FACULTY OF ENGINEERING
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EE7207 ELECTRICAL INSTALLATION I

ELECRICAL SYSTEM DESIGN FOR A WAREHOUSE AND OFFICE BUILDING

TECHNICAL REPORT

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ELECTRICAL SYSTEM DESIGN
WAREHOUSE AND OFFICE BUILDING

PROFESSIONAL REVIEW
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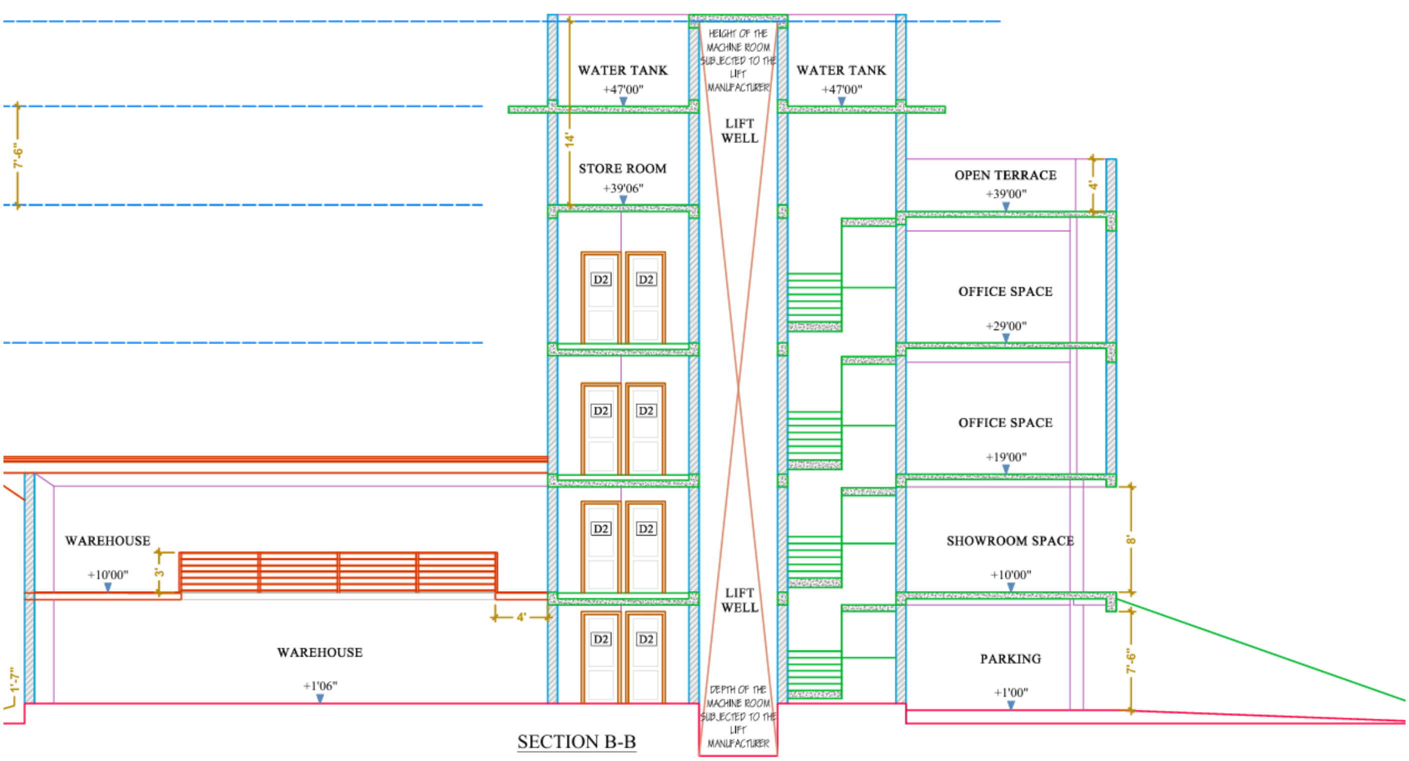

1 ELECTRICAL SYSTEM DESIGN CONCEPT

The electrical design for the proposed warehouse and office has been developed to prioritize safety, reliability, energy efficiency, and full compliance with Sri Lankan regulations. It aligns with the Sri Lanka Electricity Act No. 20 of 2009, SLS 1504 (Code of Practice for Electrical Installations), and the CEB Distribution Code, while also referencing international best practice from the IET Wiring Regulations (BS 7671) and relevant IEC standards. The facility includes a warehouse with high-bay lighting, ventilation fans, and water pumps, alongside an office area served by air-conditioning, general lighting, and socket outlets. The system is engineered for future expansion, prudent energy use, and robust coordination of protective devices.

1.1 CODES AND REGULATIONS

The design is done in line with:

- Sri Lanka Electricity Act No. 20 of 2009- regulates generation, transmission and distribution of electricity.
- Guidelines on the electrical installations of CEB- load applications, supply requirements and metering.
- Sri Lanka Standards (SLS 1504) -equivalent to IET Wiring Regulations (BS 7671), safe wiring practice.
- SLS 900: Part 1 - Earthing- grounding systems of buildings.
- IEE Wiring Regulations (17^{th} edition and above) - used to determine cable size, voltage drop and protection.
- IEC 60364 - International standard for low-voltage electrical installations.
- Factories Ordinance of Sri Lanka - which deals with the safety and lighting of the workplace as well as with emergency measures.
- Green Building Guidelines (Sri Lanka) - to be used with regards to energy efficient lighting and equipment.

Compliance with these ensures legal acceptance, safe operation, and energy efficiency.

1.2 POWER RECEIVING ARRANGEMENT

The facility will receive a three-phase, 400 V, 50 Hz supply from a dedicated, suitably rated transformer. The incoming mains terminate at the Main Switchboard (MSB) located on the service/utility floor, which houses the main isolator and protective devices. From the MSB, power is distributed to sub-distribution boards (SDBs) positioned on each office level and within the warehouse so that loads are served locally and phase loading can be balanced effectively.

Sub-mains from the MSB to each SDB will be run in armored XLPE copper cables, providing the required mechanical protection and meeting the installation practices set out in SLS 1504. Within the office and warehouse areas, final circuits such as lighting and socket outlets will be wired in non-armored PVC-insulated cables installed in conduits or trunking. This approach separates heavy-duty feeders from lighter final circuits, improves maintainability, and keeps volt-drop and thermal performance within acceptable limits.

A standby generator will be connected to the MSB through an Automatic Transfer Switch (ATS). If the CEB supply fails, the ATS will start the generator and automatically transfer designated essential circuits to generator power once voltage and frequency are stable. When the utility supply is restored and has remained steady for the preset return delay, the ATS re-transfers the load back to the grid, allows the generator to complete a short cool-down run, and then shuts it down. This arrangement ensures continuity for critical services while maintaining safe, orderly changeover between sources.

1.3 STANDBY POWER SUPPLY

A diesel-engine generator will serve as the standby power source for the warehouse and office. It will be installed on the service/utility floor, aligned with the Main Switchboard (MSB) room for straightforward cabling and maintenance access. The generator enclosure will be acoustically treated to comply with local environmental limits, achieving noise levels not exceeding 65 dBA at one meter from the room and 55 dBA at the perimeter fence.

Fuel provision will include a day tank sized for at least 12 hours of continuous operation. The generator's base (skid-mounted) tank will be arranged with a gravity feed to the day tank so the day tank is kept topped up and the set can operate reliably whenever called upon.

1.4 LOW VOLTAGE POWER DISTRIBUTION SYSTEM

The low-voltage (LV) power distribution for the facility comprises a Main Switchboard (MSB), Sub-Distribution Boards (SDBs), a standby generator, and an Automatic Transfer Switch (ATS). Dedicated distribution panels will supply specialist systems—such as water transfer pumps, air-conditioning, and ventilation—so that these loads can be isolated, protected, and maintained independently of general lighting and small-power circuits.

LV power cabling runs from the transformer and generator into the MSB, and from the MSB to the SDBs and local distribution boards (DBs). Cable constructions and installation methods are selected for current-carrying capacity, voltage-drop limits, and mechanical protection appropriate to each route:

Table 1: Cable Types and Installation Methods

Route	Cable construction	Conductor	Configuration	Installation method
Transformer → MSB; Generator → MSB	XLPE-insulated, PVC-sheathed	Copper	Multicore	Laid on cable tray/ladder or in heavy-duty conduit; correctly glanded at MSB for mechanical protection.
MSB → Busbar	XLPE/PVC	Copper	Multicore	On tray/ladder or in conduit/trunking depending on route and environment; sized for load and voltage drop.
Busbar → SDB (of each floor)	XLPE/PVC	Copper	Single-core / Multicore	On tray/ladder or in conduit/trunking

				depending on route and environment; sized for load and voltage drop.
DB → Final circuits (lighting & sockets)	XLPE/PVC	Copper	Single-core	Run in conduits or trunking within rooms/risers; segregate from data/ELV where required.

1.5 LIGHTING AND SOCKET OUTLET SYSTEM

- **Lighting System**

Design targets and calculations will follow recognized guidance, namely the CIBSE lighting guides and the Sri Lanka Energy-Efficient Building Code. Office spaces are classified as general offices with a range of typical visual tasks; the recommended illuminance, glare limits, and uniformity from these standards will be applied in the design. For the warehouse, high-bay LED luminaires will be provided in line with the client's requirements; the luminaire type, lumen output, and optics will be selected to achieve the required average illuminance at the working plane with suitable uniformity, accounting for mounting height, utilization and maintenance factors.

Table 2: Lighting Levels and Fittings by Area

Area	LUX Level	Light Fitting
Office Space	200	Power Balance Gen2 (RC461B) – 29 W, 4000 lm
Warehouse	150	Green Perform Highbay BY570P – 64 W, 10,000 lm

- **Emergency Lighting System**

A dedicated emergency lighting system will be installed in addition to the standby generator. Luminaires will be of the same general type and appearance as the normal lighting but equipped with integral batteries providing a minimum **3-hour** autonomy so that lighting remains available during any mains failure.

The emergency lighting will be designed to:

- Clearly identify escape routes with continuous, unambiguous guidance to exits.
- Illuminate the escape paths to a safe level so occupants can move quickly and safely to and through the exits.
- Highlight fire alarm call points and fire-fighting equipment located along escape routes so they can be found immediately.
- Provide self-contained "EXIT" signs with a 3-hour battery backup for clear, reliable exit marking.

Together with the generator supply, this arrangement meets applicable safety requirements and ensures dependable illumination under all emergency conditions.

- **Socket Outlet System**

General-purpose outlets (GPOs)—13 A, one-gang or two-gang—will be positioned to suit the final furniture layout and expected equipment use. Allowance for future growth will be built in by reserving spare ways in the distribution boards so additional socket circuits can be added without major rework.

Each socket circuit will be arranged as a radial circuit and protected as follows:

- **Overcurrent protection:** single-pole MCBs sized to the circuit load and cable capacity.
- **Earth-fault protection:** double-pole RCDs (as required by location and use) to achieve the prescribed disconnection times.

Wiring to outlets will use single-core PVC-insulated copper conductors drawn through PVC conduits/trunking, providing a safe, robust, and maintainable installation with clear segregation from data/ELV services.

1.6 UPS SYSTEM

A central UPS will supply uninterrupted power to critical ICT infrastructure—such as servers, core network switches/hubs, and communications equipment—serving both the warehouse and office. This system provides ride-through during mains disturbances and short outages, stabilizes voltage, and protects sensitive electronics from sags, surges, and sudden power loss.

In addition, individual desktop workstations in offices, control rooms, and administrative counters will be equipped with small UPS units. These local units ensure continuous operation during brief interruptions and allow safe shutdown of PCs when required. Together, the central and local UPS arrangements deliver reliable backup and power-quality protection for all priority equipment.

1.7 PROTECTIVE DEVICES AND COORDINATION PHILOSOPHY

Every circuit will be protected by suitable devices MCBs, MCCBs, fuses, and RCDs to guard against overload, short-circuit, and earth-fault conditions. Device selection will be based on the circuit's design current and environment, ensuring:

- **Rated current (In)** matches or exceeds the design current.
- **Breaking capacity (Icu/Ics)** is adequate for the prospective fault level at the device location.
- **Operating characteristics** (e.g., trip curves, time delays) suit the load type and expected inrush (motors, lighting ballasts, etc.).
- **RCD sensitivity** is appropriate for the application (e.g., 30 mA for personnel protection on socket/outlet circuits), with upstream time-delayed types where needed to avoid nuisance tripping.

A clear coordination (selectivity) philosophy will be applied so that, during a fault, only the device closest to the fault trips, keeping the rest of the installation energized. Coordination between upstream MCCBs and downstream MCBs/RCDs will be verified using time-current characteristic (TCC) studies, checking long-time, short-time, instantaneous, and earth-leakage settings to achieve selective tripping. All equipment and settings will comply with applicable standards and local regulations, supporting a safe, reliable, and maintainable installation.

1.8 EARTHING AND LIGHTING PROTECTION SYSTEM

A complete, low-impedance earthing arrangement will be provided in line with the IET (formerly IEE) Wiring Regulations (BS 7671). The installation will include a Main Earthing Terminal (MET) located in the main LV switchboard room, from which equipotential bonding conductors will connect all major metallic services and exposed-conductive-parts. This approach ensures safe fault-current paths, correct operation of protective devices, and controlled touch/step voltages across the facility.

Lightning protection. A building-wide lightning protection system (LPS) will be designed and installed to IEC 62305, limiting the effects of direct strikes and induced surges. All exposed metalwork and building steelwork will be bonded to the LPS to equalize potentials and prevent dangerous side-flashing.

The LPS will comprise:

- An interconnected **air-termination network** on the roof to intercept strikes.
- Multiple **down conductors** distributed around the perimeter to conduct current safely to earth; where practical, **reinforced concrete bars (rebars)** will be utilized as natural down conductors. These bars will be welded or secured with double-wrapped ties to form a **continuous, verified path** from roof to foundation.
- An **earth-termination network** with accessible **test points** for inspection, continuity checks, and periodic maintenance.

Where feasible, existing **foundation reinforcement** (earthing ring or rebar) will be incorporated into the earth-termination system to improve performance, reduce resistance, and provide a robust, durable grounding solution for the entire structure.

2 LIGHTING DESIGN CRITERIA AND CALCULATIONS

2.1 RECOMMENDED LUX LEVELS

The maintained illuminance targets for each area have been set with reference to the Energy Efficiency Building Code (Annex 1) and validated against manufacturer photometric data. The selected values balance visual comfort, task performance, and energy efficiency, while ensuring compliance with recognized lighting design practice. Targets were assigned according to the function of each space—considering the type of visual tasks, expected occupancy, safety/wayfinding needs, and appropriate glare and uniformity control. Where more demanding activities occur, higher lux levels and/or local task lighting are applied; for circulation and storage, more modest levels are used to conserve energy without compromising safety.

Table 3: Recommended LUX level for Warehouse and Office Area

Place	Area	Illuminance (lux)
Ground Floor		
Warehouse	2034 sq.ft = 189 m^2	150 lux
Chemical Store	356 sq.ft = 33 m^2	150 lux
Lobby	50 m^2	200 lux
Male toilet – 1	2 m^2	150 lux
Female Toilet - 1	2 m^2	150 lux
Male toilet – 2	2 m^2	150 lux
Female Toilet – 2	2 m^2	150 lux
Mezzanine Floor		
Staff Rest room	356 sq.ft = 33 m^2	200 lux
Show room Space	1018 sq.ft = 95 m^2	500 lux
Male toilet – 1	2 m^2	150 lux
Female Toilet - 1	2 m^2	150 lux
First Floor		
Office Space	2150 sq.ft = 200 m^2	500 lux

Board Room		400 lux
MD Secretary		500 lux
MD Office		500 lux
Male toilet – 1	2 m^2	150 lux
Female Toilet - 1	2 m^2	150 lux
Stair	7.5 m^2	150 lux
Second Floor		
Office Space	2150 sq. ft = 200 m^2	500 lux
Male toilet – 1	2 m^2	150 lux
Female Toilet - 1	2 m^2	150 lux
Stair	7.5 m^2	150 lux
Office space	200	500 lux
Roof Top and Water Tank Slab		
Store room	15 m^2	200 lux

The recommended illuminance levels for each functional space have been established in accordance with recognized industrial and office lighting guidelines, ensuring that all primary and common areas such as warehouses, offices, showrooms, board rooms, lobbies, toilets, and staircases meet their respective guidance values for safety, comfort, and efficiency. For ancillary or transitional spaces, such as connecting corridors, minor service zones, and residual areas where no specific tasks are performed, appropriate luminaires have been provided to achieve adequate background illumination, without the need for detailed lux-level calculations. This design approach ensures regulatory compliance and visual quality in critical and frequently occupied zones, while maintaining practicality, energy efficiency, and cost-effectiveness across the facility.

2.1.1 LUMEN CALCULATIONS

Target illuminance values for each space are taken from the **Energy-Efficient Building Code (Annex 1)** and validated against manufacturer product catalogues. Fixture types for each area are selected by the designer to suit function, mounting height, glare control, and ingress protection. The number of luminaires is determined using the Average Lumen Method, ensuring that the maintained illuminance on the working plane meets the design target after depreciation.

$$\boxed{N = \frac{E \times A}{F \times Z \times UF \times MF}}$$

Where:

- N required number of luminaires (round up to the next whole number)
- E target-maintained illuminance (lux)
- A area (m^2)
- F luminous flux per lamp (lumens) or per luminaire (see note)
- Z number of lamps per luminaire
- UF utilization factor
- MF maintenance factor

Important: If the catalogue provides luminaire flux (most LED fittings), set Z = 1. Only use Z > 1 when F is specified per lamp and the luminaire contains multiple lamps.

Lumen Output of Luminaries

This can be taken from the lamp catalogue which depend on the lamp to be used in the luminaries.

Table 4: Lumen Output level for light fittings

Area	Light Fitting	Lumen Output per luminaire
Office Space and other areas	1 x 29W Power Balance Gen2	4000 lm
Warehouse	1 x 64W high bay LED fitting	10000 lm
Chemical Store	1 x 29W CoreLine Waterproof	4000 lm
Toilets and Stair	1 x 9W Downlight DN060B	800 lm
Showroom	CoreLine Recessed gen4	6800 lm

- **Maintenance Factor (MF)**

The Maintenance Factor is the ratio of the illuminance at the end of the maintenance cycle to the initial illuminance when the system is new. It reflects lumen depreciation of the light source, dirt on luminaires and room surfaces, lamp/driver failures, and how often cleaning and relamping are carried out.

A useful relationship is:

$$\mathbf{MF} = \mathrm{LLMF} \times \mathrm{LSF} \times \mathrm{LMF} \times \mathrm{RSMF}$$

Where,

LLMF	lamp/LED lumen maintenance
LSF	survival
LMF	luminaire maintenance
RSMF	room surface maintenance

Typical design values:

Dirty – 0.7

Average – 0.8

Clean – 0.9

- **Utilization Factor (UF)**

The Utilization Factor (UF) expresses the proportion of light emitted by a luminaire that reaches the working plane. Although UF can, in theory, be derived for any layout, in practice it is evaluated for general lighting arranged in regular grids and with reference to the three principal interior surfaces: ceiling, walls, and floor. Most manufacturers publish UF tables for standard conditions, allowing designers to select appropriate values without running full photometric simulations.

For this project, UF for each space was chosen by considering the interior finish reflectance's, the mounting arrangement and height of the luminaires, and published manufacturer data consistent with standard lighting practice. By accounting for ceiling, wall, and floor reflectance together with the specific luminaire type, the selected UF values reflect realistic light delivery and support reliable Average Lumen Method calculations in both the office and warehouse environments.

In the office areas, a UF of 0.72 has been adopted for recessed-mounted (e.g., Power Balance Gen2) luminaires. This is appropriate for offices with light, reflective finishes—typically white ceilings (≈70–80%) and light-colored walls (≈50%)—and sits within the common range of 0.70–0.75 indicated by manufacturers for modern office installations. In the warehouse, a UF of 0.65 is used for high-bay LED fittings. The greater mounting height, larger room volume, and generally lower wall/floor reflectance reduce the proportion of light reaching the working plane; a UF in the

0.60–0.65 range is typical and provides a realistic basis for achieving the required maintained illuminance for safe operations.

2.1.2 SPECIMEN CALCULATIONS

Assumptions:

- UF (utilization factor): Offices/lobby/rest/showroom 0.72; Warehouse 0.65; Chemical store (IP65 batten) 0.70.
- MF (maintenance factor): Offices etc. 0.80; Warehouse/Chemical store 0.80 (periodic cleaning).
- If your actual mounting heights/finishes differ, re-read UF from the chosen product's UF table and update

For Warehouse – Ground Floor:

- Required lux level (E) = 150 lux
- Type = 1 x 64W high bay LED fitting
- luminous flux per lamp (F) = 10000 lm
- Number of lamps per luminaire (z) = 1
- Room area (A) = 2034 sq. ft = 189 m^2

$$N = \frac{E \times A}{F \times UF \times MF}$$

Total numbers of luminaries $= \frac{150 \text{ x } 189}{10000 \times 1 \times 0.65 \times 0.8}$

$= 5.45$

Therefore, the proposed quantity = 6 Nos.

Design illumination level $= \frac{N \times F \times Z \times UF \times MF}{Area}$

$= \frac{6 \times 10000 \times 1 \times 0.65 \times 0.8}{189}$

$=$ 165.08 lux

For Office Space – First Floor / Second Floor:

- Required lux level (E) = 500 lux
- Type = 1 x 29W Power Balance Gen2
- luminous flux per lamp (F) = 4000 lm
- Number of lamps per luminaire (z) = 1
- Room area (A) = 200 m^2

$$N = \frac{E \times A}{F \times UF \times MF}$$

Total numbers of luminaries $= \dfrac{500 \text{ x } 200}{4000 \times 1 \times 0.72 \times 0.8}$

$= 43.4$

Therefore, the proposed quantity $=$ 44 Nos.

Design illumination level $= \dfrac{N \times F \times Z \times UF \times MF}{\text{Area}}$

$= \dfrac{44 \times 4000 \times 1 \times 0.72 \times 0.8}{200}$

$=$ 506.88 lux

To illustrate the design methodology adopted, specimen calculations were carried out for selected spaces. As shown above, the warehouse (ground floor) and office spaces (first and second floors) were taken as examples, where the required illuminance levels were compared with the proposed luminaires' luminous flux, utilization factor (UF), and maintenance factor (MF). Based on these parameters, the total number of fittings was derived, and the design illumination levels were verified against the recommended lux values.

Following this approach, all other functional and common areas were calculated using the same standardized method. To ensure accuracy and consistency, the complete set of calculations for each floor was performed using Microsoft Excel, where room dimensions, luminaire specifications, and lighting parameters were systematically applied. The resulting outputs form the basis of the consolidated lighting design tables provided in the subsequent section, demonstrating compliance with industrial lighting standards and ensuring both efficiency and adequacy across the facility.

For clarity, the following codes are used in the lighting calculation tables to indicate the type of luminaire applied in each area:

- **L1** – 1 × 29 W *Power Balance Gen2*
- **L2** – 1 × 64 W *Highbay LED Fitting*
- **L3** – 1 × 29 W *CoreLine Waterproof*
- **L4** – 1 × 9 W *Downlight DN060B*
- **L5** – *CoreLine Recessed Gen4*

Table 5: Lighting Calculation - Ground Floor

Place	Type	Area (m2)	Lumen Level Required	NoS	Designed lumen Level
Warehouse	L2	189	150	6	165.08
Chemical Store	L3	33	150	3	203.64
Lobby	L1	50	200	5	230.40
Male toilet – 1	L4	2	150	1	230.40
Female Toilet - 1	L4	2	150	1	230.40

Male toilet – 2	L4	2	150	1	230.40
Female Toilet – 2	L4	2	150	1	230.40
Stair - 1	L4	7.5	150	3	184.32
Stair - 2	L4	7.5	150	3	184.32

Table 6: Lighting Calculation - Mezzanine Floor

Place	Type	Area (m2)	Lumen Level Required	NoS	Designed lumen Level
Staff Rest room	L1	33	200	3	209.45
Show room Space	L5	95	500	13	535.98
Male toilet – 1	L4	2	150	1	230.40
Female Toilet - 1	L4	2	150	1	230.40
Stair - 1	L4	7.5	150	3	184.32
Stair - 2	L4	7.5	150	3	184.32

Table 7: Lighting Calculation - First Floor

Place	Type	Area (m2)	Lumen Level Required	NoS	Designed lumen Level
Office Space	L1	200	500	44	506.88
Board Room	L1	30	400	6	460.80
MD Secretary	L1	15	500	4	614.40
MD Office	L1	15	500	4	614.40
Male toilet – 1	L4	2	150	1	230.40
Female Toilet - 1	L4	2	150	1	230.40
Stair	L4	7.5	150	3	184.32

Table 8: Lighting Calculation - Second Floor

Place	Type	Area (m2)	Lumen Level Required	NoS	Designed lumen Level
Office Space	L1	200	500	44	506.88
Male toilet – 1	L4	2	150	1	230.40
Female Toilet - 1	L4	2	150	1	230.40
Stair	L4	7.5	150	3	184.32
Store Room (Rooftop)	L1	15	200	2	307.20

3 ELECTRICAL DEMAN AND LOAD CALCULATIONS

3.1 LOAD CALCULATION

Following the client's consultant's approval of the proposed demand and diversity factors, the electrical load assessment for the warehouse and office was carried out. The assessment covered lighting, general small power, and all relevant mechanical and special loads, with the approved diversity applied to determine the diversified maximum demand. The results are compiled in the load schedule and have been used to size the main incomer, transformer, distribution boards, protective devices, and cabling in line with the applicable standards and utility requirements.

3.1.1 Assumptions

- System voltage: 400/230 V, 3-phase, 4-wire (typical LV distribution)
- Use Power factor = 0.90 (typical overall plant power factor for mixed loads)
- Diversity Factors:

Table 9: Load Categories and Design Factors

Item No.	Load Name	Power Factor	Utilization Factor	Diversity Factor
1	Air Conditioning	0.9	1	0.8
2	Ventilation	0.9	1	0.8
3	Water Transfer Pumps	0.9	1	0.8
4	Lighting	0.9	1	0.8
5	UPS	0.9	1	0.8
6	Socket outlets	0.9	1	0.6
7	Lift	0.9	1	0.8

- Utilization Factor (UF): Assumed to be **1.0**, since all connected loads are considered to operate at their rated capacity for a conservative demand load calculation
- Lift Load: Assumed to be 10 kVA based on typical passenger lift motor rating
- Water Transfer Pump: Two three-phase water transfer pumps are assumed to be located on the ground floor. (each 1.5kVA)
- Two Ventilation Fans connected in ware house area. (each 2.5kVA)
- UPS Load (First Floor): An additional 5 kVA UPS has been assumed on the first floor to supply critical loads (computers, networking, and essential equipment)
- Spare capacity allowance: 25% on final kVA (future load growth & safety margin)
- Rounding: final demand rounded up to nearest standard transformer rating

3.1.2 Specimen Calculation

- **For First Floor**

Lighting Load Calculation

Connected Load per unit	= 29 W
Power Factor	= 0.9
Per unit load in kVA	= $\frac{29}{0.9}$ kVA = 0.032 kVA
No. of luminaries for office area	= 44
Total load	= 44 x 0.032 kVA = 1.408 kVA
Diversity Factor	= 0.8
After applying diversity factor	= 1.408 x 0.8 = 1.126 kVA
Utilization factor	= 1
Total demand for lighting for office area	= 1.126 kVA
Total current	= $\frac{1.126 \times 1000}{230} = 4.897\ A$

Following the same method to calculate all the lighting loads

Total demand for lighting for office area	= 1.126 kVA
Total demand for lighting for board room	= 0.154 kVA
Total demand for lighting for MD Secretary Room	= 0.102 kVA
Total demand for lighting for MD Office	= 0.102 kVA
Total demand for lighting for Male toilet	= 0.008 kVA
Total demand for lighting for Female toilet	= 0.008 kVA
Total demand for lighting for stair	= 0.024 kVA
Total demand for spare lighting	= 0.032 kVA
Total demand load for lighting	**= 1.556 kVA**

S/O Load Calculation

Connected Load per unit	= 0.8 kVA
No. of S/O for office area	= 15
Total load	= 15 x 0.8 kVA = 12 kVA
Diversity Factor	= 0.6
After applying diversity factor	= 12 x 0.6 = 7.2 kVA
Utilization factor	= 1
Total demand of S/O for office area	= 7.2 kVA
Total current	= $\frac{7.2 \times 1000}{230} = 31.3\ A$

Following the same method to calculate all the S/O loads

Total demand of S/O for office area	= 7.2 kVA
Total demand for S/O for board room	= 0.96 kVA

Total demand for S/O for MD Secretary Room	= 0.48 kVA
Total demand for S/O for MD Office	= 0.48 kVA
Total demand of S/O for Male toilet	= 0.48 kVA
Total demand of S/O for Female toilet	= 0.48 kVA
Total demand for Spare of S/O	= 0.96 kVA
Total demand load for S/O	**= 11.04 kVA**

AC Load Calculation (Three phase)

Connected Load per unit	= 4 kVA
No. of S/O for office area	= 4
Total load	= 4 x 4 kVA = 16 kVA
Diversity Factor	= 0.8
After applying diversity factor	= 16 x 0.8 = 12.8 kVA
Total demand of S/O for office area	= 12.8 kVA
Total current	$= \frac{12.8 \times 1000}{\sqrt{3} \times 400} = 18.504\ A$

Following the same method to calculate all the AC loads

Total demand of AC for office area	= 12.8 kVA
Total demand of AC for Board room (1 Phase)	= 1.28 kVA
Total demand of AC for MD room (1 Phase)	= 1.04 kVA
Total demand of AC for sectary room (1 Phase)	= 1.04 kVA
Total demand load for AC	**= 16.16 kVA**
Total demand of UPS first floor	**= 4 kVA**
Total demand load for first floor	**= 32.725 kVA**

3.1.3 Load Calculation

Each electrical load was identified in accordance with the client's requirements, and the equipment specifications were provided by the employer. The identified loads were then systematically grouped and distributed across the phases to ensure proper load balancing. Subsequently, suitable protective devices (MCB/MCCB) with appropriate ratings were selected and assigned to each circuit to guarantee operational safety and compliance with standards. These details are comprehensively presented in the following tables.

Table 10: Load Calculation, Grouping and Protective Device selection - Ground Floor

Discription	Location	QTY	After Diversity Demand (kVA)			Current (A)			MCB (Rating)	Name of Circuit
			R	Y	B	R	Y	B		
Lighting	Warehouse	6	0.341			1.482			6A (1P)	C1
Lighting	Chemical Store	3		0.077			0.334		6A (1P)	C2
Lighting	Lobby	5		0.128			0.557			
Lighting	Male toilet - 1	1			0.008			0.035	6A (1P)	C3
Lighting	Female toilet - 1	1			0.008			0.035		
Lighting	Male toilet - 2	1			0.008			0.035		
Lighting	Female toilet - 2	1			0.008			0.035		
Lighting	Strair	6			0.048			0.209		
Lighting	Other	20			0.512			2.226		
Lighting	Spare	4			0.032			0.139	6A (1P)	C4
Socket Outlets	Warehouse	4	1.920			8.348			10A (1P)	C5
Socket Outlets	Chemical Store	1		0.480			2.087		16A (1P)	C6
Socket Outlets	Lobby	4		1.920			8.348			
Socket Outlets	Male toilet - 1	1			0.480			2.087	10A (1P)	C7
Socket Outlets	Female toilet - 1	1			0.480			2.087		
Socket Outlets	Male toilet - 2	1			0.480			2.087		
Socket Outlets	Female toilet - 2	1			0.480			2.087		
Socket Outlets	Spare	2			0.960			4.174	10A (1P)	C8
Ventilation Fan	Warehouse/3P	2	1.333	1.333	1.333	5.795	5.795	5.795	10A (3P)	C9
Water transfer pump	Building	2	0.800	0.800	0.800	3.478	3.478	3.478	10A (3P)	C10
Lift-motor	Building	1	2.664	2.664	2.664	11.583	11.583	11.583	16A (3P)	C11
TOTAL DEMAND AND CURRENT			7.058	7.402	8.301	30.685	32.181	36.090	50A (3P)	
			22.760			98.957				

Table 11: Load Calculation, Grouping and Protective Device selection - Mezzanine Floor

Discription	Location	QTY	Demand (kVA)			Current (A)			MCB (Rating)	Name of Circuit
			R	Y	B	R	Y	B		
Lighting	Staff Rest room	3	0.077			0.334			6A (1P)	C12
Lighting	Show room Space	13		0.333			1.447		6A (1P)	C13
Lighting	Male toilet – 1	1			0.008			0.035	6A (1P)	C14
Lighting	Female Toilet - 1	1			0.008			0.035		
Lighting	Stair	6			0.048			0.209		
Lighting	Other	16			0.410			1.781		
Lighting	Spare	4			0.032			0.139	6A (1P)	C15
Socket Outlets	Staff Rest room	2	0.960			4.174			6A (1P)	C16
Socket Outlets	Show room Space	5		2.400			10.435		16A (1P)	C17
Socket Outlets	Male toilet – 1	1			0.480			2.087	6A (1P)	C18
Socket Outlets	Female Toilet - 1	1			0.480			2.087		
Socket Outlets	Spare	2			0.960			4.174	6A (1P)	C19
TOTAL DEMAND AND CURRENT			1.037	2.733	2.426	4.508	11.882	10.546	20A (3P)	
			12.390			26.936				

Table 12: Load Calculation, Grouping and Protective Device selection - First Floor

Discription	Location	QTY	Demand (kVA)			Current (A)			MCB (Rating)	Name of Circuit
			R	Y	B	R	Y	B		
Lighting	Office Space	44	1.126			4.897			6A (1P)	C20
Lighting	Board Room	6		0.154			0.668		6A (1P)	C21
Lighting	MD Secretary	4		0.102			0.445			
Lighting	MD Office	4			0.102			0.445	6A (1P)	C22
Lighting	Male toilet – 1	1			0.008			0.035		
Lighting	Female Toilet - 1	1			0.008			0.035		
Lighting	Stair	3			0.024			0.104		
Lighting	Spare	4			0.032			0.139	6A (1P)	C23
Socket Outlets	Office Space	15	7.200			31.304			63A (1P)	C24
Socket Outlets	Board Room	2		0.960			4.174		12A (1P)	C25
Socket Outlets	MD Secretary	1		0.480			2.087			
Socket Outlets	MD Office	1			0.480			2.087	12A (1P)	C26
Socket Outlets	Male toilet – 1	1			0.480			2.087		
Socket Outlets	Female Toilet - 1	1			0.480			2.087		
Socket Outlets	Stair							0.000		
Socket Outlets	Spare	2			0.960			4.174	6A (1P)	C27
AC	Office Space	4	4.256	4.256	4.256	18.504	18.504	18.504	20A (3P)	C28
18000 BTU AC	Board Room	1	1.280			5.565			10A (1P)	C29
12000 BTU AC	MD Office	1		1.040			4.522		6A (1P)	C30
12001 BTU AC	MD Secretary	1			1.040			4.522	6A (1P)	C31
UPS	Office Space	1	4.000			17.391			20A (1P)	C32
TOTAL DEMAND AND CURRENT			17.862	6.992	7.870	77.663	30.400	34.219	100A (3P)	
			32.725			142.282				

Table 13: Load Calculation, Grouping and Protective Device selection - Second Floor

Discription	Location	QTY	Demand (kVA)			Current (A)			MCB (Rating)	Name of Circuit
			R	Y	B	R	Y	B		
Lighting	Office Space	44	1.126			4.897			6A (1P)	C33
Lighting	Male toilet – 1	1		0.008			0.035		6A (1P)	C34
Lighting	Female Toilet - 1	1		0.008			0.035			
Lighting	Stair	3			0.024			0.104	6A (1P)	C35
Lighting	Spare	4			0.032			0.139	6A (1P)	C36
Socket Outlets	Office Space	30	14.400			62.609			63A (1P)	C37
Socket Outlets	Male toilet – 1	1		0.480			2.087		6A (1P)	C38
Socket Outlets	Female Toilet - 1	1			0.480			2.087	6A (1P)	C39
Socket Outlets	Spare	2			0.960			4.174	6A (1P)	C40
AC	Office Space	5	5.320	5.320	5.320	23.130	23.130	23.130	32A (3P)	C41
TOTAL DEMAND AND CURRENT			20.846	5.816	6.816	90.637	25.287	29.635	100A (3P)	
			33.478			145.558				

Table 14: Load Calculation, Grouping and Protective Device selection - Rooftop

Discription	Location	QTY	Demand (kVA)			Current (A)			MCB (Rating)	Name of Circuit
			R	Y	B	R	Y	B		
Lighting	Store Room	2	0.051			0.220			10A (1P)	C42
Lighting	Spare	1	0.008			0.034				
Socket Outlets	Store Room	2	0.960			4.170				
Socket Outlets	Spare	1	0.48			2.085				
TOTAL DEMAND AND CURRENT			1.499			6.509				

Below table shows the demand load amount of the entire Building.

Table 15: Load connected with each floor and entire building

Floor	Demand Load (kVA)
Ground Floor	22.760
Mezzanine Floor	12.390
First Floor	32.725
Second Floor	33.478
Roof top	1.499
Building Total	102.852 kVA

Estimated Demand for building	=	102.852 kVA	≈ 103 kVA
For future Expansion	=	25%	
Total demand Load	=	130 kVA	
Transformer Capacity	=	150 kVA	
Generator Capacity	=	150 kVA	

4 CABLE SIZING

4.1 CABLE SIZING AND DISTRIBUTION DIAGRAMS

4.1.1 Design Criteria

Cable sizing was carried out in accordance with the 17th Edition of the IEE Wiring Regulations (BS 7671). The calculation procedure was applied to determine appropriate cable sizes for all distribution boards. The demand load of each distribution board was considered for the sizing of distribution cables, while the connected capacity was used to select feeder cables for equipment.
The selection process, in line with BS 7671 requirements, was based on the following key factors:

1. Current Carrying Capacity – Determined by the method of installation and the influence of external environmental conditions.
2. Voltage Drop – Dependent on cable impedance, load current magnitude, and load power factor.

- **Selection Based on Current Carrying Capacity**

The selection of cables was carried out in accordance with the current carrying capacity requirements defined in BS 7671. The following design relationship was applied:

$$I_b \leq I_n \leq I_c \leq I_t$$

Where:

- **Ib**: Design current of the circuit (A)
- **In**: Rating/setting of the overload protective device (A)
- **Ic**: Corrected circuit current, considering all applicable rating factors (A)
- **It**: Tabulated single-circuit current carrying capacity of the cable (A)

The design process comprised the following steps:

1. Determination of the design current (**Ib**) for the circuit.
2. Selection of the overload protective device such that **In ≥ Ib**.
3. Identification of the appropriate cable type and installation method.
4. Application of rating factors:
   - **Cg** – Correction factor for grouping
   - **Ca** – Correction factor for ambient temperature
5. Calculation of the corrected circuit current (**Ic**) using:

$$I_c = \frac{I_n}{C_g \times C_a}$$

6. Selection of a cable with a tabulated current carrying capacity satisfying **It ≥ Ic**.

For multiple feeders operating in parallel, the corrected current was calculated using:

$$I_c = \frac{I_n}{C_a \times C_g \times (\text{Number of parallel conductors per phase})}$$

- **Selection Based on Voltage Drop**

Cable sizing was also verified against the voltage drop criteria prescribed in the IEE Wiring Regulations (BS 7671). The calculation was carried out using the following expression:

$$\Delta V_c = V_p \times 1000 \times L \times I_b \quad (mV/A/m)$$

Where:

- **Vp**: Maximum permissible voltage drop of the supply voltage, as per BS 7671 (Volts)
- **L**: Route length of the cable (m)
- **Ib**: Design current of the circuit (A)

The selected cable was required to satisfy the condition:

$$\Delta V_c \leq \Delta V_t$$

Where:

- **ΔVc**: Calculated voltage drops (mV/A/m)
- **ΔVt**: Tabulated voltage drops (mV/A/m), as provided in BS 7671 tables

- **Protective Conductor Sizing**

Protective conductors were selected in accordance with conductor cross-section requirements as follows:

- For phase conductors ≤ 16 mm² → protective conductor of the same cross section.
- For phase conductors > 16 mm² and ≤ 35 mm² → protective conductor of 16 mm².
- For phase conductors > 35 mm² → protective conductor of not less than half the cross section of the phase conductor.

4.1.2 Cable Installation Methods

As per the IET wiring regulation (BS 7671) the installation methods are decided as per below table.

Cable	Installation method
Generator (LV)	On a cable ladder, cables laid in a single layer with spacing equivalent to 1D
Transformer (LV)	On a cable ladder, cables laid in a single layer with spacing equivalent to 1D
Power distribution Indoor (LV)	On a cable ladder/ Tray, cables laid in a single layer touching each other
Power distribution Out Door (LV)	Directly buried in ground, 500mm below the surface, single layer, touching

Other selected low voltage cables were supposed to be installed as per the installation method given in Cable Selection/Voltage drop calculation.

Then we need to cross check whether the cross section of the cable is enough to withstand to the prospective fault current of the particular point.

4.1.3 Specimen Calculation

4.1.3.1 Cable Selection of Transformer to MSB

Determine the Design Current of the circuit (I_b)	
Estimated Load	= 115 kVA
Design Current (I_b)	= 115 x 1000 / 400 x 1.732
	= 166 A
Selection of Protective Device	
Rating of the protection device	= 250 A MCCB
Type of cable	= XLPE/PVC/Cu
Method of Installation	= Method 34 E or F (BS 7671 17th Edition Table 4A2)
Group Correction Factor (C_g)	= 1 (BS 7671 17th Edition Table 4C1)
Temp. Correction Factor (C_a)	= 0.96 (BS 7671 17th Edition Table 4B1)
Calculated current (I_c)	= I_n / C_a x C_g
	= 250 /1 x 0.96
	= 260.417 A

Therefore, the selected cable should be permitted to carry more than 260.417 A.
Therefore 95 mm^2 4C XLPE/PVC/Cu can be choose from the BS 7671- Table 4E2A. But the voltage drop has been calculated to check whether it exceeds the permitted voltage drop or not.
Voltage Drop Calculation for above is as follows.

Voltage drop of 70 mm^2 XLPE/PVC/Cu cable	= 0.45 mV/A/m (BS 7671 17th Edition Table 4E2B)
Length (Transformer to MDB)	= 5 m
Calculated Voltage Drop	= 0.45 x 260.417 x 5 / 1000
	= 0.3735 V
Permitted Voltage Drop	= 0.5% of 400V
	= 2V

This is satisfied the condition of (Permitted Voltage Drop ≥ Calculated Voltage Drop condition).
Therefore, we proposed **4C x 95 mm2 XLPE/PVC/Cu** cable for this Transformer.

4.1.3.2 Cable Selection of Generator to MSB

In accordance with the client's requirements, a standby generator system has been designed to supply both critical and non-critical loads during a power outage. This ensures uninterrupted operation of essential services while also supporting non-critical functions, thereby minimizing disruption to the overall facility.

Similar to the transformer load calculations, the same cable sizing methodology can be applied for the generator. Since the generator is designed to supply both critical and non-critical loads as per the client's requirements, the calculated current demand remains consistent. Therefore, the selected cable size **4C x 95 mm2 XLPE/PVC/Cu** is suitable for both transformer and generator connections, ensuring safe and efficient operation under all load conditions.

4.1.3.3 Cable Selection of MSB to Busbar

The cable selection from the Main Switchboard (MSB) to the Busbar follows the same principle, as this section also carries the total load current supplied either from the transformer or the generator. The only variation in this case is the relatively short length between the MSB and the Busbar, which results in minimal voltage drop. Therefore, the previously selected cable size **4C x 95 mm² XLPE/PVC/Cu** is also suitable for this connection, ensuring safe operation and compliance with design requirements.

4.1.3.4 Cable Selection of Busbar to SDBs (Sub Distribution boxes)

For Ground Floor

Determine the Design Current of the circuit (I_b)

Estimated Load	= 22.76 kVA
Design Current (I_b)	= 22.76 x 1000 / 400 x 1.732
	= 32.04 A
Selection of Protective Device	
Rating of the protection device	= 50A MCB
Type of cable	= XLPE/PVC/Cu
Method of Installation	= Method 34 E or F (BS 7671 17th Edition Table 4A2)
Group Correction Factor (C_g)	= 0.75 (BS 7671 17th Edition Table 4C1)
Temp. Correction Factor (C_a)	= 0.96 (BS 7671 17th Edition Table 4B1)
Calculated current (I_c)	= I_n / C_a x C_g
	= 50 /0.75 x 0.96
	= 69.444 A

Therefore, the selected cable should be permitted to carry more than 69.444 A.
Therefore 10 mm² 4C XLPE/PVC/Cu can be choose from the BS 7671- Table 4E2A. But the voltage drop has been calculated to check whether it exceeds the permitted voltage drop or not. Voltage Drop Calculation for above is as follows.

Voltage drop of 10 mm² XLPE/PVC/Cu cable	= 4 mV/A/m (BS 7671 17th Edition Table 4E2B)
Length (Transformer to MDB)	= 5 m
Calculated Voltage Drop	= 4 x 32.04 x 5 / 1000
	= 0.6408 V
Permitted Voltage Drop	= 0.5% of 400V
	= 2V

This is satisfied the condition of (Permitted Voltage Drop ≥ Calculated Voltage Drop condition). Therefore, we proposed **4C x 10 mm2 XLPE/PVC/Cu** cable for this Transformer.

Using the same methodology, cable sizing calculations were carried out for all outgoing feeders from the Busbar to the respective floor Sub-Distribution Boards (SDBs). The results of these calculations, including the selected cable sizes and associated parameters, are summarized in the following table for clarity and reference.

4.1.3.5 Cable Selection of SDB – GF to Circuits (end Load)

Table 10 illustrates the allocation of different loads to their respective circuits. In this section, the cable sizing calculations are carried out for the final circuits originating from SDB-GF to the end-use points.

From SDB-GF to C1

Determine the Design Current of the circuit (I_b)

Estimated Load	= 0.25 kVA
Design Current (I_b)	= 0.25 x 1000 / 230
	= 1.482
Selection of Protective Device	
Rating of the protection device	= 6A MCB
Type of cable	= XLPE/PVC/Cu
Method of Installation	= Method 34 E or F (BS 7671 17th Edition Table 4A2)
Group Correction Factor (C_g)	= 1 (BS 7671 17th Edition Table 4C1)
(Here assume that cables are run for different circuits separately)	
Temp. Correction Factor (C_a)	= 0.96 (BS 7671 17th Edition Table 4B1)
Calculated current (I_c)	= I_n / C_a x C_g
	= 6 /1 x 0.96
	= 6.25 A

Therefore, the selected cable should be permitted to carry more than 6.25 A.
Therefore 1 mm^2 1C XLPE/PVC/Cu can be choose from the BS 7671- Table 4E2A. But the voltage drop has been calculated to check whether it exceeds the permitted voltage drop or not.
Voltage Drop Calculation for above is as follows.

Voltage drop of 1 mm^2 XLPE/PVC/Cu cable	= 46 mV/A/m (BS 7671 17th Edition Table 4E2B)
Length (Transformer to MDB)	= 15 m
Calculated Voltage Drop	= 46 x 1.482 x 15 / 1000
	= 1.0226 V
Permitted Voltage Drop	= 0.5% of 400V
	= 2V

This is satisfied the condition of (Permitted Voltage Drop ≥ Calculated Voltage Drop condition).
Therefore, we proposed **1C x 1 mm2 XLPE/PVC/Cu** cable for this Transformer.

4.2 Selected Cables

Using the same methodology adopted in the previous specimen calculation, the cable sizes for this section have been determined. This consistent approach ensures accuracy, compliance with standards, and uniformity throughout the design process.

Table 16: Main Supply Cable Selection

Cable From	Cable To	Lay. Mtd.	Len (m)	*Ib(A)*	*In(A)*	Cg	Ca	It(A)	Iz(A)	Type pro. Device	Cross Sectional Area of cable (mm^2)		Type	%VD
Generator	MDB	Tray	5	166.000	250	1	0.96	260.417	298	MCCB	95	4C	XLPE	0.09%
T/F	MDB	Tray	5	166.000	250	1	0.96	260.417	298	MCCB	95	4C	XLPE	0.09%
MDB	Busbar	Tray	1	166.000	250	1	0.96	260.417	298	MCCB	95	4C	XLPE	0.02%

Table 17: Cable Sizing from Busbar to SDBs

Cable From	Cable To	Lay. Mtd.	Len (m)	*Ib(A)*	*In(A)*	Cg	Ca	It(A)	Iz(A)	Type pro. Device	Cross Sectional Area of cable (mm^2)		Type	%VD
Busbar	SDB -GF	Conduit on wall	5	32.040	50	0.75	0.96	69.444	75	MCB	10	4C	XLPE	0.16%
Busbar	SDB-MF	Conduit on wall	10	16.560	20	0.77	0.96	27.056	32	MCB	2.5	4C	XLPE	0.66%
Busbar	SDB-FF	Conduit on wall	15	47.230	100	0.82	0.96	127.033	158	MCB	35	4C	XLPE	0.20%
Busbar	SDB-SF	Conduit on wall	20	48.320	100	0.88	0.96	118.371	127	MCB	25	4C	XLPE	0.40%
Busbar	SDB-RT	Conduit on wall	25	2.160	10	1	0.96	10.417	14	MCB	1	1C	XLPE	0.62%

Table 18: Cable Sizing from SDB-GF to Circuits

Cable From	Cable To	Lay. Mtd.	Len (m)	*Ib(A)*	*In(A)*	Cg	Ca	It(A)	Iz(A)	Type pro. Device	Cross Sectional Area of cable (mm^2)		Type	%VD
SDB-GF	C1	Conduit on wall	15	1.482	6	1	0.96	6.250	14	MCB	1	1C	XLPE	0.26%
SDB-GF	C2	Conduit on wall	12	0.900	6	1	0.96	6.250	14	MCB	1	1C	XLPE	0.12%
SDB-GF	C3	Conduit on wall	8	0.140	6	1	0.96	6.250	14	MCB	1	1C	XLPE	0.01%
SDB-GF	C4	Conduit on wall	8	0.139	6	1	0.96	6.250	14	MCB	1	1C	XLPE	0.01%
SDB-GF	C5	Conduit on wall	10	8.348	10	1	0.96	10.417	14	MCB	1	1C	XLPE	0.96%
SDB-GF	C6	Conduit on wall	10	10.435	16	1	0.96	16.667	14	MCB	1	1C	XLPE	1.20%
SDB-GF	C7	Conduit on wall	12	8.348	10	1	0.96	10.417	14	MCB	1	1C	XLPE	1.15%
SDB-GF	C8	Conduit on wall	12	4.174	10	1	0.96	10.417	14	MCB	1	1C	XLPE	0.58%
SDB-GF	C9	Conduit on wall	6	5.774	10	1	0.96	10.417	18	MCB	1	4C	XLPE	0.35%
SDB-GF	C10	Conduit on wall	8	3.464	10	1	0.96	10.417	18	MCB	1	4C	XLPE	0.28%
SDB-GF	C11	Conduit on wall	6	11.534	10	1	0.96	10.417	18	MCB	1	4C	XLPE	0.69%

Table 19: Cable Sizing from SDB-MF to Circuits

Cable From	Cable To	Lay. Mtd.	Len (m)	*Ib(A)*	*In(A)*	Cg	Ca	It(A)	Iz(A)	Type pro. Device	Cross Sectional Area of cable (mm^2)		Type	%VD
SDB-MF	C12	Conduit on wall	6	0.334	6	1	0.96	6.250	14	MCB	1	1C	XLPE	0.02%
SDB-MF	C13	Conduit on wall	8	1.447	6	1	0.96	6.250	14	MCB	1	1C	XLPE	0.13%
SDB-MF	C14	Conduit on wall	6	0.070	6	1	0.96	6.250	14	MCB	1	1C	XLPE	0.00%
SDB-MF	C15	Conduit on wall	6	0.139	6	1	0.96	6.250	14	MCB	1	1C	XLPE	0.01%
SDB-MF	C16	Conduit on wall	12	4.174	6	1	0.96	6.250	14	MCB	1	1C	XLPE	0.58%
SDB-MF	C17	Conduit on wall	10	10.435	16	1	0.96	16.667	19	MCB	1.5	1C	XLPE	0.81%
SDB-MF	C18	Conduit on wall	12	4.177	6	1	0.96	6.250	14	MCB	1	1C	XLPE	0.58%
SDB-MF	C19	Conduit on wall	8	4.177	6	1	0.96	6.250	14	MCB	1	1C	XLPE	0.38%

Table 20: Cable Sizing from SDB-FF to Circuits

Cable From	Cable To	Lay. Mtd.	Len (m)	*Ib(A)*	*In(A)*	Cg	Ca	It(A)	Iz(A)	Type pro. Device	Cross Sectional Area of cable (mm^2)		Type	%VD
SDB-FF	C20	Conduit on wall	8	4.897	6	1	0.96	6.250	14	MCB	1	1C	XLPE	0.45%
SDB-FF	C21	Conduit on wall	8	1.013	6	1	0.96	6.250	14	MCB	1	1C	XLPE	0.09%
SDB-FF	C22	Conduit on wall	14	0.619	6	1	0.96	6.250	14	MCB	1	1C	XLPE	0.10%
SDB-FF	C23	Conduit on wall	6	0.139	6	1	0.96	6.250	14	MCB	1	1C	XLPE	0.01%
SDB-FF	C24	Conduit on wall	10	31.304	63	1	0.96	65.625	81	MCB	16	1C	XLPE	0.23%
SDB-FF	C25	Conduit on wall	12	6.261	12	1	0.96	12.500	14	MCB	1	1C	XLPE	0.86%
SDB-FF	C26	Conduit on wall	14	6.261	12	1	0.96	12.500	14	MCB	1	1C	XLPE	1.01%
SDB-FF	C27	Conduit on wall	8	4.174	6	1	0.96	6.250	14	MCB	1	1C	XLPE	0.38%
SDB-FF	C28	Conduit on wall	9	18.430	20	1	0.96	20.833	23	MCB	1.5	4C	XLPE	1.12%
SDB-FF	C29	Conduit on wall	6	5.565	10	1	0.96	10.417	14	MCB	1	1C	XLPE	0.23%
SDB-FF	C30	Conduit on wall	8	4.522	6	1	0.96	6.250	14	MCB	1	1C	XLPE	0.24%
SDB-FF	C31	Conduit on wall	8	4.522	6	1	0.96	6.250	14	MCB	1	1C	XLPE	0.24%
SDB-FF	C32	Conduit on wall	10	17.391	20	1	0.96	20.833	26	MCB	2.5	1C	XLPE	0.83%

Table 21: Cable Sizing from SDB-FF to Circuits

Cable From	Cable To	Lay. Mtd.	Len (m)	*Ib(A)*	*In(A)*	Cg	Ca	It(A)	Iz(A)	Type pro. Device	Cross Sectional Area of cable (mm^2)		Type	%VD
SDB-SF	C33	Conduit on wall	20	4.897	6	1	0.96	6.250	14	MCB	1	1C	XLPE	0.66%
SDB-SF	C34	Conduit on wall	12	0.070	6	1	0.96	6.250	14	MCB	1	1C	XLPE	0.01%
SDB-SF	C35	Conduit on wall	10	0.104	6	1	0.96	6.250	14	MCB	1	1C	XLPE	0.01%
SDB-SF	C36	Conduit on wall	12	0.139	6	1	0.96	6.250	14	MCB	1	1C	XLPE	0.01%
SDB-SF	C37	Conduit on wall	6	62.609	6	1	0.96	6.250	14	MCB	1	1C	XLPE	2.54%
SDB-SF	C38	Conduit on wall	8	2.087	6	1	0.96	6.250	14	MCB	1	1C	XLPE	0.11%
SDB-SF	C39	Conduit on wall	10	2.087	6	1	0.96	6.250	14	MCB	1	1C	XLPE	0.14%
SDB-SF	C40	Conduit on wall	10	4.174	6	1	0.96	6.250	14	MCB	1	1C	XLPE	0.28%
SDB-SF	C41	Conduit on wall	8	23.040	32	1	0.96	33.333	42	MCB	4	3C	XLPE	0.46%
SDB-RT	C42	Conduit on wall	12	6.509	10	1	0.96	10.417	14	MCB	1	1C	XLPE	0.53%

5 SINGLE LINE DIAGRAMS

5.1 Single Line Diagram for Main Distribution Board

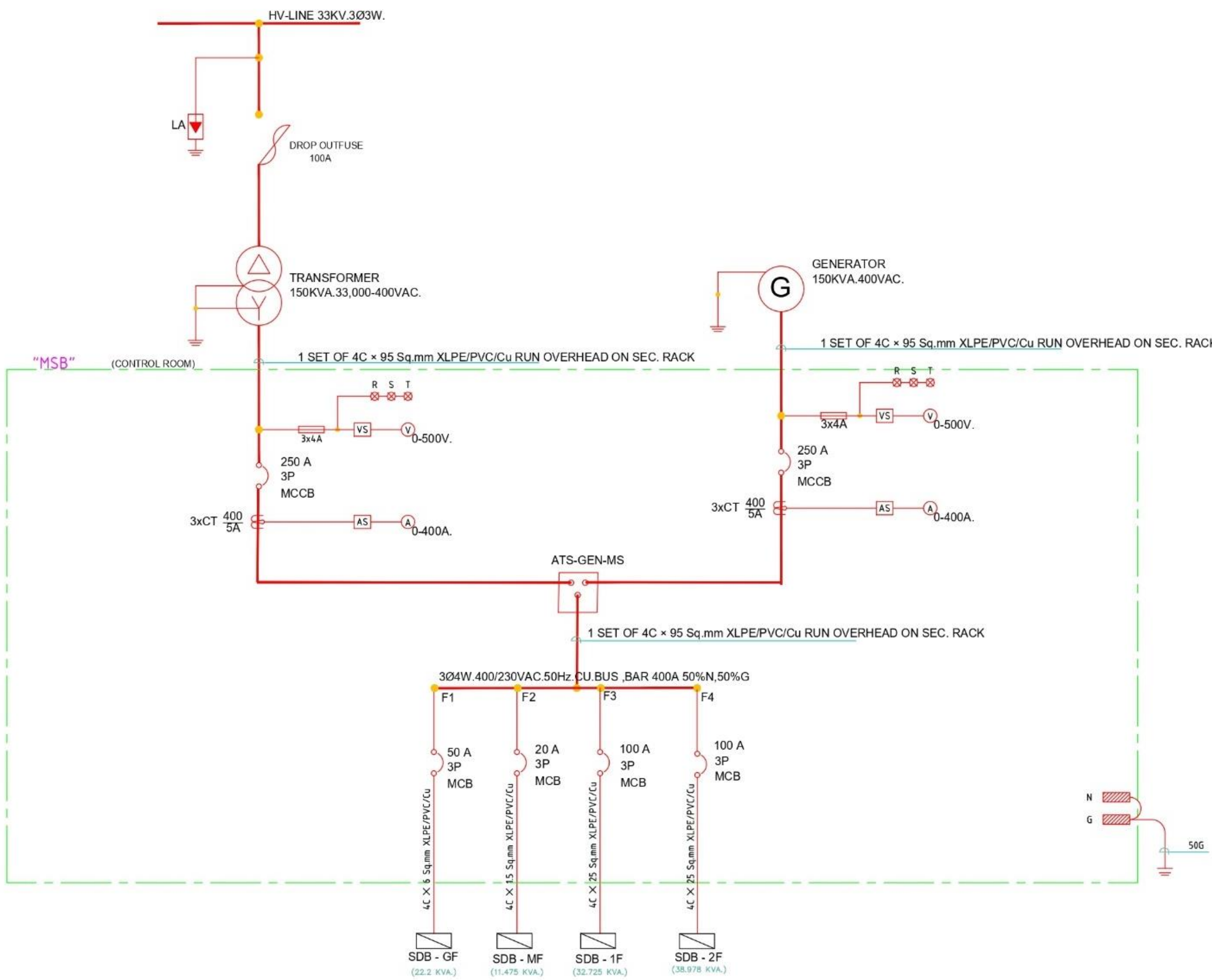

Figure 1: Single Line Diagram of MSB

5.2 Single Line Diagram for Ground Floor

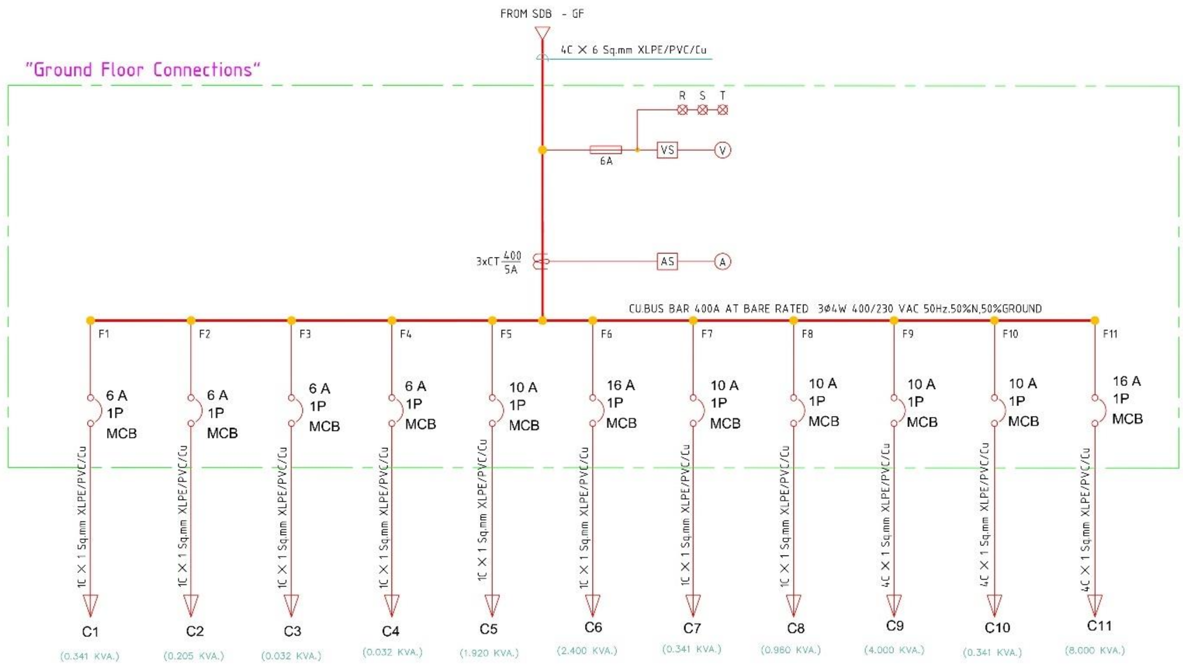

Figure 2: Single Line Diagram for Ground Floor

5.3 Single Line Diagram for Mezzanine Floor

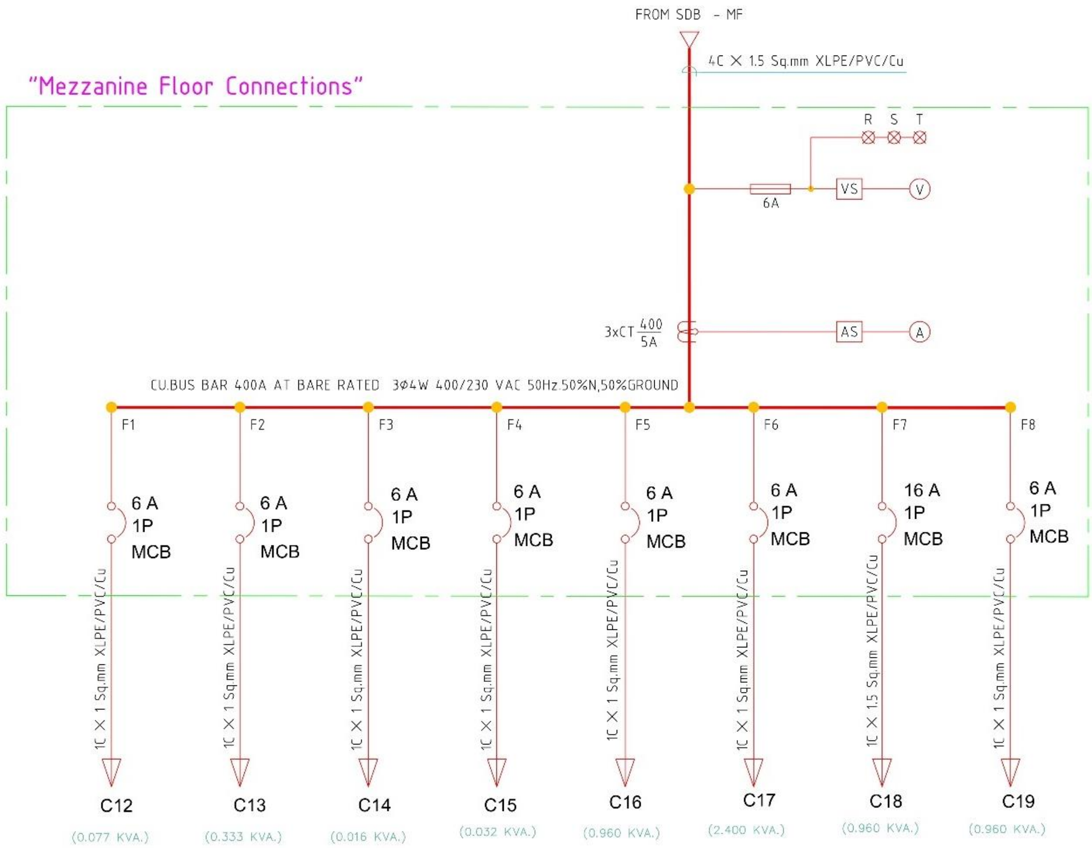

Figure 3: Single Line Diagram for Mezzanine Floor

5.4 Single Line Diagram for First Floor

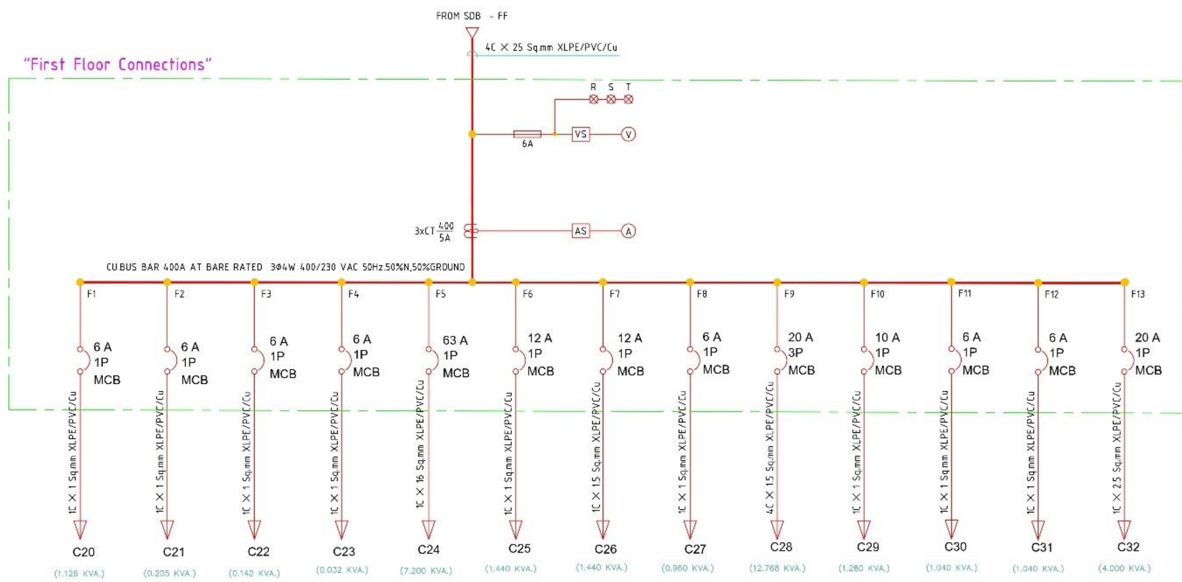

Figure 4: Single Line Diagram for First Floor

5.5 Single Line Diagram for Second Floor and Rooftop Loads

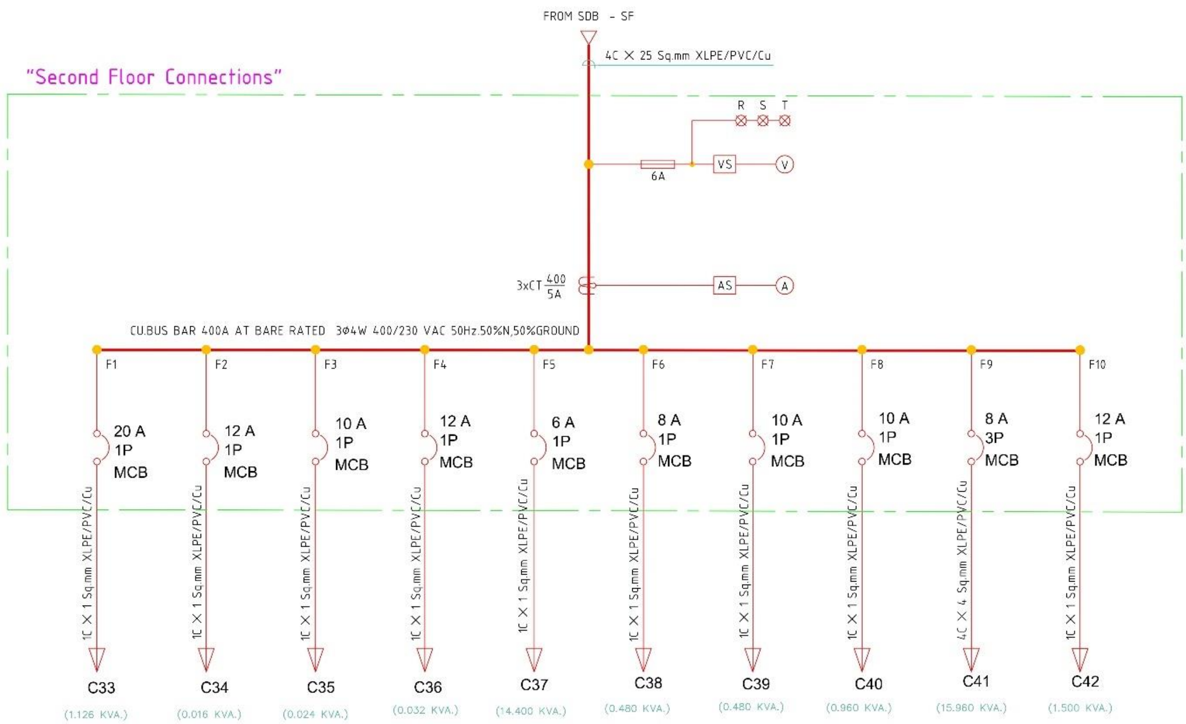

Figure 5: Single Line Diagram for Second Floor and Rooftop Loads

6 ELECTRICAL LAYOUT DRAWING

6.1 Electrical Layout Diagram for Ground Floor

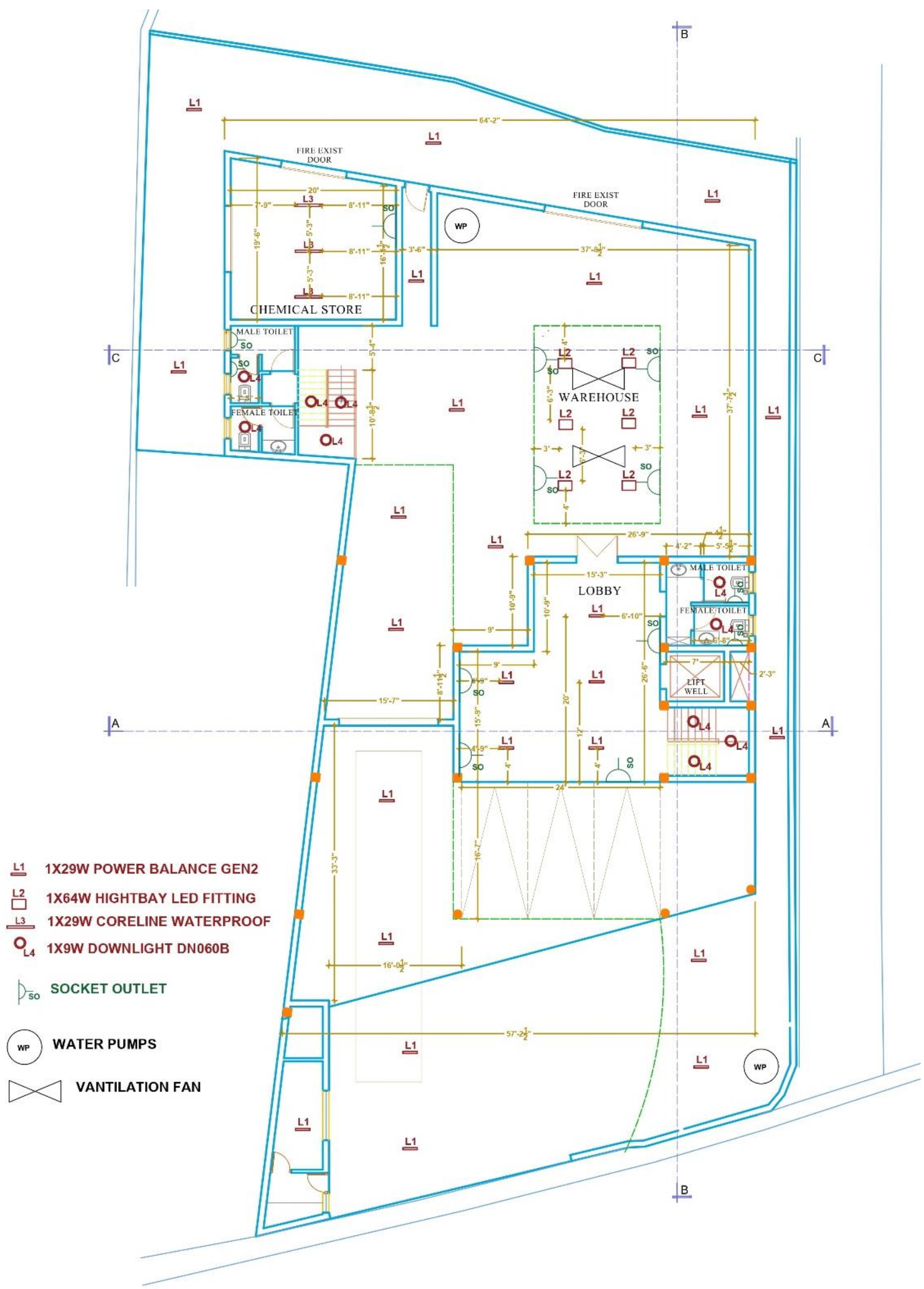

Figure 6: Electrical Layout Diagram for Ground Floor

6.2 Electrical Layout Diagram for Mezzanine Floor

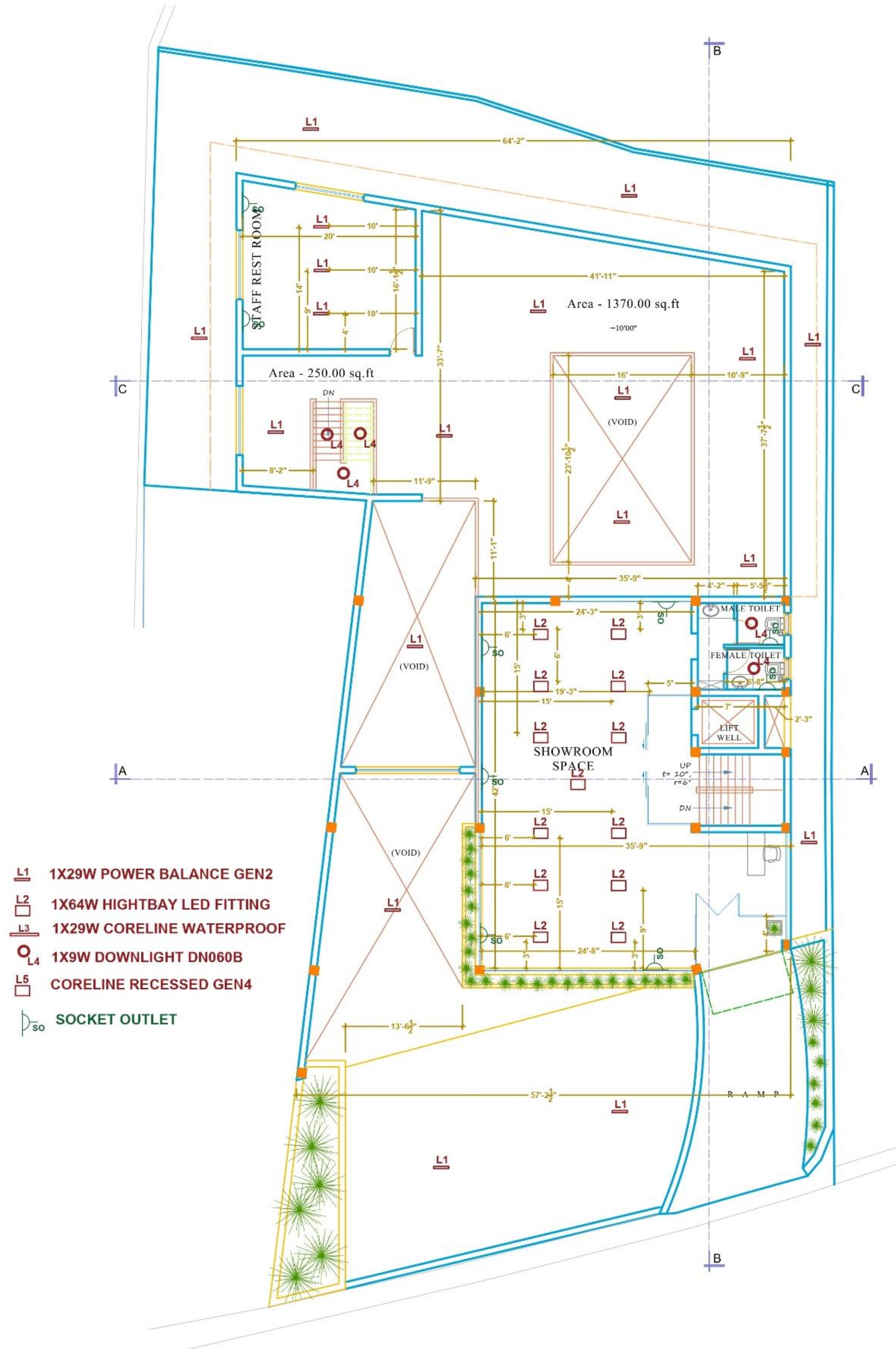

Figure 7: Electrical Layout Diagram for Mezzanine Floor

6.3 Electrical Layout Diagram for First Floor

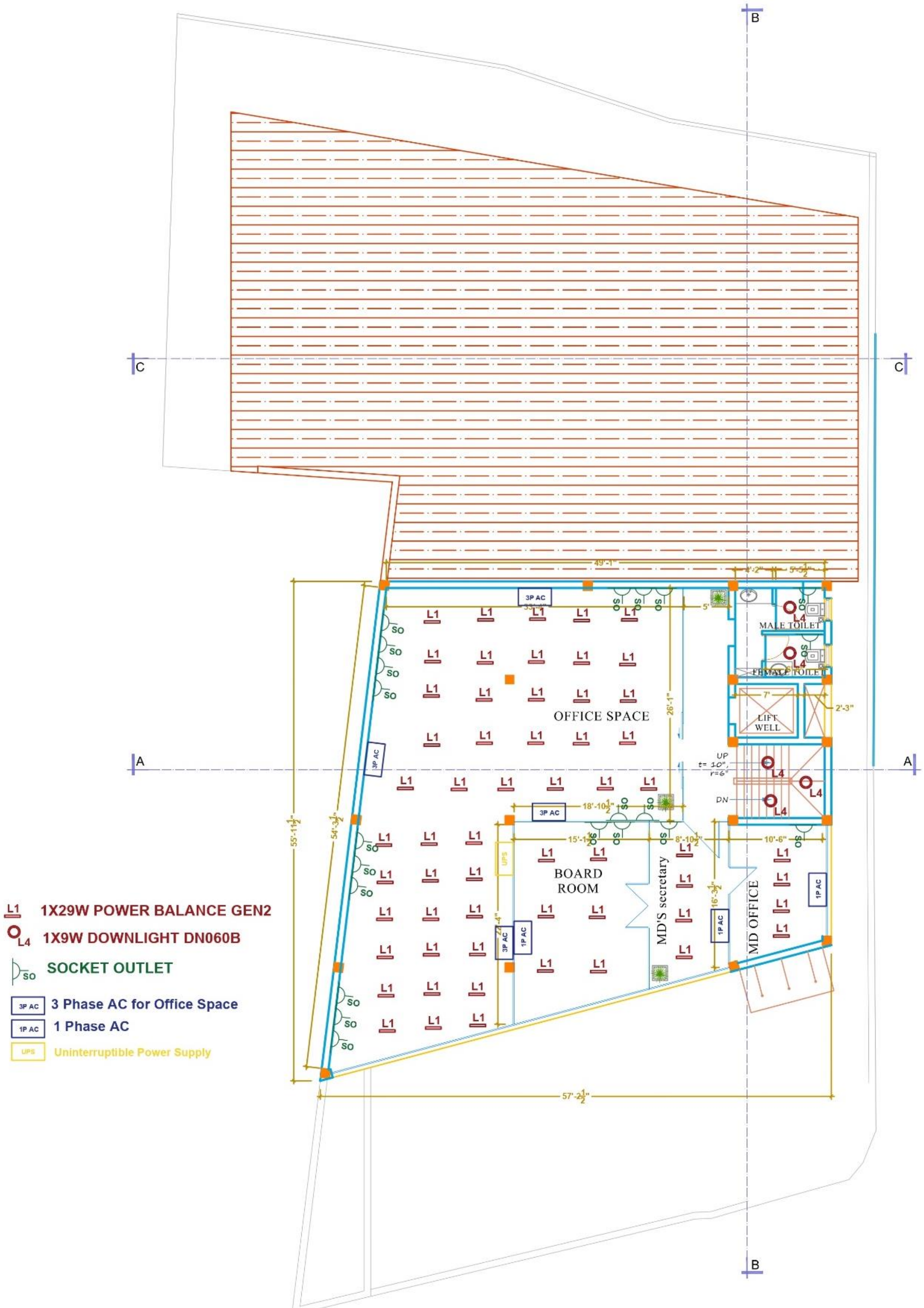

Figure 8: Electrical Layout Diagram for First Floor

6.4 Electrical Layout Diagram for Second Floor

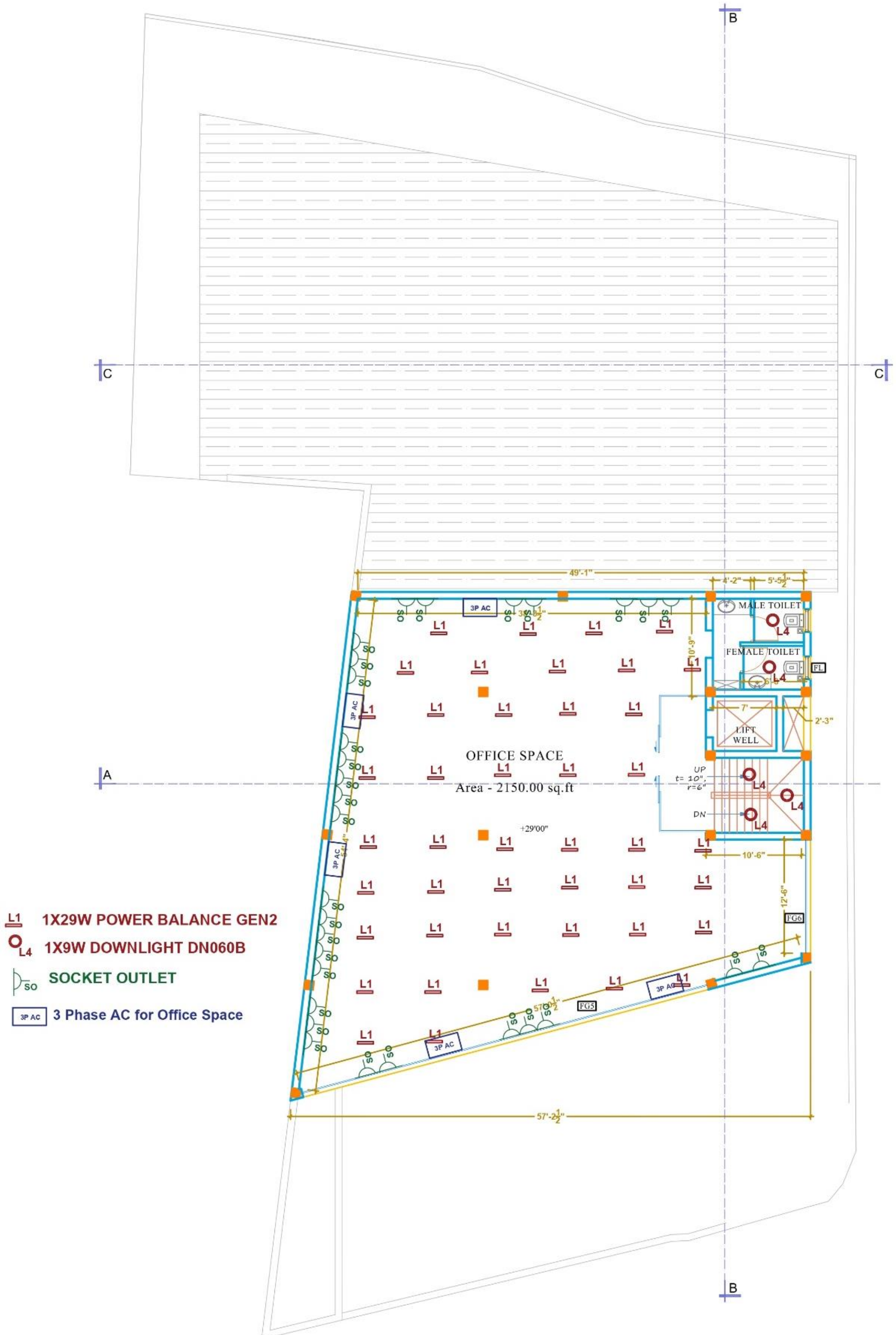

Figure 9: Electrical Layout Diagram for Second Floor

6.5 Electrical Layout Diagram for Roof Top

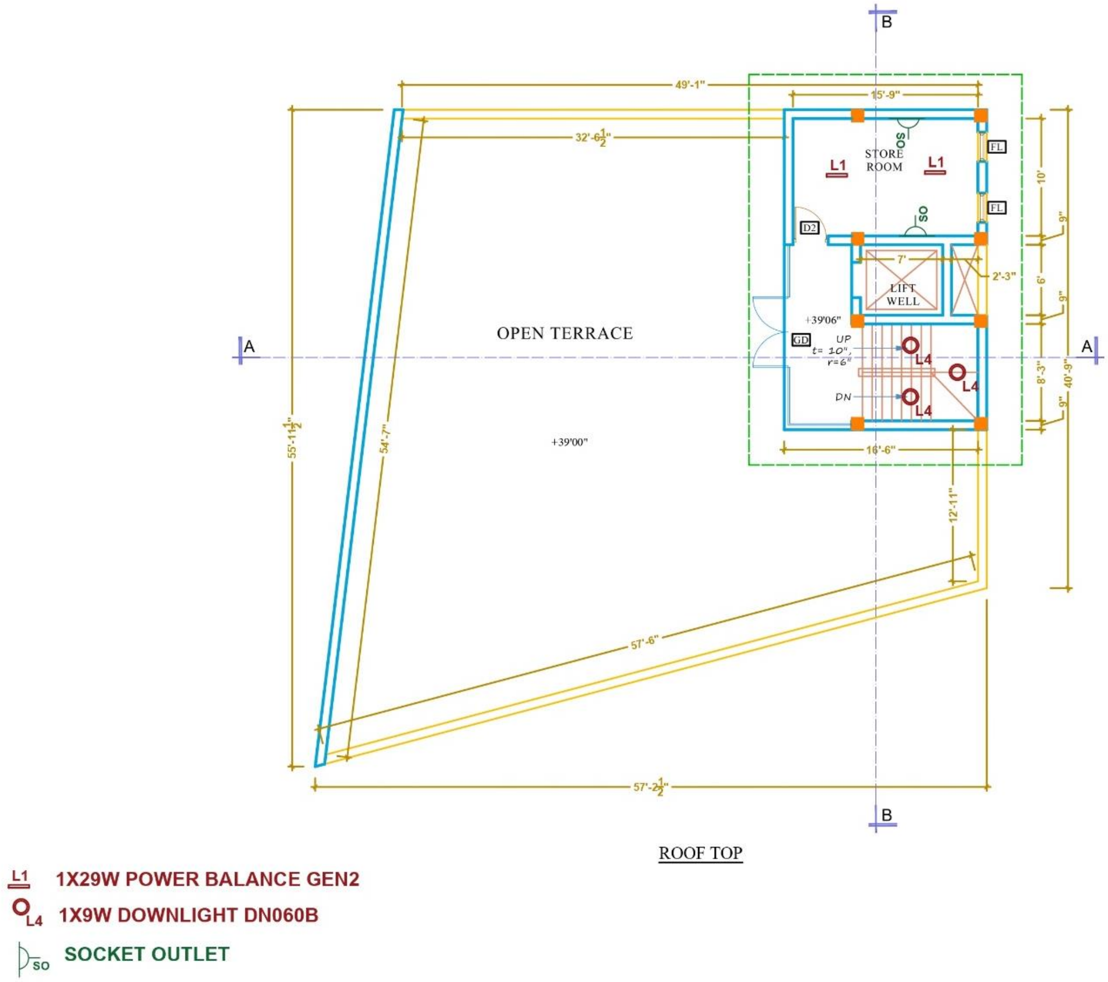

Figure 10:Electrical Layout Diagram for Roof Top