Project Report on

Course Code: ENEL 674 (L01)

Course Name: Industrial and Commercial Power Systems

Submitted By,

Group: 09

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Objective

The objective of this study is to develop the electrical design for a building by analyzing customer requirements. In the first milestone, the focus will be on performing load calculations to determine appropriate cable and panel sizes, designing the lighting layout and schedules based on lumen calculations, and preparing the mechanical schedule. Additionally, a single-line diagram will be created, including preliminary equipment sizing and placement.

Scope of Work

- **Requirement Analysis** – Assess customer needs for the electrical system.
- **Load Schedule** – Prepare a detailed load calculation for each room.
- **Lighting Schedule** – Design lighting based on lumen calculations and submit a lumen schedule.
- **Panel Schedule** – Develop a balanced load distribution across phases.
- **Power Layout** – Plan the placement of equipment, receptacles, and feeding panels.
- **Lighting Layout** – Determine the types and number of luminaires.
- **Single-Line Diagram (SLD)** – Create a diagram showing panel locations, breakers, utility connections, and backup systems.
- **Modification Proposal** – Present recommendations to the customer for any necessary changes.

Project Consideration

- ✓ The Project is based on a 10-acre land with 05 building plans, among which 01 building layout is the primary consideration.
- ✓ The utility supply is 112.5 KVA from 25 KV Delta connected feeder.
- ✓ The secondary voltage of transformer is considered 208 V 3phase Star connection.
- ✓ A generator with 125% of continuous load is considered to recover the power outage condition.
- ✓ The building will be used as a multipurpose hall for renting purpose so adequate receptacles has been considered for external equipment for sound and lighting.
- ✓ Loads are primarily calculated based on room requirement, lighting requirement, and additional receptacles for maintenance and external equipment.
- ✓ Panel has been designed with balanced load between 3 phases (15% max deviation) and load which require schedule maintenance has been taken from separate panels for not hampering daily operation.
- ✓ Security and fire protection has been considered but with bare minimum details as it's out of scope for milestone 1.
- ✓ Conductor and conduit sizing has been considered as per CEC regulation.
- ✓ The minimum conductor size was 12 AWG and minimum conduit size 21 mm.
- ✓ The generator and utility line will be operated through an Automatic transfer switch system.
- ✓ The total secondary cable from Transformer/Generator to electrical room is underground and no overhead cable is considered. From panels to room wiring will be in conduit and all sizing calculation is done based on this.
- ✓ Average ambient temperature in room is considered 30 deg.
- ✓ Additional features considered:
    - PA system
    - Water sprinkler system
    - WIFI at each corner
    - Card reader in sensitive entrance
    - Security camera
    - Barrier free switch
    - Fire exit lighting and Smoke detector
- ✓ All 20A receptacles are T type receptacles.
- ✓ Other receptacles are duplex receptacles.
- ✓ Receptacles close to water source like sinks are weather proof receptacles.
- ✓ A 30 HP motor with mechanical starter has been considered for fire pump.

- ✓ Breakers are rated with 125% of load.
- ✓ Cable sizing considered with 5% future growth and 125% of load current.
- ✓ For lighting, LED light is considered in most of the places considering high efficacy and long-life span. But in different room, different sorts of lighting has been considered based on the requirement.
- ✓ Lights for big room like Cultural activities or common are considered suspended lighting.
- ✓ Equipment like Generator and Transformer will be in a separate room outside the building to ensure fire safety and avoiding sound disturbance.

Process Flow

The following figure illustrates the process flow of this project. By analyzing customer's requirement, we have performed the electrical design of the building. We have done lumen calculation, receptacle calculation, load calculation, panel scheduling of every room in the base plan. After that, we have estimated conduit sizing for both continuous and non-continuous load. Finally based on all the calculations, we have conducted lighting design, power layout, normal and emergency SLD. The below figure displays the process flow:

Technical Specification

Lumen Calculation

For calculation of number of luminaire, we have considered a light loss factor (LLF) of 0.9 and RCR = 10 if RCR is greater than 10 on luminaire cut sheets. We have used the following formula to determine the number of luminaire.

So, Number of luminaire = $\frac{illuminance * L * W}{lumen\ per\ luminiare * Cu * LLF}$

Here, for L & W, we have considered the base plan and we have calculated the Cu from spec sheet based on the RCR.

In this section, we have calculated number of luminaire for all the rooms displayed in the base plan. In the below figure, we have considered Room 101 classroom, Room 102 Closet, Room 103 W. Washroom, Room 104 M. Washroom, Room 105 Washroom Corridor, Room 106 Janitor and Room 107 Water Meter.

Lumeniare Feature	Room 100 Foyer	Room 101 Classroom	Room 102 Closet	Room 103 W. Washroom	Room 104 M. Washroom	Room 105 Washroom Corridor	Room 106 Janitor	Room 107 Water Meter
Illuminace	350	375	150	280	280	250	300	75
number of lumaniare	1	9	4	16	7	2	2	1
lumen per luminiare	4000	4000	300	1200	1200	270	600	1000
Luminaire type (LED)	Ceiling-mounted spot light	Flat Panel LED.	Recessed LED Downlight	LED Recessed Downlight.	LED Recessed Downlight.	LED Recessed Downlight	LED Recessed Downlight.	LED Utility Light
Description (Model No)	Hue White and Color Ambiance Centris 4-Spot Ceiling Light	Lithonia CPX 2X4 4000LM 40K M2	Energizer 4" LED Recessed Ceiling Light	Juno LED 6" Recessed Downlight	Juno LED 6" Recessed Downlight	Cree 4" LED Downlight	Halo RL560 Series LED	KT-WPLED10-840
mounting (Suspended Celling)	Ceiling-mounted	Recessed mounting	Recessed	Recessed ceiling installation.	Recessed ceiling installation.	Recessed Ceiling Mount	Recessed ceiling installation.	ceiling-mounted light
wattage(W)	40 W	40	6	12	12	3	9	10
lumens(lm)	4,600 lumens	4000	300	1200	1200	270	600	1000
manufacturer	Philips Hue	Lithonia Lighting	Energizer	Juno Lighting	Juno Lighting	Cree	Halo	Keystone
Remarks	Provides both functional and ambient lighting, with individual spot adjustability			ENERGY STAR certified, dimmable.	ENERGY STAR certified, dimmable	Energy-efficient, low-wattage	ENERGY STAR certified, smooth light distribution	
Driver	Integrated LED driver	constant current LED driver	Internal driver	Integrated driver	Integrated driver	Integrated LED driver	Integrated driver	Internal constant-current LED driver.
CCT(K)	Adjustable from 2000K to 6500K	4000	4000	4000	4000	4000	5000	4000
CRI	80	80	>80	>90	>90	> 80	>90	>80
Controls(V)	Philips Hue app, Bluetooth, Alexa, Google Assistant, Hue Bridge integration	0-10	0-10	Compatible with dimmers	Compatible with dimmers	Non-dimmable		Non-dimmable
voltage(V)	24 V	120 - 277	120	120V.	120V.	120	120V.	120-277
Efficacy(lm/W)	115 lumens per watt (lm/W)	100	50-60	100	100	90	66.7	100

In the below figure, we have considered Room 108 Catering Kicthenette, Room 109 Commons, Room 110 Cultural Room, Room 111 Storage, Room 112 Snack, Room 113 Information, Room 114 and Room 115 Yukuta.

Lumeniare Feature	Room 108 Catering Kicthenette	Room 109 Commons	Room 110 Cultural Room	Room 111 Storage	Room 112 Snack	Room 113 Information	Room 114	Room 115 Yukuta
Illuminace	500	450	750	100	350	300	200	200
number of lumaniare	13	12	11	1	3	6	3	6
lumen per luminiare	4000	3600	21,000	2000	4000	4,000 lumens	400 lumens	800 lumens
Luminaire type (LED)	LED Recessed Panel	LED Panel Light	LED High Bay Light	LED Vapor Tight Fixture	LED Vapor Tight Fixture	LED Panel	LED Recessed Downlight	LED Recessed Downlight
Description (Model No)	Lithonia Lighting CPX 2X2	Philips CoreLine LED Panel 600x600	ps Ultra Efficient LED High Bay 1	SHARK2-22N	SHARK2-48N	Philips CorePro LED Panel 40W	Philips CorePro LED Downlight 5W	Philips CorePro LED Downlight 10W
mounting (Suspended Celling)	Recessed Ceiling Grid Mount	Surface Mount	Suspended	Ceiling or wall mount	Ceiling or wall mount	Ceiling Surface Mount (Recessed option available)	Recessed (Ceiling Mount)	Recessed (Ceiling Mount)
wattage(W)	40	36	150	24	48	40W	5W	10W
lumens(lm)	4000	3600	21000	2000	4000	4,000 lumens	400 lumens	800 lumens
manufacturer	Lithonia	Philips	Philips	RAB Lighting	RAB Lighting	Philips	Philips	Philips
Remarks	Glare-free design, high efficiency	Slim, energy-efficient	Ideal for high ceilings and large spaces	IP66-rated for dust and water resistance.	rated for dust and water resista	Ideal for offices and workspaces, energy-efficient, uniform lighting	Suitable for small rooms, energy-efficient, compact	Suitable for minimalistic and serene settings, energy-efficient, long-lasting
Driver	Integrated Driver	LED Driver	high-efficiency driver	0-10V	0-10V	Integrated LED Driver	Integrated LED Driver	Integrated LED Driver
CCT(K)	4000	3600	4000	4000	4000	4000K (Neutral White)	3000K (Warm White)	3000K (Warm White)
CRI	> 90	80+	80+	>80	>80	≥80 (Good color rendering)	≥80 (Good color rendering)	≥80 (Good color rendering)
Controls(V)	0-10	Compatible with dimmers	Compatible with dimmers	Dimmable with compatible switch	immable with compatible switc	Non-dimmable (Dimmable versions available)	Non-dimmable (Dimmable versions available)	Non-dimmable (Dimmable versions available)
voltage(V)	120-277	120-277	120-277	120-277	120-277	120V	120V	120V
Efficacy(lm/W)	105	100	140	83	83	100 lm/W	80 lm/W	80 lm/W

In the below figure, we have considered Room 116 Education, Room 117 Mechanical, Room 118 Staff, Room 119 Administration, Room 120 Vestibule, Room 121 Classroom, Room 122 Exhibit and Room 123 Tea.

Lumeniare Feature	Room 116 Education	Room 117 Mechanical	Room 118 Staff	Room 119 Administration	Room 120 Vestibule	Room 121 Classroom	Room 122 Exhibit	Room 123 Tea
Illuminace	500	200	300	500	300	375	300	150
number of lumaniare	5	6	4	5	5	9	16	4
lumen per luminiare	4,000 lumens	800 lumens	2,000 lumens	4,000 lumens	800 lumens	400	1800 lumens	400
Luminaire type (LED)	LED Panel	LED Recessed Downlight	LED Panel	LED Panel	LED Recessed Downlight	flat panel LED	LED Recessed Downlight	recessed LED panel light
Description (Model No)	Philips CorePro LED Panel 40W	Philips CorePro LED Downlight 10W	Philips CorePro LED Panel 20W	Philips CorePro LED Panel 40W	Philips CorePro LED Downlight 10W	Lithonia CPX 2X4 4000LM 40K M2	Philips CorePro LED Downlight 20W	Philips CoreLine LED Panel 600x600 36W 4000K
mounting (Suspended Celling)	Ceiling Surface Mount (Recessed option available)	Recessed (Ceiling Mount)	Ceiling Surface Mount (Recessed option available)	Ceiling Surface Mount (Recessed option available)	Recessed (Ceiling Mount)	Recessed mounting	Recessed (Ceiling Mount)	Recessed
wattage(W)	40W	10W	20W	40W	10W	40	20W	36
lumens(lm)	4,000 lumens	800 lumens	2,000 lumens	4,000 lumens	800 lumens	4000	1800 lumens	4000
manufacturer	Philips	Philips	Philips	Philips	Philips	Lithonia Lighting	Philips	Philips
Remarks	Ideal for educational spaces, energy-efficient, uniform lighting	Ideal for low to medium height spaces, energy-efficient, long-lasting	Ideal for general spaces, provides even lighting, energy-efficient	Ideal for office spaces, energy-efficient, provides uniform lighting	Suitable for general illumination, energy-efficient, long-lasting		Suitable for general illumination in galleries, energy-efficient, long-lasting	
Driver	Integrated LED Driver	Integrated LED Driver	Integrated LED Driver	Integrated LED Driver	Integrated LED Driver	constant current LED driver	Integrated LED Driver	Integrated LED driver
CCT(K)	4000K (Neutral White)	4000K (Neutral White)	4000K (Neutral White)	4000K (Neutral White)	3000K (Warm White)	4000	4000K (Neutral White)	4000
CRI	≥80 (Good color rendering)	≥80 (Good color rendering)	≥80 (Good color rendering)	≥80 (Good color rendering)	≥80 (Good color rendering)	80	≥80 (Good color rendering)	85
Controls(V)	Non-dimmable (Dimmable versions available)	Non-dimmable (dimmable versions available)	Non-dimmable (Dimmable versions available)	Non-dimmable (Dimmable versions available)	Non-dimmable (Dimmable versions available)	0-10	Non-dimmable (Dimmable versions available)	0-10
voltage(V)	120V	120V	120V	120V	120V	120 - 277	120V	120V - 277V
Efficacy(lm/W)	100 lm/w	80 lm/W	100 lm/W	100 lm/W	80 lm/W	100	90 lm/W	110

In the below figure, we have considered Room 200 Stairewell, Room 202 Electrical, Room 203 Mechanical and Room 204 Telecom.

Lumeniare Feature	Room 200 Stairwell	Room 202 Electrical	Room 203 Mechanical	Room 204 Telecom
Illuminace	150	500	250	750
number of lumaniare	2	27	13	31
lumen per luminiare	800 lumens	7,000 lumens	8,000 lumens	7200 lumens
Luminaire type (LED)	LED Recessed Downlight	LED Linear Strip	Vapor-Tight LED	LED Panel Light (2x4 ft)
Description (Model No)	Philips CorePro LED Downlight 10W	**Philips Ledalite TruGroove 4ft LED Strip**	**Philips Day-Brite Vapor-Tight LED (VT1)**	Philips Ledalite TruGroove
mounting (Suspended Celling)	Recessed (Ceiling Mount)	**Surface-mounted or suspended**	Surface-mounted or suspended	Recessed, surface-mounted, or suspended
wattage(W)	10W	55W	65W	56W
lumens(lm)	800 lumens	7,000 lm	8,000 lm	7200 lm
manufacturer	Philips	**Philips (Ledalite TruGroove Series)**	**Philips (Day-Brite)**	**Philips (Ledalite TruGroove Series)**
Remarks	Suitable for indoor spaces such as stairwells, energy-efficient, long-lasting	**Glare-free, uniform illumination, ideal for electrical rooms**	**IP65-rated**, dust & moisture resistant, ideal for mechanical rooms	Uniform illumination, glare-free, ideal for telecom environments
Driver	Integrated LED Driver	Philips Advance Xitanium	Philips Advance Xitanium	Philips Advance Xitanium
CCT(K)	3000K (Warm White)	4000K (Neutral White)	4000K (Neutral White)	5000K (Cool White)
CRI	≥80 (Good color rendering for residential and commercial areas)	>80	>80	>80
Controls(V)	Non-dimmable (available dimmable versions)	0-10V Dimmable, Motion & Daylight Sensor Compatible	0-10V Dimmable, Motion & Daylight Sensor Compatible	0-10V Dimmable, Motion & Daylight Sensor Compatible
voltage(V)	120V	120-277V AC	120-277V AC	120-277V AC
Efficacy(lm/W)	80 lm/W	~127 lumens per watt	~123 lumens per watt	~128 lumens per watt

Receptacle Calculation

The below table illustrate the number of receptacles we have used in every room in this project:

Room name	Room no.	Equipment	Quantity
Foyer	Room 100	Receptacles (2-15A)	2
Classroom	Room 101	Receptacles (4-15A)	4
Closet	Room 102	Receptacles	2
W. Washrrom	Room 103	Receptacles waterproof (3-15A)	3
M. Washroom	Room 104	Receptacles waterproof (1-15A)	1

Janitor	Room 106	Receptacles (1-20A)	1
Catering Kicthenette	Room 108	Receptacles Waterproof (4-20A/ 1-30A/1-15A)	6
Commons	Room 109	Receptacles (3-15A)	3
Cultural Room	Room 110	Receptacles (5-15A)	5
Storage	Room 111	Receptacles (2-15A)	2
Snack	Room 112	Receptacles (1-15A/ 3-20A)	4
Information	Room 113	Receptacles (3-15A)	3
Room 114	Room 114	Receptacles (2-15A)	2
Yukuta	Room 115	Receptacles (1-15A)	1
Education	Room 116	Receptacles (3-15A/ 1-15A)	4
Mechanical	Room 117	Receptacles (1-20A/1-15A)	2
Staff	Room 118	Receptacles (3-15A)	3
Administration	Room 119	Receptacles (1-20A/2-15A)	3
Vestibule	Room 120	Receptacles (2-15A)	2
Classroom	Room 121	Receptacles (4-15A)	4
Exhibit	Room 122	Receptacles (3-15A)	3
Tea	Room 123	Receptacles (1-15A)	1
Electrical	Room 202	Receptacles (2-15A)	2
Mechanical	Room 203	Receptacles (2-15A)	2
Telecom	Room 204	Receptacles (3-15A)	3

Table: Receptacle Calculation (Room wise)

Equipment List

Equipment	Model
Access Control System	HID VertX V1000
Barrier-Free Access	Openpath OP-ABP
CC Camera	Hikvision DS-2CD2142FWD7
Coffee Machine	Keurig K1500
Commercial Oven	Blodgett DFG-100
Computer	Dell OptiPlex 7070
Digital Display	Samsung QB65R
Dishwasher	Bosch SHX878ZD5N
Emergency Light and Exit Sign	Lithonia ELM2 LED
Espresso Machine	La Marzocco Linea Mini
Fire Alarm System	Honeywell MS-9200UDLS
Firefighter Access Point	Motorola APX 6000XE
Flat Top Grill	Vulcan VCRG36-M
Fridge	LG LTCS20020S
Hand Dryer (Automatic)	Dyson Airblade V
Intercom	Aiphone LEF-3L
Microwave	Panasonic NE-1054F
Microwave	Panasonic NN-SN686S
Printer/Scanner/Copier	HP LaserJet Pro MFP M428

Projector	Epson PowerLite 2250U
Push Switch	Legrand 93151
Receptacles	Leviton 5362-W
Smoke Detector	System Sensor 2W-B0.5
Warming Oven	Nemco 6150-36
Water Purifier	Brita Total 360
Wifi	Cisco Aironet 2802i

Table: Equipment List

Load Calculation

For load calculation, we have considered PF = 0.95. From the data sheet, we have find out the power (KW) and voltage (V). Then we have calculated the current (A) and apparent power S (KVA) based on the below formula:

Current, I (A) = $\frac{P\ (KW)*1000}{PF*V\ (v)}$

Apparent Power, S (KVA) = $\frac{P\ (KW)}{PF}$

Sl.	Room name	Room no.	Total Load (Per Room KW)	Total Load (Building kW)
1	Foyer	Room 100	4.8445	250.63975
2	Classroom	Room 101	8.467	
3	Closet	Room 102	3.624	
4	W. Washroom	Room 103	7.2605	
5	M. Washroom	Room 104	3.0725	
6	Washroom Corridor	Room 105	0.0275	
7	Janitor	Room 106	1.818	
8	Water Meter	Room 107	0.75	
9	Catering Kicthenette	Room 108	22.34775	
10	Commons	Room 109	12.2775	
11	Cultural Room	Room 110	53.4695	
12	Storage	Room 111	3.624	
13	Snack	Room 112	11.556	
14	Information	Room 113	5.9235	
15	Room 114	Room 114	3.615	
16	Yukuta	Room 115	1.91	
17	Education	Room 116	8.447	
18	Mechanical	Room 117	8.624	
19	Staff	Room 118	5.4985	
20	Administration	Room 119	6.647	
21	Vestibule	Room 120	6.317	
22	Classroom	Room 121	9.0525	
23	Exhibit	Room 122	6.9525	
24	Tea	Room 123	1.9675	
25	Stairwell	Room 200	0.0635	
26	Electrical	Room 202	29.0575	
27	Mechanical	Room 203	16.006	
28	Telecom	Room 204	7.4195	

Table: Load Calculation (Room Wise)

Panel Schedule

Here, we have done panel for A, B, C, D, E, F, G and H.

Panel A load distribution:

Here Panel ID is 12A. 1 for 1st floor, 2 for 208V and A for Panel A. In Panel A, we have connected Room 100 Foyer, Room 101 Classroom, Room 102 Closet, Room 103 W. Washroom, Room 104 M. Washroom, Room 106 Janitor, Room 107 Water Meter and Room 200 Stairwell.

Panel Schedule														
Date			Panel ID	12A			Breaker (A)		Main Breaker/MLO					
Project Name			Mountaining Type	Surface			Total Circuit		ISC Rating					
Location			Voltage (V)	120/208			BUS Rating (A)		ISCA (Calculated)					
Owner Details			Phase	3			No. Wire	4						
Note														
Room No	Circuit No	Equipments Description	Quantity	Load (KVA)	Pole	Breaker Size	BUS	Breaker Size	Pole	Load (KVA)	Quantity	Equipments Description	Circuit No	Room No
	1	Receptacles (15A)	1	1.85	1	20	A	40	1	3.789473684	2	Receptacles (20A)	2	
	3	Receptacles (15A)	2	3.7	1	39	B	1	1	0.021052632	1	Sprinkler Flow Switch and Temper Switch1	4	
	5	Receptacles (15A)	5	9.25	1	97	C	8	1	0.757894737	1	FF-4 120V 1phase 6FLA	6	
	7	Light	23	1.44	1	15	A	1	1	0.021052632	1	Access Control	8	101-107, 200
	9	Wifi	6	0.082105263	1	1	B						6	
	11	Intercom	4	0.021052632	1	1	C						8	
	13	Close Circuit Camera	4	0.023157895	1	1	A						10	
	15	Barrier free access	3	0.052631579	1	1	B						12	
	17	Emergency light and exit sign	5	0.018421053	1	1	C						14	
	19	Push switch	6	0.012631579	1	1	A						16	
101-107, 200	21	120V 6FLA FF-1	1	0.757894737	1	8	B						18	
	23	Annunciator Panel used as Fire fighter access point	1	0.421052632	1	5	C						20	
	25	Projector	1	0.421052632	1	5	A						26	
	27	Computer	1	0.273684211	1	3	B						36	
	29	Speaker	1	0.231578947	1	3	C						38	
	31	Receptacles waterproof (15A)	2	3.78	1	40	A							
	33	Light / Sensor light	32	6.4672	1	68	B							
	35	Hand Dryer Automatic	2	0.252631579	1	3	C							
	37	Barrier free Access	1	0.052631579	1	1	A							
	39	Barrier free Access	1	0.052631579	1	1	B							
	41	BBH-8 120V 1phase, 1KW	1	1.052631579	1	11	C							

Load Balance Summary		
Sl	Phase	Total Load (KVA)
1	A	11.38
2	B	11.4
3	C	11.95

Panel B load distribution:

Here Panel ID is 12B. 1 for 1st floor, 2 for 208V and B for Panel B. In Panel B, we have connected Room 108 Catering Kicthenette.

Panel Schedule														
Date			Panel ID	12B			Breaker (A)		Main Breaker/MLO					
Project Name			Mountaining Type	Surface			Total Circuit	44	ISC Rating					
Location			Voltage (V)	120/208			BUS Rating (A)		ISCA (Calculated)					
Owner Details			Phase	3			No. Wire	4						
Note														
Room No	Circuit No	Equipments Description	Quantity	Load (KVA)	Pole	Breaker Size	Phase	Breaker Size	Pole	Load (KVA)	Quantity	Equipments Descriptio	Circuit No	Room No
	1	Receptacles Waterproof (2-20A)	2	3.7600	1	40.000	A	1	1	0.0053	1	Intercom	2	108
	3	Receptacles Waterproof (1-30A/1-15A)	2	3.7600	1	40.000	B						4	
	5	Receptacles Waterproof (2-20A)	2	3.76	1	40.000	C						6	
	7	Light	13	0.5474	1	6.000	A						8	
	9	Fridge	1	0.7632	1	8.000	B						10	
	11	Dishwasher	1	1.37	1	15.000	C						12	
	13	Espresso Machines	1	1.5789	1	17.000	A						14	
	15	Digital Display	1	0.1158	1	2.000	B						16	
	17	Flat top grill	1	0.94	3	10.000	C						18	
	19	Flat top grill	1	0.9400	3	10.000	A						20	
Room 108	21	Flat top grill	1	0.9400	3	10.000	B						22	
	23	Water Purifier	1	0.06	1	1.000	C						24	
	25	Commercial Oven	1	0.3800	3	4.000	A						26	
	27	Commercial Oven	1	0.3800	3	4.000	B						28	
	29	Commercial Oven	1	0.38	3	4.000	C						30	
	31	Wifi	1	0.0137	1	1.000	A						32	
	33	BBH-1	1	2.6316	1	28.000	B						34	
	35	Close Circuit Camera	2	0.01	1	1.000	C						36	
	37	Emergency light and exit sign	1	0.0037	1	1.000	A						38	
	39	Exhaust Fan	1	0.0003	1	1.000	B						40	
	41	BBH-2	1	1.05	1	11.000	C						42	

Load Balance Summary		
Sl	Phase	Total Load (KVA)
1	A	7.23
2	B	8.59
3	C	7.58

Panel C load distribution:

Here Panel ID is 12C. 1 for 1st floor, 2 for 208V and C for Panel C. In Panel C, we have connected Room 110 Cultural Room.

Panel Schedule														
Date			Panel ID					Breaker (A)		Main Breaker/MLO				
Project Name			Mountaining Type					Total Circuit		ISC Rating				
Location			Voltage					BUS Rating (A)		ISCA (Calculated)				
Owner Details			Phase					No. Wire						
Note														
Room No	Circuit No	Equipments Description	Quantity	Load (KVA)	Pole	Breaker Size	Phase	Breaker Size	Pole	Load (KVA)	Quantity	Equipments Descriptio	Circuit No	Room No
Room 110	1	Receptacles (5-15A)	5	9.473684211	1	99	A						2	
	3	Light Proper for spotting	11	1.736842105	1	19	B						4	
	5	Wifi	1	0.013684211	1	1	C						6	
	7	Intercom	1	0.005263158	1	1	A						8	
	9	Close Circuit Camera	4	0.023157895	1	1	B						10	
	11	Emergency light and exit sign	1	0.003684211	1	1	C						12	
	13	Projector	2	0.842105263	1	9	A						14	
	15	Barrier free access	1	0.052631579	1	1	B						16	
	17	Push button	1	0.001052632	1	1	C						18	
	19	Egress Door	1	0.052631579	1	1	A						20	
	21	Microphone	2	0.004210526	1	1	B						22	
	23	Speaker	1	0.231578947	1	3	C						24	
	25	BBH-6 1phase 2.5 KW 208 V	1	2.631578947	1	28	A						26	
	27	BBH-7 1phase 2.5 KW 208 V	1	2.631578947	1	28	B						28	
	29	Condensing unit,208,3ph,14fla	1	5.043157895	3	53	C						30	
	31	Condensing unit,208,3ph,18fla	1	6.484210526	3	68	A						32	
	33	Condensing unit,208,3ph,39fla	1	13.68421053	3	143	B						34	
	35	Condensing unit,208,3ph,37fla	1	13.36842105	3	140	C						36	
	37												38	
	39												40	
	41												42	

Load Balance Summary		
Sl	Phase	Total Load (KVA)
1	A	19.33
2	B	18.59
3	C	18.66

Panel D load distribution:

Here Panel ID is 12D. 1 for 1st floor, 2 for 208V and D for Panel D. In Panel D, we have connected Room 109 Commons, Room 111 Storage and Room 112 Snack.

Panel Schedule														
Date			Panel ID					Breaker (A)		Main Breaker/MLO				
Project Name			Mountaining Type					Total Circuit		ISC Rating				
Location			Voltage					BUS Rating (A)		ISCA (Calculated)				
Owner Details			Phase					No. Wire						
Note														
Room No	Circuit No	Equipments Description	Quantity	Load (KVA)	Pole	Phase	Breaker Size	Equipments Description	Quantity	Load (KVA)	Pole	Breaker Size	Phase	Circuit No	Room No
109	1	Receptacles (15A)	3	5.6893	1	A	60	Warming Oven	1	1.052631579	1	11	A	2	112
109	3	Light	12	0.454736842	1	B	5	Wifi	1	0.013684211	1	1	B	4	112
109	5	Wifi	1	0.013684211	1	C	1	Intercom	1	0.005263158	1	1	C	6	112
109	7	Intercom	1	0.005263158	1	A	1	Close Circuit Camera	1	0.005789474	1	1	A	8	112
109	9	Close Circuit Camera	4	0.023157895	1	B	1	Emergency light and exit sign	1	0.003684211	1	1	B	10	112
109	11	Emergency light and exit sign	1	0.003684211	1	C	1	Receptacles (15A)	1	1.8974	1	20	C	14	112
109	13	Projector	2	0.842105263	1	A	9							16	
109	15	Barrier free access	1	0.052631579	1	B	1							18	
109	17	Push button	2	0.002105263	1	C	1							20	
109	19	Egress Door	1	0.052631579	1	A	1							22	
109	21	BBH-3 120 V	1	1.052631579	1	B	11							24	
109	23	BBH-4 208 V	1	2.631578947	1	C	28							26	
109	25	BBH-5 120 V	1	1.052631579	1	A	11							28	
109	27	BBH-9 120V	1	1.052631579	1	B	11							30	
111	29	Receptacles (15A)	2	3.789384211	1	C	40							32	
111	31	Light	1	0.025263158	1	A	1							34	
112	33	Receptacles (20A)	3	5.6893	1	B	60							36	
112	35	Light	3	0.151578947	1	C	2							38	
112	37	Microwave	1	1.052631579	1	A	11							40	
112	39	Coffee Machine	1	1.536842105	1	B	17							42	
112	41	Fridge	1	0.763157895	1	C	8							44	

Load Balance Summary		
Sl	Phase	Total Load (KVA)
1	A	9.772
2	B	9.812
3	C	9.324

Panel E load distribution:

Here Panel ID is 12E. 1 for 1st floor, 2 for 208V and E for Panel E. In Panel E, we have connected Room 113 Information, Room 114, Room 115 Yukuta, Room 116 Education, Room 118 Staff and Room 119 Administration.

Panel Schedule

Date		Panel ID	12E	Breaker (A)		Main Breaker/MLO	
Project Name		Mountaining Type	Surface	Total Circuit	42	ISC Rating	
Location		Voltage	120/208	BUS Rating (A)		ISCA (Calculated)	
Owner Details		Phase	3	No. Wire	4		

Note

Room No	Circuit No	Equipments Description	Quantity	Load (KVA)	Pole	Breaker Size	BUS	Breaker Size	Pole	Load (KVA)	Quantity	Equipments Description	Circuit No	Room No
Room - 113	1	Receptacles (3-15A)	3	5.684210526	1	60	A	40	1	3.789473684	2	Receptacles (2-15A)	2	Room - 114
Room - 113	3	Light	6	0.252631579	1	3	B	1	1	0.015789474	3	Light	4	Room - 114
Room - 113	5	Wifi	1	0.013684211	1	1	C	20	1	1.894736842	1	Receptacles (1-15A)	6	Room - 115
Room - 113	7	Intercom	1	0.005263158	1	1	A	1	1	0.063157895	6	Light	8	Room - 115
Room - 113	9	Close Circuit Camera	1	0.005789474	1	1	B	1	1	0.052631579	1	Climate Controlled	10	Room - 115
Room - 113	11	Computer	1	0.273684211	1	3	C	79	1	7.578947368	4	Receptacles (4-15A)	12	Room - 116
Room - 118	13	Light	4	0.084210526	1	1	A	3	1	0.210526316	5	Light	14	Room - 116
Room - 118	15	Receptacles (3-15A)	3	5.684210526	1	60	B	1	1	0.013684211	1	Wifi	16	Room - 116
Room - 118	17	Wifi	1	0.013684211	1	1	C	1	1	0.005263158	1	Intercom	18	Room - 116
Room - 118	19	Close Circuit Camera	1	0.005789474	1	1	A	1	1	0.005789474	1	Close Circuit Camera	20	Room - 116
Room - 119	21	Receptacles (1-20A/2-15A)	3	5.684210526	1	60	B	1	1	0.003684211	1	Emergency light and exit sign	22	Room - 116
Room - 119	23	Light	5	0.210526316	1	3	C	6	1	0.547368421	2	Computer	24	Room - 116
Room - 119	25	Printer, Scanner, Copier	1	0.526315789	1	6	A	6	1	0.526315789	1	Printer, Scanner, Copier	26	Room - 116
Room - 119	27	Intercom	1	0.005263158	1	1	B	1	1	0.005789474	1	Close Circuit Camera	28	Room - 119
Room - 119	29	Wifi	1	0.013684211	1	1	C	1	1	0.003684211	1	Emergency light and exit sign	30	Room - 119
Room - 119	31	Computer	2	0.547368421	1	6	A	0	1				32	
Room - 119	33												34	
Room - 119	35												36	
Room - 119	37												38	
Room - 119	39												40	
Room - 119	41												42	
Room - 119	43												44	

Load Balance Summary

Sl	Phase	Total Load (KVA)
1	A	11.45
2	B	11.72
3	C	10.56

Panel F load distribution:

Here Panel ID is 12F. 1 for 1st floor, 2 for 208V and F for Panel F. In Panel F, we have connected Room 117 Mechanical.

Panel Schedule

Date		Panel ID	12F	Breaker (A)		Main Breaker/MLO	
Project Name		Mountaining Type	Surface	Total Circuit	42	ISC Rating	
Location		Voltage	120/208	BUS Rating (A)		ISCA (Calculated)	
Owner Details		Phase	3	No. Wire	4		

Note

Room No	Circuit No	Equipments Descriptio	Quantity	Load (KVA)	Pole	Breaker Size	BUS	Breaker	Pole	Load (KVA)	Quantity	Equipments Descriptio	Circuit N	Room No
	1	force flow fan,120V,1ph,1.5K	1	1.578947368	1	17	A						2	
	3	Receptacles (1-20A)	1	1.89	1	20	B						4	
	5	Receptacles (1-15A)	1	1.89	1	20	C						6	
	7	force flow fan,120V,1ph,1.5K	1	1.578947368	1	17	A						8	
	9	Light	6	0.063157895	1	1	B						10	
	11	Access Control	1	0.021052632	1	1	C						12	
	13	furnace,208,3ph,10fla F-1, F	1	1.2	3	13	A						14	
	15	furnace,208,3ph,10fla F-1, F	1	1.2	3	13	B						16	
	17	furnace,208,3ph,10fla F-1, F	1	1.2	3	13	C						18	
	19	Wifi	1	0.013684211	1	1	A						20	
117	21	Intercom	1	0.005263158	1	1	B						22	
	23	Emergency light and exit sig	1	0.003684211	1	1	C						24	
	25												26	
	27												28	
	29												30	
	31												32	
	33												34	
	35												36	
	37												38	
	39												40	
	41												42	

Load Balance Summary

Sl	Phase	Total Load (KVA)
1	A	4.37
2	B	3.15
3	C	3.11

Panel G load distribution:

Here Panel ID is 12G. 1 for 1st floor, 2 for 208V and G for Panel G. In Panel G, we have connected Room 120 Vestibule, Room 121 Classroom and Room 122 Exhibit.

Panel Schedule

Date		Panel ID	12G	Breaker (A)		Main Breaker/MLO	
Project Name		Mountaining Type	Surface	Total Circuit	42	ISC Rating	
Location		Voltage	120/208	BUS Rating (A)		ISCA (Calculated)	
Owner Details		Phase	3	No. Wire	4		

Note

Room No	Circuit No	Equipments Description	Quantity	Load (KVA)	Pole	Breaker Size	BUS	Breaker Size	Pole	Load (KVA)	Quantity	Equipments Description	Circuit No	Room No
Room - 120	1	Light	5	0.052631579	1	1	A	79	1	7.578947368	4	Receptacles (4-15A)	2	Room - 121
Room - 120	3	Receptacles (2-15A)	2	3.789473684	1	40	B	1	1	0.013684211	1	Wifi	4	Room - 121
Room - 120	5	Wifi	1	0.013684211	1	1	C	4	1	0.378947368	9	Light	6	Room - 121
Room - 120	7	Intercom	1	0.005263158	1	1	A	1	1	0.005263158	1	Intercom	8	Room - 121
Room - 120	9	Close Circuit Camera	1	0.005789474	1	1	B	1	1	0.003684211	1	Emergency light and exit sign	10	Room - 121
Room - 120	11	Emergency light and exit sign	1	0.003684211	1	1	C	3	1	0.273684211	1	Computer	12	Room - 121
Room - 120	13	Access Control	1	0.021052632	1	1	A	1	1	0.011578947	2	Close Circuit Camera	14	Room - 121
Room - 120	15	exhaust fan,208,3ph,1.5HP	1	0.393	3	5	B	5	1	0.421052632	1	Projector	16	Room - 121
Room - 120	17	exhaust fan,208,3ph,1.5HP	1	0.393	3	5	C	9	1	0.842105263	1	Sound System	18	Room - 121
Room - 120	19	exhaust fan,208,3ph,1.5HP	1	0.393	3	5	A	2	1	0.126315789	6	Spot Light	20	Room - 122
Room - 120	21	force flow fan,120V,1ph, 1.5KW FF-2	1	1.578947368	1	17	B	4	1	0.336842105	16	Light	22	Room - 122
Room - 123	23	Light Minimal	4	0.151578947	1	2	C	60	1	5.684210526	3	Receptacles (3-15A)	24	Room - 122
Room - 123	25	Wifi	1	0.013684211	1	1	A	1	1	0.013684211	1	Wifi	26	Room - 122
Room - 123	27	Receptacles (1-15A)	1	1.894736842	1	20	B	1	1	0.005263158	1	Intercom	28	Room - 122
Room - 123	29	Sound System	1	0.842105263	1	9	C	1	1	0.011578947	2	Close Circuit Camera	30	Room - 122
Room - 123	31	Close Circuit Camera	1	0.005789474	1	1	A	5	1	0.421052632	1	Projector	32	Room - 122
Room - 122	33	Intercom	1	0.005263158	1	1	B	1	1	0.003684211	1	Emergency light and exit sign	34	Room - 122
	35				1		C						36	
	37				1		A						38	
	39				1		B						40	
	41				1		C						42	

Load Balance Summary

SI	Phase	Total Load (KVA)
1	A	8.65
2	B	8.45
3	C	8.59

Panel H load distribution:

Here Panel ID is M2H. M for Mezzanine floor, 2 for 208V and H for Panel H. In Panel H, we have connected Room 202 Electrical, Room 203 Mechanical and Room 204 Telecom.

Panel Schedule

Date		Panel ID	M2H	Breaker (A)		Main Breaker/MLO	
Project Name		Mountaining Type	Surface	Total Circuit	42	ISC Rating	
Location		Voltage	120/208	BUS Rating (A)		ISCA (Calculated)	
Owner Details		Phase	3	No. Wire	4		

Note

Room No	Circuit No	Equipments Description	Quantity	Load (KVA)	Pole	Breaker Size	BUS	Breaker Size	Pole	Load (KVA)	Quantity	Equipments Description	Circuit No	Room No
Room - 202	1	Close Circuit Camera	2	0.011578947	1	1	A	10	1	0.889473684	13	Light	2	Room - 203
Room - 202	3	Light	27	1.563157895	1	17	B	3	1	0.196842105	1	Exhaust Fan,120,1ph,0.25HP	4	Room - 203
Room - 202	5	Wifi	1	0.013684211	1	1	C	13	3	1.2	1	Furnace,208,3ph,12FLA	6	Room - 203
Room - 202	7	Fire Alarm Control Panel	1	1.010526316	1	11	A	13	3	1.2	1	Furnace,208,3ph,12FLA	8	Room - 203
Room - 202	9	Receptacles (2-15A)	2	3.789473684	1	40	B	13	3	1.2	1	Furnace,208,3ph,12FLA	10	Room - 203
Room - 202	11	Intercom	1	0.005263158	1	1	C	50	1	4.736842105	1	Domestic hot water tank,120V,1ph 5FLA	12	Room - 203
Room - 202	13	Fire Pump (30 HP)	1	7.85	3	82	A	1	1	0.013684211	1	Wifi	14	Room - 203
Room - 202	15	Fire Pump (30 HP)	1	7.85	3	82	B	1	1	0.005263158	1	Intercom	16	Room - 203
Room - 202	17	Fire Pump (30 HP)	1	7.85	3	82	C	1	1	0.011578947	2	Close Circuit Camera	18	Room - 203
Room - 202	19	Fire Alarm Booster panel	1	0.631578947	1	7	A	60	1	5.684210526	3	Receptacles (3-15A)	20	Room - 204
Room - 202	21	Emergency light and exit sign	1	0.003684211	1	1	B	20	1	1.827368421	31	Light	22	Room - 204
Room - 203	23	Receptacles (2-15A)	2	3.789473684	1	40	C	1	1	0.013684211	1	Wifi	24	Room - 204
Room - 203	25	Furnace,208,3ph,10FLA	1	1.2	3	13	A	1	1	0.005263158	1	Intercom	26	Room - 204
Room - 203	27	Furnace,208,3ph,10FLA	1	1.2	3	13	B	1	1	0.005789474	1	Close Circuit Camera	28	Room - 204
Room - 203	29	Furnace,208,3ph,10FLA	1	1.2	3	13	C	3	1	0.273684211	1	Computer	30	Room - 204
	31												32	
	33												34	
	35												36	
	37												38	
	39												40	
	41												42	

Load Balance Summary

SI	Phase	Total Load (KVA)
1	A	18.5
2	B	17.64
3	C	19.1

Power Supply

A Power Factor Improvement (PFI) panel is used to improve the power factor by adding capacitor banks, reducing reactive power (KVAR) and improving system efficiency.

- **Active Power (P)** = 250.74 kW
- **Assumed Existing Power Factor (PF_{old})** = 0.95
- **Desired Power Factor (PF_{new})** = 0.98

The relationship between active power, reactive power, and apparent power is:

$Q_{old} = P * \tan * \cos^{-1}(PF_{old})$
$= 250.74 * \tan * \cos^{-1}(0.95) = 82.41$

$Q_{new} = P * \tan * \cos^{-1}(PF_{new})$
$= 250.74 * \tan * \cos^{-1}(0.98) = 50.91$

The required capacitor bank size $Q_c = Q_{old} - Q_{new} = 31.5$ KVAR
So, we need 32 KVAR capacitor bank.

Service Sizing

For conductor sizing, we have assumed ambient temperature is 30 deg. We have considered Cu conductor with an insulating temperature 60 deg. For conductor sizing, as per CEC code, any load which run more than 3 hours is continuous load.

For Continuous load $_{\text{rated current}}$ = 1.25 * load current

Total Rated current = Discontinuous load $_{\text{rated current}}$ + Continuous load $_{\text{rated current}}$

Power (KW) Continous	Power (KW) Discontinous	Voltage (V)	Pf	Current (A) Continous	Current (A) Discontinous	Rated Current(A)	Conductor Sizing (Kcmil)
110.49	140.74	208	0.95	404.0172825	411.7034471	815.7207297	800

Table: Service Sizing (Whole Building)

From, Table 2, we have found the conductor size. Here, 800 continuous current (A) 404.0172825, we need conductor of 800 Kcmil size.

The below figure illustrate the conductor size and conduit size of every room in the base plan. From Table 6A, we have measured the conduit size based on the conductor size.

Room Name	Load (KW)	Panel	Current (A) Room	Required Ampacity	Conductor Size	Conduit size (mm)
Room 100 Foyer	4.84	12A	24.54112159	30.67640199	8 AWG	21
Room 101 Classroom	8.46	12A	42.89625799	53.62032248	6 AWG	27
Room 102 Closet	3.624	12A	18.37541831	22.96927289	10 AWG	21
Room 103 W. Washrrom	7.26	12A	36.81168239	46.01460298	6 AWG	27
Room 104 M. Washroom	3.07	12A	15.56637258	19.45796572	12 AWG	21
Room 105 Washroom Corridor	0.0275	12A	0.139438191	0.174297739	12 AWG	21
Room 106 Janitor	1.81	12A	9.177568198	11.47196025	12 AWG	21
Room 200 Stairwell	0.063	12A	0.319440219	0.399300274	12 AWG	21
Room 107 Water Meter	0.75	12A	3.802859751	4.753574688	12 AWG	21
Room 108 Catering Kicthenette	22.34	12B	113.27	141.59	2/0	41
Room 110 Cultural Room	53.46	12C	271.06	338.83	600 kcmil	78
Room 109 Commons	12.27	12D	62.21478552	77.7684819	3 AWG	27
Room 111 Storage	5.42	12D	27.4819998	34.35249975	10 AWG	21
Room 112 Snack	11.55	12D	58.56404016	73.2050502	3 AWG	27

Room 113 Information	5.92	12E	30.01723963	37.52154954	8 AWG	21
Room 114	3.61	12E	18.3044316	22.8805395	10 AWG	21
Room 115 Yukuta	1.91	12E	9.684616165	12.10577021	12 AWG	21
Room 116 Education	8.44	12E	42.79484839	53.49356049	6 AWG	27
Room 118 Staff	5.49	12E	27.83693337	34.79616672	8 AWG	21
Room 119 Administration	6.64	12E	33.66798499	42	6 AWG	27
Room 117 Mechanical	8.64	12F	43.8	54.76	6 AWG	27
Room 120 Vestibule	6.317	12G	32.03022006	40.03777507	6 AWG	27
Room 121 Classroom	9.05	12G	45.88784099	57.35980124	4 AWG	27
Room 122 Exhibit	6.95	12G	35.23983369	44.04979211	6 AWG	27
Room 123 Tea	1.96	12G	9.938140148	12.42267519	12 AWG	21
Room 202 Electrical	29.05	M2H	147.2974343	184.1217929	4/0	53
Room 203 Mechanical	16	M2H	81.12767468	101.4095933	1 AWG	35
Room 204 Telecom	7.41	M2H	37.57225434	46.96531792	6 AWG	27

Table: Service Sizing (Room wise)

Lightening Layout Diagram:

For lightening layout, we have used DIALux software to design it.

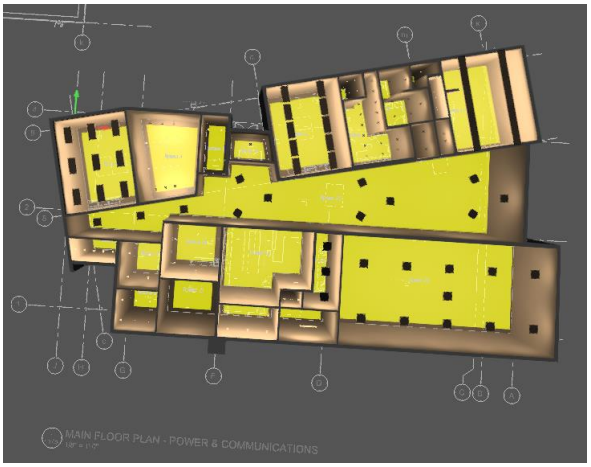

Fig: Main Floor Lightening Layout.

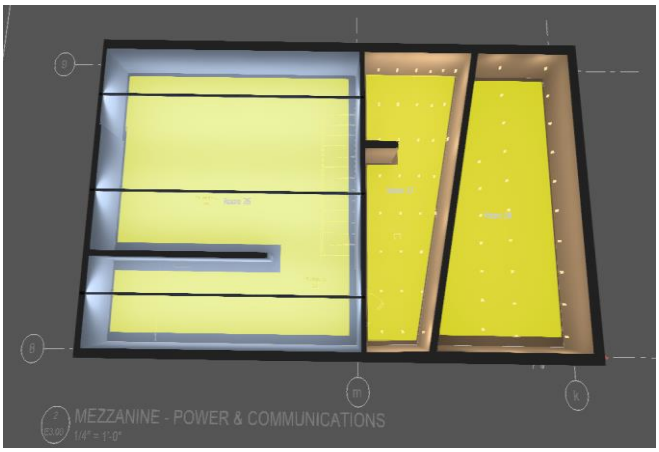

Fig: Mezzanine Floor Lightening Layout.

Power Layout Diagram:

The below figure illustrates the power layout diagram for the given base plan of this project:

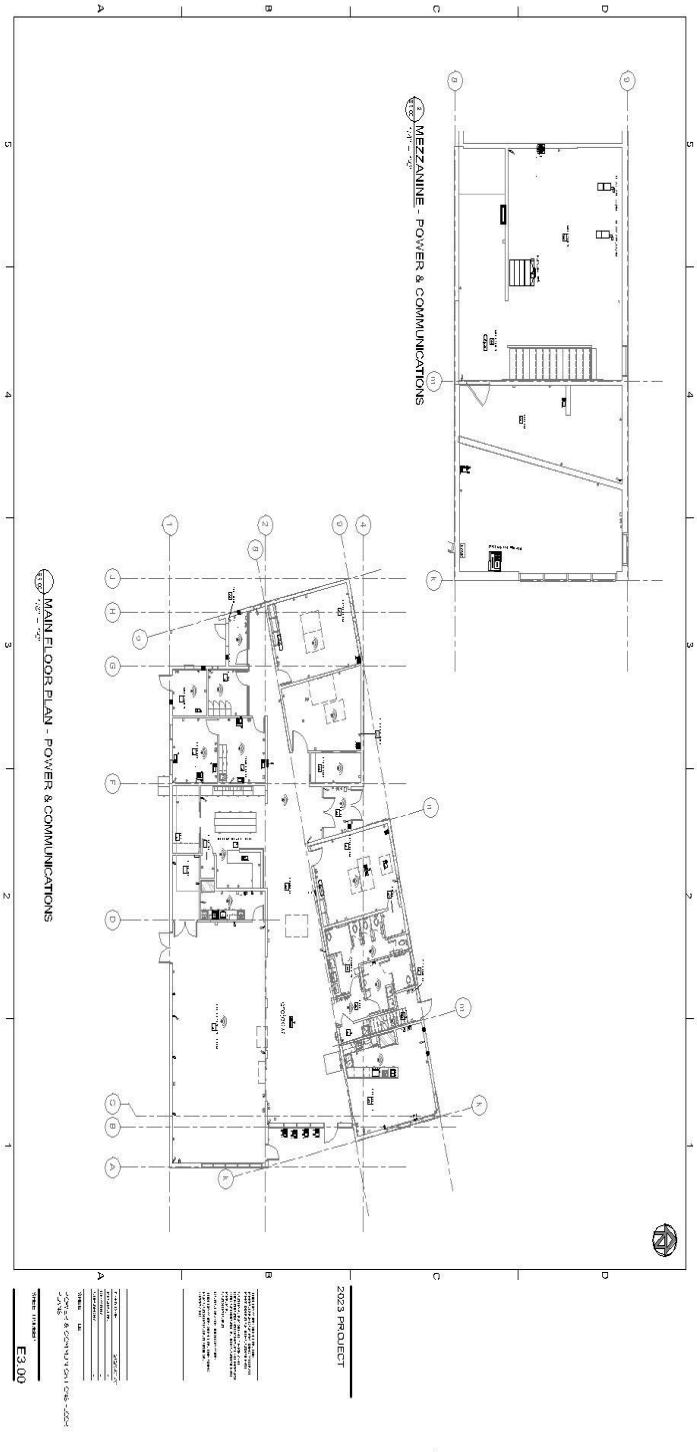

Fig: Power Layout Diagram

Mechanical Schedule:

The below figure illustrates the mechanical schedule for the given base plan of this project:

MECHANICAL EQUIPMENT SCHEDULE

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Unit No.	Description	Location	Nameplate Voltage (V)	Nameplate Phase Ø	Nameplate MCA (A)	Nameplate Load (HP, FLA, kW)	Overcurrent Protection Type	Overcurrent Protection Rating	Overcurrent Protection Poles	Feeder Conductors	Feeder Bond	Feeder Conduit	Fed From	Disconnect NEMA Rating	Disconnect S	Disconnect I	Disconnect C	Starter/VFD Type	Starter/VFD NEMA Size	Starter/VFD S	Starter/VFD I	Starter/VFD C	Starter Control Type	Starter Control Remote Type	Starter Control N/O Contacts	Starter Control N/C Contacts	Starter Control S	Starter Control I	Starter Control C	Remarks
AIR CONDITIONING EQUIPMENT																														
CU-1	CONDENSING UNIT	EXTERIOR - SOUTH CULTURAL ACTIVITY	208	3		14.0 FLA	MCC	40	3	8 AWG		21	Panel 12C										INT							CONTROLLED BY FURNACE
CU-2	CONDENSING UNIT	EXTERIOR - SOUTH CULTURAL ACTIVITY	208	3		18.0	MCC	40	3	8 AWG		21	Panel 12C										INT							CONTROLLED BY FURNACE
CU-3	CONDENSING UNIT	EXTERIOR - SOUTH CULTURAL ACTIVITY	208	3		39.0	MCC	90	3	2 AWG		35	Panel 12C										INT							CONTROLLED BY FURNACE
CU-4	CONDENSING UNIT	EXTERIOR - SOUTH CULTURAL ACTIVITY	208	3		37.0	MCC	90	3	2 AWG		35	Panel 12C										INT							CONTROLLED BY FURNACE
AIR HANDLING																														
F-1	FURNACE	MECHANICAL ROOM 117	208	3		10.0 FLA	MCC	25	3	10 AWG		21	Panel 12F										LTST							CONTROLLED BY THERMOSTAT
F-2	FURNACE	MECHANICAL ROOM 117	208	3		10.0 FLA	MCC	25	3	10 AWG		21	Panel 12F										LTST							CONTROLLED BY THERMOSTAT
F-3	FURNACE	MECHANICAL ROOM 203	208	3		10.0 FLA	MCC	25	3	10 AWG		21	Panel M2H										LTST							CONTROLLED BY THERMOSTAT
F-4	FURNACE	MECHANICAL ROOM 203	208	3		12.0 FLA	MCC	25	3	10 AWG		21	Panel M2H										LTST							CONTROLLED BY THERMOSTAT
DOMESTIC HOT WATER																														
DHWT-1	DOMESTIC HOT WATER TANK	MECHANICAL ROOM 203	120	1		5.0 FLA		15	1	12 AWG		21	Panel M2H					VFD					INT							
EXHAUST FANS																														
EF-1	EXHAUST FAN	MECHANICAL ROOM 203	120	1		0.25 HP	MCC	15	1	12 AWG		21	Panel M2H					Mag					COM		2	2				INTERLOCK LOCAL LIGHTING
MOTOR	30Hp fire pump motor	Electrical ROOM 202	208	3		30HP	MCC	200	3	2/0		41	Panel M2H					Mag					VFD		2	2				pressure or flow switches
EF-2	EXHAUST FAN	ROOM 120	208	3		1.5 HP	MCC	15	3	12AWG		21	Panel 12G					Mag							2	2				INTERLOCK LOCAL LIGHTING
BASEBOARD HEATERS																														
BB-1	BASEBOARD HEATER	KITCHENETTE 108	208	1		2.5 kW	MCC	20	1	12 AWG		21	Panel 12B										LTST							CONTROLLED BY THERMOSTAT
BB-2	BASEBOARD HEATER	KITCHENETTE 108	120	1		1.0 kW	MCC	15	1	12 AWG		21	Panel 12B										LTST							CONTROLLED BY THERMOSTAT
BB-3	BASEBOARD HEATER	COMMONS 109	120	1		1.0 kW	MCC	15	1	12 AWG		21	Panel 12D										LTST							CONTROLLED BY THERMOSTAT
BB-4	BASEBOARD HEATER	COMMONS 109	208	1		2.5 kW	MCC	20	1	12 AWG		21	Panel 12D										LTST							CONTROLLED BY THERMOSTAT
BB-5	BASEBOARD HEATER	COMMONS 109	120	1		1.0 kW	MCC	15	1	12 AWG		21	Panel 12D										LTST							CONTROLLED BY THERMOSTAT
BB-6	BASEBOARD HEATER	CULTURAL ACTIVITY 110	208	1		2.5 kW	MCC	20	1	12 AWG		21	Panel 12C										LTST							CONTROLLED BY THERMOSTAT
BB-7	BASEBOARD HEATER	CULTURAL ACTIVITY 110	208	1		2.5 kW	MCC	20	1	12 AWG		21	Panel 12C										LTST							CONTROLLED BY THERMOSTAT
BB-8	BASEBOARD HEATER	MENS 104	120	1		1.0 kW	MCC	15	1	12 AWG		21	Panel 12A										LTST							CONTROLLED BY THERMOSTAT
BB-9	BASEBOARD HEATER	COMMONS 109	120	1		1.0 kW	MCC	15	1	12 AWG		21	Panel 12D										LTST							CONTROLLED BY THERMOSTAT
FORCE FLOWS																														
FF-1	FORCE FLOW FAN	FOYER 100	120	1		6.0 FLA	MCC	15	1	12 AWG		21	Panel 12A					Mag					LTST		2	2				CONTROLLED BY THERMOSTAT
FF-2	FORCE FLOW FAN	ROOM 120	120	1		1.5 kW	MCC	20	1	12 AWG		21	Panel 12G					Mag					LTST		2	2				CONTROLLED BY THERMOSTAT
FF-3	FORCE FLOW FAN	MECHANICAL ROOM 117	120	1		1.5 kW	MCC	20	1	12 AWG		21	Panel 12F					Mag					LTST		2	2				CONTROLLED BY THERMOSTAT
FF-4	FORCE FLOW FAN	WATER METER 107	120	1		6.0 FLA	MCC	15	1	12 AWG		21	Panel 12A					Mag					LTST		2	2				CONTROLLED BY THERMOSTAT

COMMON ABBREVIATIONS

E=ELECTRICAL CONTRACTOR M=MECHANICAL CONTRACTOR INT=INTEGRAL TO UNIT (BY MANUFACTURER) S=SUPPLIED BY I=INSTALLED BY C=CONNECTED BY NR=NOT REQUIRED

NAMEPLATE & FEEDER ABBREVIATIONS

FLA=FULL LOAD AMPACITY MCA=MINIMUM CIRCUIT AMPACITY HP=HORSE POWER FU=FUSE(S) P=POLES

STARTER TYPE ABBREVIATIONS

VFD=VARIABLE FREQUENCY DRIVE MAG=MAGNETIC FVNR MAN=MANUAL COM=COMBO BREAKER + MAG FVNR=FULL VOLTAGE NON-REVERSING FVR=FULL VOLTAGE REVERSING SOFT=SOFT STARTER TST=LINE VOLTAGE THERMOSTAT

STARTER CONTROL TYPE ABBREVIATIONS

BMS=BUILDING MANAGEMENT SYSTEM H,O,A=HAND,OFF,AUTO F,O,R=FORWARD,OFF,REVERSE O,O=ON,OFF LTST=LOW VOLTAGE THERMOSTAT R,J=RUN,JOG F,R=FORWARD,REVERSE O,C=OPEN,CLOSE

GENERAL NOTES

a. IN MOST CASES THE FLA'S AND ASSOCIATED BRANCH CIRCUITS ARE BASED ON THE CANADIAN ELECTRICAL CODE. CONFIRM THE ACTUAL FLA'S OF MOTORS WITH THE MECHANICAL CONTRACTOR DISTRIBUTION SHOP DRAWINGS IS BASED ON THE ASSUMPTION THAT FLA'S OF MOTORS HAVE BEEN CONFIRMED. NO ADDITIONAL COSTS WILL BE CONSIDERED FOR FAILURE TO CONFIRM THE FLA'S OF MOTORS PRIOR TO SUBMISSION OF DISTRIBUTION EQUIPMENT

[3] -

b. IF MOTOR FEEDER SIZES ARE NOT SHOWN, REFER TO SINGLE LINE DIAGRAM.

c. ELECTRICAL CONTRACTOR IS TO UPDATE ALL INFORMATION IN THIS SCHEDULE PRIOR TO SUBMITTING AS-BUILT DRAWINGS. THE OVERCURRENT PROTECTION AND MOTOR NAMEPLATE COLUMNS ARE TO BE FILLED IN BY THE CONTRACTOR.

d. WHERE INDICATED, PROVIDE ROOFTOP GFCI RECEPTACLES AS PER CEC RULE 26-704.

e. UNLESS NOTED OTHERWISE, ALL EQUIPMENT TEMPERATURE RATINGS ARE ASSUMED TO BE 75°C (CONDUCTOR TEMPERATURE). FOR EXISTING EQUIPMENT, CONFIRM THAT THE TEMPERATURE RATINGS ARE 75°C. IF THE EQUIPMENT IS UNMARKED AND RATED 100 A OR LESS, ASSUME THE TEMPERATURE RATING IS 60°C AND INCREASE THE CONDUCTOR SIZE APPROPRIATELY (CEC RULE 4- 006).

REFERRAL NOTES

[1] - PRIOR TO ORDERING EQUIPMENT (BREAKERS, OVERLOADS, ETC.), AND INSTALLATION OF BRANCH CIRCUITS. APPROVAL OF

[2] - SHOP DRAWINGS.

Normal SLD

The below figure is the Normal single line diagram for 25 KV voltage (Underground)

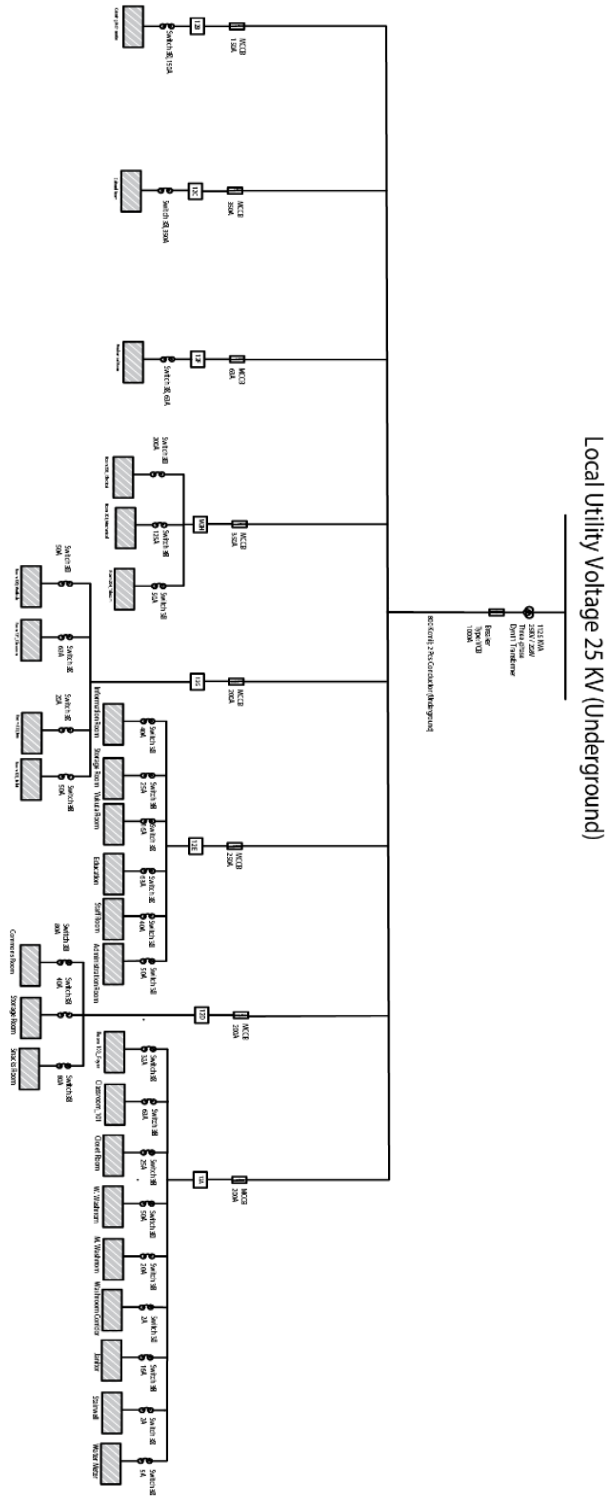

Fig: Normal SLD

Emergency SLD

The below figure is the Emergency single line diagram for 25 KV voltage (Underground).

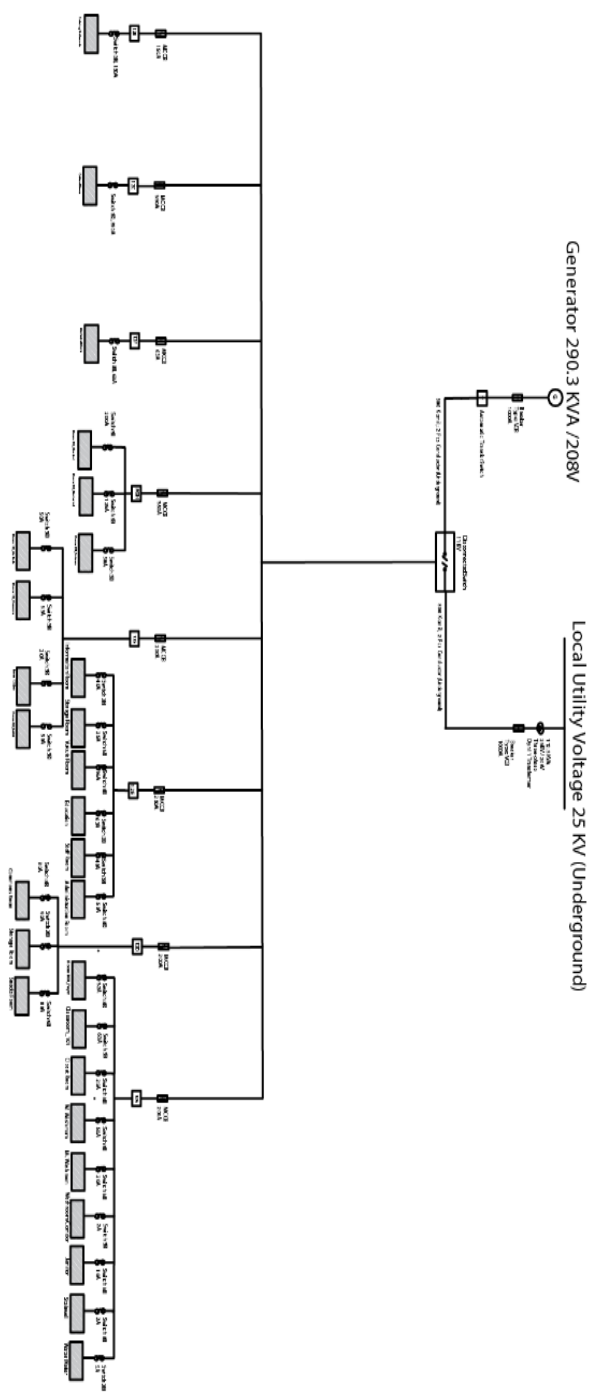

Fig: Emergency SLD

Safety Measures

In this project, we have considered multiple safety measure in our electrical design. For 24/7 monitoring, we have given CCTV in every room. Furthermore, we have used fire protection & detection system in every room. Also, we have used smoke detector, sprinkler to detect fire detect. Besides that, we have used MCCB (Molded Case Circuit Breaker) to protect the electric circuit from overload and short circuit in every room. In the building main panel, we have used VCB (Vacuum Circuit Breaker) to protect against overload and short circuits. Finally, we have set emergency exit sign in some of the room.

Recommendations

The project electrical calculation is done at preliminary stage considering client's requirement. Firstly, in the design, there is no male washroom. So, we have designed a male washroom and calculated all the technical aspects. Secondly, after considering only the continuous current, we need 800 Kcmil conductor. But, if we consider both the continuous and discontinuous current, then we will need 2 conductor of 800 Kcmil size.

Conclusion

In this project, we have developed the electrical layout for a building situated on a 10-acre site. As part of Milestone 1, we performed lumen calculations, receptacle placement analysis, load assessment, and panel scheduling for each room based on the base plan. Following these calculations, we determined the appropriate conduit sizing for both continuous and non-continuous loads. Using these data points, we proceeded with the lighting design, power distribution layout, and single-line diagrams (SLD) for both normal and emergency systems. Finally, we implemented safety measures and provided recommendations for further optimizing the design.