1. **Project Title:** Floor plan and electrical service design for a residential unit.
2. **Project Type:** Private.
3. **Project Profile:**

I. Project Name: Blossoms

II. Location:

Longitude : 90°26'49"E
Latitude : 23°49'24"N

III. Client Name:

IV. Architect Name:

V. Finance Type: Personal.

VI. Development Authority:

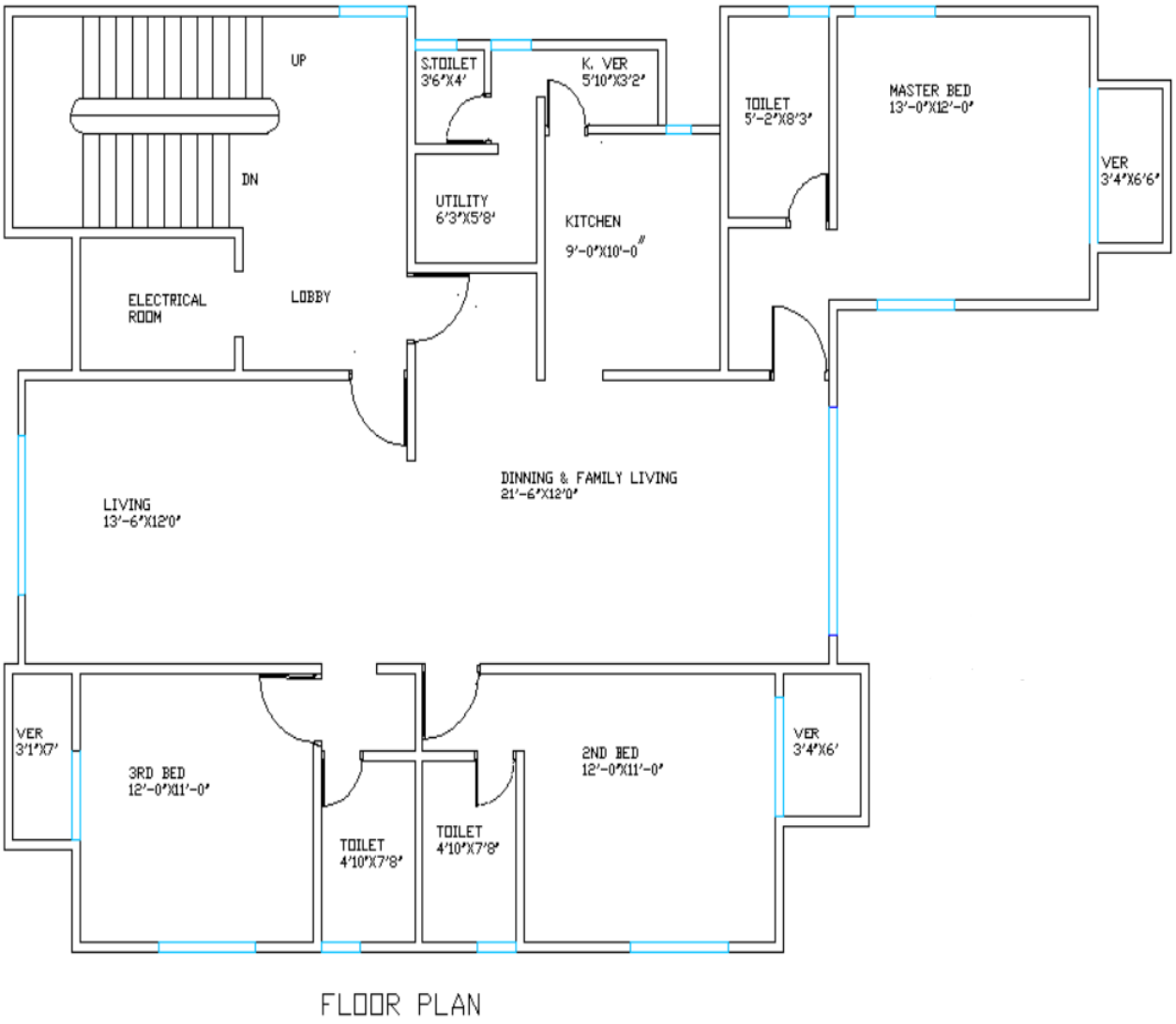
VII. Description of the Main layout Plan: Our project proposal is to design a floor plan layout along with electrical services for a residential unit which is around 1875 sqft. This will include:

- 3 Bedrooms.
- 3 attached bathrooms.
- 1 Kitchen.
- 1 utility room.
- 1 servant toilet.
- 1 Dining and Family living Room
- 1 Drawing Room.
- Stairs.
- Lobby.
- 4 Verandas.

VIII. Size of the rooms:

- Master Bedroom- (13'-0"×12'-0") sqft.
  - Toilet: (5'-2"×8'-3") sqft.
  - Veranda: (3'-4"×6'-0") sqft.
- 2nd Bedroom- (12'-0"×11'-0") sqft.
  - Toilet: (4'-10"×7'-8") sqft.
  - Veranda: (3'-4"×6'-0") sqft.
- 3rd Bedroom-(12'-0"×11'-0") sqft.
  - Toilet: (4'-10"×7'-8") sqft.
  - Veranda: (3'-1"×7'-0") sqft.
- Kitchen: (9'-0"×10'-0") sqft.
  - Veranda: (5'-10"×3'-2") sqft.
- utility room: (6'-3"×5'-0") sqft.
  - S. Bathroom: (3'-6"×4'-0") sqft.
- Dining and Family living Room: (21'-6"×12'-0") sqft.
- Drawing Room: (13'-6"×12'-0") sqft.

4. **Detail Plan Drawing:**




FLOOR PLAN

## 5. Fittings & Fixtures:

Electrical fittings and fixtures are the essential building blocks of a safe and functional electrical system. They work together to bring electricity into your home, illuminate your space, and power your appliances.

### a) Selection of lights:

For the selection of lights, we use different codes from Bangladesh National Building Code.

- For the lighting calculations we have use lumen method according to the BNBC-1.2.3.1(Lighting Calculations) code.
- For the standard height of lighting we have to use BNBC-1.2.5 (Artificial Lighting to Supplement Daylight) code.
- For the recommended illumination of lighting we have to use BNBC-1.2.6.2 (Classification of light fittings) code.
- For the selection of appropriate type of lamp we have to use BNBC-1.2.8 (Selection of Appropriate Type of Lamp) code.

According to the lumen method:

$$\text{No. of lights} = \frac{E\ (Required\ lux) \times Area\ (m^2)}{lumen\ for\ each\ luminaire \times Utilization\ Factor(UF) \times Maintainance\ Factor(MF)}$$

$$\text{Room index} = \frac{a.b}{Useful\ height \times (a+b)}$$

For the residential building Useful height is 2.5m.

The mounting height should be between 1.5 to 2 m above the work plane. According to the BNBC 1.2.6.2 Code the recommended values of illumination for residential areas are -

| Area of activity | Illuminance |
|---|---|
| Bedrooms | 70 |
| Kitchens | 200 |
| Dinning Rooms | 150 |
| Stairs | 100 |
| Lounges | 100 |
| Garages | 100 |
| Basement Car Park | 100 |

I. No. of lights in the Master Bedroom:

$$\text{Room index} = \frac{3.964 \times 3.6576}{2.5 \times (3.964+3.6576)} = 0.7631$$

Lumen of 40 Watt light is 2300.

$$\text{No. of lights} = \frac{70 \times 14.5}{2300 \times 0.44 \times 0.8} = 1.2537$$

= 2*40 watts light.

II. No. of lights in the Master Bedroom Toilet:

$$\text{Room index} = \frac{3.96}{2.5 \times (1.5748+2.5146)} = 0.3873$$

Lumen of 20 Watt light is 700.

$$\text{No. of lights} = \frac{100 \times 3.96}{700 \times 0.44 \times 0.8} = 1.6071$$

= 2*20 watts light.

III. No. of lights in the 2nd Bedroom:

$$\text{Room index} = \frac{12.263}{2.5 \times (3.3528+3.6576)} = 0.7$$

Lumen of 40 Watt light is 2300.

$$\text{No. of lights} = \frac{70 \times 12.263}{2300 \times 0.44 \times 0.8} = 1.14$$

= 2*40 watts light.

IV. No. of lights in the Master Bedroom Toilet:

Room index = 0.322

Lumen of 20 Watt light is 700.

$$\text{No. of lights} = \frac{100 \times 2.9}{700 \times 0.44 \times 0.8} = 1.177$$

= 2*20 watts light.

V. No. of lights in the 3rd Bedroom:

$$\text{Room index} = \frac{12.263}{2.5 \times (3.3528+3.6576)} = 0.7$$

Lumen of 40 Watt light is 2300.

$$\text{No. of lights} = \frac{70 \times 12.263}{2300 \times 0.44 \times 0.8} = 1.14$$

= 2*40 watts light.

VI. No. of lights in the 3rd Bedroom Toilet:

Room index = 0.322

Lumen of 20 Watt light is 700.

$$\text{No. of lights} = \frac{100 \times 2.9}{700 \times 0.44 \times 0.8} = 1.177$$

= 2*20 watts light.

VII. For all the veranda 20 watts light is used.

VIII. No. of lights in the Kitchen:

$$\text{Room index} = \frac{8.36}{2.5 \times (2.7432+3.048)} = 0.577$$

Lumen of 60 Watt light is 3450.

Lumen of 20 Watt light is 2250.

$$\text{No. of lights} = \frac{200 \times 8.36}{(3450+2250) \times 0.44 \times 0.8} = 0.833$$

= 1*60 watts & 1*20 watts light.

IX. No. of lights in the Dinning:

$$\text{Room index} = \frac{23.9}{2.5 \times 10.21} = 0.94$$

Lumen of 60 Watt light is 3450.

$$\text{No. of lights} = \frac{150 \times 23.96}{3450 \times 0.44 \times 0.8} = 2.96$$

= 2*60 watts & 1*20 watts light.

X. No. of lights in the Living room:

$$\text{Room index} = \frac{15.05}{2.5 \times (4.1148+3.6576)} = 0.7745355$$

Lumen of 60 Watt light is 3450.

$$\text{No. of lights} = \frac{100 \times 15.05}{3450 \times 0.454 \times 0.8} = 1.2$$

= 1*60 watts light & 3*15 watts spotlight.

For the selection of appropriate type of lamp, we use 40 W, 60 W, 100W, 150 W and 200W lamps.

**b) Selection of Fan:**

For the selection fan we use BNBC 1.3.3.5 code. Recommended fan sizes for the room are-

| Room Area ($m^2$) | Fan Sweep |
|---|---|
| Up to 6 | 915 mm |
| Over 6 to 9 | 1220 mm |
| Over 9 to 12 | 1442 mm |

According to this table no. of fans in the residential units are-

| Rooms | Size of the rooms($m^2$) | No. of Fans | Size of the Fans(mm) |
|---|---|---|---|
| Master Bed | 14.5 | 1 | 1442 |
| 2nd Bed | 12.263 | 1 | 1442 |
| 3rd Bed | 12.263 | 1 | 1442 |
| Utility Room | 2.9 | 1 | 915 |
| Living Room | 15.05 | 1 | 1442 |
| Dinning and Family Living | 23.96 | 2 | 1442 |

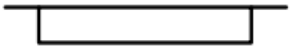
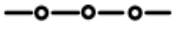
- Fans in large halls may be spaced at 3 to 3.5m.
- The height of fan blades is at 2.5 m above the finished floor level.
- The fan hook is to be made using a 12 mm dia MS rod having at least 600 mm.

**c) No. of 13A (3 pin) outlet:**

According to the BNBC 1.3.3.2 code no. of 3 pin 13A outlets are –

| ROOMS | No. of 13A (3 pin) outlet |
|---|---|
| Bedrooms | 2 |
| Living Room | 3 |
| Drawing Room | 3 |
| Dinning Room | 3 |
| Kitchen | 1 |

d) Symbols used for fittings and fixtures according to the BNBC 1.3.1 code-

| | |
|---|---|
| Main Distribution Board (MDB) |  |
| Switch Board (SB) |  |
| Circuit breaker |  |
| Wall mounted bracket light fitting |  |
| Ceiling fan |  |
| 2 pin socket Outlet (single phase) |  |
| 3 pin 13A switched socket Outlet (single phase) |  |
| Double fluorescent lamp on wall |  |
| Spot light |  |
| Exhaust fan |  |
| TV socket outlet |   |
| Conduit, concealed in ceiling or in wall |  |
| Conduit, concealed in floor or through under ground |  |

## The estimated electrical components are:

- Master Bedroom : 40W light-2
  20W light-1

Fan-1

3 pin socket- 2

2 pin socket- 1

Switch Board – 1

- Master Bathroom : 20W light-2

  2 pin socket- 1

  Switch Board – 1.

- 2nd Bedroom : 40W light-1

  20W light-2

  Fan-1

  3 pin socket- 2

  2 pin socket- 1

  Switch Board – 1

- 2nd Bathroom : 20W light-2

  2 pin socket- 1

  Switch Board – 1

- 3rd Bedroom : 40W light-1

  20W light-2

  Fan-1

  3 pin socket- 2

  2 pin socket- 1

  Switch Board – 1

- 3rd Bathroom : 20W light-2

  2 pin socket- 1

  Switch Board – 1

- Drawing Room: 20w Light- 3

  60w Light – 1

  15w Spot Light - 3

  Fan – 1

  3 pin socket- 3

  Switch Board - 1

- Dining and
  Family living Room: 60w Light- 2

  40w Light – 1

  Fan – 2

  3 pin socket- 2

  Switch Board – 1

- Kitchen: 60w Light- 1

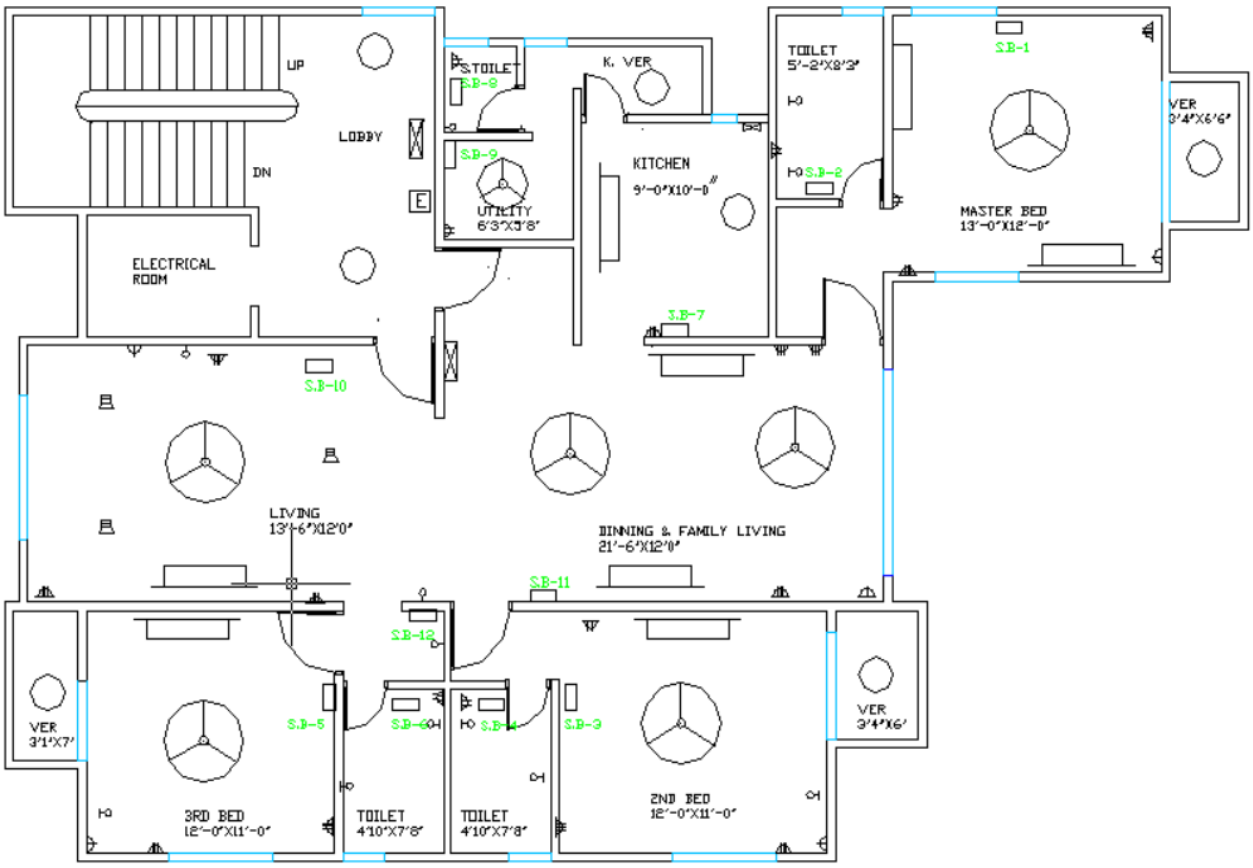
  20w Light- 2

  Exhaust Fan- 1

  3 pin socket- 1

  Switch Board – 1

- Veranda (Each): Light - 1




Fittings and Fixtures

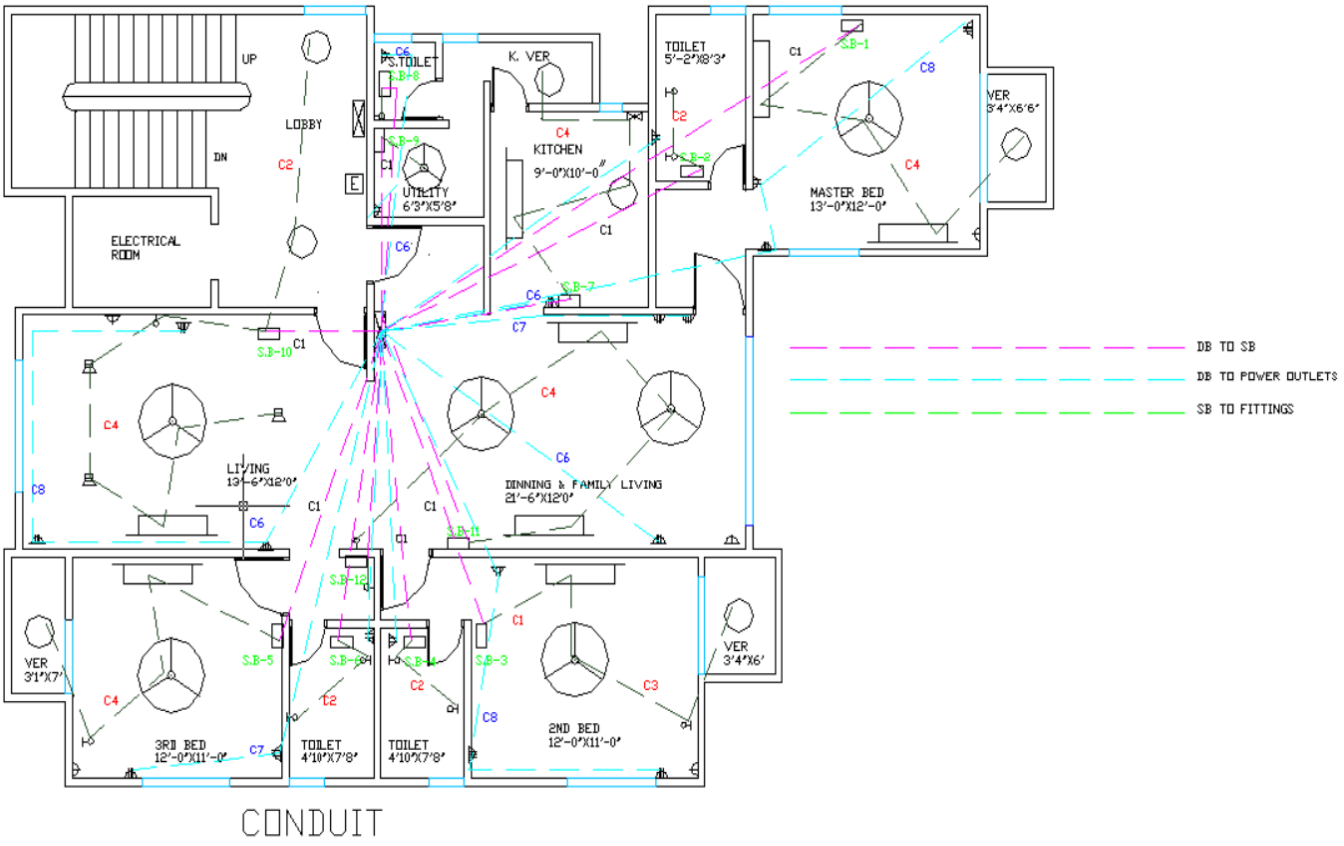
## 6. **Conduit Drawing:**

No. of single-core wires of different sizes for various sizes of PVC conduits

| Conductor Cross-sectional area ($mm^2$) | Conduit Diameter. | | |
|---|---|---|---|
| | 19 mm | 25 mm | 32 mm |
| 1.5 | 6 | 10 | 14 |
| 2.5 | 5 | 10 | 14 |

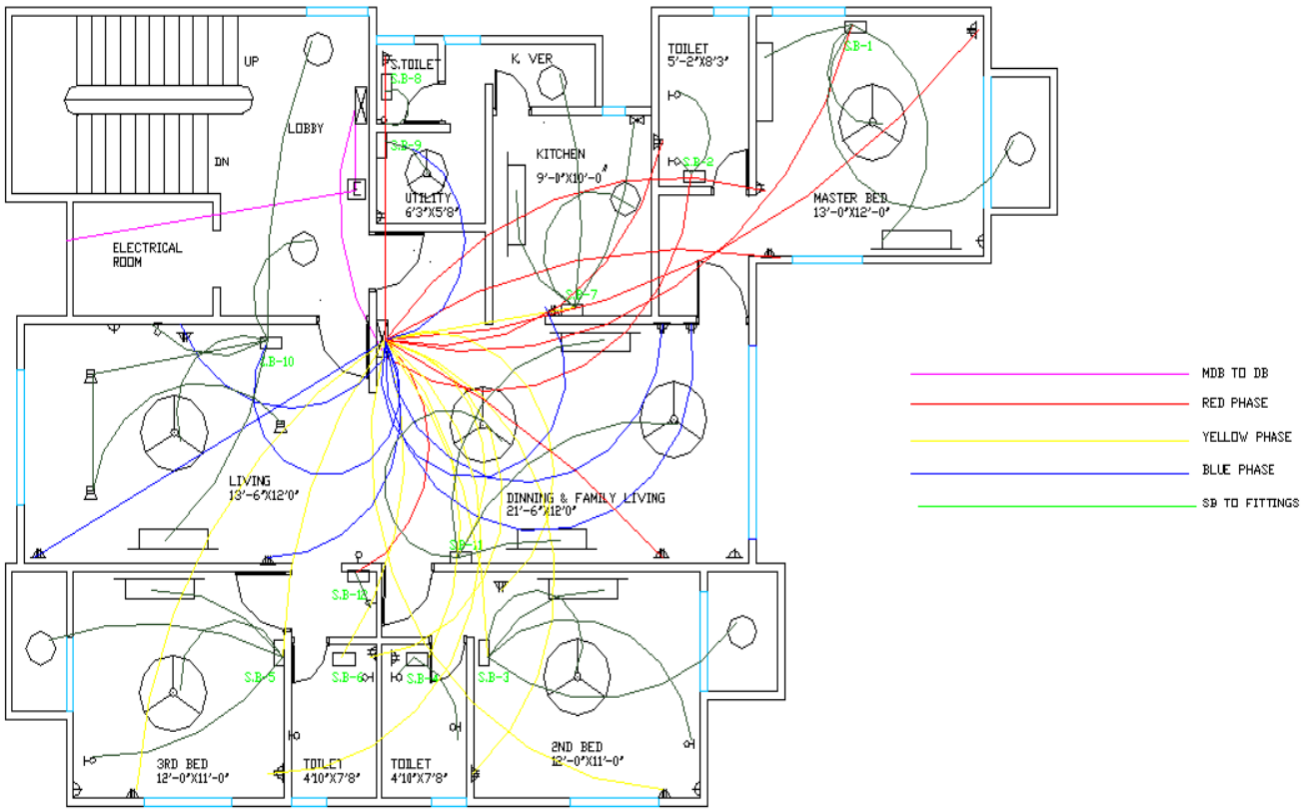
The symbol of conduit according to cable size are-

| Symbol | Cable Size |
|---|---|
| C1 | 2 × 1.5 rm BYA cable |
| C2 | 4 × 1.5 rm BYA cable |
| C3 | 6 × 1.5 rm BYA cable |
| C4 | 8 × 1.5 rm BYA cable |
| C6 | 2 × 2.5 rm BYA cable |
| C7 | 4 × 2.5 rm BYA cable |
| C8 | 6 × 2.5 rm BYA cable |




CONDUIT

## 7. Cabling Drawing:




CABLING

## 8. One Line Diagram:

Cable Size & Length:

According to the BNBC 1.3.4.3(Circuit wiring) Code the minimum corresponding Circuit wire should not be less than 1.5 $mm^2$. The cables must be PVC insulated cables.

Cable size for lights:

- 60 W lights: Current, I = $\frac{60\times1.25}{230\times0.8}$ = 0.4A; 1.5 rm wire should be used.
- 40 W lights: Current, I = $\frac{40\times1.25}{230\times0.8}$ = 0.272A; 1.5 rm wire should be used.
- 15 W lights: Current, I = $\frac{15\times1.25}{230\times0.8}$ = 0.10A; 1.5 rm wire should be used.
- 20 W lights: Current, I = $\frac{20\times1.25}{230\times0.8}$ = 0.14A; 1.5 rm wire should be used.

Cable size for Fans:

- 100 W Fans: Current, I = $\frac{100\times1.25}{230\times0.8}$ = 0.68A; 1.5 rm wire should be used.

- 70 W Fans: Current, I = $\frac{70\times1.25}{230\times0.8} = 0.4755$A; 1.5 rm wire should be used.
- 40 W Fans: Current, I = $\frac{40\times1.25}{230\times0.8} = 0.271$A; 1.5 rm wire should be used.

Cable size for 3 pin outlet

- Total Load = 1500 watts.
- Current, I = $\frac{1500\times1.25}{230\times0.8} = 10.19$A.
- So, 2.5 rm wire should be use.

Cable size for 2 pin outlet

- Total Load = 1500 watts.
- Current, I = $\frac{1500\times1.25}{230\times0.8} = 10.19$A.
- So, 2.5 rm wire should be use.

Cable size for TV:

- 150 W TV: Current, I = $\frac{150\times1.25}{230\times0.8} = 1.019$A; 1.5 rm wire should be used.

Cable size for Refrigerator:

- 400 W Refrigerator: Current, I = $\frac{400\times1.25}{230\times0.8} = 2.71$A; 1.5 rm wire should be used.

Cable size for Air Conditioner:

- 1500 W AC: Current, I = $\frac{1500\times1.25}{230\times0.8} = 10.19$A; 2.5 rm wire should be used.

Cable size for Microwave:

- 1500 W AC: Current, I = $\frac{1200\times1.25}{230\times0.8} = 8.152$ A; 2.5 rm wire should be used.

- DB►SB

| Switch Board No. | No. of wires | Size of the wire($mm^2$) | Conduit Size.(mm) | Wire Length |
|---|---|---|---|---|
| 1 | 2 | 1.5 | 19 | 31'-8.8" |
| 2 | 2 | 1.5 | 19 | 20'-1.7" |
| 3 | 2 | 1.5 | 19 | 16'-1.1" |
| 4 | 2 | 1.5 | 19 | 15'-1.1" |
| 5 | 2 | 1.5 | 19 | 16'-10.5" |

| | | | | |
|---|---|---|---|---|
| 6 | 2 | 1.5 | 19 | 16’-0.4” |
| 7 | 2 | 1.5 | 19 | 10’-11.5” |
| 8 | 2 | 1.5 | 19 | 13’-4.3” |
| 9 | 2 | 1.5 | 19 | 10’-0” |
| 10 | 2 | 1.5 | 19 | 6’-8” |
| 11 | 2 | 1.5 | 19 | 12’-8.3” |
| 12 | 2 | 1.5 | 19 | 11’-8.4” |

- SB ► Fittings

A. S.B-1

| Name of the fittings | No. of wires | Size of the wire($mm^2$) | Conduit Size.(mm) | Wire Length |
|---|---|---|---|---|
| 40W light | 2 | 1.5 | 25 | 7’-2” |
| 40W light | 2 | 1.5 | 25 | 5’-10.7” |
| 20W light | 2 | 1.5 | 25 | 7’-2” |
| 100W FAN | 2 | 1.5 | 25 | 7’-0.9” |

B. S.B-2

| Name of the fittings | No. of wires | Size of the wire($mm^2$) | Conduit Size.(mm) | Wire Length |
|---|---|---|---|---|
| 20W light | 2 | 1.5 | 19 | 0’-6” |
| 20W light | 2 | 1.5 | 19 | 3’-4” |

C. S.B-3

| Name of the fittings | No. of wires | Size of the wire($mm^2$) | Conduit Size.(mm) | Wire Length |
|---|---|---|---|---|
| 40W light | 2 | 1.5 | 25 | 5’-7.1” |
| 20W light | 2 | 1.5 | 25 | 7’-5.4” |
| 20W light | 2 | 1.5 | 25 | 6’-4.2” |
| 100W FAN | 2 | 1.5 | 25 | 4’-2” |

D. S.B-4

| Name of the fittings | No. of wires | Size of the wire($mm^2$) | Conduit Size.(mm) | Wire Length |
|---|---|---|---|---|
| 20W light | 2 | 1.5 | 19 | 1’-0.1” |
| 20W light | 2 | 1.5 | 19 | 4’-2” |

E. S.B-5

| Name of the fittings | No. of wires | Size of the wire($mm^2$) | Conduit Size.(mm) | Wire Length |
|---|---|---|---|---|
| 40W light | 2 | 1.5 | 25 | 8’-2.5” |
| 20W light | 2 | 1.5 | 25 | 5’-0.8” |
| 20W light | 2 | 1.5 | 25 | 5’-4” |
| 100W FAN | 2 | 1.5 | 25 | 5’-0.8” |

F. S.B-6

| Name of the fittings | No. of wires | Size of the wire($mm^2$) | Conduit Size.(mm) | Wire Length |
|---|---|---|---|---|
| 20W light | 2 | 1.5 | 19 | 1’-0.1” |
| 20W light | 2 | 1.5 | 19 | 4’-2” |

G. S.B-7

| Name of the fittings | No. of wires | Size of the wire($mm^2$) | Conduit Size.(mm) | Wire Length |
|---|---|---|---|---|
| 60W light | 2 | 1.5 | 25 | 5’-4” |
| 20W light | 2 | 1.5 | 25 | 6’-10.5” |
| 20W light | 2 | 1.5 | 25 | 8’-4” |
| 40W Exhaust FAN | 2 | 1.5 | 25 | 2’-6” |

H. S.B-8

| Name of the fittings | No. of wires | Size of the wire($mm^2$) | Conduit Size.(mm) | Wire Length |
|---|---|---|---|---|
| 20W light | 2 | 1.5 | 19 | 1’-8” |

I. S.B-9

| Name of the fittings | No. of wires | Size of the wire($mm^2$) | Conduit Size.(mm) | Wire Length |
|---|---|---|---|---|
| 20W light | 2 | 1.5 | 19 | 3’-0.1” |

J. S.B-10

| Name of the fittings | No. of wires | Size of the wire($mm^2$) | Conduit Size.(mm) | Wire Length |
|---|---|---|---|---|
| 60W light | 2 | 1.5 | 32 | 4’-10.3” |
| 20W light | 2 | 1.5 | 32 | 5’-10.7” |
| 20W light | 2 | 1.5 | 19 | 5’-3.2” |
| 100W FAN | 2 | 1.5 | 32 | 5’-0.8” |
| 20W light | 2 | 1.5 | 19 | 10’-0.4” |
| 45W spot light | 2 | 1.5 | 32 | 16’-7” |

K. S.B-11

| Name of the fittings | No. of wires | Size of the wire($mm^2$) | Conduit Size.(mm) | Wire Length |
|---|---|---|---|---|
| 40W light | 2 | 1.5 | 25 | 10’-0.4” |
| 60W light | 2 | 1.5 | 25 | 5’-10.7” |
| 60W light | 2 | 1.5 | 25 | 5’-10.7” |
| 100W FAN | 2 | 1.5 | 25 | 8’-3” |
| 100W FAN | 2 | 1.5 | 25 | 10’-0.4” |

L. S.B-12

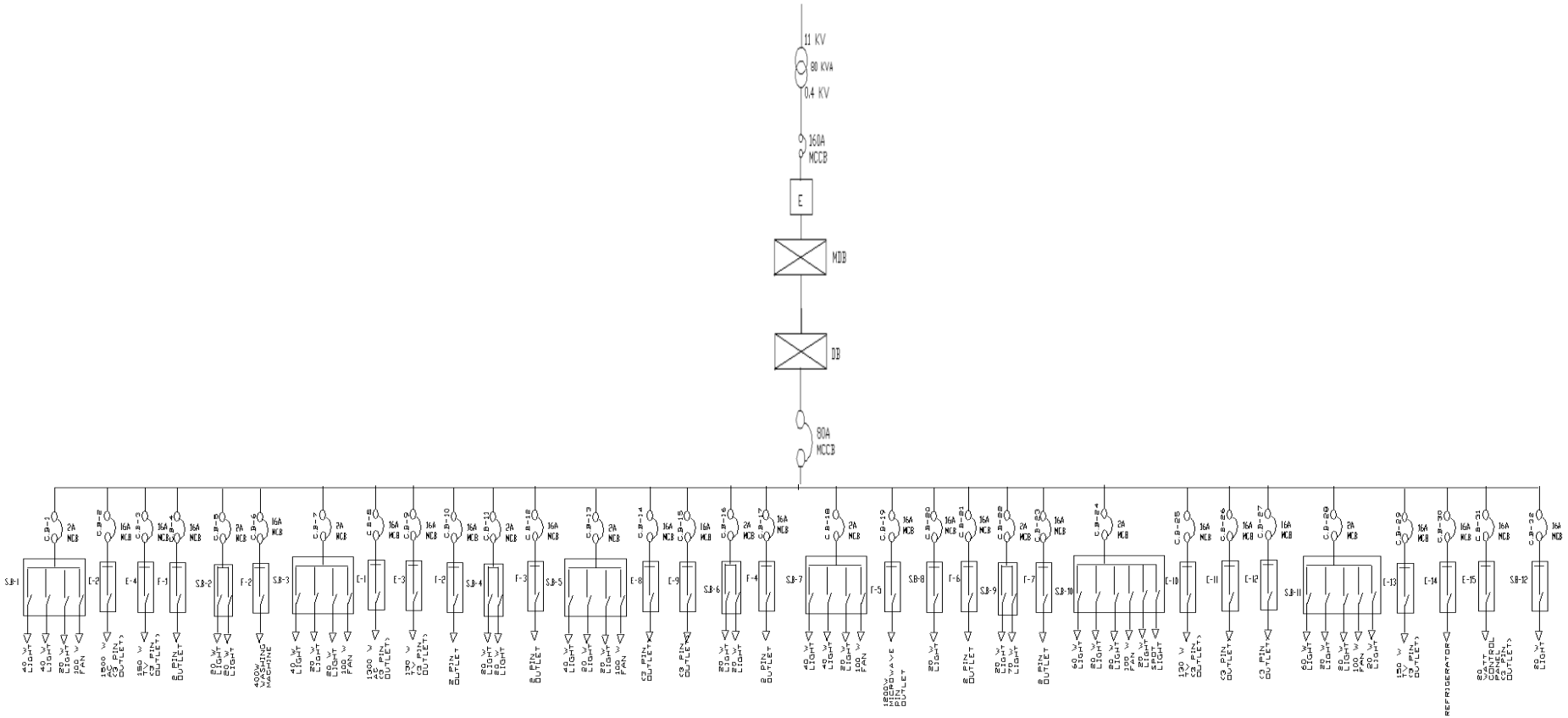
| Name of the fittings | No. of wires | Size of the wire($mm^2$) | Conduit Size.(mm) | Wire Length |
|---|---|---|---|---|
| 20W light | 2 | 1.5 | 19 | 1’-8” |

- DB ► 2 Pin & 3 Pin Outlet

| ROOM | No. of 3 pins | No. of wires | Size of the wire($mm^2$) | Conduit Size.(mm) | Wire Length |
|---|---|---|---|---|---|
| Master Bed | 2 | 4 | 2.5 | 25 | 38’-1” |
| $2^{nd}$ Bed | 2 | 4 | 2.5 | 25 | 21’-5” |

| | | | | | |
|---|---|---|---|---|---|
| 3rd Bed | 2 | 4 | 2.5 | 19 | 30’-9.8” |
| Drawing Room | 3 | 6 | 2.5 | 25 | 23.6’-9.96” |
| Dinning | 3 | 6 | 2.5 | 25 | 36’-8.7” |

| ROOM | No. of 2 pins | No. of wires | Size of the wire($mm^2$) | Conduit Size.(mm) | Wire Length |
|---|---|---|---|---|---|
| Master Bed | 1 | 2 | 2.5 | 25 | 3’-5.2” |
| 2nd Bed | 1 | 2 | 2.5 | 25 | 14’-2” |
| Utility & S. toilet | 2 | 4 | 2.5 | 19 | 17’-5.2” |
| Master Bathroom | 1 | 2 | 2.5 | 19 | 18’-8.7” |
| 2nd Bathroom | 1 | 2 | 2.5 | 19 | 15’-10.3” |
| 3rd Bathroom | 1 | 2 | 2.5 | 19 | 15’-10.3” |
| Kitchen | 1 | 2 | 2.5 | 25 | 10’-10.6” |


11 KV
80 KVA
0.4 KV
160A MCCB
E
MDB
DB
80A MCCB

## 9. Installation Schedule:

Designing and installing electrical service for a residential building ground floor involves several steps. They are given below for our design

| | |
|---|---|
| **1. Preliminary Planning:** | **a. Review architectural plans and identify electrical load requirements.**<br>**b. Determine the location of electrical panels, outlets, switches, and lighting fixtures.**<br>c. Verify compliance with Bangladesh electrical codes and regulations. |
| **2. Site Preparation:** | a. Ensure the construction site is ready for electrical installation.<br>b. Coordinate with other trades (plumbing, HVAC, etc.) to ensure proper placement of electrical components. |
| **3. Rough-In Wiring:** | a. Install the main service panel in a central, accessible location.<br>b. Run conduit or wiring from the service panel to key locations (outlets, switches, lighting points).<br>c. Install junction boxes where necessary.<br>d. Rough-in wiring for major appliances (e.g., kitchen appliances, HVAC). |
| **4. Electrical Panel Installation:** | a. Mount the main service panel securely.<br>b. Install the main service disconnect.<br>c. Connect grounding and bonding according to BNBC<br>d. Label circuit breakers for each circuit. |
| **5. Outlet and Switch Installation:** | a. Install electrical boxes at designated locations.<br>b. Run wiring from the service panel to outlets and switches.<br>c. Install outlets, switches, and cover plates.<br>d. Ensure proper grounding for all outlets |
| **6. Lighting Installation:** | a. Install lighting fixtures in designated areas.<br>b. Connect wiring from the service panel to light fixtures.<br>c. Install dimmer switches, if applicable.<br>d. Ensure proper grounding for all lighting fixtures. |
| **7. Final Inspection:** | a. Conduct a thorough inspection of the entire electrical system.<br>b. Verify compliance with BNBC.<br>c. Check for proper grounding and bonding.<br>d. Ensure all connections are secure and safe. |

| | |
|---|---|
| **8. Testing:** | a. Perform electrical tests, including continuity, voltage drop, and insulation resistance.<br>b. Verify the correct operation of all outlets, switches, and lighting fixtures. |

- Wiring Installation:

There are different types of methods of installing wiring. Among them we have selected conduit wiring. It covers various aspects of conduit wiring, including types of conduits, such as thin wall conduits, rigid conduits, and flexible conduits, as well as conduit accessories like couplings, elbows, bushings, locknuts, and more.

Here's a breakdown of the main points :

- ❖ Types of Conduits used:
  - Non-metallic conduits (fiber, plastic etc.)
- ❖ Classification of Conduits:
  - Flexible conduits (Used for residential Building)
- ❖ Conduit Finishes:
  - Black enamelled conduits (for indoor use)
- ❖ Flexible Conduits:
  - Made from galvanized steel strips
  - Type: flat double strip
- ❖ Conduit Accessories:
  - Couplings (for joining conduit lengths)
  - Elbows (for changing direction)
  - Conduit bushings (prevent insulation damage)
  - Locknuts

- Electrical Panel Installation:
  - ❖ Circuit Breaker Sizing:

For Transformer:

Total Load = Total Flat Load + Total Common Load
= (10*8+10.33) kw
= 90.33 kw.

According to the client total Demand Factor = 0.6
Demand Factor = peak demand/Total Connected load
So, peak demand = demand factor * total connected load
= 0.6*90.33
= 54.2 kw.
KVA = kw/p.f = 54.2/0.8 = 67.75 KVA.
According to the standard size, we select 80 KVA rated transformer. So the current rating of the transformer with 25% safety factor is 140A.
So, for the transformer 160A M.C.C.B is needed.

For the residential unit:

Total load for a single unit flat is 10kw. Circuit breaker size for the single unit flat is –

$$I = \frac{10\times10^3\times1.25}{415\times0.8} = 37.65\ A$$

It is suitable to select 80A MCCB size circuit breaker.

a. Master Bedroom:
S.B-1
Total Load = 40*2+100+20 = 200 watts.
Current, $I = \frac{200\times1.25}{230\times0.8} = 1.35A.$
So, 2A MCB should use.

For 3 pin outlet
Total Load = 1500 watts.
Current, $I = \frac{1500\times1.25}{230\times0.8} = 10.19A.$
So, two 16A MCB should use.

For 2 pin outlet
Total Load = 1500 watts.
Current, $I = \frac{1500\times1.25}{230\times0.8} = 10.19A.$
So, one 16A MCB should use.

b. Master Bedroom toilet:
S.B-2
Total Load = 20*2= 40 watts.
Current, $I = \frac{40\times1.25}{230\times0.8} = 0.27A.$
So, 2A MCB should use.

For 2 pin outlet
Total Load = 1500 watts.

Current, I = $\frac{1500\times1.25}{230\times0.8} = 10.19\text{A}.$
So, one 16A MCB should use.

c. 2nd Bedroom:
S.B-3
Total Load = 40*1+20*2+100 = 180 watts.
Current, I = $\frac{180\times1.25}{230\times0.8} = 1.23\text{A}.$
So, 2A MCB should use.

For 3 pin outlet
Total Load = 1500 watts.
Current, I = $\frac{1500\times1.25}{230\times0.8} = 10.19\text{A}.$
So, two 16A MCB should use.

For 2 pin outlet
Total Load = 1500 watts.
Current, I = $\frac{1500\times1.25}{230\times0.8} = 10.19\text{A}.$
So, one 16A MCB should use.

d. 2nd Bedroom toilet:
S.B-4
Total Load = 20*2 = 40 watts.
Current, I = $\frac{40\times1.25}{230\times0.8} = 0.27\text{A}.$
So, 2A MCB should use.

For 2 pin outlet
Total Load = 1500 watts.
Current, I = $\frac{1500\times1.25}{230\times0.8} = 10.19\text{A}.$
So, one 16A MCB should use.

e. 3rd Bedroom:
S.B-5
Total Load = 20*2+40+100 = 180 watts.
Current, I = $\frac{180\times1.25}{230\times0.8} = 1.23\text{A}.$
So, 2A MCB should use.

For 3 pin outlet
Total Load = 1500 watts.

Current, I = $\frac{1500\times1.25}{230\times0.8} = 10.19A.$

So, two 16A MCB should use.

f. 3rd Bedroom toilet:

S.B-6

Total Load = 20*2= 40 watts.

Current, I = $\frac{40\times1.25}{230\times0.8} = 0.27A.$

So, 2A MCB should use.

For 2 pin outlet

Total Load = 1500 watts.

Current, I = $\frac{1500\times1.25}{230\times0.8} = 10.19A.$

So, one 16A MCB should use.

g. Kitchen:

S.B-7

Total Load = 60+20*2+40= 140 watts.

Current, I = $\frac{140\times1.25}{230\times0.8} = 0.951A.$

So, 2A MCB should use.

For 2 pin outlet

Total Load = 1500 watts.

Current, I = $\frac{1500\times1.25}{230\times0.8} = 10.19A.$

So, one 16A MCB should use.

h. S. toilet:

S.B-8

Total Load = 20*1= 20 watts.

Current, I = $\frac{20\times1.25}{230\times0.8} = 0.136A.$

So, 2A MCB should use.

For 2 pin outlet

Total Load = 1500 watts.

Current, I = $\frac{1500\times1.25}{230\times0.8} = 10.19A.$

So, one 16A MCB should use.

i. Utility:

S.B-8

Total Load = 20*1+70= 90 watts.

Current, I = $\frac{90\times1.25}{230\times0.8} = 0.611A.$

So, 2A MCB should use.

For 2 pin outlet
Total Load = 1500 watts.
Current, I = $\frac{1500\times1.25}{230\times0.8} = 10.19\text{A}.$
So, one 16A MCB should use.

j. Dinning:

S.B-11
Total Load = 60*2+100*2+40= 360 watts.
Current, I = $\frac{360\times1.25}{230\times0.8} = 2.4456\text{A}.$
So, 6A MCB should use.

For 3 pin outlet
Total Load = 1500 watts.
Current, I = $\frac{1500\times1.25}{230\times0.8} = 10.19\text{A}.$
So, two 16A MCB should use.

For 2 pin outlet
Total Load = 1500 watts.
Current, I = $\frac{1500\times1.25}{230\times0.8} = 10.19\text{A}.$
So, one 16A MCB should use.

k. Family Living Room:

S.B-10
Total Load = 60*1+20*3+100+15*3 =265 watts.
Current, I = $\frac{265\times1.25}{230\times0.8} = 1.8\text{A}.$
So, 40A MCB should use.

For 3 pin outlet
Total Load = 1500 watts.
Current, I = $\frac{1500\times1.25}{230\times0.8} = 10.19\text{A}.$
So, three 16A MCB should use.

- **Size of MDB:**

  According to the BNBC 1.3.12.2 code size of the DB panels are -

| Dimensions (mm) | | | No. of MCB's or Fuses |
|---|---|---|---|
| Height | Width | Depth | |
| 350 | 390 | 120 | up to 12 |
| 480 | 390 | 120 | up to 24 |
| 610 | 390 | 120 | up to 36 |
| 740 | 390 | 120 | up to 48 |

  For this residential unit building we use 33 circuit breakers, so the dimensions of the MDB will be 610 x 390 x120 $mm^3$.

- **No. of 13A (3 pin) outlet:**

  According to the BNBC 1.3.3.2 code no. of 3 pin 13A outlets are –

| ROOMS | No. of 13A (3 pin) outlet |
|---|---|
| Bedrooms | 2 |
| Living Room | 3 |
| Drawing Room | 3 |
| Dinning Room | 3 |
| Kitchen | 1 |

- **Lighting Installation:**

  For the installation of lights in the residential unit we use one way switching arrangement.

  - **One-way switch circuit:** The single-pole switch must be connected to the live conductor. To ensure that both live and neutral conductors are isolated from the supply a double-pole switch may be used.

    For the all rooms except of the drawing room we use one way single pole switch circuit for controlling one lamp.

    In the drawing room we had use one way single pole switch circuit for controlling two or more lamps.

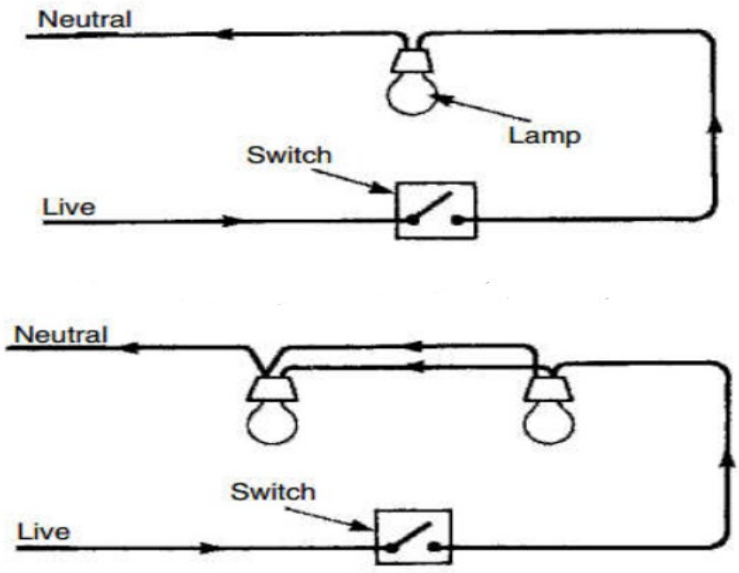
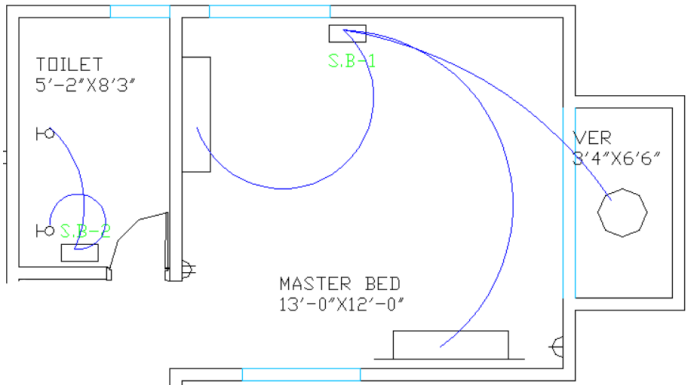
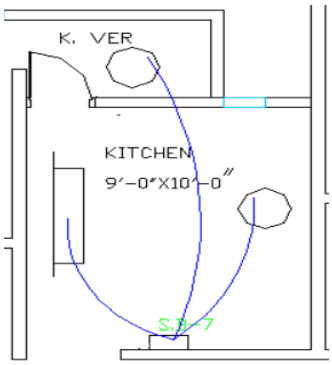


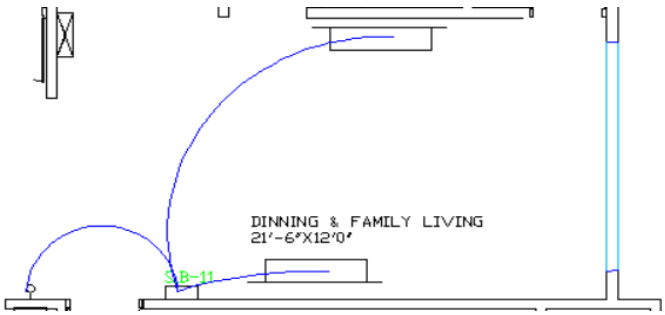

Fig. 1. one way single pole switch circuit for controlling one lamp and one way single pole switch circuit for controlling two or more lamps.




a. Master Bedroom




b. Kitchen




c Dinning and Family living.

Fig. 2. one way single pole switch circuit for controlling one lamp in different rooms.

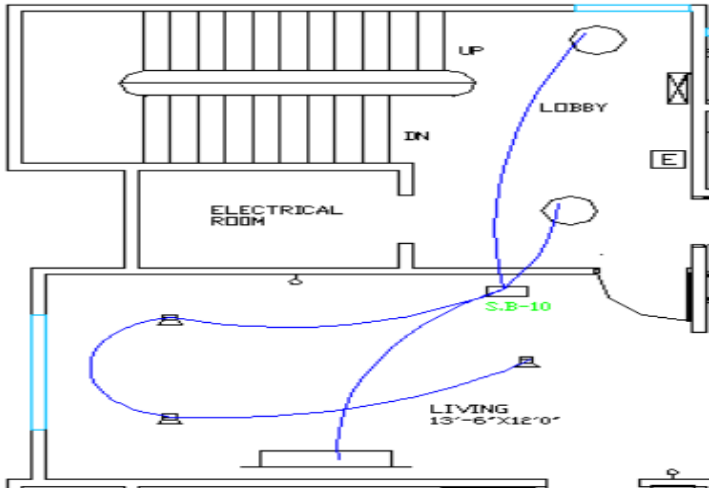



Fig. 3. one way single pole switch circuit for controlling two or more lamps used in Living room.

10. **Load Study :**

| Load Description | LOAD(WATTS) | p.f | VA | VOLTAGE | AB | BC | CA |
|---|---|---|---|---|---|---|---|
| LIGHT(S.B-1) | 40 | 1 | 40 | 230 | 0.173913 | | |
| LIGHT(S.B-3) | 80 | 1 | 80 | 230 | | 0.347826 | |
| LIGHT(S.B-9) | 20 | 1 | 20 | 230 | | | 0.086957 |
| LIGHT(S.B-1) | 20 | 1 | 20 | 230 | 0.086957 | | |
| FAN(S.B-1) | 100 | 0.9 | 90 | 230 | | 0.391304 | |
| FAN(S.B-9) | 70 | 0.9 | 63 | 230 | | | 0.273913 |
| FAN(S.B-1) | 100 | 0.9 | 90 | 230 | 0.391304 | | |
| AC(S.B-E1) | 1300 | 0.85 | 1105 | 230 | | 4.804348 | |
| LIGHT(S.B-10) | 45 | 1 | 45 | 230 | | | 0.195652 |
| AC(S.B-E2) | 1500 | 0.85 | 1275 | 230 | 5.543478 | | |
| TV(S.B-E3) | 130 | 0.96 | 124.8 | 230 | | 0.542609 | |
| LIGHT(S.B-10) | 120 | 1 | 120 | 230 | | | 0.521739 |
| TV(S.B-E4) | 150 | 0.96 | 144 | 230 | 0.626087 | | |
| LIGHT(S.B-4) | 40 | 1 | 40 | 230 | | 0.173913 | |
| FAN(S.B-10) | 100 | 0.9 | 90 | 230 | | | 0.391304 |
| LIGHT(S.B-2) | 20 | 1 | 20 | 230 | 0.086957 | | |
| LIGHT(S.B-5) | 80 | 1 | 80 | 230 | | 0.347826 | |
| TV(S.B-10) | 130 | 0.96 | 124.8 | 230 | | | 0.542609 |
| WASHING MACHINE(F-2) | 400 | 0.75 | 300 | 230 | 1.304348 | | |
| FAN(S.B-5) | 100 | 0.9 | 90 | 230 | | 0.391304 | |
| MICROWAVE(S.B-E5) | 1200 | 0.98 | 1176 | 230 | | | 5.113043 |
| LIGHT(S.B-8) | 20 | 1 | 20 | 230 | 0.086957 | | |
| LIGHT(S.B-6) | 40 | 1 | 40 | 230 | | 0.173913 | |
| TV(S.B-E10) | 130 | 0.9 | 117 | 230 | | | 0.508696 |
| LIGHT(S.B-12) | 20 | 1 | 20 | 230 | 0.086957 | | |
| LIGHT(S.B-7) | 80 | 1 | 80 | 230 | | 0.347826 | |
| REFRIGERATOR(S.B-E14) | 400 | 0.96 | 384 | 230 | | | 1.669565 |
| TV(S.B-E7) | 150 | 0.96 | 144 | 230 | 0.626087 | | |
| FAN(S.B-7) | 40 | 0.9 | 36 | 230 | | 0.156522 | |
| Control Panel(S.B-E15) | 20 | 0.9 | 18 | 230 | 0.078261 | | |
| LIGHT(S.B-11) | 200 | 1 | 200 | 230 | | 0.869565 | |
| LIGHT(S.B-2) | 20 | 1 | 20 | 230 | 0.086957 | | |
| FAN(S.B-11) | 200 | 0.9 | 180 | 230 | | 0.782609 | |
| | | | | | | | |
| 0 | 6945 | 29.33 | 6276.6 | 7130 | 9.004348 | 8.981739 | 9.303478 |

Three phase balance check = $\frac{MAX.(RYB) - MIN(RYB)}{MAX.(RYB)} = \frac{9.33 - 9.18}{9.33}$ = 1.60 %.

So, all the phase are balanced.

11. **Bill of Quantity:**
12. **Estimation:**

Per square feet cost is near about 2000 taka.

So to build a residential unit, the total budget will be near about 1875* 2000 taka

= 37,50,000 taka.

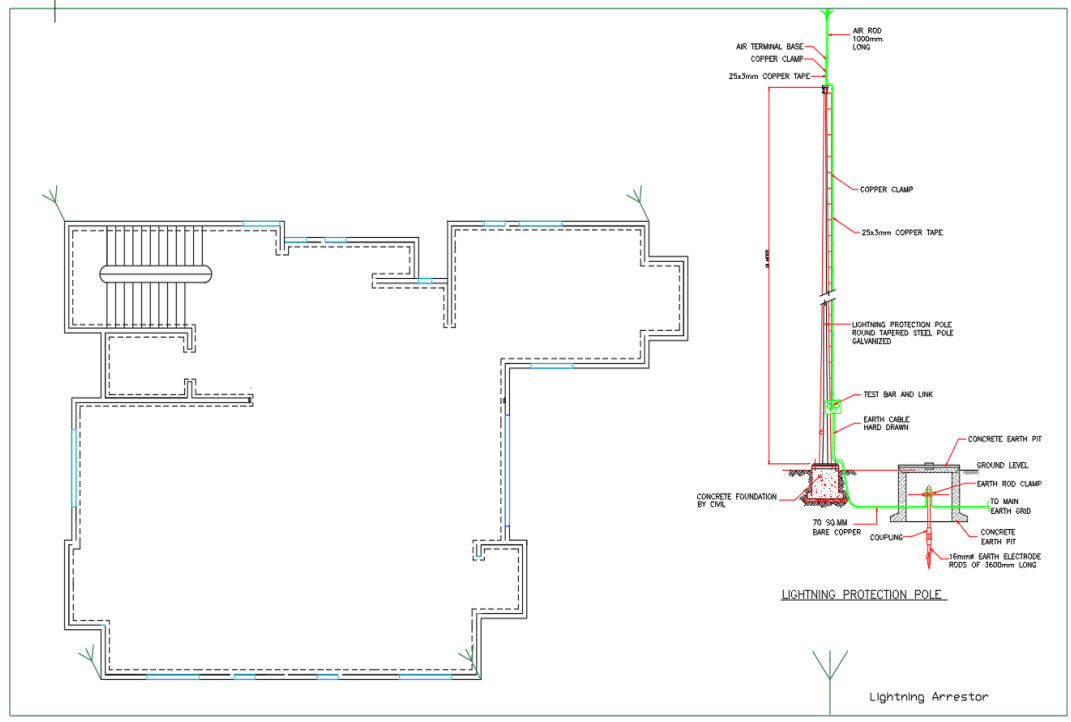
So the total cost of the electrical service design would be 10% of the total budget. So the total estimated cost for the electrical installation is = 37,50,000*0.1 taka

=3,75,000 taka.

Here the bill of quantity is below our budget.

13. **Lightning Protection System:**

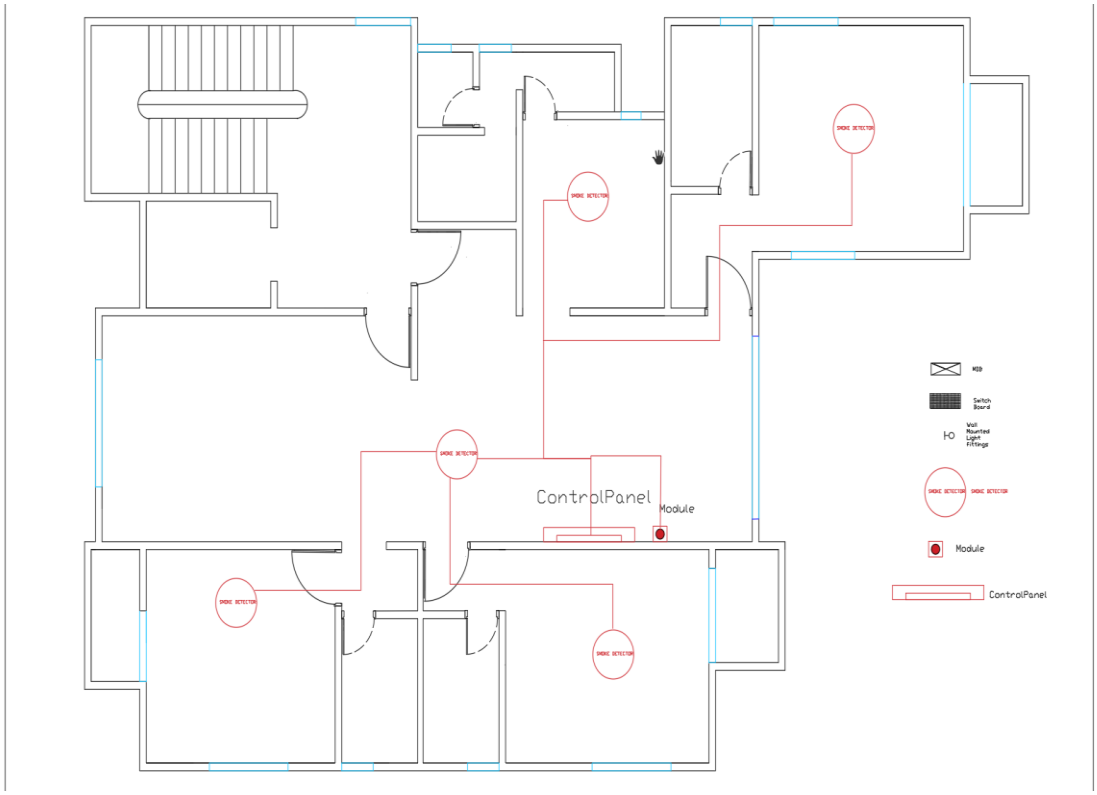
Implemented in each building corner, four lightning arrestors fortify our lightning protection system. Adherence to the regulations set by the Bangladesh National Building Code ensures the ongoing maintenance of this safeguard.




14. **Fire and Emergency:**

The system was designed by the regulations set by the Bangladesh National Building Code which ensures the ongoing maintenance of this safeguard. We accomplished this by installing

smoke detectors in rooms with the minimum required concrete height for their placement. These detectors are interconnected through a control panel and a module for seamless integration.




15. **<u>Grounding Technique:</u>**

a. Total Load = Total Flat Load + Total Common Load
= (10*8+10.33) kw
= 90.33 kw.

According to the client total Demand Factor = 0.6
Demand Factor = peak demand/Total Connected load
So, peak demand = demand factor * total connected load
= 0.6*90.33
= 54.2 kw.
KVA = kw/p.f = 54.2/0.8 = 67.75 KVA.

b. Secondary Current = $\frac{67.75 \times 1000}{1.732 \times 380}$ = 102.94 amp.

c. Leakage Reactance, Z(%) = 4.

d. Short Circuit Current = $\frac{I_{sec} \times 100}{Z} = \frac{102.94 \times 100}{4}$ = 2573.46 amp =2.58 Ka

e. Transformer Resistance, R = $\frac{220}{2.58 \times 10^3}$ = 0.085271 ohm.

f. Resistance of cable inserting into residential unit (4 × 35 sm) = 0.524 × 0.015 $\Omega$
= 0.008 $\Omega$

g. Total Resistance = $R_{cable} + R_{Transformer}$ = 0.008 + 0.085271 = 0.093271 $\Omega$

h. Short Circuit Current = $\frac{220}{0.093271}$ = 2358.72 amp = 2.4 KA.

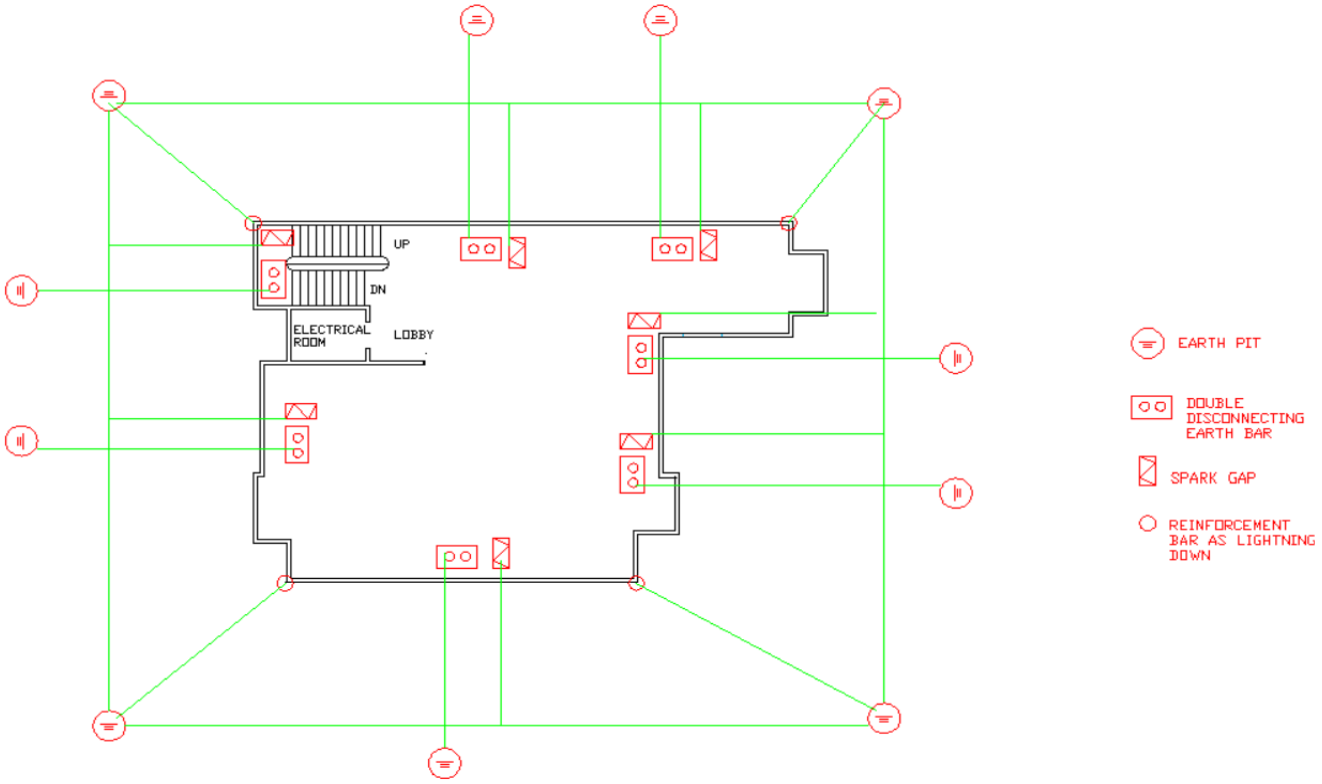
i. Resistance of one rod = $R = \frac{\rho}{2\pi L}\left[ In\left(\frac{8L}{d}\right) - 1 \right]$

Here , $\rho$ = 15 , L= 2.44 m , d = 0.0127 m.

j. Resistance of number of rods = $R_n = R.\left(\frac{1+\lambda.a}{n}\right)$ = 0.91142 ohm.

Here, $\lambda$ = 8 , n=11, a = 0.077 $mm^2$

k. the conductor cross section is = $S = \frac{\sqrt{(I)^2 t}}{K}$ = 13.4 $mm^2$. t =1 and k = 176



16. **Concluding Remarks:**

In conclusion, the meticulous design of electrical services for this residential building exemplifies a commitment to both safety and compliance with the Bangladesh National Building Code. By integrating cutting-edge technology and adhering to the stringent regulations outlined in the code, we have crafted a robust electrical infrastructure that not only meets the highest standards but also prioritizes the well-being and convenience of the residents. This holistic approach considers not only the present needs but also anticipates future demands, ensuring a sustainable and resilient electrical system for the long-term. Our dedication to excellence in design, coupled with strict adherence to regulatory frameworks, sets a benchmark for electrical services in residential buildings, contributing to the overall advancement of safety and quality standards in construction practices.