



DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

**PROJECT-01:**

**Electrical Service Design for 500sq ft Studio Apartment**

**Submitted By :**

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**Abstract :**

This report contains electrical service design plan of a studio apartment(500sq ft), which includes floor plan, fittings and fixture layout, conduit layout, switch board diagram and sub-distribution board diagram. All the calculation of currents and circuit breaker ratings have also been given. It helps me to learn how to give maximum benefit in minimum power usage according to the demand of electricity.

**Keywords :** Floor Plan, Fittings & Fixture Layout, Conduit Diagram Layout, Power Fitting Layout, Switchboard Connection Diagram, Distribution Board Connection Diagram, Calculation of Current Ratings.













**Introduction :**

Through this project I am going to introduce my 500sq ft studio apartment. “A studio apartment is basically a self-contained unit and houses everything in the single room except bathroom. It’s usually max out at a total of 600 square feet but can get as small as 300 square feet.” [1]. This project will give us an overall concept about different type of electrical equipment uses. Also give current rating calculation idea.

**Objective :**

The objective of this project is how to make floor plan design, fitting and fixture, conduit layout, power fitting layout, draw switch board and distribution diagram, and calculate current rating for different electric appliances for an apartment in real life .

### Symbols used in fittings and fixtures and in conduit layout:

	C	Conduit Going Down
	F	Ceiling Fan Outlet
	L	Wall Bracket Light at Lintel Level
	SB	Switch Board Concealed
	MDB	Main Distribution Board
	SS	2 Pin 5A Socket at SB Level
	TS	TS Two Pin 5A Socket at Skirting Level for TV
	ST	ST Two Pin 5A Socket at Table Height
	SL	3-Pin 5A Socket at Lintel Level
	SK	3-Pin 5A/15A Socket at Skirting Level
	FL	Fluorescent Wall Light Fitting
		Glass Door for AC
	EF	Exhaust Fan

## 1. Floor Plan :

Here in the floor plan of the 500m square feet studio apartment which has a living room with veranda, a dining space and kitchen. There is an AC over the bed with attached veranda, a bathroom where electric geyser can be installed. There are also space for refrigerator, washing machine and micro-oven. All these appliances are for all luxurious lifestyle.

In the living space, here used a glass door partition so that AC can be used only for the living room. Here also attached a veranda and bathroom with closet with attached window. Window and veranda will help to enter enough light and air into the living space. On other portion, dining table is attached with the kitchen part that minimize the space wasting problem.

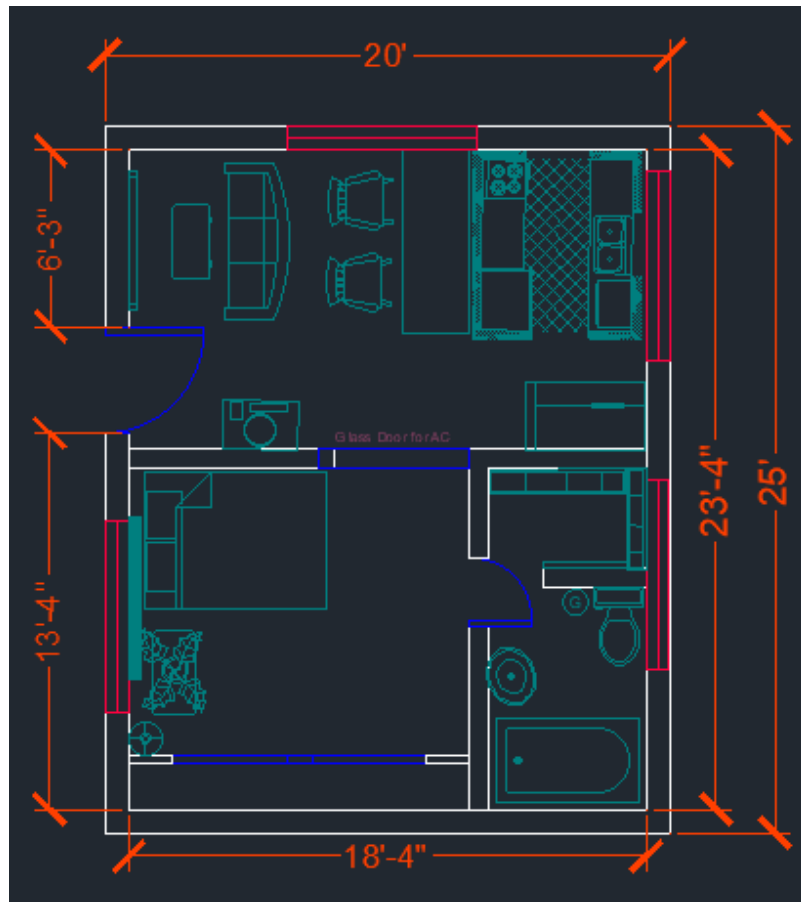


Figure 1: Floor plan of 500sq ft *STUDIO APARTMENT* (i)

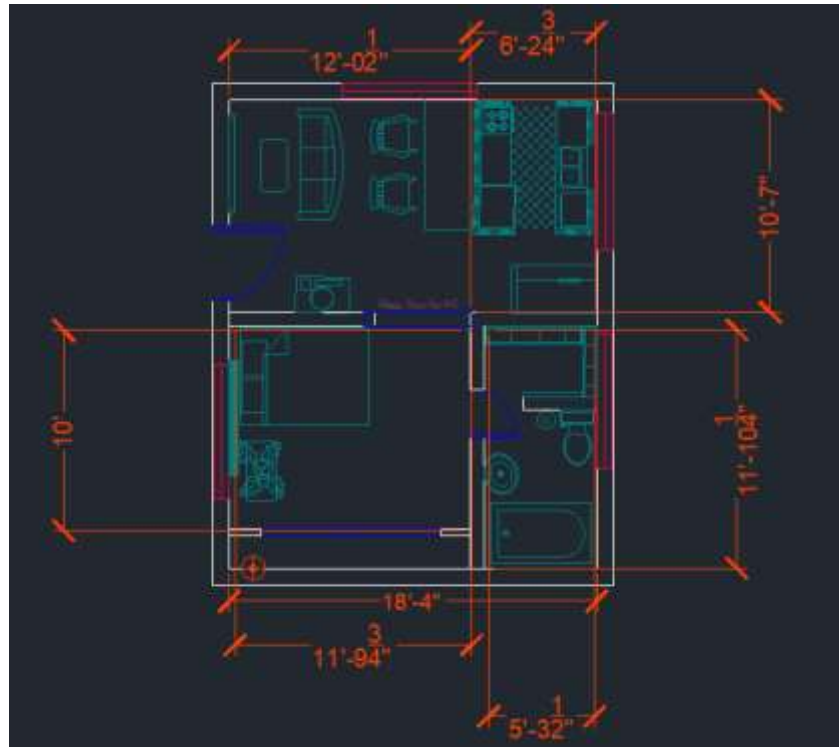


Figure 1: Floor plan of 500sq ft *STUDIO APARTMENT* (ii)

## **2.Fittings and Fixture Layout :**

In this part all I have shown where all fitting and fixture items like light ,fan,2 pin sockets,tv pin,exhaust fan,switch board and distribution board are placed. It gives us a overall look of electric equipment setup.

- 1.In the living room,AC socket and lamp socket are installed.
- 2.Few light sockets (CFL) and floroceint light are used few different places as required.
3. TV pin socket is placed just beside the TV.
4. Switchboard (SB2) and Main distribution board (MDB) are placed on the on the latch side of the main door. It can help to turn on the lights just after entering the apartment.

5. Exhaust fan, refrigerator pin socket, washing machine pin socket and oven pin socket are also installed near to them.

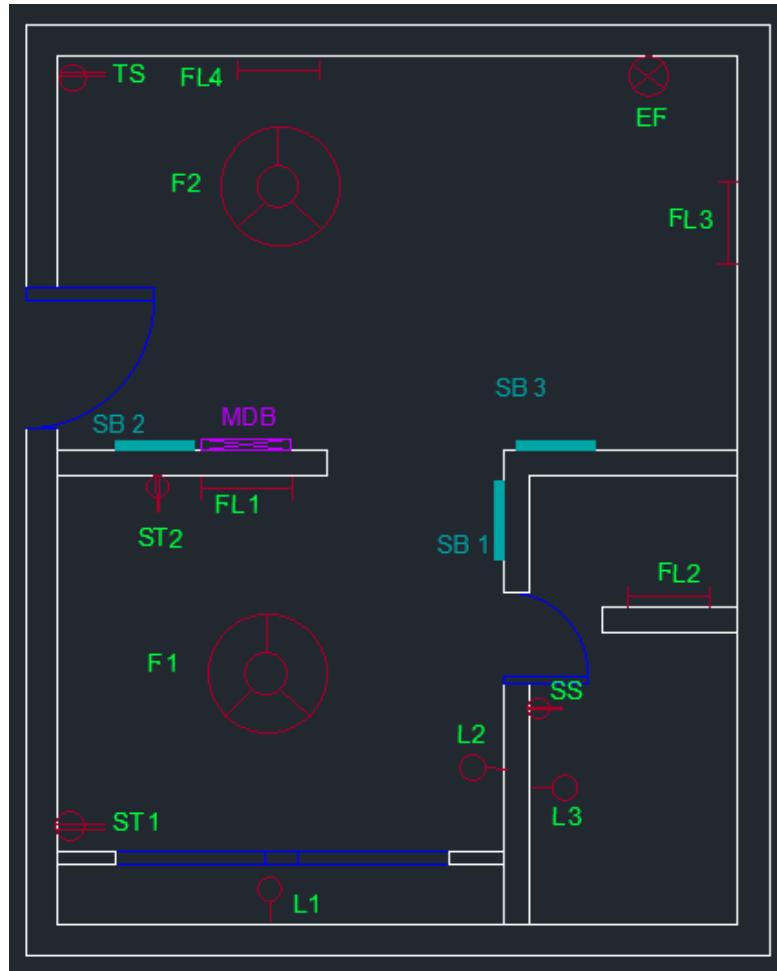


Figure 2: Fittings and Fixture

### 3. Conduit Layout :

For this part I draw 3 different conduit layouts(i ,ii,ii).Among them *Conduit layout (i)* is preferred.Because all the rules and regulation have been followed in this layout. In conduit Layout (i) -

1. Kept least length of conduits.
2. Try to keep less distance between fittings and switchboard.
3. For most of them try to maintain 90 degree alignment.

#### Conduit Layout (i)

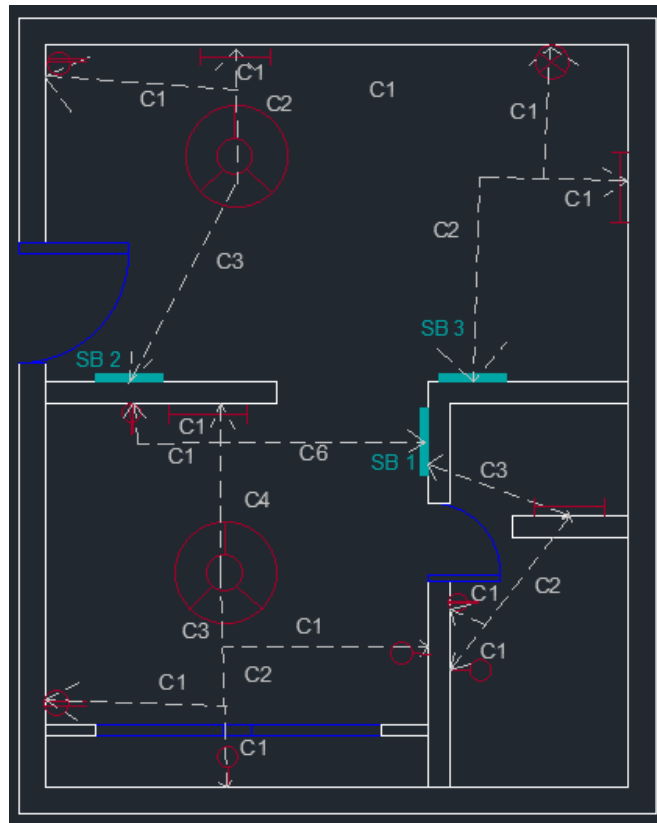


Figure 3: Conduit layout (i)

**Conduit Layout (ii) :**

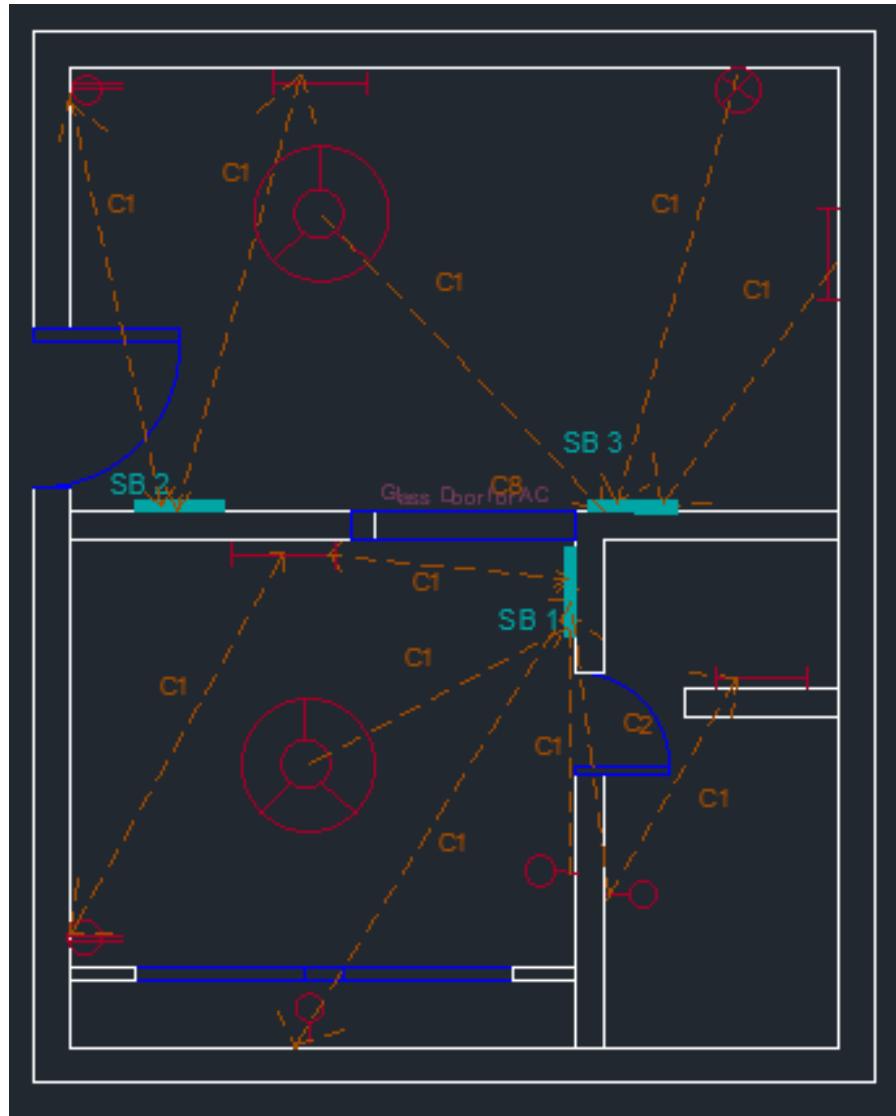


Figure 3: Conduit layout (ii)



**Conduit Layout (iii) :**

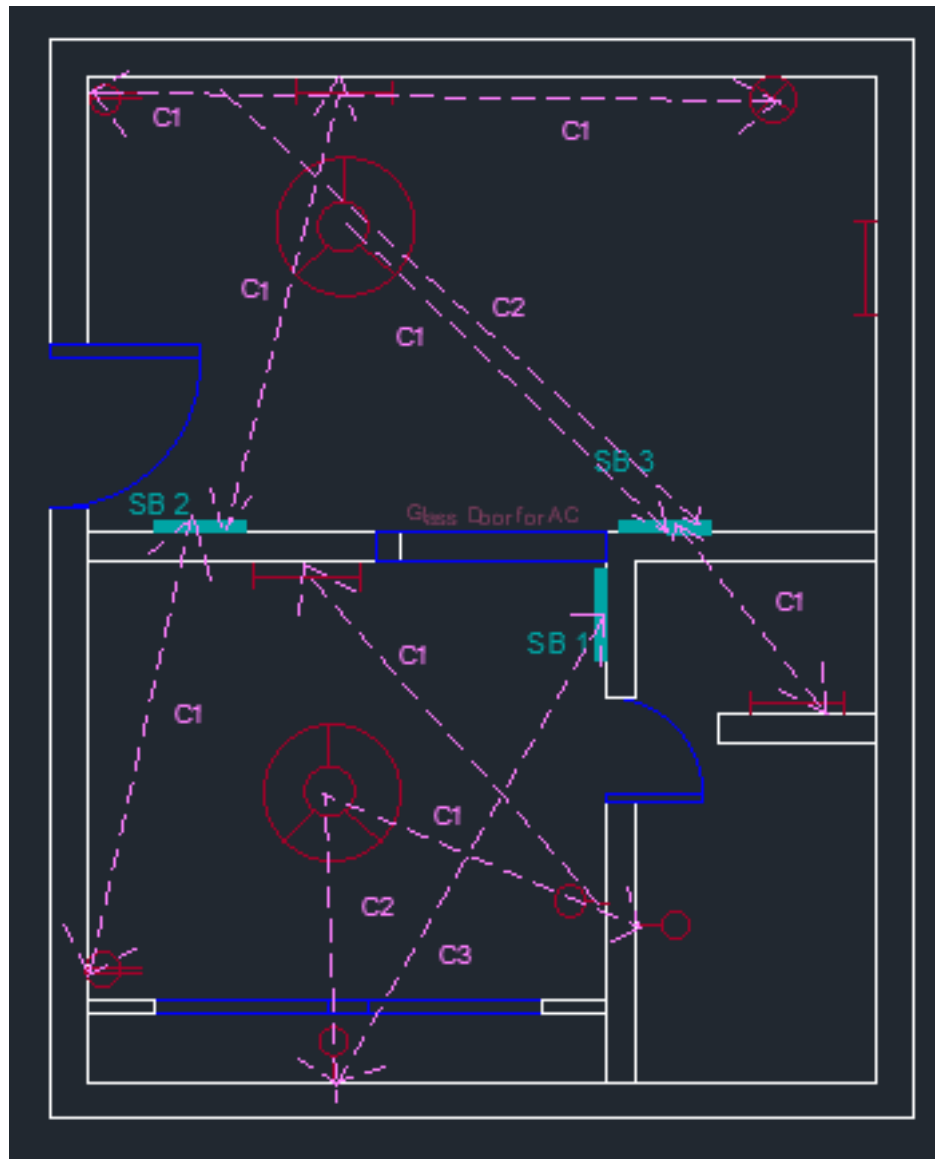


Figure 3: Conduit layout (iii)

#### 4 . Power Fitting Layout :

Here, in power fitting layout, all the 3 pin 15A sockets connection to main distribution board have been shown.

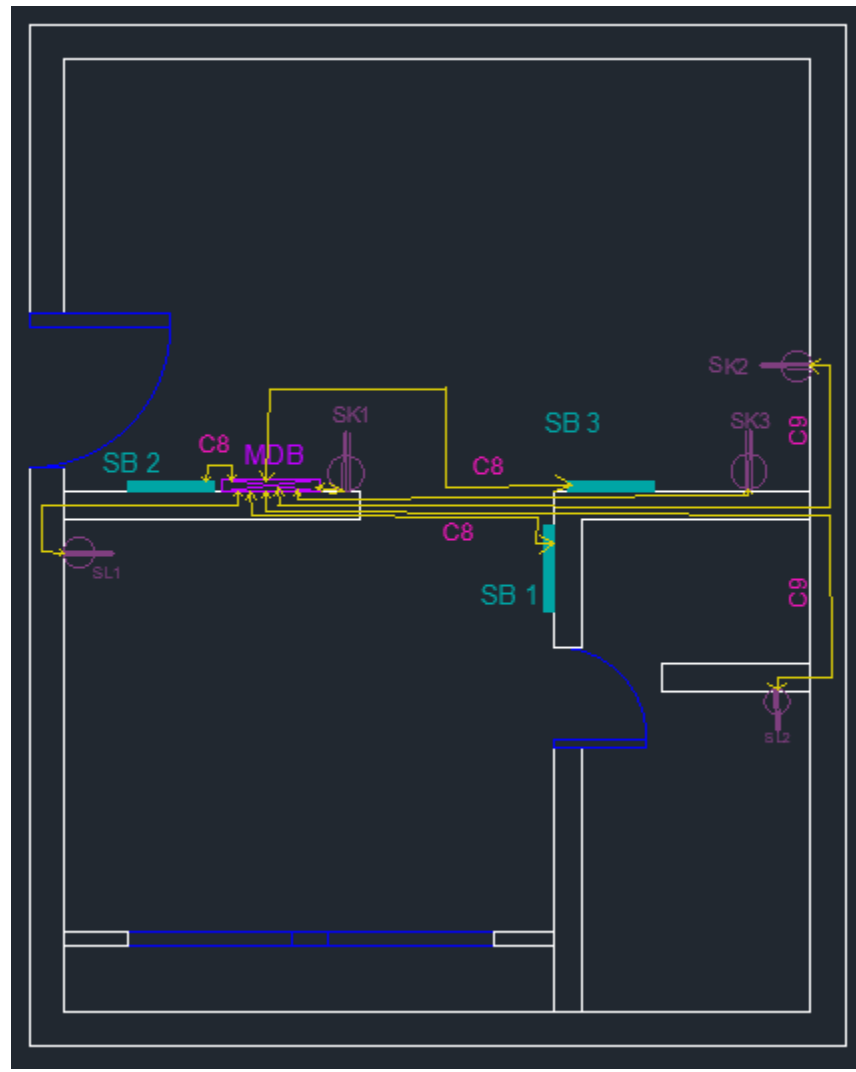


Figure 4: Power Fitting Layout

## 5. Switch board Connection Diagram :

### Legends of wires :

C1=2x1.5mm<sup>2</sup> ; C2=4x1.5mm<sup>2</sup> ; C3=6x1.5mm<sup>2</sup> ; C4=8x1.5mm<sup>2</sup>

C5=10x1.5mm<sup>2</sup> ; C6=12x1.5mm<sup>2</sup> ; C7=14x1.5mm<sup>2</sup> ;

C8=2x2.5mm<sup>2</sup> ; C9=2x4mm<sup>2</sup>

Here, how to connect all 3 switch board is shown here. From SB to MDB, wire used is C8 = 2x2.5 mm<sup>2</sup> (the maximum size conduit) for direct connection in MDB.

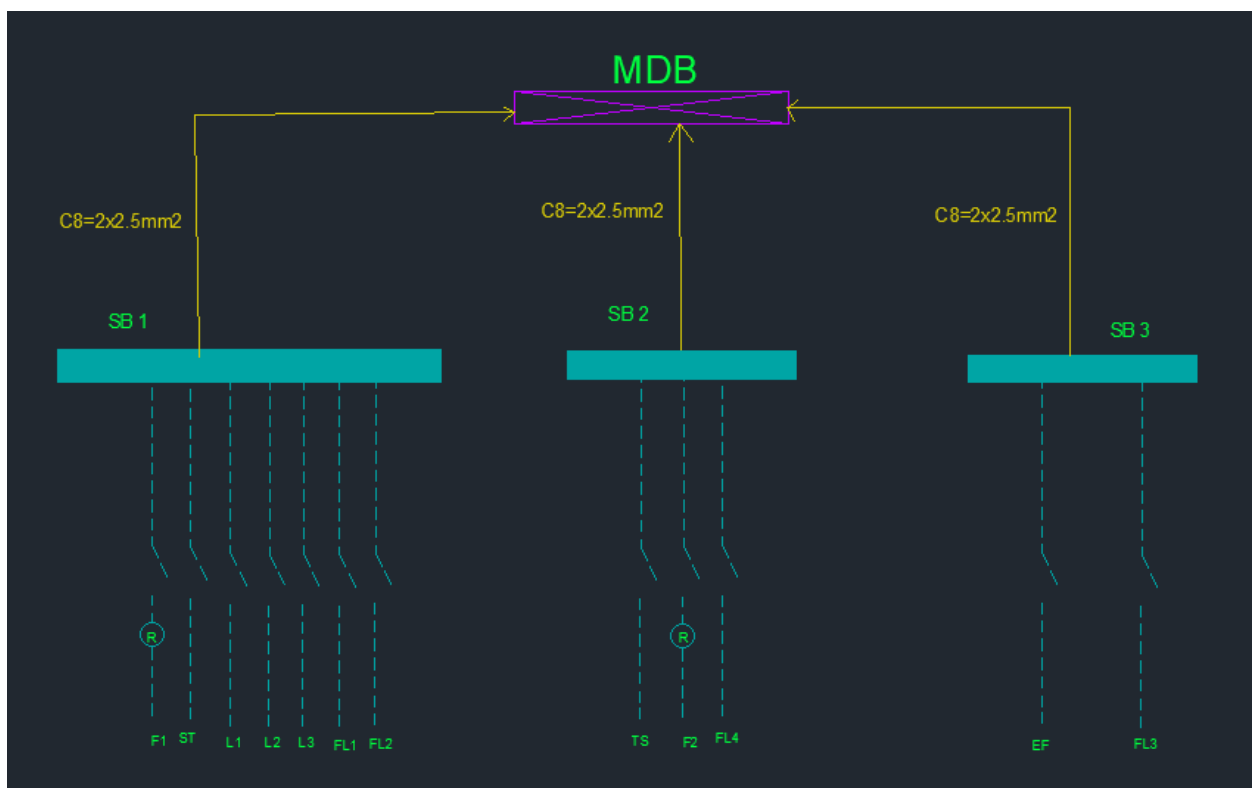


Figure 5: Switch Board Connection Diagram

## 6. Distribution Board Diagram :

Here, all the connection to Main Distribution Board has been shown.

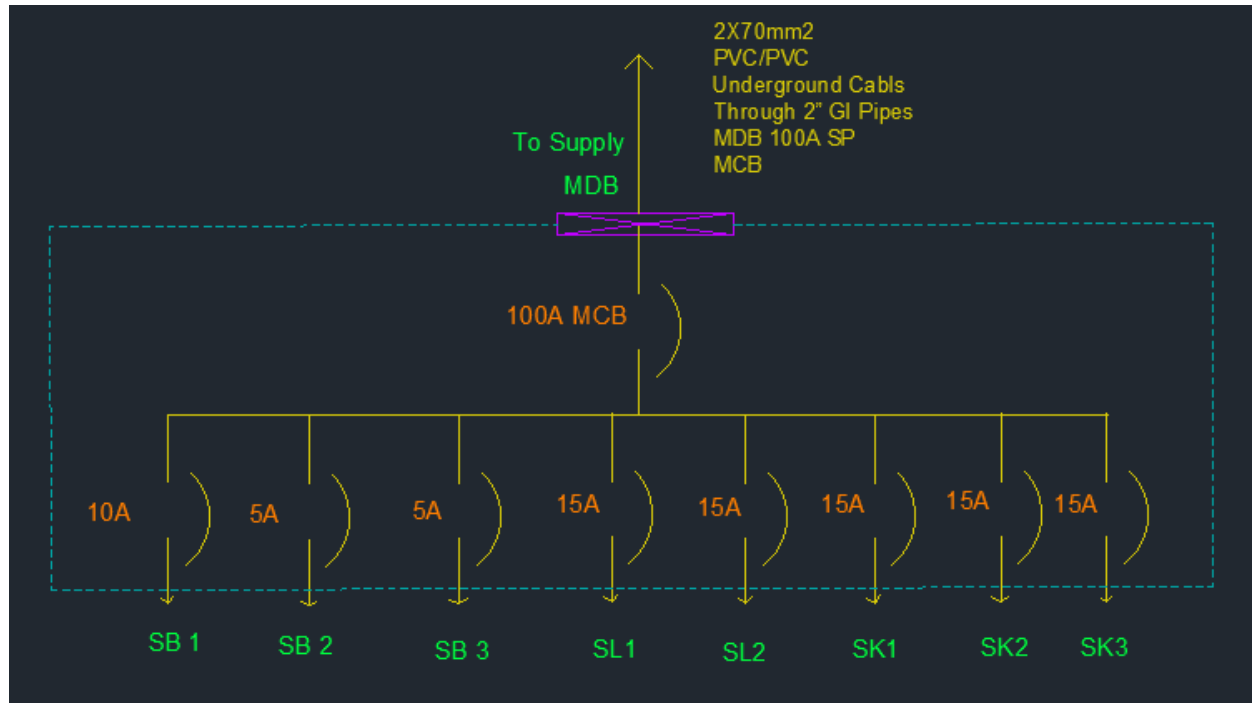


Figure 6: Main Distribution Board Connection Diagram

## 7. Calculation of current ratings of each type of circuits:

According to BNBC 2020, typical watt rating for some of the equipment/fittings is given below . [2]

**Table -1 : Calculate Load for Different Fittings and Fixtures**

Type of Fitting and Fixture	Ratings in Watt
CFL	6 -65
Fluorescent Light (FL)	20
Celling Fan	100(max)
Exhaust Fan	100(max)
Television (medium size)	120-200
Refrigerator (Domestic)	100 -250
5A socket outlets	300
Washing machine (domestic)	350-500
Geyser (water heater, domestic)	1000- 1200
Microwave Oven (domestic)	1200- 1500
Split type A.C. machine	1300
15 A (3pin)Socket outlets	1500

For the calculation of current of the appliances, the ratings are to be multiplied by a factor of 1.65 to take care of the power factor and the starting current situation. Here operating voltage 220V [3]

$$\text{Current, } I_{\text{Celling Fan}} = \frac{100 \times 1.65}{\sqrt{3} \times 220} = 0.43\text{A}$$

$$\text{Current, } I_{\text{Exhaust Fan}} = \frac{100 \times 1.65}{\sqrt{3} \times 220} = 0.43\text{A}$$

$$\text{Current, } I_{\text{Telivision}} = \frac{200 \times 1.65}{220} = 1.50\text{A}$$

$$\text{Current, } I_{\text{CFL}} = \frac{65 \times 1.65}{220} = 0.48\text{A}$$

$$\text{Current, } I_{\text{FL}} = \frac{20 \times 1.65}{220} = 0.15\text{A}$$

$$\text{Current, } I_{5\text{A Socket Outlet}} = \frac{300 \times 1.65}{220} = 2.25\text{A}$$

### **For 3 pin Appliances:**

3 pin socket of 15A can give 1500-Watt power in BNBC rule.

So, for refrigerator, microwave oven, washing machine, AC & Geyser current rating 1500W (per appliance) = (1500×5) W = 7500W So, we can use 15A MCB for each Socket(SK and SL).

So, Total Current for Washing machine, Refrigerator, Micro-Oven, Geyser and AC =(15×5) = 75A.

### **For SB1 :**

$$\text{Current Rating of CB1} = 1.25 * (I_{\text{CF}} + I_{\text{ST}} + (3 \times I_{\text{L}}) + (2 \times I_{\text{FL}}))$$

$$= 1.25 * (0.43 + 2.25 + (3 \times 0.48) + (2 \times 0.15)) = 5.525 \text{ A}$$

**So, for SB3, 10A circuit breaker is used.**

### **For SB2 :**

$$\text{Current Rating of CB2} = 1.25 * (I_{\text{CF}} + I_{\text{TS}} + (3 \times I_{\text{CF}}) + (2 \times I_{\text{FL}}))$$

$$= 1.25 * (1.50 + 0.43 + 0.15) = 2.6 \text{ A}$$

**So, for SB2, 5A circuit breaker is used.**

**For SB3 :**

Current Rating of CB3 =  $1.25 \times I_{FL} + 1 \times I_{EF}$

$$= 1.25 \times 0.15 + 1 \times 0.43 = 0.617 \text{ A}$$

**So, for SB3, 5A circuit breaker is used.**

**And for 3 pin 15A socket outlets, 15A circuit breaker is used.**

Now, The Main Distribution Board is connected via  $(10 + 5 + 5 + 75) = 95\text{A} \approx 100\text{A}$  circuit breaker. [Available Circuit Breaker ]

**Minimize the total electrical power demand:**

- I can use few more fluorescent lights, but I used for only the necessary places.
- I can skip the veranda or few windows but I didn't do it because enough light and air will help to reduce the electricity.
- In AC room, I used a glass door that also minimize the AC power consumption.
- I also can use another luxurious appliances ,but I didn't thing its important.

All these steps ,help to minimize the total electrical power demand.

**Conclusion :**

The 500 sq ft studio apartment has enough lights, fans, ventilation and luxury appliances like – TV, AC, Refrigerator ,Microwave, Washing Machine, Geyser are also included. So, the design minimized the total power demand while ensuring maximum comfort. Through this project I have got a complete idea about electrical wiring, Fittings and Fixture Layout. And also I got a proper knowledge on how to make Conduit Layout diagram according to BNBC 2020 Book. Also get an overall idea on how to nalyze electrical power demand in a building based on customer needs.

**REFERENCES**

1. <https://www.apartmentguide.com/blog/difference-between-studio-and-apartment/> **[1]**
2. Bangladesh National Building Code (BNBC), 2020, pp. 4545-4546. **[2]**
3. Bangladesh National Building Code (BNBC), 2020, pp. 4546. **[3]**