Objectives

The objective of this project is-

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

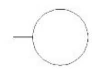
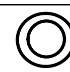
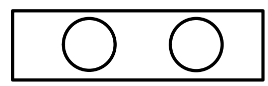
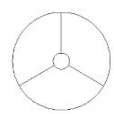
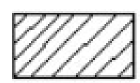
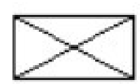
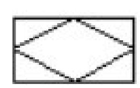
The project was carried out according to the following design steps:

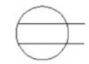
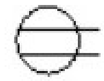
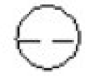
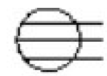
1. Ground floor and typical floor plan of a three-storey building
2. Fittings and fixtures for each floor
3. Conduit layout planning for each floor
4. Switchboard and distribution board diagram
5. Lightening protection system (LPS) design

Fittings and Fixtures

Fixture Legends

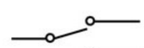
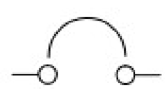
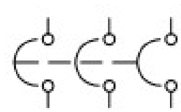
The types of different fixtures used along with their placement and symbol are presented below:

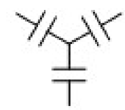
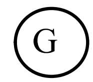
Description	Height	Caption	Symbol
Wall Mounted Light	Lintel	LL	
Ceiling Light	Ceiling	CL	
Wall Mounted Tube Light	Lintel	TL	
Ceiling Mounted Tube Light	Ceiling		
Fan (56” diameter)	Ceiling	F	
Switch Board	Mid wall	SB	
Sub Distribution Board	Mid wall	SDB	
Main Distribution Board	Mid wall	MDB	
Exhaust 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	E
SPDT Two Way Switch for Automatic Transfer	
Fan Regulator	R
Single Pole Circuit Breaker (SP MCCB)	
Triple Pole Circuit Breaker (TP MCCB)	

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

Theory

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 to be deteriorated due to dust, aging etc.

<u>Calculation of Utilization Factor:</u>

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

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

Where,

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]:

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

Calculation

Master bedroom

L = 12’ 1” = 3.683 meters
W = 11’ 2” = 3.4036 meters
Room index = 0.9672 (taken as 1)
UF (from table for C=0.7, W = 0.5, F = 0.2) = 0.61

MF = 0.8

E = 70 lux

F = 1250 lumen (wall light, ceiling light and fluorescent tube-light)

Then, number of lights,

$$N = \frac{E * L * W}{F * UF * MF} = \frac{70 * 3.683 * 3.4036}{1250 * 0.61 * 0.8} = 1.438$$

So, the number of lights is taken as 2.

Number of fans,

$$M = \frac{L(in\,ft) * W(in\,ft)}{100} = \frac{(12.0833) * (11.1667)}{100} = 1.349$$

So, the number of fans is taken as 1.
Summary of number of required lights and fans for all the bed-rooms and kitchen are provided below:

Room	**E (lux)**	**Height (ft)**	**Width (ft)**	**Area (m^2)**	**Index**	**UF**	**N**	**M**
M. Bedroom	70	12’1”	11’2”	12.5	0.97	0.61	1.43 (2)	1.34 (1)

Bedroom	70	12’1”	10’2”	11.4	0.92	0.61	1.3 (2)	1.22 (1)
G. Bedroom	70	11’2”	10’7”	11.0	0.91	0.61	1.26 (2)	1.18 (1)
Kitchen	200	9’6”	7’4”	6.5	0.69	0.61	2.12 (2)	0.70 (1)

*The number inside the brackets () in the N and M column represent the actual number of lights and fans respectively.

Dining Room

L = 29’ 1” = 8.8646 meters
W = 10’ 2” = 3.0988 meters
Room index = 1.26 (taken as 1.25)
UF (from table for C=0.7, W = 0.5, F = 0.2) = 0.65

MF = 0.8

E = 100 lux

F = 1250 lumen (wall light and fluorescent tubelight)

Then, number of lights,

$$N = \frac{E * L * W}{F * UF * MF} = \frac{100 * 8.8646 * 3.0988}{1250 * 0.65 * 0.8} = 4.226$$

So, the number of lights is taken as 4.

Number of fans,

$$M = \frac{L(in\ ft) * W(in\ ft)}{100} = \frac{(29.08333) * (10.1667)}{100} = 2.956$$

So, the number of fans is taken as 2 because there is a lot of empty space close to the entrance gate where no fan is required.

Living Room

L = 13’ 6” = 4.114 meters
W = 12’ 11” = 3.937 meters
Room index = 1.1 (taken as 1)
UF (from table for C=0.7, W = 0.5, F = 0.2) = 0.61

MF = 0.8

E = 70 lux

F = 1250 lumen (fluorescent tubelight)

Then, number of lights,

$$N = \frac{E * L * W}{F * UF * MF} = \frac{70 * 4.114 * 3.937}{1250 * 0.61 * 0.8} = 1.858$$

So, the number of lights is taken as 2.

Number of fans,

$$M = \frac{L(in\ ft) * W(in\ ft)}{100} = \frac{(13.5) * (12.916)}{100} = 1.74$$

So, the number of fans is taken as 2.

Veranda Attached to Living Room

L = 11’ 10” = 3.6068 meters
W = 3’ 10” = 1.1684 meters
Room index = .746 (taken as 1)
UF (from table for C=0.7, W = 0.5, F = 0.2) = 0.61

MF = 0.8

E = 50 lux

F = 1250 lumen (ceiling light)

Then, number of lights,

$$N = \frac{E * L * W}{F * UF * MF} = \frac{50 * 3.6068 * 1.1684}{1250 * 0.61 * 0.8} = 0.345$$

So, the number of lights is taken as 1. There is no need of fans in the veranda. Similar procedure has been followed for all the remaining verandas and the results are summarized below:

Veranda Attachment	**E (lux)**	**Height (ft)**	**Width (ft)**	**Area (m^2)**	**Index**	**UF**	**N**
Living Room	50	11’10”	3’10”	4.214	1	0.61	0.345 (1)
Dining Space	50	10’2”	3’4”	3.117	1	0.61	.255 (1)
Kitchen	50	4’	5’2”	1.901	1	0.61	.155 (1)
Master Bedroom	50	4’11”	4’10”	2.186	1	0.61	.179 (1)

Bathroom attached to master bedroom

L = 7’ 10” = 2.387 meters

W = 5’ 10” = 1.777 meters

Room index = .861 (taken as 1)

UF (from table for C=0.7, W = 0.5, F = 0.2) = 0.61

MF = 0.8

E = 50 lux

F = 1250 lumen (ceiling light)

Then, number of lights,

$$N = \frac{E * L * W}{F * UF * MF} = \frac{50 * 2.387 * 1.777}{1250 * 0.61 * 0.8} = 0.347$$

So, the number of lights is taken as 1. There is no need of fans in the bathroom. Similar procedure has been followed for all the remaining bathrooms and the results are summarized below:

Bathroom Attachment	**E (lux)**	**Height (ft)**	**Width (ft)**	**Area (m^2)**	**Index**	**UF**	**N**
Master Bedroom	50	7’10”	5’10”	4.241	1	0.61	0.347 (1)
Bedroom	50	7’10”	4’7”	3.334	1	0.61	.273 (1)
Guest Bedroom	50	7’3”	5’2”	3.478	1	0.61	.285 (1)
Common	50	8’2”	5’	3.793	1	0.61	.310 (1)

Garage

Area = 1073 square feet = 99.7 square meter
Room index = 1
UF = 0.61

MF = 0.9

E = 100 lux

F = 2500 lumen (ceiling mounted tubelights)

Then, number of lights,

$$N = \frac{E * Area}{F * UF * MF} = \frac{100 * 99.7}{1250 * 0.61 * 0.9} = 14.52$$

So, the number of ceiling mounted tube lights is taken as 14. If we use 2 lights per luminaire, then we will need 7 such luminaires. There is no need of fans in the garage.

Store Room

L = 5’ 2” = 1.574 meters
W = 3’ = 0.914 meters
Room index = .489 (taken as 1)
UF (from table for C=0.7, W = 0.5, F = 0.2) = 0.61

MF = 0.8

E = 50 lux

F = 1250 lumen (ceiling light)

Then, number of lights,

$$N = \frac{E * L * W}{F * UF * MF} = \frac{50 * 1.574 * 0.914}{1250 * 0.61 * 0.8} = 0.120$$

So, the number of lights is taken as 1. There is no need of fans in the store room.

Generator Room

L = 5’ = 1.524 meters
W = 2’ 5” = 0.736 meters
Room index = .419 (taken as 1)
UF (from table for C=0.7, W = 0.5, F = 0.2) = 0.61

MF = 0.8

E = 50 lux

F = 1250 lumen (ceiling light)

Then, number of lights,

$$N = \frac{E * L * W}{F * UF * MF} = \frac{50 * 1.524 * 0.736}{1250 * 0.61 * 0.8} = 0.091$$

So, the number of lights is taken as 1. There is no need for fans in the generator room.

Guard Room

L = 9’ 6” = 2.895 meters
W = 8’ 2” = 2.489 meters
Room index = 1.126 (taken as 1)
UF (from table for C=0.7, W = 0.5, F = 0.2) = 0.61

MF = 0.8

E = 50 lux

F = 1250 lumen (ceiling light)

Then, number of lights,

$$N = \frac{E * L * W}{F * UF * MF} = \frac{70 * 2.895 * 2.489}{1250 * 0.61 * 0.8} = 0.826$$

So, the number of lights is taken as 1.

Number of fans,

$$M = \frac{L(in\,ft) * W(in\,ft)}{100} = \frac{(9.5) * (8.166)}{100} = 0.775$$

So, the number of fans is taken as 1.

Conduit

The different types of conduits used in the layout along with their ratings and geometry[2] are summarized below:

Symbol	Wire Rating (single core)-mm^2	Current Rating (ampere)	GI Pipe Diameter (inch)
C1	2x1.5	5A	¾
C2	4x1.5	5A	¾
C3	6x1.5	5A	¾
C4	8x1.5	5A	¾
C5	10x1.5	5A	1
C6	12x1.5	5A	1
C7	14x1.5	5A	1
C8	2x4+4 ECC	15A	1
C9	2x6+6 ECC	20A	1

C1-C9 cables are BYA cables (PVC insulated non-sheathed single core cable)
Transformer to main bus bar and generator to generator bus bar cables are NYY cables (PVC insulated PVC sheathed cable)

Switchboard

Example calculation for SDB-1

Dining room is under the sub distribution board as CKT-7. There are two switchboards in dining room, SB7 draws connection from the SDB, and SB6 draws connection from SB7.

For SB6 the power and current requirements are:
LL9 (lintel level light) = 20 watts → 20W/220V = 0.09A
CL1 (ceiling level light) = 20 watts → 20W/220V = 0.09A
F4 (ceiling fan) = 80 watts → 80W/220V = 0.36A
SS2 (2 pin socket without earth conductor) = 5A
Total current requirement for SB6 = (5+0.09+0.09+0.36) = 5.54A
Wire from SB7 to SB6 has to be rated higher than 5A, we use C8 wire here (2x4rm, 4rm ECC, 15A conduction capacity)

For SB7, the power requirements are:
SB6 → 5.54A
LL10 (lintel level light) = 20W → 20W/220V = 0.09A
Total SB7 incoming current = (5.54 + 0.09) = 5.63A
Wire from SDB1 to SB7 has to be rated higher than 5A, we use C8 wire here (2x4rm, 4rm ECC, 15A conduction capacity)
Required circuit breaker for CKT-4 (Dining room) = 10A SP MCCB (single pole mold case circuit breaker)

Switch Board Summary

Sub distribution board (SDB)-1 Fixtures							
Room Name	Circuit No	Switchboard	Fixture	Power (W)	Current Rating	Wire Rating	Breaker to SDB
			LL1(Light)	20	0.09		
			LL6(Light)	20	0.09		
M. Bedroom	CKT1	SB2	Total		0.18	C1	5A
			LL3(Light)	20	0.09		
			LL7(Light)	20	0.09		
			SS2(2 pin socket)		5		
Bedroom	CKT2	SB4	Total		5.18	C8	10A
			LL4(Light)	20	0.09		
			F3(Fan)	80	0.36		
			TL3(Light)	20	0.09		
			SS3(2 pin socket)		5		
Kitchen	CKT3	SB5	Total		5.54	C8	10A
			LL9(Light)	20	0.09		
			CL1(Light)	20	0.09		
			F4(Fan)	80	0.36		
		SB6	SS4(2 pin socket)		5		
		SB7	LL10(Light)	20	0.09		
Dining	CKT4		Total		5.63	C8	10A
			CL2(Light)	20	0.09		
			SS6(2 pin socket)		5		
G. Bedroom	CKT5	SB8	Total		5.09	C8	10A
			TS1(TV socket)		5		
			TL8(Light)	20	0.09		
			CL3(Light)	20	0.09		
			F8(Fan)	80	0.36		
Living Room	CKT6	SB9	Total		5.54	C8	10A

Sub distribution board (SDB)-1 Power Circuits			
Room Name	Power Socket	Current Rating (A)	Wire Rating
M. Bedroom	S1	20	C9
Bedroom	S2	20	C9
Kitchen	S3	15	C8
Dining	S4	15	C8
G. Bedroom	S5	20	C9
Living Room	S6	20	C9

Sub distribution board (SDB)-0 Power Circuits			
Room Name	Power Socket	Current Rating (A)	Wire Rating
Guard Room	S1	15	C8
Water Pump	S2	20	C9

Emergency sub distribution board (ESDB)-1 Fixtures							
Room Name	Circuit No	Switchboard	Fixture	Power Rating	Current Rating	Wire Rating	Breaker to ESDB
M. Bedroom	CKT1	SB2	LL2(Light)	20	0.09	C8	10A
			F1(Fan)	80	0.36		
			TL1(Light)	20	0.09		
			SS1(2 pin socket)		5		
			Total		5.54		
Bedroom	CKT2	SB4	TL2(Light)	20	0.09	C1	5A
			F2(Fan)	80	0.36		
			Total		0.45		
Kitchen	CKT3	SB5	LL5(Light)	20	0.09	C1	5A
			E1(Exhaust Fan)	40	0.18		
			LL8(Light)	20	0.09		
			Total		0.36		
Dining	CKT4	SB6	LL11(Light)	20	0.09	C8	10A
		SB7	TL4(Light)	20	0.09		
			TL5(Light)	20	0.09		
			F5(Fan)	80	0.36		
			SS5(2 pin socket)		5		
			Total		5.63		
G. Bedroom	CKT5	SB8	TL6(Light)	20	0.09	C1	5A
			F6(Fan)	80	0.36		
			Total		0.45		
Living Room	CKT6	SB9	TL7(Light)	20	0.09	C8	10A
			F7(Fan)	80	0.36		
			SS7(2 pin socket)		5		
			Total		5.45		

Emergency sub distribution board (ESDB)-0 Fixtures							
Room Name	Circuit No	Switchboard	Fixture	Power Rating	Current Rating	Wire Rating	Breaker to ESDB
Guard Room	CKT1	SB1	TL1(Light)	20	0.09	C8	10A
			F1(Fan)	80	0.36		
			SS1(2 pin socket)		5		
		SB2	LL1(Light)	20	0.09		
			Total		5.54		
Garage	CKT2	SB3	CL4(light)	20	0.09	C8	10A
			CL5(light)	20	0.09		
			CL6(light)	20	0.09		
			CL7(light)	20	0.09		
			CL8(light)	20	0.09		
			CL9(light)	20	0.09		
			CL10(light)	20	0.09		
			SS2(2 pin socket)		5		
			Total		5.63		
Gen. Room	CKT3	SB5	CL3(light)	20	0.09	C1	5A
Stairs	CKT4	SB4 (ground floor)	CL1(light)	20	0.09	C1	5A
			CL2(light)	20	0.09		
		SB6 (1st floor)	CL1(light)	20	0.09		
			CL2(light)	20	0.09		
		SB7 (2nd floor)	CL1(light)	20	0.09		
			CL2(light)	20	0.09		
			Total		0.54		

Sub-Distribution Board Calculations

Sub-distribution board 1

Total current rating in fixtures = (CKT1 + CKT2 + CKT3 + CKT4 + CKT5 + CKT6) = (0.18 + 5.18 + 5.54 + 5.63 + 5.09 + 5.54) A = 27.16 A

Total current rating in power circuits = (S1 + S2 + S3 + S4 + S5 + S6) = (20 + 20 + 15 + 15 + 20 + 20) = 110 A

Activity factor for fixtures = 0.8

Activity factor for power circuits = 0.4

Total current rating for SDB-1 to MDB = (0.8x27.16 + 0.4x110) = 65.728A

Thus, breaker rating for SDB-1 = 70A SP MCCB

Wire rating for SDB-1 = 2x50rm BYA + 25rm BYA ECC

Sub-distribution board 0

Total current rating in power circuits = (S1 + S2) = (15+20) A = 35A

Without adding activity factor to SDB0 in case of peak load,

Breaker rating for SDB-0 = 40A SP MCCB

Wire rating for SDB-0 = 2x16rm BYA + 10rm BYA ECC

Emergency Sub-distribution board 1

Total current rating in fixtures = (CKT1 + CKT2 + CKT3 + CKT4 + CKT5 + CKT6) = (5.54 + 0.45 + 0.36 + 5.63 + 0.45 + 5.45) A = 17.88A

Activity factor for fixtures = 0.8

Total current rating for ESDB-1 = 0.8x17.88 = 14.3A

Breaker rating for ESDB-1 = 15A; ATS rating for ESDB-1 = 15A

Wire rating for ESDB-1 = 2x4rm BYA + 4rm BYA ECC

Emergency Sub-distribution board 0

Total current rating in fixtures = (CKT1 + CKT2 + CKT3 + CKT4) = (5.54 + 5.63 + 0.09 + 0.54) A = 11.8A

Activity factor for fixtures = 0.8

Total current rating for ESDB-0 = 0.8x11.8A = 9.44A

Breaker rating for ESDB-0 = 10A MCCB

ATS rating for ESDB-0 = 10A

Wire rating for ESDB-0 = 2x4rm BYA + 4rm BYA ECC

Main and Emergency Distribution Board Calculations

Main bus bar

Total number of sub-distribution boards = 6

Sub-distribution boards per phase of MDB bus-bar = 2

Total maximum current rating for phase R/Y/B from main lines = 2x65.73A = 131.46A

Total maximum current rating for phase R/Y/B from gen. lines = 2x14.3A = 28.6A

Total current from main bus bar to phase = 131.46A + 28.6A = 160.06A

Thus, triple phase breaker rating for transformer to main bus bar = 200A TP MCCB

Line rating from transformer to main bus bar = 4x150rm NYY + 70rm NYY ECC

Power meter line

Current supply to SDB1 = 65.73A

Current supply to ESDB1 = 14.3A

Total current for each standard unit = 80.03A

Wire rating from power meter to bus bar = 2x70rm BYA + 25rm BYA ECC

Generator bus bar

Total number of sub-distribution boards = 6

Sub-distribution boards per phase of MDB bus-bar = 2

Total maximum current rating for phase R/Y/B from gen. lines = 2x14.3A = 28.6A

Thus, triple phase breaker rating for generator to gen. bus bar = 30A TP MCCB

Line rating from transformer to main bus bar = 4x10rm NYY + 4rm NYY ECC

NYY – PVC insulation with PVC sheathing, underground cable.

Transformer, PFI Plant and Generator Calculations

Transformer

Total current from main bus bar to phase = 131.46A + 28.6A = 160.06A

Worst case power factor = 0.9

KVA rating of DPDC to main bus bar 3-phase transformer,

$$Transformer\ Rating = \frac{3 * phase\ voltage * line\ current}{pf}$$

$$= \frac{3 * 220 * 160.06}{0.9} = 117.377\ kVA \sim 120\ kVA$$

Since transformer rating < 200kVA, separate substation is not required.

PFI Plant

For improving PFI from worst case 0.9 to 0.95

Total real power draw, P = 3x220 volts x160.06 Amps = 105.639 kW

Worst case reactive power for 0.9 pf,

$$Q_{worst} = P\sqrt{\left(\frac{1}{0.9}\right)^2 - 1} = 51.163\ kVAR$$

Best case reactive power for 0.95 pf,

$$Q_{best} = P\sqrt{\left(\frac{1}{0.95}\right)^2 - 1} = 34.721\ kVAR$$

PFI plant rating = $Q_{worst} - Q_{best}$ = 16.442 kVAR ~ 20kVAR

Generator

Total current to generator bus bar per phase = 28.6A
Worst case power factor = 0.9
KVA rating of 3-phase generator,

$$Generator\ Rating = \frac{3 * phase\ voltage * line\ current}{pf}$$

$$= \frac{3 * 220 * 28.6}{0.9} = 20.973 \sim 20\ kVA$$

Lightning Protection System

Risk Assessment [3]

Index	Parameter	Class	Value
A	Use of Structure	Houses and similar buildings	2
B	Type of Construction	Brick, plain concrete or masonry with nonmetal roof	4
C	Contents of Consequential Effects	Ordinary domestic of office building, factories and workshops not containing valuable materials	2
D	Degree of Isolation	Located in a large area having structures of similar or greater height	2
E	Type of Terrain	Flat terrain at any level	2
F	Height of Structure	9-15m	4
G	Lightning Prevalence	Over 21	21
Total			37

Recommendation: Risk assessment factor < 40, lightning protection system is not mandatory but can be used for increased safety.

LPS Design Parameters

Lightning Arrestor

Rod Height = 2m

Roof perimeter = 2x(67’1” + 48’11”) = 232’

We place arrestors 25’ apart, requiring 4 arrestors along the length of the roof perimeter, 3 arrestors along the width, and 4 on the corners of the stair-room.

Down conductor:

Total Area = 3281.5 sq ft = 304.861 sq m

Number of down conductors- 1 conductor for first 80msqr

(304.861-80)/100 = 2.25 ~ 3 extra conductors

Thus we use total of 4 down conductors as well as ground electrodes.

Earth termination resistance of ground electrodes – less than 10 ohms

Roof Conductors

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

Conclusion

In this project, we have performed the designing of a three-storey building floor plan along with the electrical fixtures and conduit layout. Then, we have designed the switchboard connection diagram showing how the incoming electric power is distributed throughout the residential building. Along with the general connectivity, different wire schedules and protection equipment such as circuit breakers have been shown in the single line diagrams. To protect the building from electrical surges caused by lightning strike, we have planned the necessary lightning protection system. Thus, we have gained a hands-on experience on the electrical service design of a residential building.

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References

[1] BNBC Table 8.1.5 (Recommended Values of Illumination for Residential Buildings

[2] 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)

[3] BNBC Table 8.1.27 (Index Figures Associated with Lightning Protection Design)

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
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