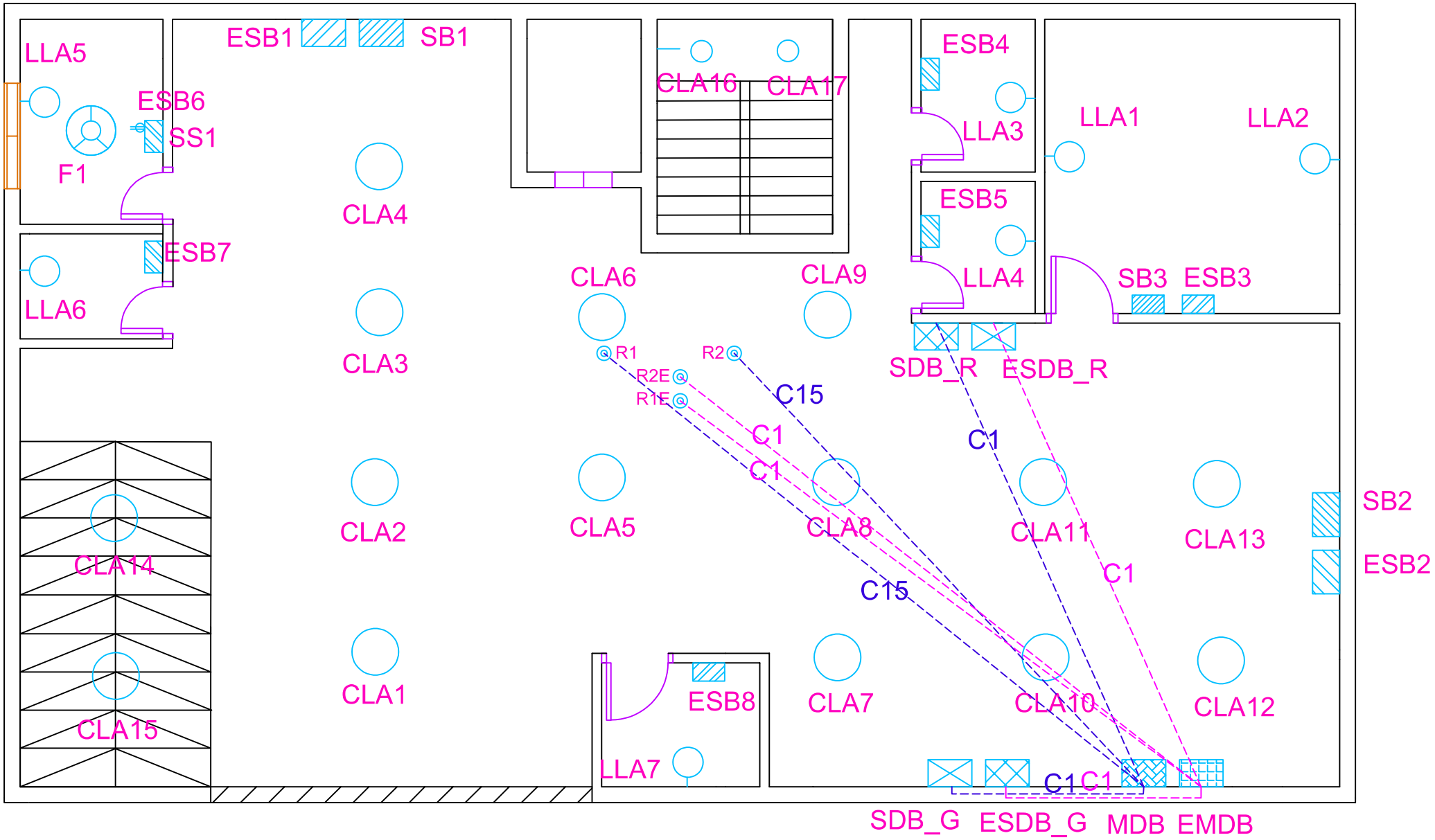
ESB Connection Diagram for Ground



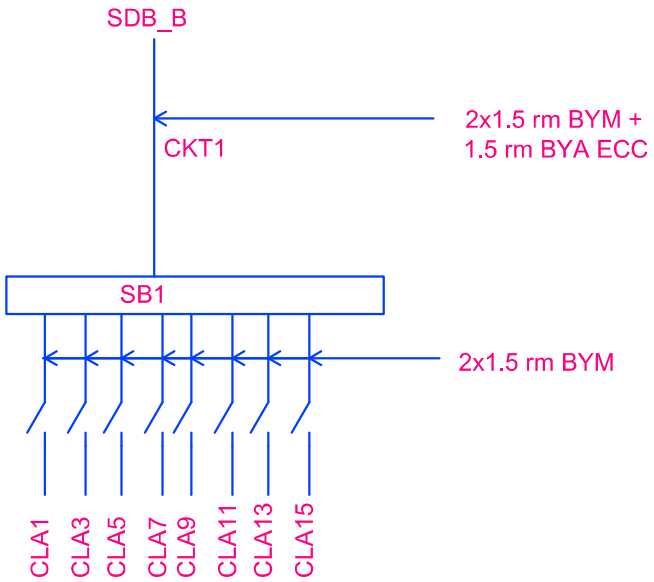
ESDB Connection Diagram for Ground



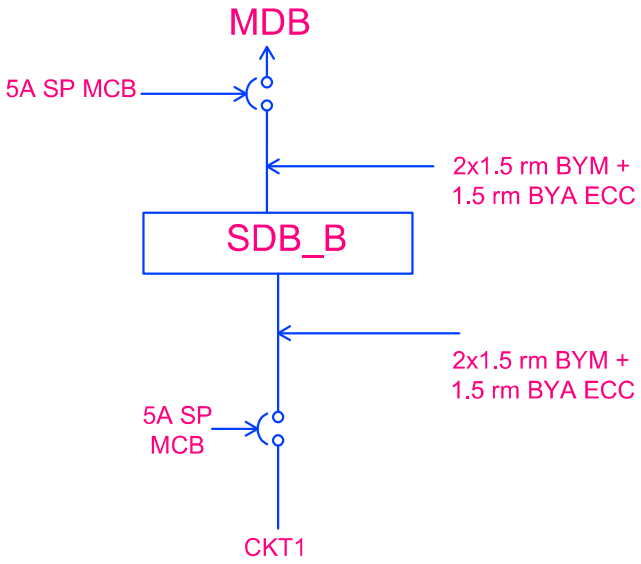
SDB/ESDB TO MDB/EMDB CONDUIT



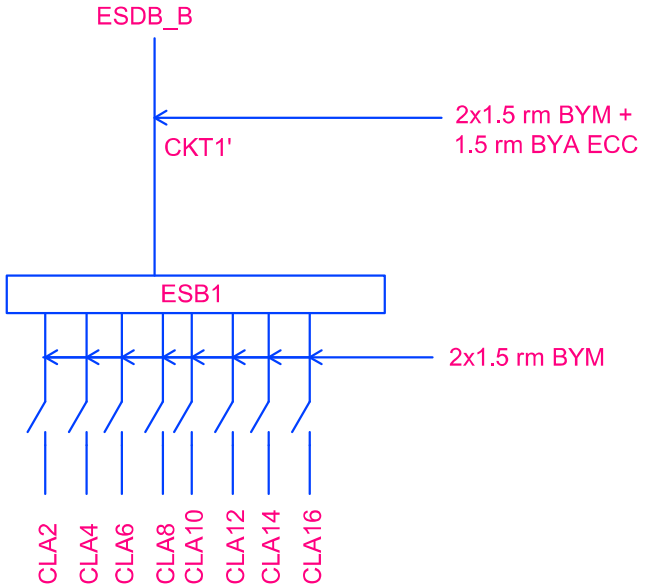
SB Connection Diagram of Basement



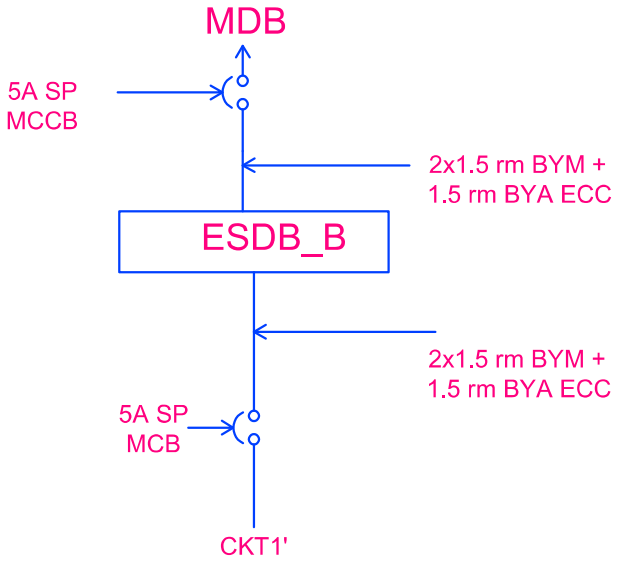
SDB Connection Diagram for Basement



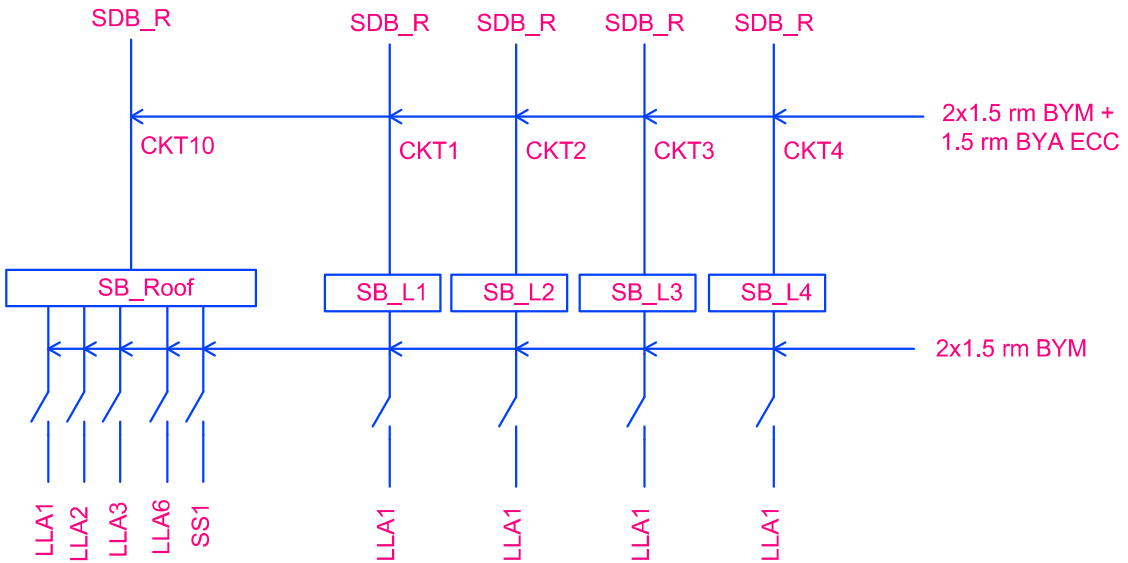
ESB Connection Diagram of Basement

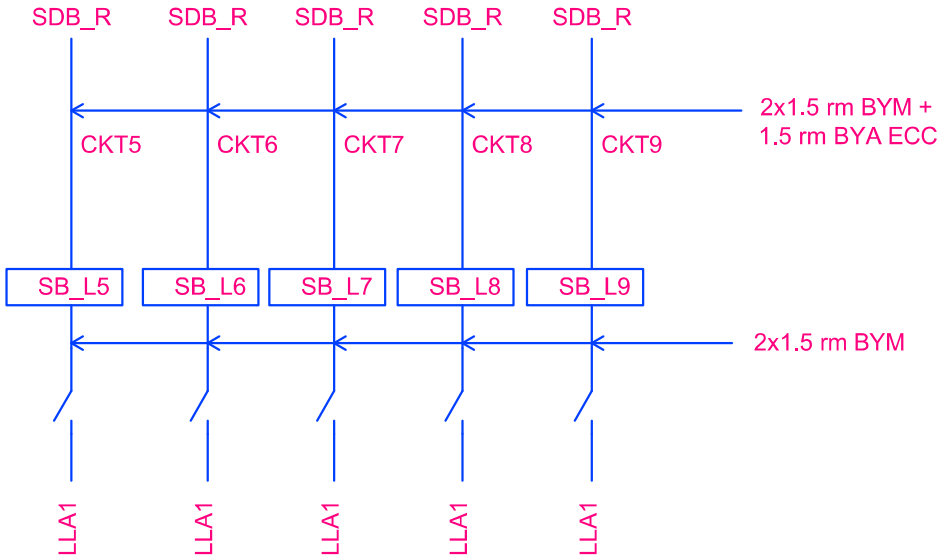


ESDB Connection Diagram for Basement

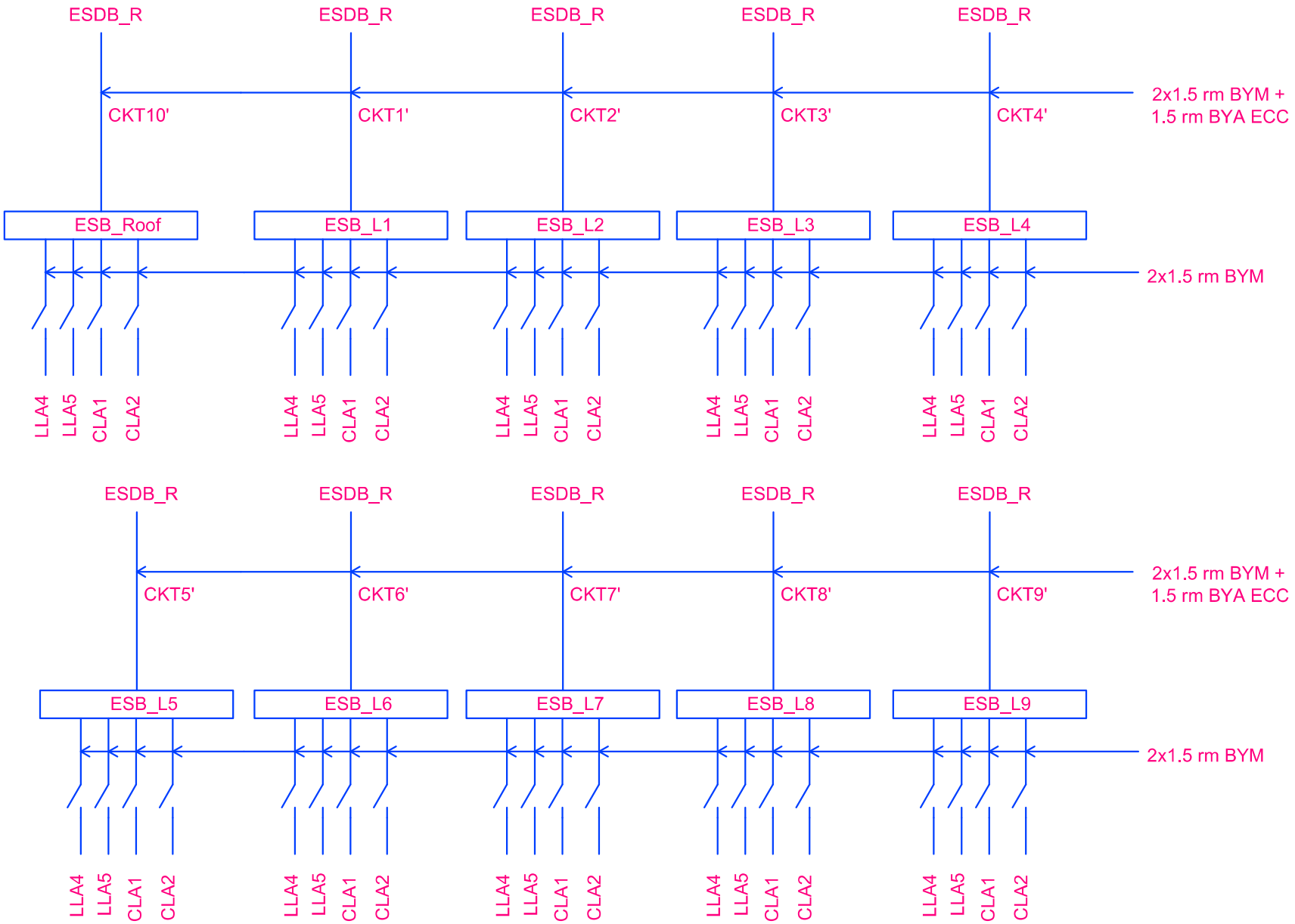


SB Connection Diagram of Roof, Lobby & Stairs

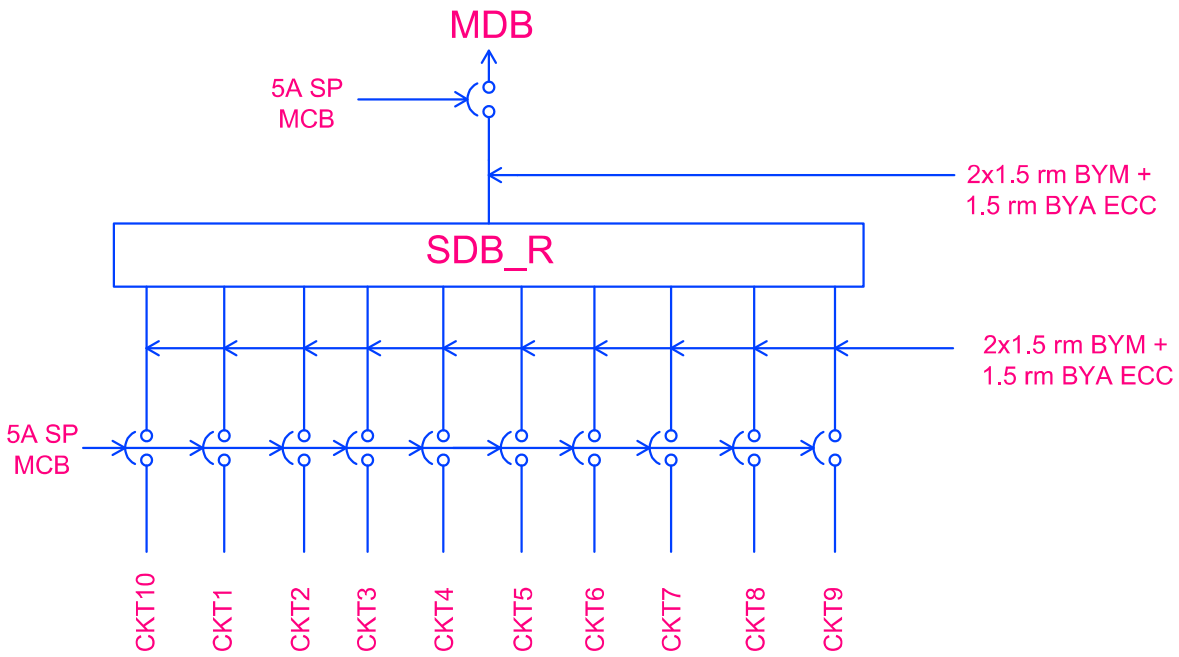




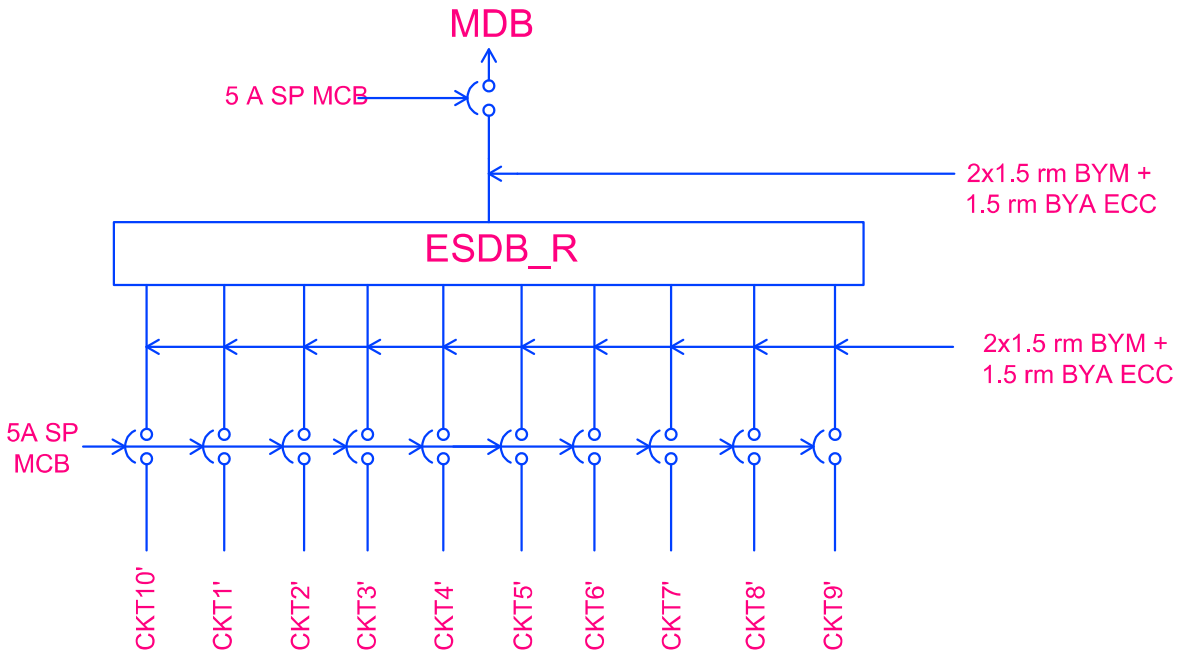
ESB Connection Diagram of Roof, Lobby & Stairs



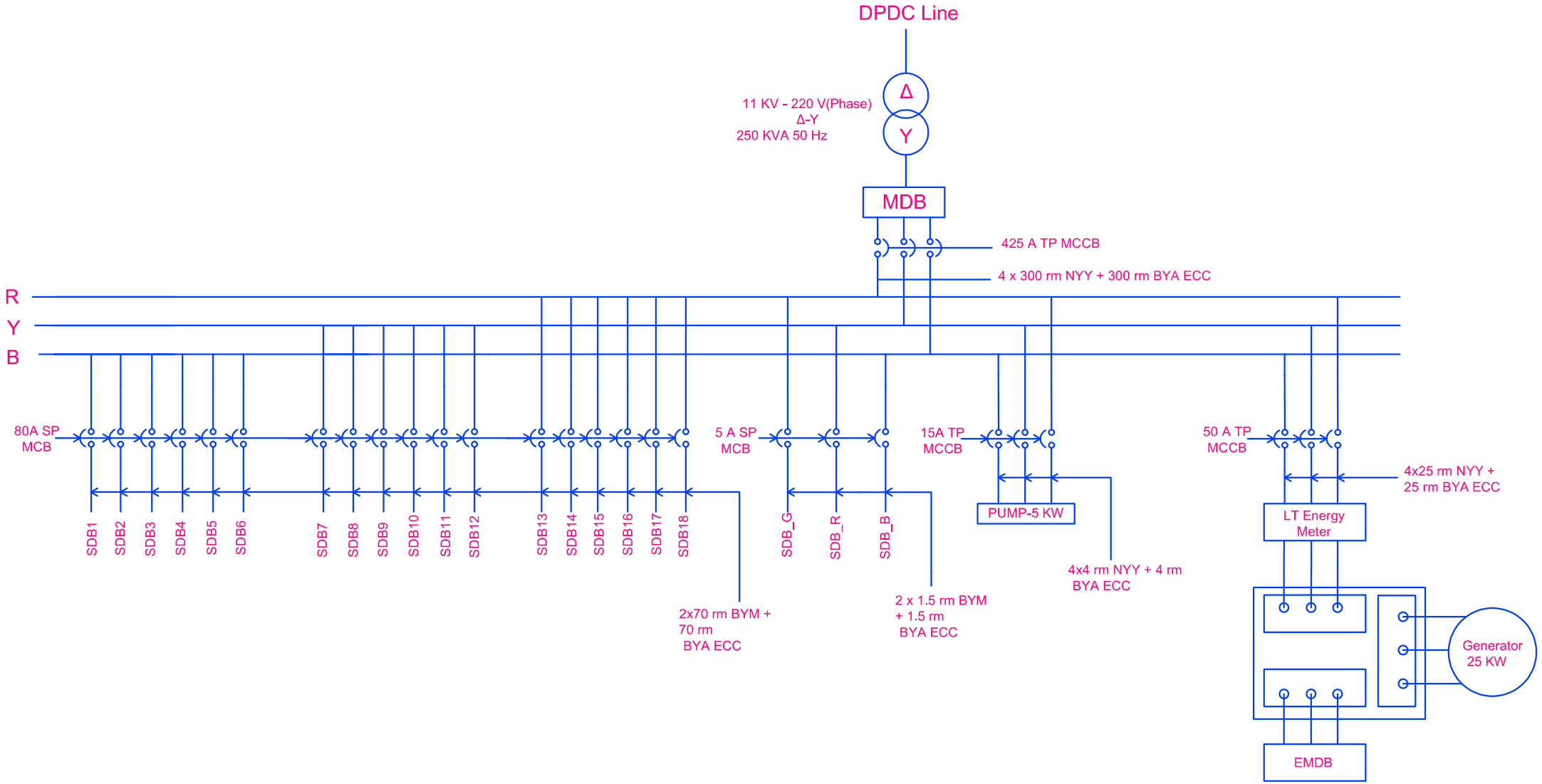
SDB Connection Diagram for Roof, Lobby & Stairs



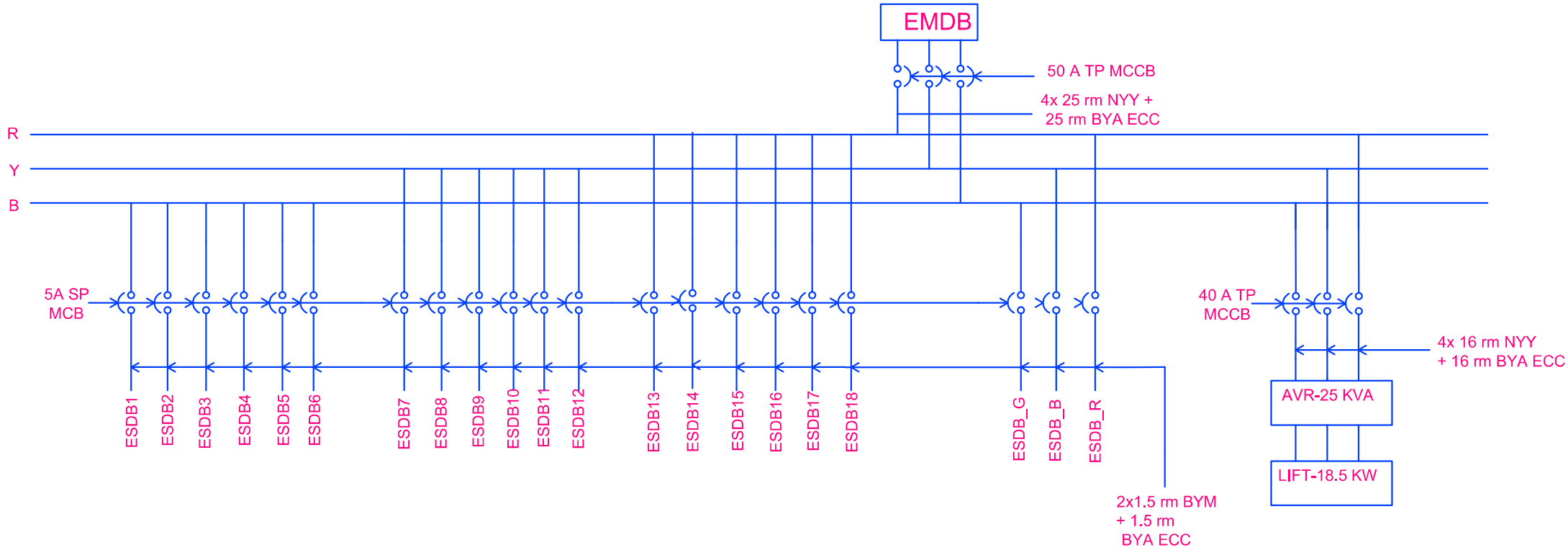
ESDB Connection Diagram for Roof, Lobby & Stairs



MDB Connection Diagram

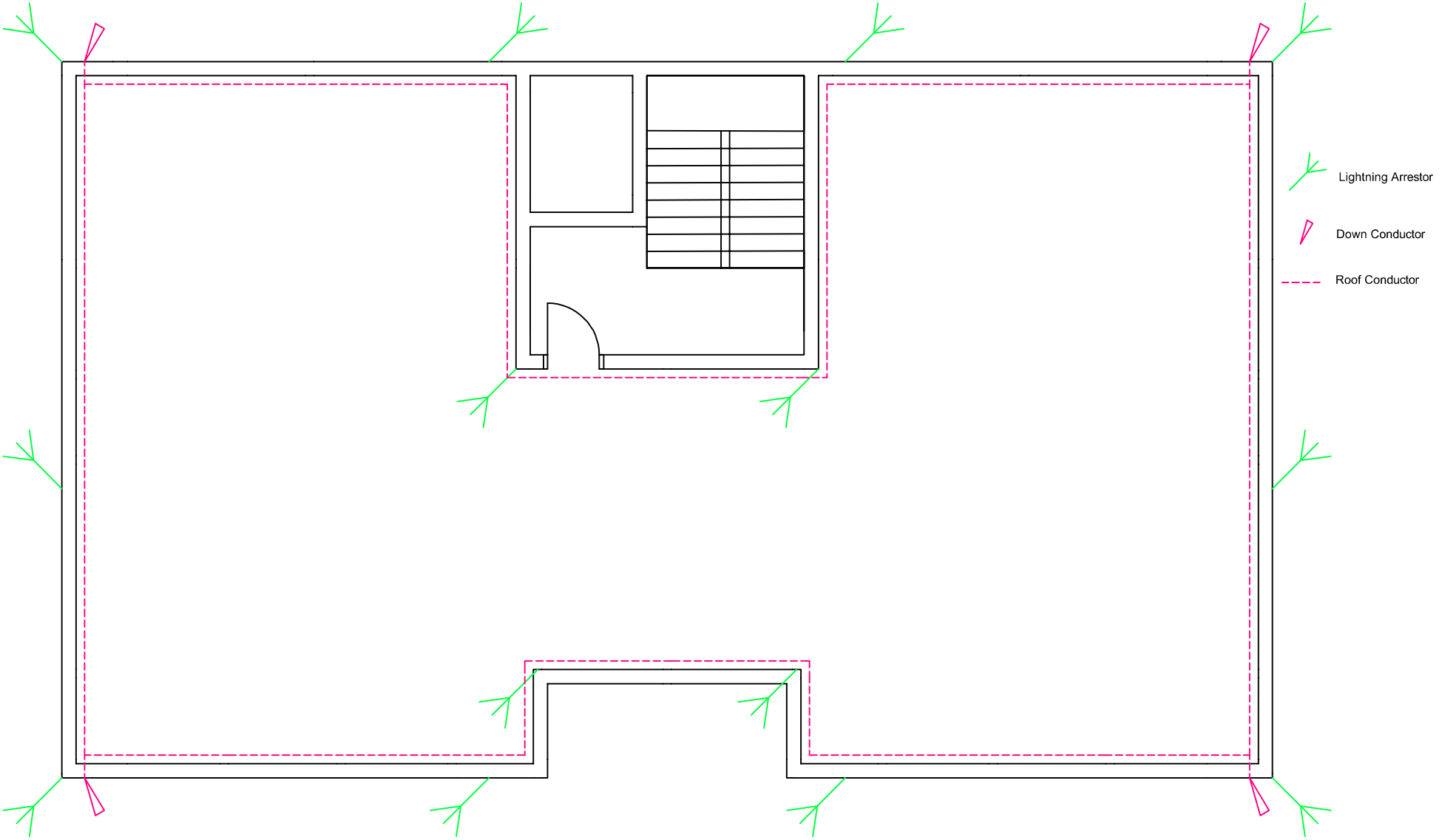


Emergency Main Distribution Board Connection Diagram



Roof Calculation	
Lightning Arrestor	
Rod Height (ft)	2
Roof length (ft)	70.88
Roof Width (ft)	41.92
Roof Perimeter (ft)	225.58
Arrestors are placed every 25 ft apart	
Arrestors along length	4
Arrestors along width	3
Down Conductor	
Total Area (sqft)	2395.56
Total Area (m^2)	222.55
1 conductor for first 80 m^2	
Total Down Condutors	$\frac{(222.55\text{-}80)}{100} = 3$
Roof Conductor	
Roof conductors are placed 6” away from the roof railing connecting all the lightning arrestors to the down conductors.	

ROOF LAYOUT (LIGHTENING PROTECTION SYSTEM)



Conclusion:

In conclusion, the culmination of this project report for the Electrical Services Design course represents a significant milestone in our academic journey. Through the application of AutoCAD software, we systematically designed the electrical layout for a 10-story residential building, addressing key components such as lighting, fan placement, and conduit calculations. This project provided invaluable hands-on experience, reinforcing theoretical concepts learned in class and enhancing our understanding of the practical implications of electrical engineering in building design. As we conclude this endeavor, we reflect on the importance of rigorous analysis, attention to detail, and collaborative effort in achieving successful project outcomes. These lessons will undoubtedly inform our future academic pursuits and professional endeavors in the field of engineering

Contributions:

Layout (Common Unit)	1906014
Fittings and Fixtures (Common Unit)	1906014
Conduit (Common Unit)	1906014
Layout (Ground)	1906027
Fittings and Fixtures (Ground)	1906027
Conduit (Ground)	1906014
Layout (Basement)	1906012
Fittings and Fixtures (Basement)	1906012
Conduit (Basement)	1906014
Layout (Roof)	1906018
Fittings and Fixtures (Roof)	1906018
Conduit (Roof)	1906018
Fittings and Fixtures Calculation	1906029
Power Calculation	1906029
Lightning Arrestor	1906029
Switch Board Diagram (Common Unit)	1906020
Switch Board Diagram (Ground)	1906020
Switch Board Diagram (Basement)	1906020
Switch Board Diagram (Roof)	1906020
Switch Board Diagram (MDB/EMDB)	1906020

References:

1. https://ssgeshop.com/shop/super-star-led-lux-eye-safe/
2. https://ssgeshop.com/shop/ac-led-20-watt-4ft-daylight-t-8-compact/
3. https://www.displayspecifications.com/en/model-power-consumption/78e8d13
4. https://vision.com.bd/fan/exhaust-fan/vision-exhaust-fan-8-en-2/

Table 8.1.5: Recommended Values of Illumination for Residential Buildings

Area or Activity	Illuminance (lux)	Area or Activity	Illuminance (lux)
Dwelling Houses		**Hotels**	
Bedrooms		Entrance halls	150
General	70	Reception and accounts	300
Bed-head, Dressing table	250	Dining rooms (tables)	150
Kitchens	200	Lounges	150
Dining rooms (tables)	150	Bedrooms	
Bathrooms		General	100
General	100	Dressing tables, bed heads, etc.	250
Shaving, make-up	300	Writing rooms (tables)	300
Stairs	100	Corridors	70
Lounges	100	Stairs	100
Garages & Porches	100	Laundries	200

Area or Activity	Illuminance (lux)	Area or Activity	Illuminance (lux)
Basement Car Park	100	Kitchens	
Porches, Entrances	70	Food stores	100
Sewing and darning	600	Working areas	250
Reading (casual)	150	Goods and passenger lifts	70
Home work and sustained reading	300	Cloak-rooms and toilets	100
		Bathrooms	100
		Above mirror in bathrooms	300

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Table for Cables, Conduits, ECC, EL, Voltage drop and Current ratings of different specifications as per Manual of Eastern Cables, BICC cables and Tables, Electrical Conductors (International Standard Sizes) etc. :

A	B	C	D	E	F		G	H	I		J	
					a'	b'			a"	b"	a"'	B"'
3/0.029	1.5	5	16	10	6	10		27	27	22	16	20
7/0.029	2.5	10	16	10	4	7		16	36	30	22	28
7/0.036	4	15	14	10	3	5	1	10	47	39	30	37
7/0.044	6	20	14	10	2	4	1	6.8	59	50	38	47
7/0.052	10	30	10	10	1	2	1.5	4	78	68	52	63
7/0.064	16	40	10	10		1	1.5	2.6	100	94	70	85
19/0.052	25	50	6	6		1	2	1.6	130	125	91	110
19/0.064	35	60	6	6			2	1.2	155	160	112	136
19/0.072	50	70	6	6			2	0.93	185	195	136	164
19/0.083	70	100	1/0	1/0			2	0.65	225	245	173	207
37/0.072	95	120	1/0	1/0			2.5	0.48	270	300	216	253
37/0.083	120	150	1/0	1/0			2.5	0.4	310	350	244	291
37/0.093	150	200	1/0	1/0			3	0.34	350	405		333
37/0.130	185	250	3/0	3/0			3.5	0.29	390	460		381
61/0.093	240	300	3/0	3/0			4	0.24	450	555		452
61/0.103	300	425	3/0	3/0			4	0.22	515	640		526
91/0.093	400	585	3/0	3/0			6	0.2	586	770		639
91/0.103	500	685	3/0	3/0			6	0.18	680	900		752
127/0.103	630	800	3/0	3/0			6	0.17	800	1030		855

A : Single core cable construction diameter, inch .... as per Imperial Standard Size :B .S .S (old).

B : Single core cable construction area, mm² .... as per Metric Standard Size : VDE.

C : CB designed current rating amps.

D : ECC (Earth Continuity Conductor), SWG.

E : EL (Earthing Lead), SWG

F : No. of cables in
- a') 3/4" diameter conduit
- b') 1" diameter conduit

G : GI pipe diameter (for 4 – core cable), inch.

H : Volt drop /amp/meter, Vd in mV (For PVC insulated, non-armoured single core cable 600/1000 volts as per BICC Metric Supplement, page 20-22, September 1969).

I : Maximum Current rating (For Type : NYY to VDE 0271/3, 69)
- a") 30° C ambient temperature, underground, amps
- b") 35° C ambient temperature in air, amps

J : Maximum current carrying capacity (For Type : BYA to B.S. 6004 : 1975)
- a"') Bunched & Enclosed in conduit, two cables single phase at 35° C, amps
- b"') Clipped to a surface or on a cable tray bunched and un-enclosed two cables single phase at 35° C, amps

NYY : PVC insulated and PVC sheathed cable, rated voltage 600/1000 volts.

BYA : PVC insulated non-sheathed single core cable, rated voltage 450/750 volts.

1.3.33 Lightning Protection of Buildings

Whether a building needs protection against lightning depends on the probability of a stroke and acceptable risk levels. Assessment of the risk and of the magnitude of the consequences needs to be made. As an aid to making a judgment, a set of indices is given in Table 8.1.27 below for the various factors involved.

Table 8.1.27 (a): Index Figures Associated with Lightning Protection Design

Index A: Use of Structure	Index	Index B: Type of Construction	Index
Houses and similar buildings	2	Steel framed encased with nonmetal roof[a]	1
Houses and similar buildings with outside aerial	4	Reinforced concrete with nonmetal roof	2
Small and medium size factories, workshops and laboratories	6	Brick, plain concrete, or masonry with nonmetal roof	4
Big industrial plants, telephone exchanges, office blocks, hotels, blocks of flats	7	Steel framed encased or reinforced concrete with metal roof	5
Places of assembly, for example, places of workshop, halls, theatres, museums, exhibitions, department stores, post offices, stations, airports, stadiums	8	Timber formed or clad with any roof other than metal or thatch	7
Schools, hospitals, children's homes and other such structures	10	Any building with a thatched roof	10

[a] A structure of exposed metal which is continuous down to ground level is excluded from the table as it requires no lightning protection beyond adequate earthing arrangements.

Table 8.1.27 (b): Index Figures Associated with Lightning Protection Design

Index C : Contents or Consequential Effects	Index	Index D : Degree of Isolation	Index
Ordinary domestic or office building, factories and workshops not containing valuable materials	2	Structure located in a large area having structures or trees of similar or greater height, e.g. a large town or forest	2
Industrial and agricultural buildings with specially susceptible [b] contents	5	Structure located in an area with a few other structures or trees of similar height	5
Power stations, gas works, telephone exchanges, radio stations	6	Structure completely isolated or exceeding at least twice the height of surrounding structures or trees	10
Industrial key plants, ancient monuments, historic buildings, museums, art galleries	8	**Index E : Type of Terrain**	**Index**
Schools, hospitals, children's and other homes, places of assembly	10	Flat terrain at any level	2
[b] This means specially valuable plant or materials vulnerable to fire or the results of fire.		Hilly terrain	6
		Mountainous terrain 300 m and above	8

Table 8.1.27 (c) : Index Figures Associated with Lightning Protection Design

Index F : Height of Structure	Index	Index G : Lightning Prevalence	Index
Up to 9 m	2	Number of thunderstorm days per year:	
9-15 m	4	Up to 3	2
15-18 m	5	4-6	5
18-24 m	8	7-9	8
24-30 m	11	10-12	11
30-38 m	16	13-15	14
38-46 m	22	16-18	17
46-53 m [c]	30	19-21	20
[c] Structures higher than 53 m require protection in all cases		Over 21	21