Islamic University of Technology

PROJECT REPORT

Electrical Service Design (EEE 4418)

GROUP NO: 04

Submitted by -

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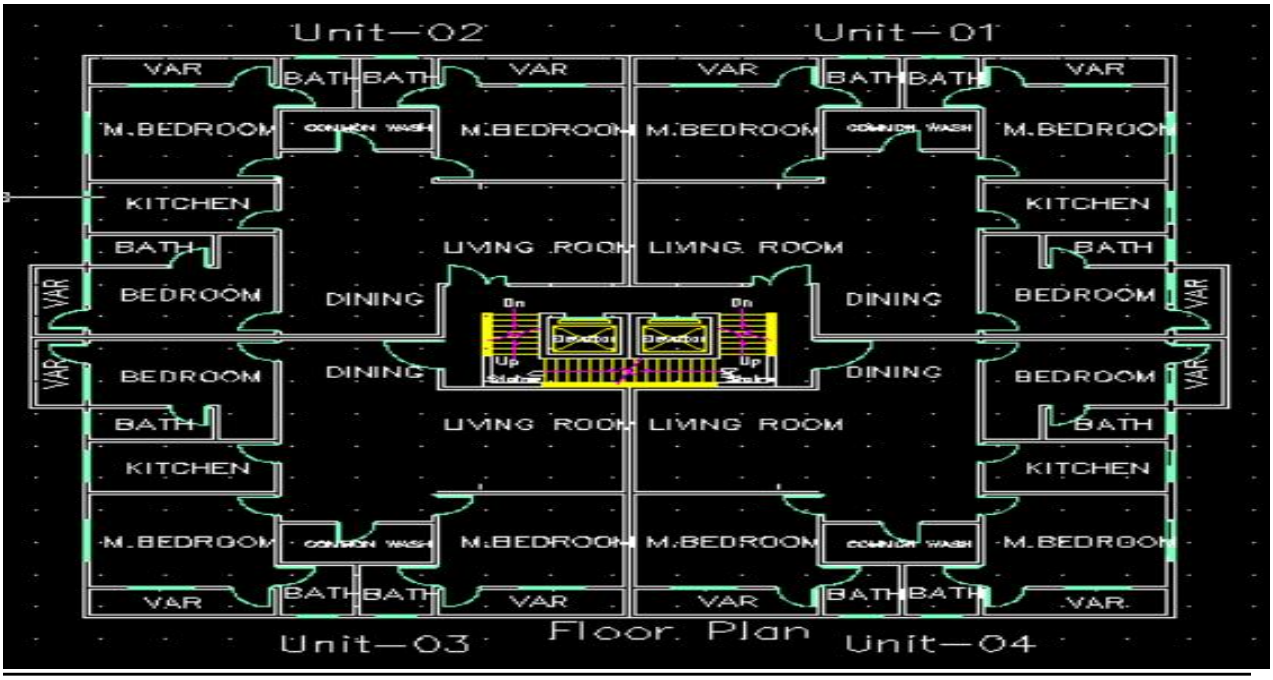
Project Summary: –

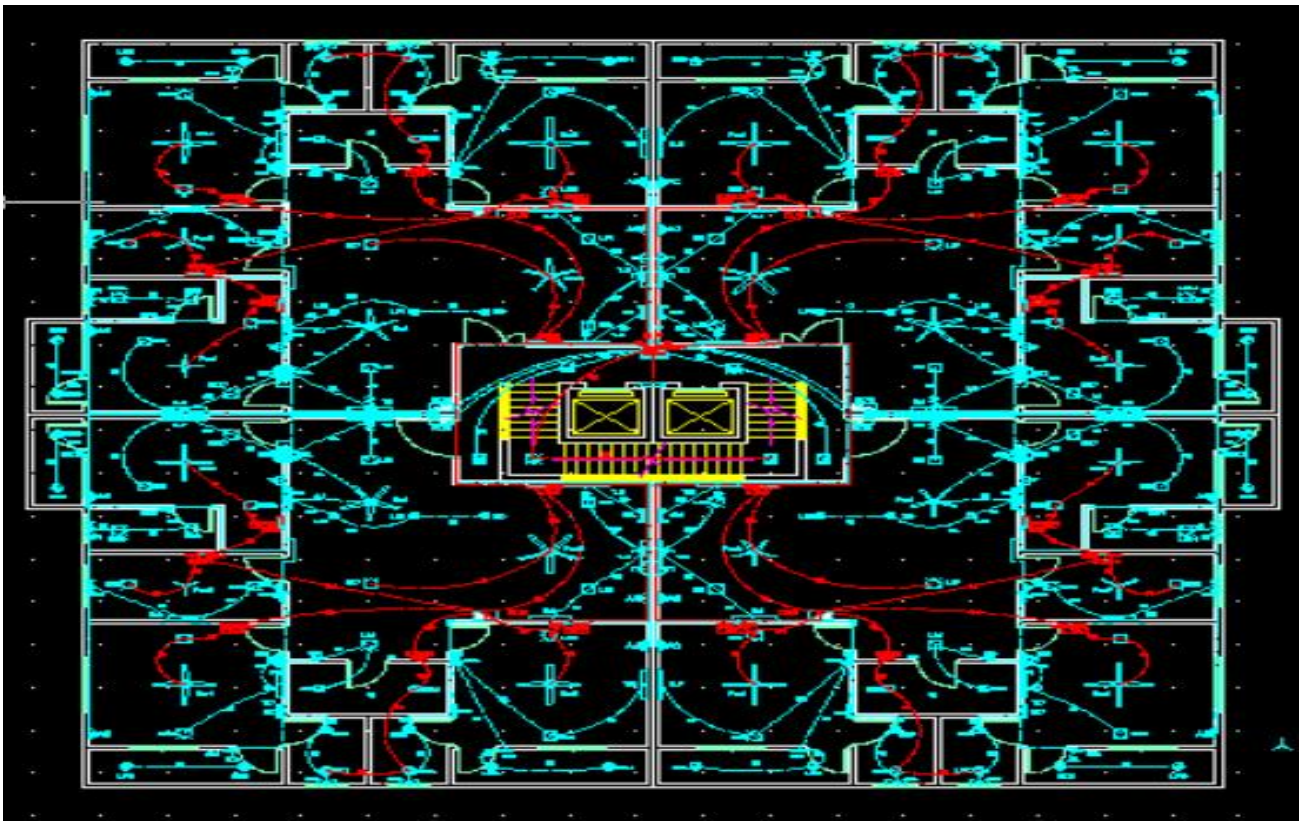
This project presents a fully integrated architectural and electrical design of a residential building using AutoCAD 2007, encompassing detailed layouts for the ground floor, unit floors, and rooftop. Each residential unit is thoughtfully arranged to include three spacious bedrooms, a modern kitchen, three functional toilets, three verandas, a cozy living room, and a dedicated dining area, ensuring comfort and practicality. The ground floor accommodates essential amenities such as parking spaces, a generator room, a service room, and additional toilets for convenience. The rooftop is designed with a lot of free space, a small room and water tanks. Comprehensive electrical diagrams have been developed for each level, detailing switchboard connections, sub-distribution boards, and main distribution boards for both standard and emergency scenarios, ensuring system safety, reliability, and operational readiness. Legends for conduits, fittings, and fixtures are included to enhance clarity, and all necessary calculations have been meticulously performed to validate the design's feasibility and efficiency, resulting in a robust and well-executed building plan.

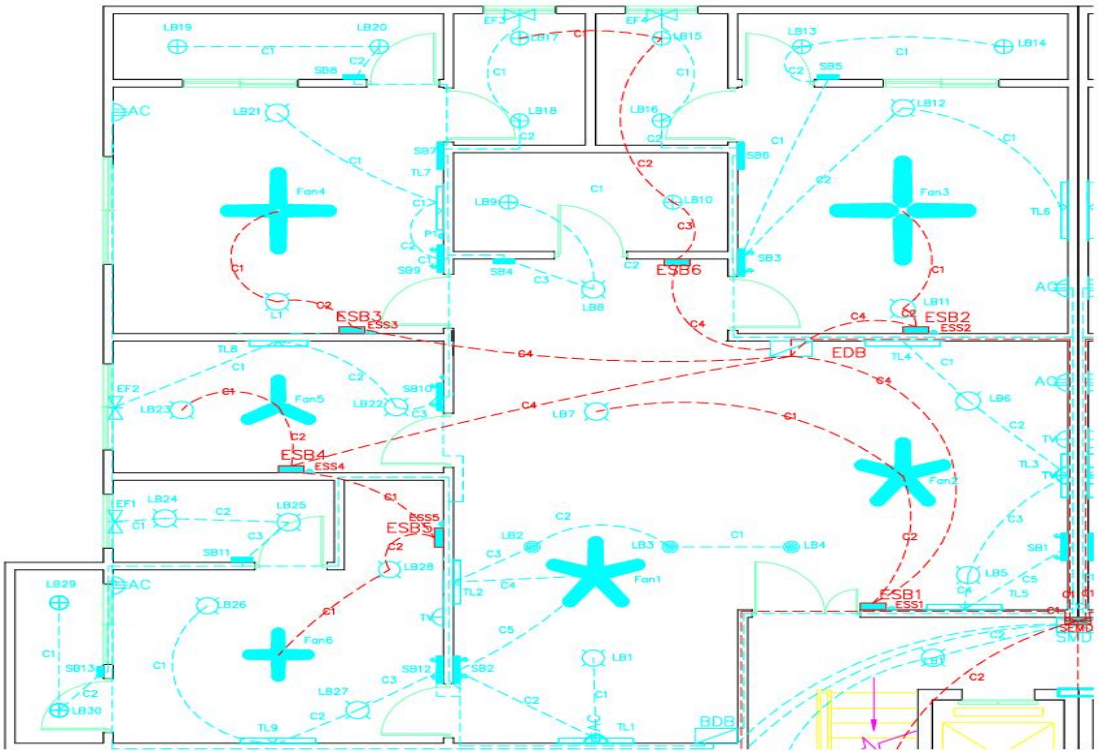
Legends:

Fittings & Fixtures	
Description	**Symbol**
Light Bulb	
2-Pin 5A Socket at SB Level	
3-Pin 5A/15A Socket	
2-Pin 5A Socket at Table Height	
2-Pin 5A Socket at Skirting Level for TV	
Switch Board	
Tube Light	
Ceiling Light Fitting Type K	
Sub Main Distribution Board	
Main Distribution Board	
Exhaust Fan	
Ceiling Fan	
Lift	
Emergency Switch Board	
Emergency Distribution Board	
Conduits	
Description	**Size**
C1=2 x 1.5 rm BYM	0.75”
C2=4 x 1.5 rm BYM	0.75”
C2=4 x 1.5 rm BYM	0.75”
C4=8 x 1.5 rm BYM	0.75”
C5=2 x 1.5 rm BYM + 1.5 rm BYA ECC	0.75”

Floor Plan (Main—Fittings & Fixtures—Conduits):

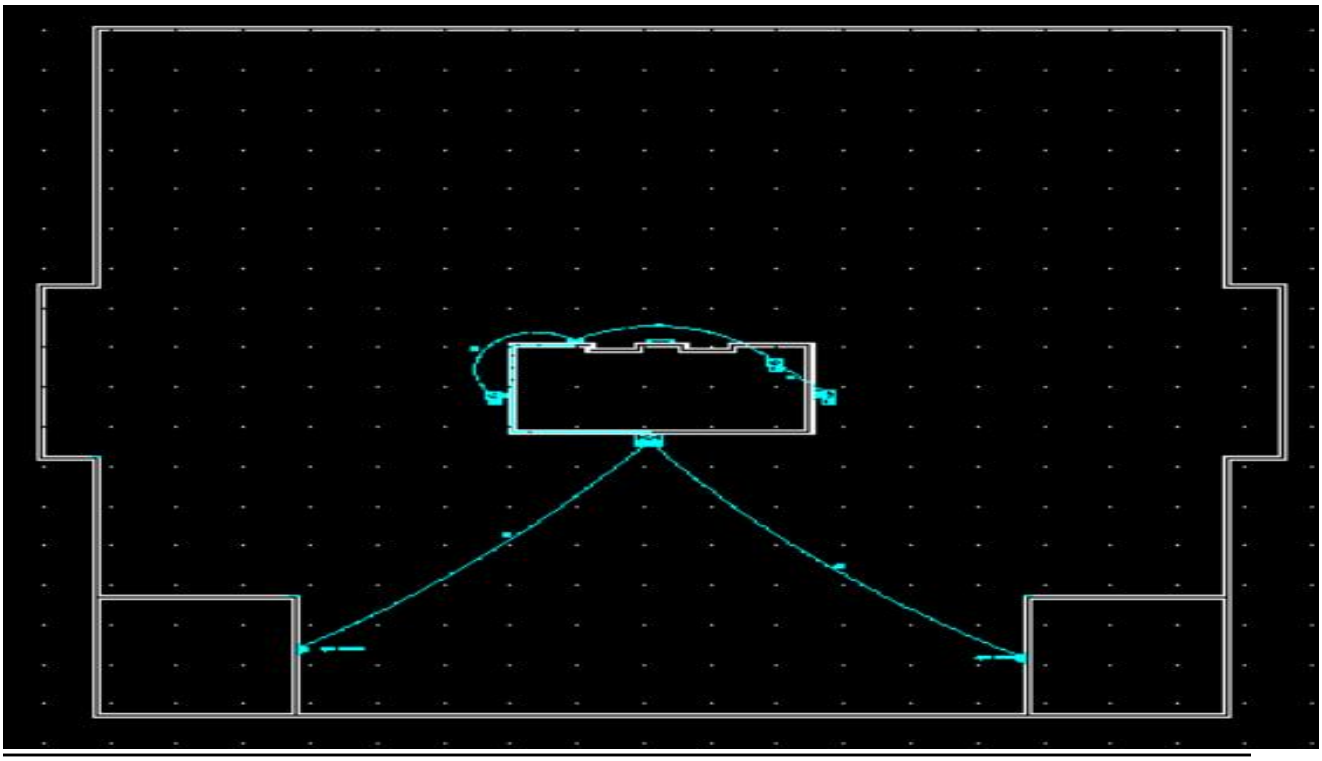




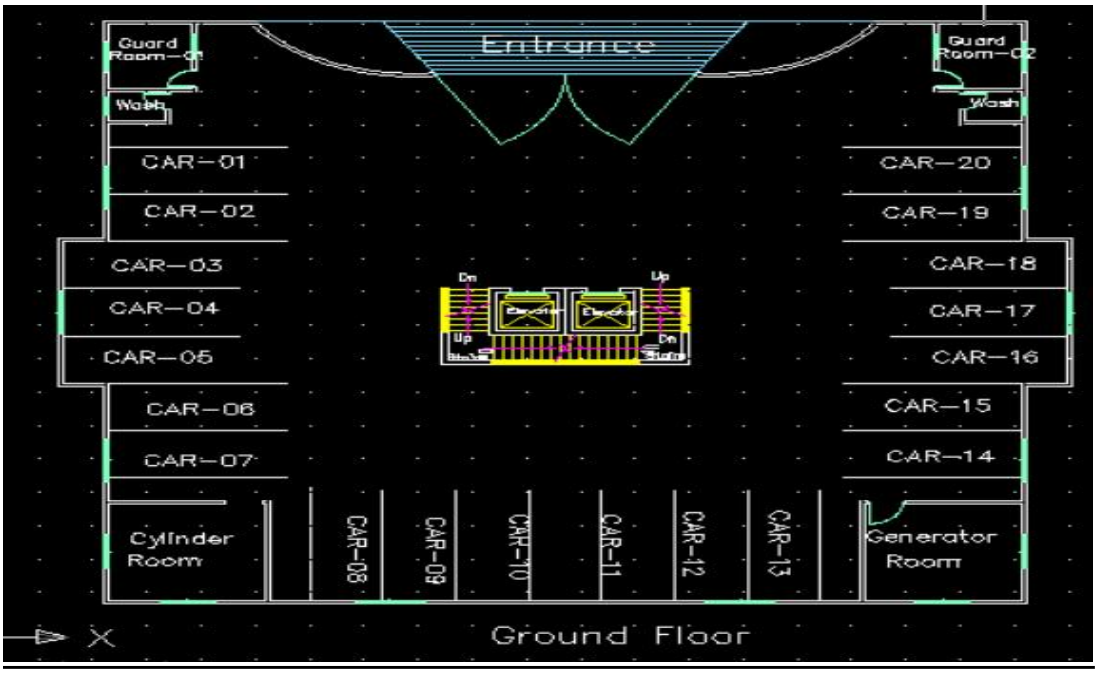


Single unit layout

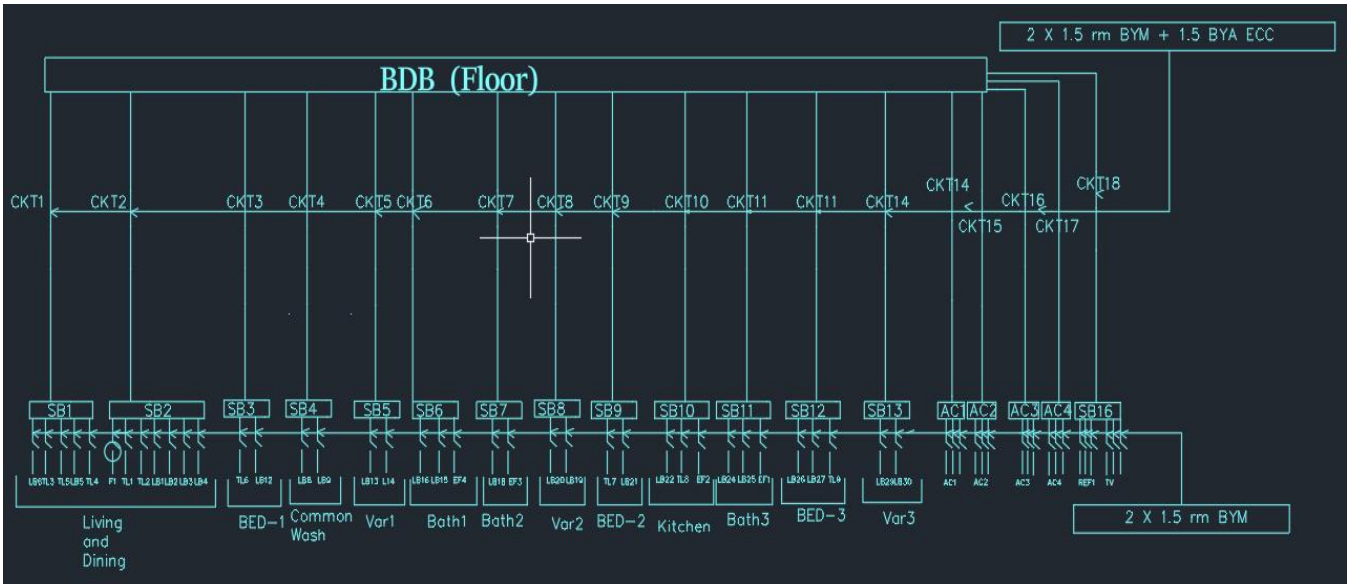
Rooftop Plan (Main—Fittings & Fixtures—Conduits):



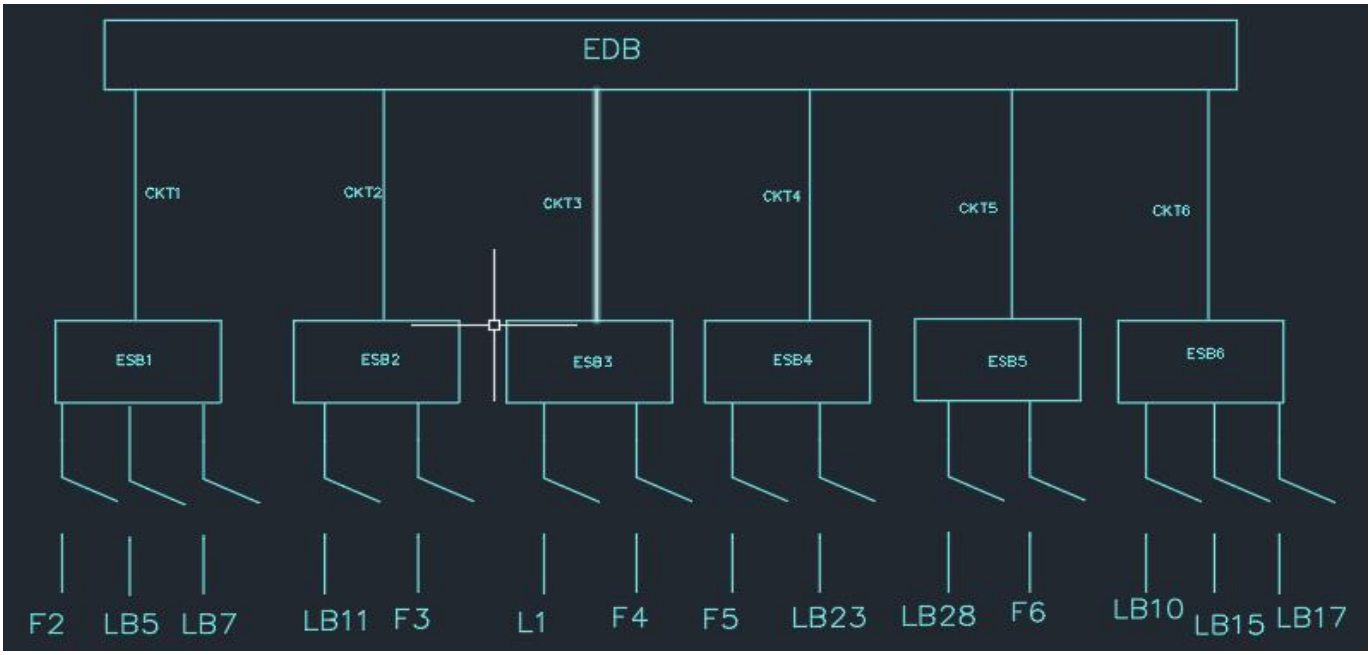
Ground Floor Plan (Main—Fittings & Fixtures—Conduits):



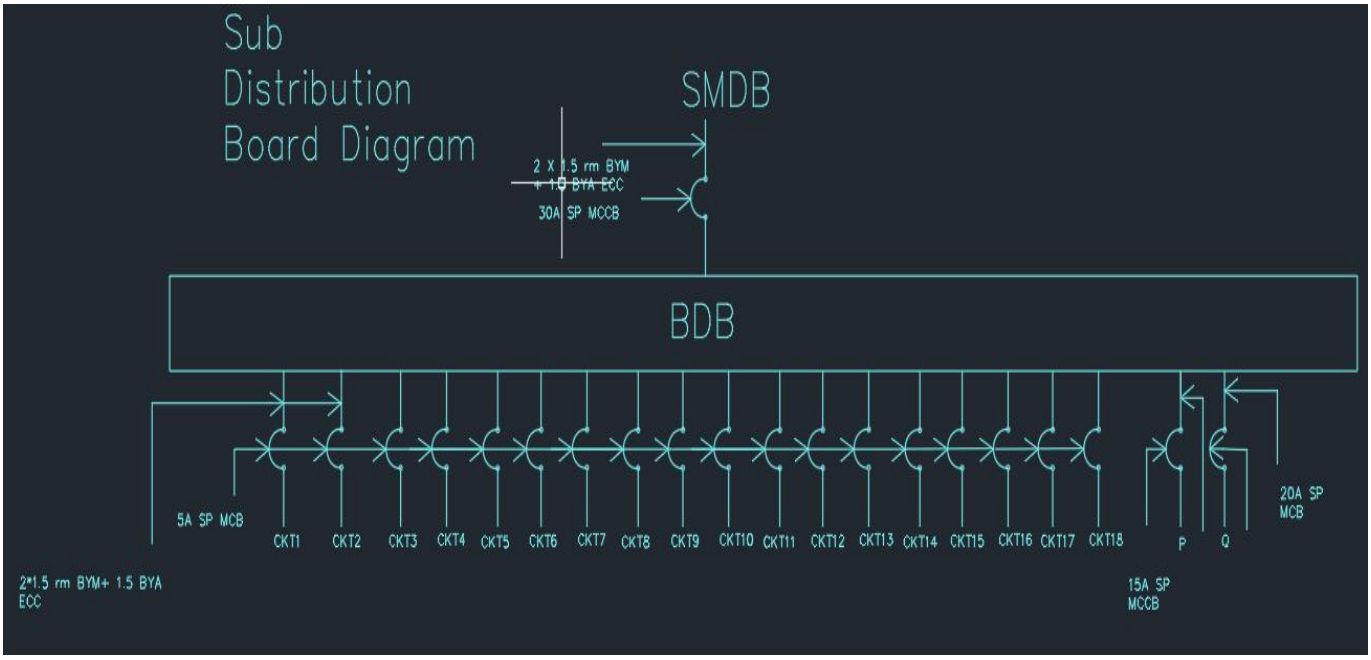
Switch Board Connection Diagram (Floor):



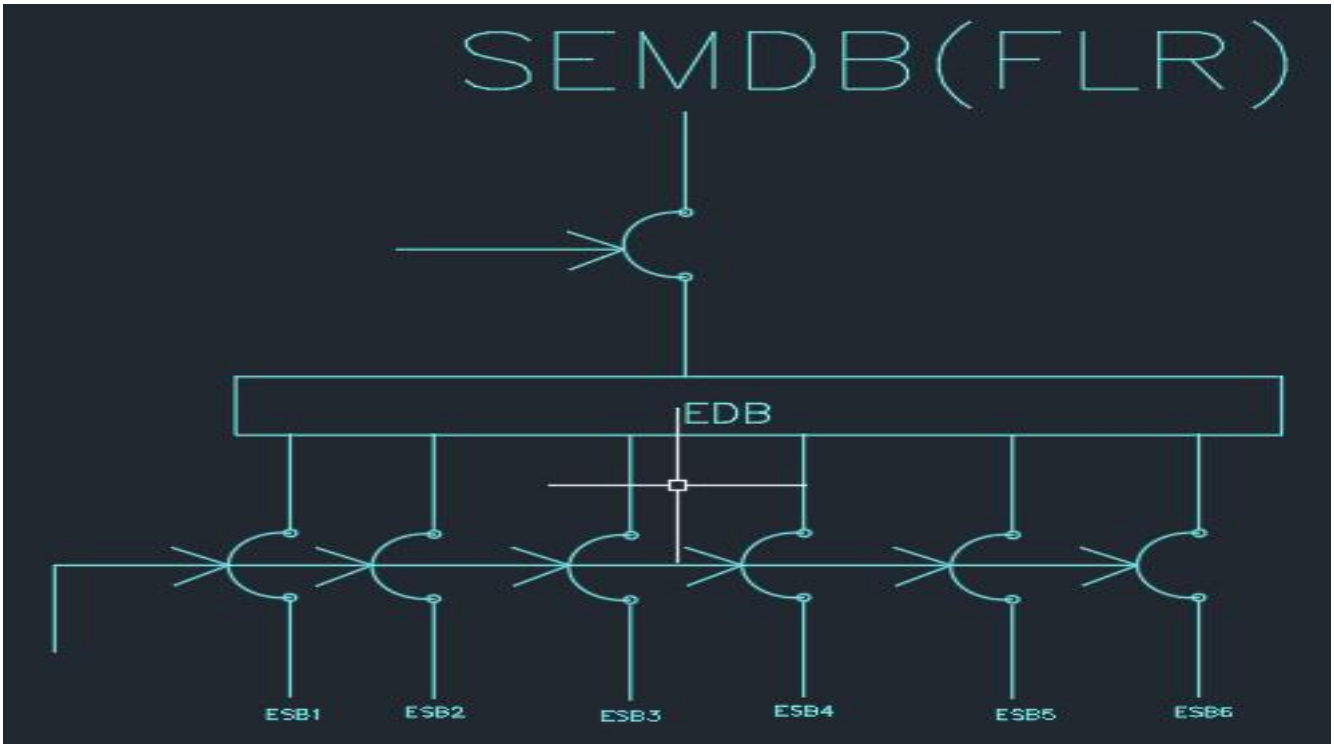
Emergency Switch Board Connection Diagram (Floor):



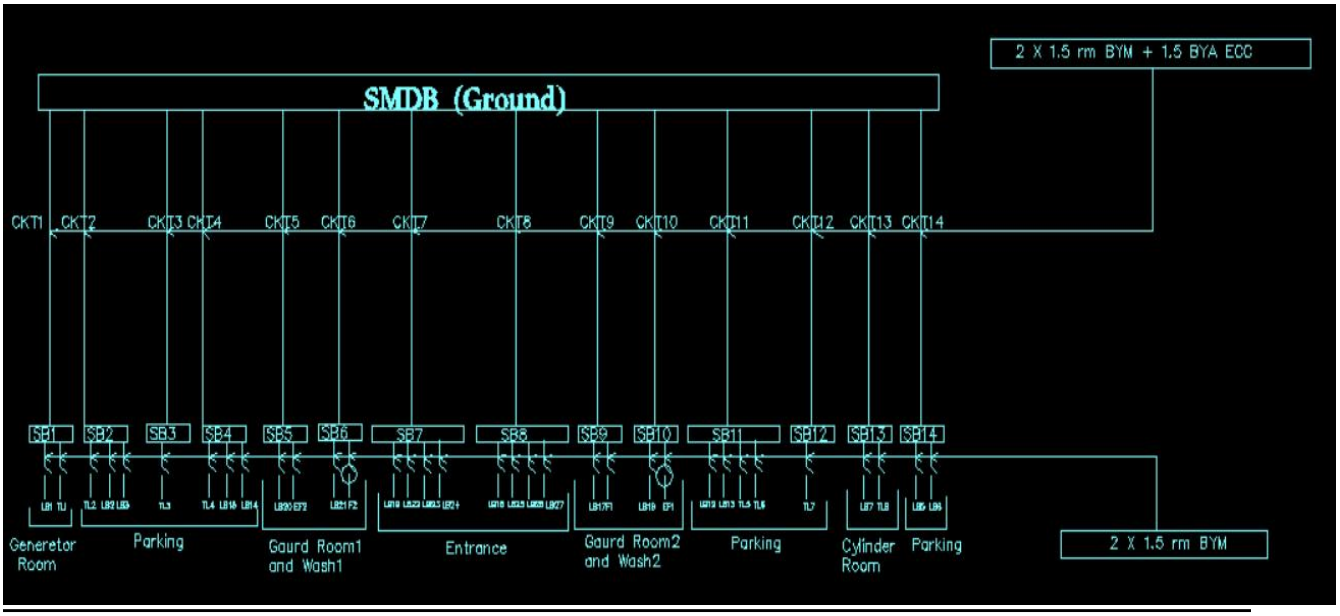
Sub Distribution Board Diagram (Floor):



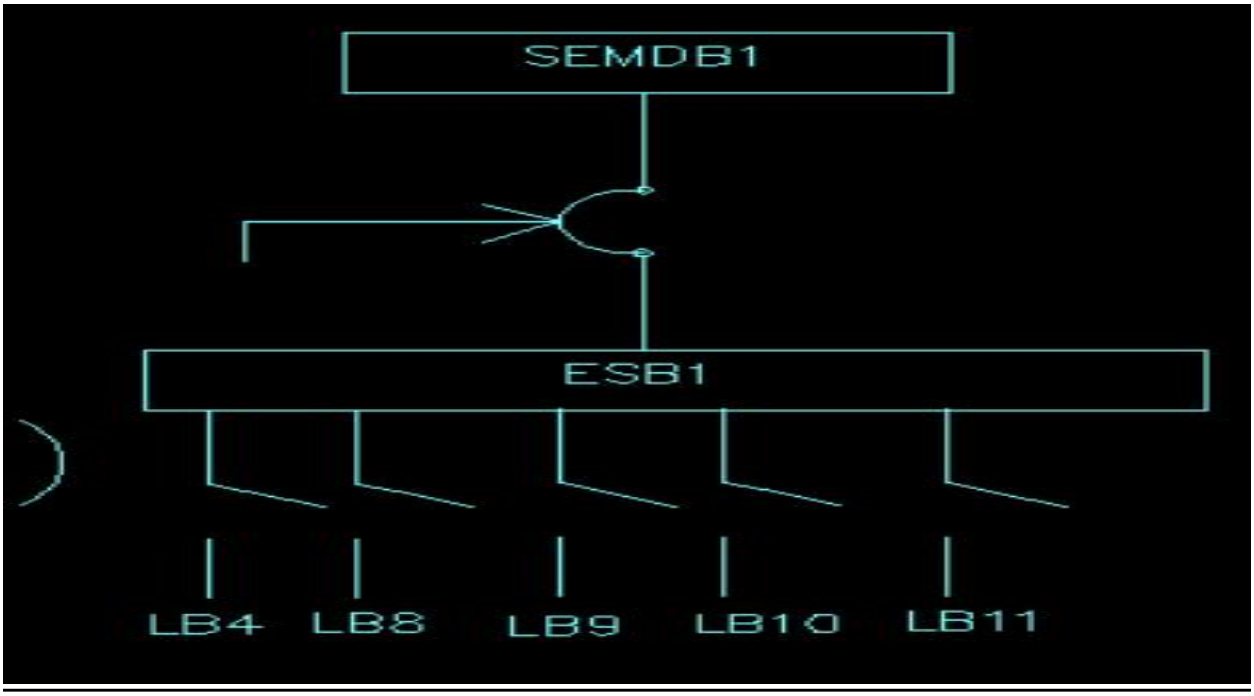
Emergency Sub Distribution Board Diagram (floor):



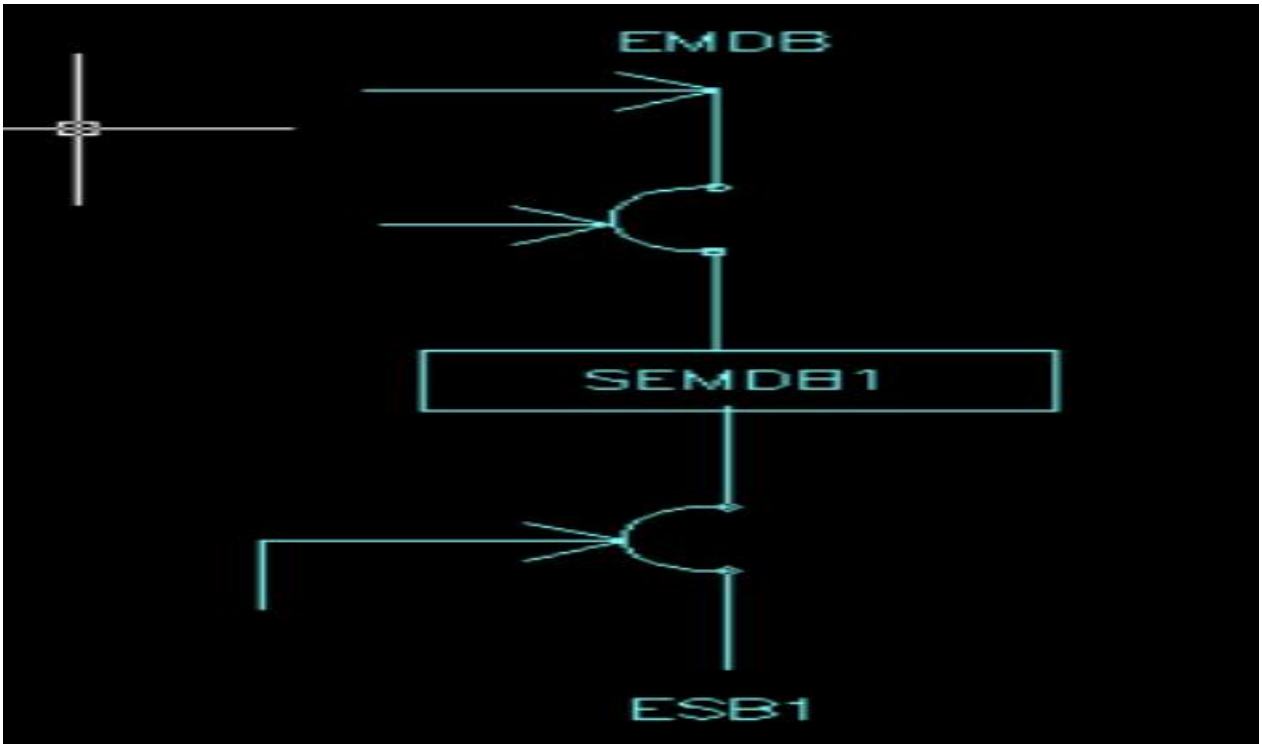
Switch Board Connection Diagram (Ground):



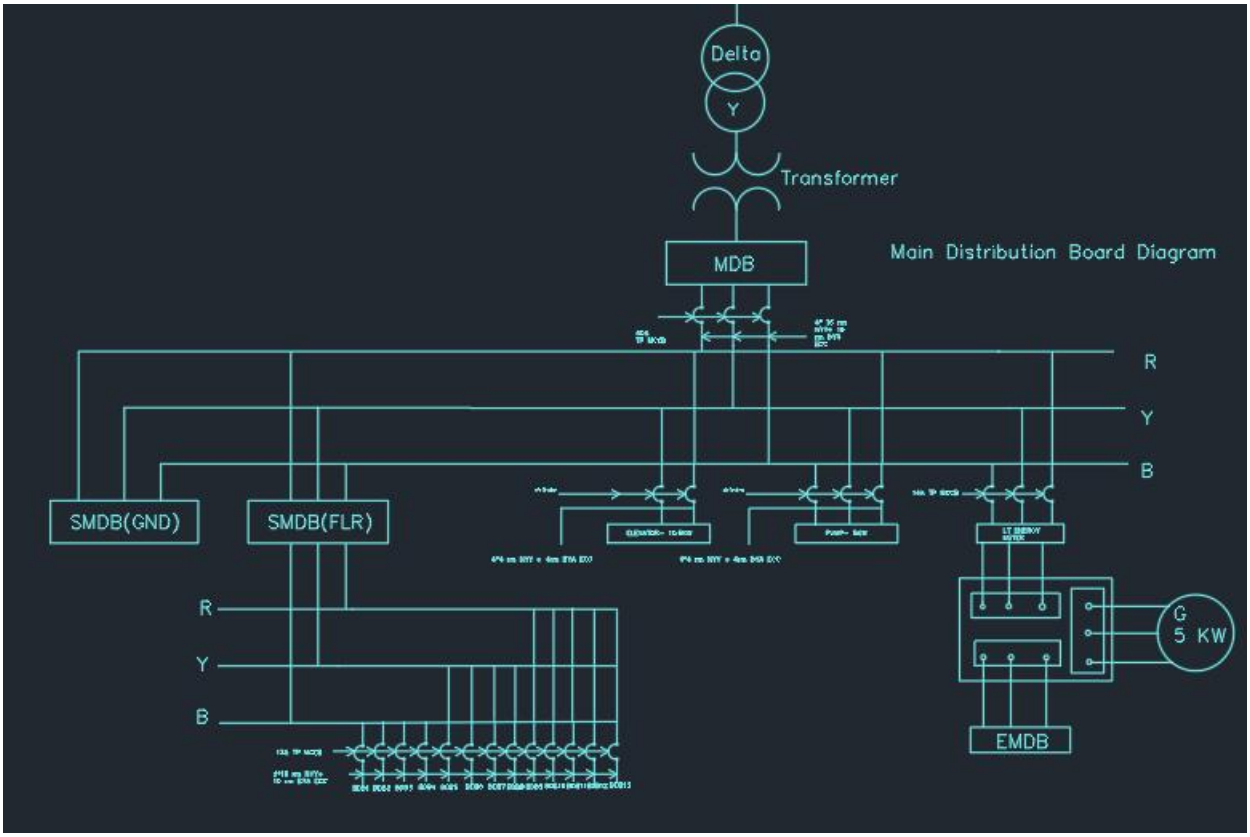
Emergency Switch Board Connection Diagram (Ground):



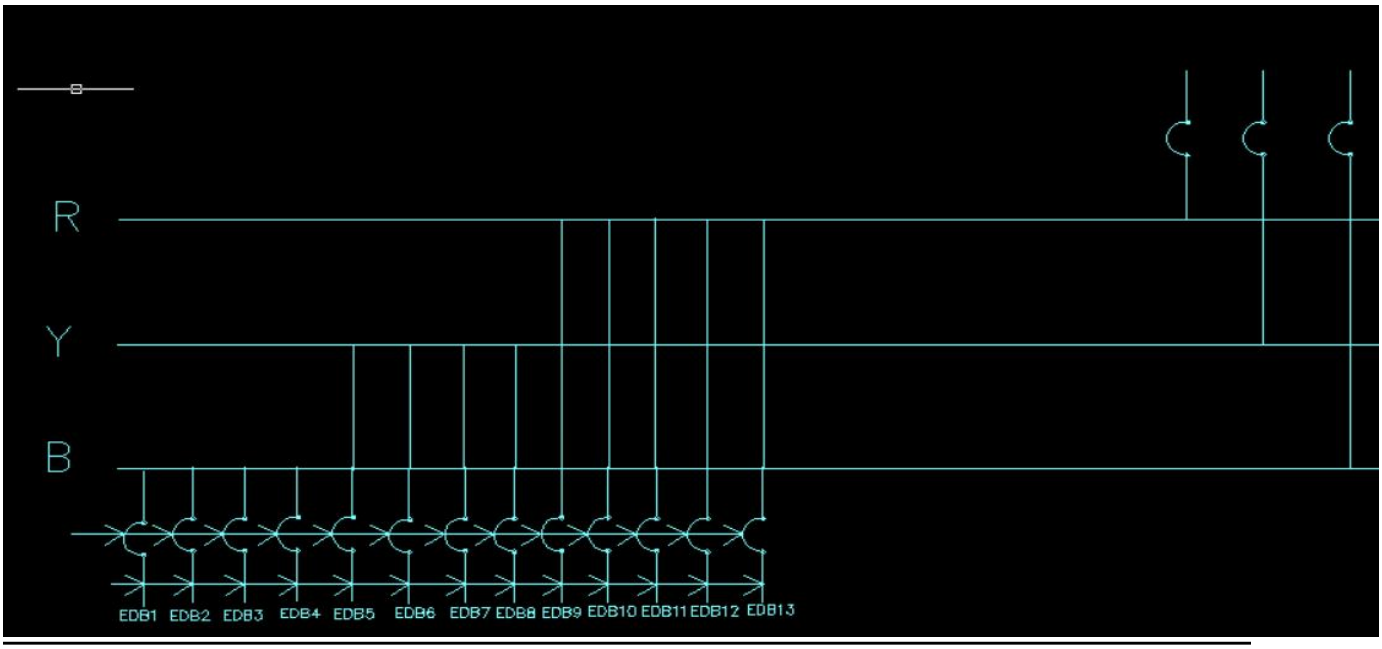
Emergency Sub Distribution Board Diagram (Ground):



Main Distribution Board Diagram:



Emergency Main Distribution Board Diagram:



Calculations:

Lights and Fans

- **Bedroom 1**

  Area, A = (14.36×0.3046 × 9.94×0.3046) m² = 4.374056×3.027724 = 13.2434 m²
  E = 100 lumen/m²; LLF×UF = 0.7
  Required lamp lumen = E×A / (LLF×UF) = 100×13.2434 / 0.7 = 1891.92 lm Choose: bulb = 800 lm, tube = 1250 lm; Proposed = 1 bulb + 1 tube
  Total lamp lumen = 1×800 + 1×1250 = 2050 lm; Delivered = 2050×0.7 = 1435 lm
  Achieved illuminance = 1435 / 13.2434 = 108.3 lux (>100)
  Number of fans = A/100 = 13.2434/100 = 0.132 → 1

  fan Final: 1 fan, 1 tubelight, 1 lightbulb

- **Common washroom**

  Area, A = (6×0.3046 × 5×0.3046) m² = 1.8276×1.523 = 2.78343 m²
  E = 100 lumen/m²; LLF×UF = 0.7
  Required lamp lumen = E×A / (LLF×UF) = 100×2.78343 / 0.7 = 397.63 lm Choose: bulb = 800 lm; Proposed = 2 bulbs, 0 tube
  Total lamp lumen = 2×800 = 1600 lm; Delivered = 1600×0.7 = 1120 lm Achieved illuminance = 1120 / 2.78343 = 402.38 lux (>100)
  Number of fans = A/100 = 3.395568/100 = 0.0339(Exhaust Fan)
  Final: **1 exhaust fan, 2 light bulbs, 0 tube lights**

- **VAR-1,2,3**

  Area, A = (12×0.3046 × 6×0.3046) m² = 3.6552×1.8276 = 6.68024 m²
  E = 100 lumen/m²; LLF×UF = 0.7
  Required lamp lumen = E×A / (LLF×UF) = 100×6.68024 / 0.7 = 954.32 lm Choose: bulb = 800 lm; Proposed = 2 bulbs
  Total lamp lumen = 2×800 = 1600 lm; Delivered = 1600×0.7 = 1120 lm Achieved illuminance = 1120/6.68024 = 167.7 lux(>100)
  Final: 2 light bulbs, 0 tube lights

- **Bedroom 2,3**

  Area, A = (14.36×0.3046 × 9.94×0.3046) m² = 4.374056×3.027724 = 13.2434 m²
  E = 100 lumen/m²; LLF×UF = 0.7
  Required lamp lumen = E×A / (LLF×UF) = 100×13.2434 / 0.7 =
  1891.92 lm Choose: bulb = 800 lm, tube = 1250 lm; Proposed =
  1 bulb + 1 tube
  Total lamp lumen = 1×800 + 1×1250 = 2050 lm; Delivered = 2050×0.7 = 1435 lm
  Achieved illuminance = 1435 / 13.2434 = 108.3 lux (>100)
  Number of fans = A/100 = 13.2434/100 = 0.132 → 1

  fan Final: 1 fan, 1 tubelight, 1 lightbulb

- **Dining Room**

  Area, A = (18×0.3046 × 12×0.3046) m² = 5.4828×3.6552 = 20.0407 m²
  E = 100 lumen/m²; LLF×UF = 0.7
  Required lamp lumen = E×A / (LLF×UF) = 100×20.0407 / 0.7 =
  2862.96 lm Choose: bulb = 800 lm, tube = 1250 lm; Proposed =
  4 bulbs + 2 tubes
  Total lamp lumen = 4×800 + 2×1250 = 5700 lm; Delivered = 5700×0.7 = 3990 lm
  Achieved illuminance = 3990 / 20.0407 = 199.1 lux (>100)
  Number of Fans (your rule: 18×12/100) = 18×12 / 100 = 2.16 → **1 fan**

  Final: **1 fan, 2 tube lights, 4 light bulbs**

- **Living Room**

Area, A = (12.15×0.3046) ×(12.15×0.3046) m² = 3.70089×3.70089 = 13.6966 m²
E = 100 lumen/m²; LLF×UF = 0.7
Required lamp lumen = E×A / (LLF×UF) = 100×13.6966 / 0.7 =
1956.66 lm Choose: bulb = 800 lm, tube = 1250 lm; Proposed = 3
bulbs + 2 tubes
Total lamp lumen = 3×800 + 2×1250 = 4900 lm; Delivered = 4900×0.7 = 3430 lm
Achieved illuminance = 3430 / 13.6966 = 250.4 lux
(>100) Number of fans = A/100 = 13.6966/100 =

0.137 → 1 fan Final: **1 fan, 3 light bulbs, 2 tube lights**

- **Bathroom 1**

  Area, A = (6.63×0.3046 × 5.52×0.3046) m² = 2.019498×1.681392 = 3.395568 m²
  E = 100 lumen/m²; LLF×UF = 0.7
  Required lamp lumen = E×A / (LLF×UF) = 100×3.395568 / 0.7 = 485.08 lm Choose: bulb = 800 lm; Proposed = 2 bulbs
  Total lamp lumen = 2×800 = 1600 lm; Delivered = 1600×0.7 = 1120 lm Achieved illuminance = 1120 / 3.395568 = 329.8 lux (>100)
  Number of fans = A/100 = 3.395568/100 = 0.0339 → 1 exhaust fan

  Final: **1 exhaust fan, 2 light bulbs, 0 tube lights**

- **Bathroom-2,3**

  Area, A = (6.63×0.3046 × 5.52×0.3046) m² = 2.019498×1.681392 = 3.395568 m²
  E = 100 lumen/m²; LLF×UF = 0.7
  Required lamp lumen = E×A / (LLF×UF) = 100×3.395568 / 0.7 = 485.08 lm Choose: bulb = 800 lm; Proposed = 1 bulb
  Total lamp lumen = 1×800 = 800 lm; Delivered = 800×0.7 = 560 lm Achieved illuminance = 560 / 3.395568 = 164.9 lux (>100)
  Number of fans = A/100 = 3.395568/100 = 0.0339 → 1 exhaust fan Final: **1 exhaust fan, 1 light bulb, 0 tube lights**

- **Kitchen**
  Area, A= (12.15 x 0.3046 x 5.52 x 0.3046) m2

  Illuminance, E= 200 lumen/m2

  Light Loss Factor and Utilization Factor, LLF x UF = 0.7

  Number of Lights per Illuminaire, n= 1

  Flux = 1250 lumen

  Number of Lights=0.71

So, **1 Light Bulb and 1 Tube Light are needed**

So, **1 Exhaust Fan is needed**

Emergency Main Distribution Board (EMDB) Calculation

Given:

- Phase voltage = 220 V; Line voltage = √3 × 220 = 381.05 V.

- Power factor, pf = 0.7.

- Ratings used: Bulb = 20 W; Ceiling/Exhaust fan = 100 W; Ground SDB load = 40 W.

- Emergency circuits: Bedrooms (3), Kitchen (1), Bathrooms (2), Living (1).

- Each bedroom = 1 fan + 1 bulb; Kitchen = 1 bulb; Each bathroom = 1 bulb; Living = 1 bulb + 1 fan.

ESDB load (sum of emergency loads):

- Bedrooms: 3 × (100 + 20) = 360 W

- Kitchen: 1 × 20 = 20 W

- Bathrooms: 2 × 20 = 40 W

- Living: 1 × (100 + 20) = 120 W

Total ESDB load = 540 W

EMDB load (using factor and ground SDB load):

- EMDB load = (4 × 540 × 0.7) + (40 × 0.7)

- EMDB load = 1540 W

EMDB current:

- Denominator (√3 × 220 × 0.7) = 266.74

- I = 1540 / 266.74 = 5.77 A

Final selection

- EMDB load = 1540 W

- EMDB current ≈ 5.77 A → choose 5 A TP MCCB (standard size with margin).

- Recommended emergency generator: 2 kW (to provide margin above 1540 W).

Notes:

- Values rounded for clarity.

Conduit:

Formula for Ampere Rating, I=$\mathrm{P}/\mathrm{pf}(\mathrm{A})*\mathrm{V}$

pf =0.7 is considered on average.

Energy Saving Bulb=20W

Tube Light=20W

Ceiling Fan=100W

Switchboard Socket (max)=100W

Ceiling light=20W

All internal wires are below 5A rating. So, 2×1.5 rm BYM is used in all Internal Wiring.

AutoCAD Circuit Calculation Report

SMDB (Typical Floor Unit) Circuits

Formula: I = P / (V × pf)

Use V = 220 V, pf = 0.7.

Wattages used: Bulb = 20 W; Tube = 20 W; Ceiling/Exhaust fan = 100 W;

Switchboard socket (max) = 100 W; Ceiling light = 20 W.

Cable rule used: all internal circuits < 5 A → 2×1.5 mm BYM + 1.5 mm BYA ECC.

Circuit (SB)	Total Power (W)	Current I=P/V*Pf(A)	Conduit Size
SB1 Living/Dining	680	4.42	2 × 2.5 mm² + 1 × 1.5 mm² (E)
SB2 BED-1	440	2.86	2 × 2.5 mm² + 1 × 1.5 mm² (E)
SB3 Common Wash	20	0.13	2 × 1.5 mm² + 1 × 1.5 mm² (E)
SB4 Var1	20	0.13	2 × 1.5 mm² + 1 × 1.5 mm² (E)
SB5 Bath1	120	0.78	2 × 2.5 mm² + 1 × 1.5 mm² (E)
SB6 Bath2	120	0.78	2 × 2.5 mm² + 1 × 1.5 mm² (E)
SB7 Var2	20	0.13	2 × 1.5 mm² + 1 × 1.5 mm² (E)
SB8 BED-2	440	2.86	2 × 2.5 mm² + 1 × 1.5 mm² (E)
SB9 Kitchen	480	3.12	2 × 2.5 mm² + 1 × 1.5 mm² (E)
SB10 Bath3	120	0.78	2 × 2.5 mm² + 1 × 1.5 mm² (E)
SB11 BED-3	440	2.86	2 × 2.5 mm² + 1 × 1.5 mm² (E)
SB12 Var3	20	0.13	2 × 1.5 mm² + 1 × 1.5 mm² (E)
SB13 Corridor	140	0.91	2 × 2.5 mm² + 1 × 1.5 mm² €
AC-1	2500	16.233	2 × 6 mm² + 1 × 2.5 mm² €
AC-2	2500	16.233	2 × 6 mm² + 1 × 2.5 mm² €
AC-3	2500	16.233	2 × 6 mm² + 2 × 1.5 mm² €
AC-4	2500	16.233	2 × 6 mm² + 2 × 1.5 mm² €
SB16(REF,TV)	650	4.22	2 × 2.5 mm² + 1 × 1.5 mm² €
FLOOR FEEDER	**13700**	88.762	2 × 70 mm² + 70 rm €

Summary: All calculated circuit currents are well below 5 A. Therefore, the chosen internal wiring 2×1.5 mm BYM + 1.5 mm BYA ECC is valid for all circuits.

There are 3 more similar units in the floor.

SMDB (Ground Floor) Circuits

Circuit (SB)	Total Power (W)	Current I=P/154I=P/154 (A)	Conduit Size
SB1 Generator Room	120	0.78	2 × 1.5 mm² + 1 × 1.5 mm² (E)
SB2 Parking A	80	0.52	2 × 1.5 mm² + 1 × 1.5 mm² (E)
SB3 Parking B	80	0.52	2 × 1.5 mm² + 1 × 1.5 mm² (E)
SB4 Parking C	80	0.52	2 × 1.5 mm² + 1 × 1.5 mm² (E)
SB5 Guard Room1 & Wash1	240	1.56	2 × 2.5 mm² + 1 × 1.5 mm² (E)
SB6 Entrance	40	0.26	2 × 1.5 mm² + 1 × 1.5 mm² (E)
SB7 Guard Room2 & Wash2	240	1.56	2 × 2.5 mm² + 1 × 1.5 mm² (E)
SB8 Entrance2	40	0.26	2 × 1.5 mm² + 1 × 1.5 mm² (E)
SB9 Parking D	80	0.52	2 × 1.5 mm² + 1 × 1.5 mm² (E)
SB10 Cylinder Room	20	0.13	2 × 1.5 mm² + 1 × 1.5 mm² (E)
SB11 Parking E	80	0.52	2 × 1.5 mm² + 1 × 1.5 mm² (E)
SB12 Parking F	80	0.52	2 × 1.5 mm² + 1 × 1.5 mm² (E)
SB13 Parking G	80	0.52	2 × 1.5 mm² + 1 × 1.5

Circuit (SB)	Total Power (W)	Current I=P/154I=P/154 (A)	Conduit Size
			mm² (E)
SB14 Misc	40	0.26	2 × 1.5 mm² + 1 × 1.5 mm² (E)
GROUND FLOOR TOTAL	1300 W	8.44 A	Feeder: 2 × 4 mm² Cu + 1 × 2.5 mm² (E)

SEMDB (Typical Floor) Circuits

Load Type	Quantity per Unit	Wattage (W)	Total per Unit (W)	Total for 4 Units (W)	Current at 220 V (A)	Conduit Size
Fans	5	100	500	2000	9.1	2 × 2.5 mm² Cu + 1 × 1.5 mm² (earth)
Bulbs	9	20	180	720	3.3	2 × 2.5 mm² Cu + 1 × 1.5 mm² (earth)
Total	–	–	680	2720	12.4	2 × 4 mm² Cu + 1 × 2.5 mm² (earth)

SEMDB (Ground Floor) Circuits

Load Type	Total P (W)	Current I(A)	Conduit
Emergency lights (LB4, LB8, LB9, LB10, LB11)	100	0.65 A	2 × 1.5 mm^2 Cu + 1 × 1.5 mm^2 (E)

MDB –

Item	Power (W)	Current (A)
1 unit	13700	88.762
1 floor (4 units)	54800	355.048
3 residential floors (12 units)	164400	1066
Ground floor common	1,300	8.44
Lift (assumed)	10,000	32.5
2 Water pump (assumed)	5,000*2	13.0
Building total	185700	11120

Board Level Summary

Board	Load_W	Current_A	Breaker_Upstream	Feeder_Cable
SMDB (typical floor)	13700	88.761	100A SP MCCB (to MDB)	2x70 rm BYM + 70 rm BYA ECC
SMDB (ground)	1300	8.44	10A SP MCCB (to MDB)	2x2.5 rm BYM + 2.5 rm BYA ECC
SEMDB (typical floor)	2720	12.4	15A SP MCCB (to EMDB)	2x4 rm BYM + 4 rm BYA ECC
SEMDB (ground)	100	0.65	5A SP MCCB (to EMDB)	2x1.5 rm BYM + 1.5 rm BYA ECC
EMDB	968.8	2.28	5A TP MCCB (to MDB)	2x1.5 rm BYM + 1.5 rm BYA ECC
MDB	185700	11120	425A TP MCCB (main line)	2x300 rm BYM + 300 rm BYA ECC

As the load is over 50KW we will need a transformer.

Transformer –

If PF truly is 0.70 and 185.7 kW is peak demand →We pick **315 kVA** (covers ~318 kVA with ~20% margin).

315 kVA line current: $I = 315000 \div 692.82 \approx 454.8$ A.

If we can **improve power factor** (e.g., to 0.9) with capacitor banks, we required S drops to 185.7/0.9=206.3 kVA and then **250 kVA** could be acceptable.

If motor starting (lift and pumps) causes high inrush, consider **soft starters / VFDs** or the larger transformer (315 kVA).

- so the downstream switchgear and feeders should be sized accordingly, and motor loads like the lift and pumps are best equipped with soft starters or VFDs to reduce stress on the transformer.

Generator –

A 100 kVA, 3-phase (400/230 V), diesel standby generator (rated at 0.8 pf) as the practical choice for our building — it comfortably covers the calculated load (≈185.7 kW) plus motor starting and future growth. Specify: AVR, automatic start/stop and engine protection, sound-attenuated weatherproof canopy, bunded base, and a 200 L fuel tank (≈12–14 hours at typical loading). Fit an ATS and an MCCB/ACB on the genset sized ≥160 A on the LV side and use soft-starters or VFDs for the lift and pumps to limit start currents; if you expect heavy simultaneous motor starts without soft starters, consider upsizing to 150 kVA or using two parallel 100 kVA sets for redundancy.

Conclusion:

This project showcases our capability to design a well-functioning and visually appealing residential building using AutoCAD 2007, with meticulous attention to both architectural and electrical details. Each unit is thoughtfully planned to ensure comfort and convenience. Comprehensive electrical diagrams have been developed for every floor, detailing both regular and emergency switchboard connections, sub-distribution boards, and main distribution boards to guarantee safety,

reliability, and preparedness for any contingency. Altogether, the project reflects our dedication to delivering a high-quality, secure, and comfortable living environment for all residents.