

INSTALLING AND COMMISSIONING OF 1.5 KW SOLAR ENERGY SYSTEM AT COLLEGE POWERHOUSE

Submitted in partial fulfillment of the requirements for the award of

Bachelor of Engineering degree in
Electrical and Electronics Engineering

by

MEET MEHTA (38140028)

ABHIJEET KUMAR (3814002)

ARNOLD BLESSTEN A (38140009)

B. GOWTHAM NAIDU (38140010)



**DEPARTMENT OF ELECTRICAL & ELECTRONICS
ENGINEERING SCHOOL OF ELECTRICAL & ELECTRONICS
ENGINEERING**

SATHYABAMA

(DEEMED TO BE UNIVERSITY)

Accredited with Grade “A” by NAAC

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119

MAY 2022



SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited "A" Grade by NAAC | 12B Status by UGC | Approved by AICTE

www.sathyabama.ac.in

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **MEET MEHTA** (Reg No. 38140028), **ABHIJEET KUMAR** (Reg No. 38140002), **ARNOLD BLESSTEN A** (Reg No. 38140009), **B. GOWTHAM NAIDU** (Reg No. 38140010) who

carried out the project entitled

"Installing and commissioning of 1.5 KW solar energy system at college Powerhouse"

under our supervision from September 2021 to April 2022.

Internal guide

Dr. D. SUSITRA

Head of the Department

Dr. V. SIVACHIDAMBARANATHAN

Submitted for Viva voice Examination held on _____

Internal Examiner

External Examiner

DECLARATION

We **MEET MEHTA** (Reg No. 381400028), **ABHIJEET KUMAR**(Reg No.38140002),**ARNOLD BLESSTEN A**(38140009) and **B.GOWTHAM NAIDU**(Reg No.38140010)hereby declare that the Project Report entitled “**INSTALLING AND COMMISSIONING OF 1.5 KW SOLAR ENERGY SYSTEM AT COLLEGE POWERHOUSE**”done by us under theguidance of Dr. D.SUSITRA is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Electrical and ElectronicsEngineering.

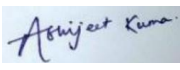
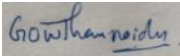
1. MEET MEHTA

2. ABHIJEET KUMAR

3. ARNOLD BLESSTEN A

4. B. GOWTHAM NAIDU

DATE:

PLACE:

SIGNATURE OF THECANDIDATES

ACKNOWLEDGEMENT

The fulfillment and delight that go with the effective consummation of any task would be inadequate without the notice of individuals who have made it conceivable. It is our incredible honor to express our gratitude and regard to every one of the people who have directed us and propelled us over the span of our project work.

First and foremost, we would express our sincere gratitude to our beloved Founder Chancellor **Col. Dr. JEPPIAAR, M.A., B.L., Ph.D.**, we would like to thank Chancellor madam **Dr. Mariazeena Johnson, B.E., M.B.A., M.Phil., Ph.D.**, President **Dr. Marie Johnson, B.E., M.B.A., M. Phil., Ph.D.**, and Vice President **Ms. Maria Bernadette Tamilarasi** for providing us the permission to complete the project. We also acknowledge our Vice-Chancellor **Dr. T. Sasipraba, M.E., Ph.D.**, and pro-Vice Chancellor **Dr. E. Logashanmugam M.E., Ph.D.**, for their constant support and endorsement.

We like to express our gratitude to **Dr. N. M. Nandhita** Dean, School of Electrical and Electronics, and **Dr. V. Sivachidambaramanathan** Head of the Department of Electrical and Electronics Engineering, Sathyabama Institute of science and technology for the steady wellspring of help and support for the completion of the project.

We would like to express our sincere thanks to our internal guide of the project **Dr. D. Susitram** madam, for her constant guidance and supervision during the period of our project work and for providing us with the necessary specialized inputs for the completion of our project. We would also like to thank our college powerhouse in charge Mr. Alderin to provide us with the necessary information to design the layout and completion of the project on time.

ABSTRACT

This project presents the installation and commissioning of the 1.5 KW solar power system at powerhouse premises in the institute. Whenever there is power failure from electricity board during night time , powerhouse employees have to switch on generators for the whole college in dark due to a lack of backup power at the powerhouse. Unfortunately, sometimes workers will fall into cable trench due to darkness during EB failure which makes it quite difficult for the workers to operate at night. Our solution to this problem is to provide a sustainable power system, that in our case is a solar power system as backup power. This solar power will be charging the batteries in the daytime and will be given as backup power at night to the powerhouse. We are giving backup power to the powerhouse to illuminate the whole powerhouse whenever there is EB failure at night. Unlike others here we are using LOGIC CIRCUITS to operate the whole power system to save more power. Our solar power system will operate for 3 hours time period at 100 percent load and then it will shift 50 percent load for the remaining 9 hours. So total light hours would be Morning from 6 o'clock to the evening at 6 o'clock.

CONTENTS

CHAPTER No.	TITLE	PAGE No.
	BONAFIDE	
	DECLARATION	
	ACKNOWLEDGEMENT	
	ABSTRACT	
1	INTRODUCTION	01
	1.1 General	
	1.2 Solar energy in India	
2	LITERATURE SURVEY	03
3	SCOPE OF THE PROJECT	
	3.1 Problem statement	
	3.2 Planning	
	3.3 Execution	
	3.4 Advantages	
4	DESCRIPTION OF THE PROJECT	16
	4.1 Software simulation	
	4.2 Calculation	
	4.3 Components description	
5	INSTALLATION AND RESULTS	27
	5.1 Panel Installation	
	5.2 Assembling components and connection	
	5.3 Logic Circuit	
	5.4 Installing light fixtures	
	5.5 Working	
	5.6 Commissioning	
6	CONCLUSION	

CHAPTER 1

INTRODUCTION

1.1 GENERAL

The Sun has been praised as a day-to-day existence provider to our planet since antiquated times. The modern ages provided us with the comprehension of daylight as an energy source. The steady abatement in fossil fuels holds on the planet and waste issues of thermal energy stations have pushed individuals to look for energy assets that have low unit costs, cause less harm to nature furthermore, and are inexhaustible. To this end, escalated endeavors have been spent to take advantage of the sun delivering electric energy.

Nowadays it is like everyone is quite familiar with the solar power system, but it was not like that back then. Although we discovered solar energy in the 7th century BC, the technology got improvised in 1883 when Sir Charles Fritts an American inventor came up with the first solar cells made from selenium wafers. Lately, major inventions were on making solar cells for research and development, like Jan Czochralski a Polish scientist who found the way to fabricate single-crystal silicon in 1918. After that, we got tremendous success in the field of solar cells in 1954. When Daryl Chapin, Calvin Fuller, and Gerald Pearson fabricated the silicon PV cell at Bell Labs.

It was the first solar cell capable of converting the sun's energy into power to run electrical equipment. In 1956 William Cherry first proposed developing PV cells for orbiting Earth satellites. In 1959, Hoffman Electronics achieved 10 % efficiency and commercially available photovoltaic cells came. Over the period years, we came across a lot of new technologies in the field of solar energy. From 4% efficiency to 21% efficiency of solar panels.

1.2 SOLAR ENERGY IN INDIA

India is having numerous amounts of solar energy potential. Approx area of 5,000 trillion kWh/year of energy is falling over India. with generating capacity of 4 to 7 kWh/m² in a day.

National Institute of Solar Energy has inspected the nation's solar potential which came to about 748 GW taking into account 3% of land which is not utilized.

National Solar Mission (NSM) was started on the 11th of January 2010 and played the main role to change the environmental aspects of each place across the country. It gives data to the different bodies of the government to improvise solar energy in different states of the country.

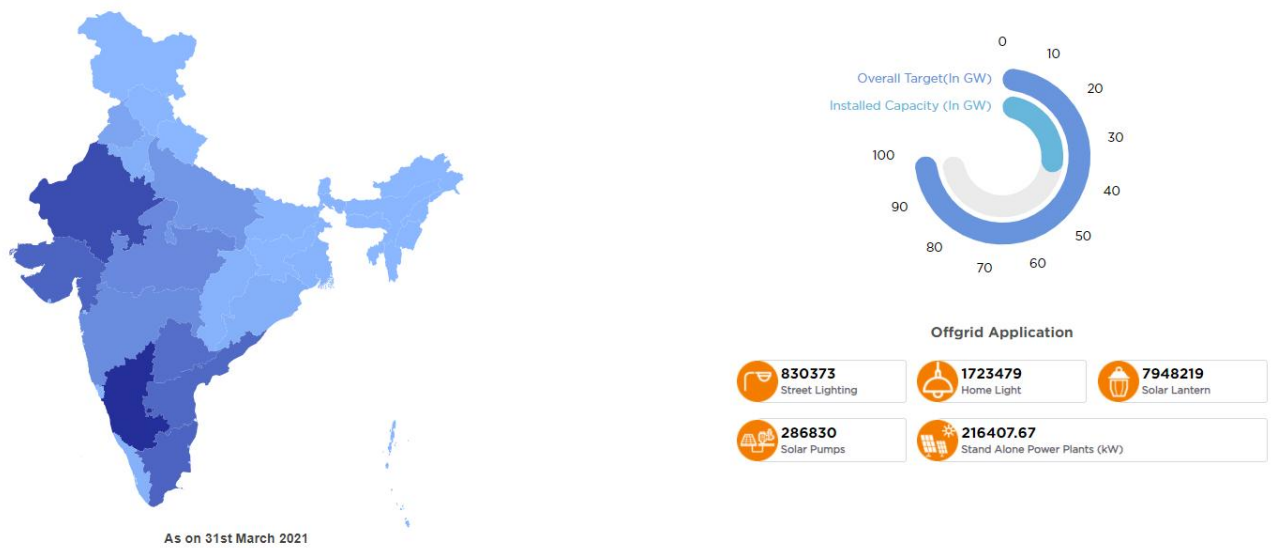


Fig 1.1: Installed capacity.

Source MNRE

CHAPTER 2

LITERATURE SURVEY

Deepak Purohit, Goverdhan Singh, Udit Mamodiya – SOLAR ENERGY SYSTEM

In this paper, we discussed and create an inverter 1-kilo watt solar system using an MPPT inverter. The energy of light shifts electrons in some semiconducting materials this photovoltaic effect is capable of large-scale electricity generation. So we have installed a 1kw system on the rooftop.

Dr. Frank Yildiz, Sam Houston State University, Dr. Keith L. Coogler Sam Houston state University - DESIGN AND IMPLEMENTATION OF 1KW PHOTOVOLTAIC SYSTEM

The paper as discussed to provide power to serve the lab section installed 1kilo watt to use the solar renewable energy and is to help and support the creation of well trained and highly qualified professionals on solar.

Dr. Peter Ping Liu, Dr. Jerry Cloward, Dr.Rendong Bhai – DESIGN AND METHODOLOGY OF OFF-GRID SOLAR SYSTEM

This paper provides the methodology for the design of an off-grid PV system. It helps to reduce the dependency on-grid and it will allow us to live in sufficient manner without reliance on one or more public utilities

KPMG file (2015) - The most important disruption that will alternate the energy landscape may additionally come from the solar rooftop enterprise. As in line with their forecast, sun rooftop strength, supported through internet-metering coverage and mixed with storage, could be cheaper than grid energy after 2022, for a huge segment of customers

Shanmugavalli and Vedamuthu (2015) -conducted an area examination of the power intake of group housing schemes in Chennai and Coimbatore in India. They have a look at discovered that there is enough rooftop for self-consumption in both the towns. however, the owners are not willing to invest within the RTPV scheme as the majority of them had been tenants and are no longer proprietors

Prasanna - He conducted the financial feasibility of 100 KW rooftop solar PV power for a training institute. The findings revealed that putting in of 100KW solar PV electricity system with a battery and without a battery may be undertaken at an interest charge of 13%.

Jha (2015). They analyzed the feasibility of a Grid-connected rooftop solar PV setup in BVUCOEP Campus, Pune. It became suggested that the institute would have the ability to keep Rs.95,81,250 in five years submit set up of sun device.

CHAPTER 3

SCOPE OF THE PROJECT

Our project is based on an applied approach to solve the real-time problem and enhance technology in the area of green energy. We are doing this project to gain more theoretical and practical knowledge on solar energy. In our project, we came across a lot of challenges when we started mapping the layout of the powerhouse. First and foremost, the problem statement of the project, to better understand the project.

3.1 PROBLEM STATEMENT

During EB failure at night in college, the whole powerhouse becomes dark because of no backup power. Because of that a lot of times when powerhouse employees try to switch on the generator to give backup power to the whole college may fall into a cable trench or get hit by obstacles due to darkness in the powerhouse since no backup power is there.

Since the college powerhouse is being isolated from the college area due to safety measures, if someone got serious injuries it will be difficult to carry that person to the nearest medical help. So, considering all the issues, we gave a solution to the powerhouse in charge after analyzing the problem. We will be installing lighting fixtures to illuminate the whole powerhouse and this all will work on solar energy as a backup.

3.2PLANNING

After getting permission from the department for inspection of the powerhouse we made project planning for execution.

- Vision to illuminate the whole powerhouse
- First and foremost, designing the layout of the powerhouse
- Analyzing the position of lighting fixtures
- Permission from the management
- Ordering the components
- Installing and commissioning.

Taking all these factors in mind, we did the design and calculation for further understanding of our project. Our main objective was to create a layout that we can handover in the future to the department and Powerhouse. Because of that we did a lot of research and executed further.



Fig: 3.1 First visit to Powerhouse-06.01.2022

3.3 EXECUTION

To execute any bigger project, we need to have proper project planning and analysis. After the plan has been made, we jump to the execution.

When we started to execute we faced many objectionable issues. Like we started to design the whole layout of the powerhouse and got a lot of challenges regarding the measuring factor of the whole area.

Since there was no blueprint available to analyze the powerhouse.

Our main objective was to illuminate the powerhouse and to do that we needed some design to analyze the whole area of the powerhouse to keep lighting fixtures in the proper place.

The total area of the powerhouse is almost 7750 sq. ft and it was measured manually by us. It took more than 4 days to complete the mapping of the whole powerhouse since there are a lot of obstacles in the powerhouse.

To complete the whole design in software took more than 8 days.

We used to visit the powerhouse consecutively to again map and analyze the powerhouse because we wanted to make a perfect design layout.

Our vision was that, once this project is over we are going to hand over this design to the college powerhouse.

After mapping cable routing of the whole powerhouse and positioning the electrical instrument like Transformers, APFC panel, MV panel, HT panel, and the generators in the AUTOCAD we moved to calculate the lux level of the whole powerhouse to find how many lighting fixtures we are going to use.

Here we used DIALUX software to find the lux level required and the positioning of the light. It is also used to visualize indoor lighting as well as outdoor lighting condition. In DIALUX we get a 3D design simulation of the whole area.

With the help of this software, we analyzed and concluded the number of lights required with the average lux level of 80 in the whole area.

In execution, our main objective was to analyze and develop the project by all means of engineering works.

That's why we have used designing software and calculated the all necessary aspect in the field of engineering.

Here are some highlights of our project:

- We would like to install a 1 KW solar energy system at the college powerhouse as backup power at night for the powerhouse.
- Our solar power system will work on a LOGIC circuit because we wanted sufficient power utilization as well as power saving.
- Designed and cabling using AUTOCAD
- Calculated and Analysed lux level as per Bureau of Indian standard (BIS-6665)
- Positioned the lighting fixtures by using DIALUX software.
- Maintained the lux level after installation of light.



Fig 3.2: MV Panel



Fig 3.3 Mapping the powerhouse

3.4 ADVANTAGES

- ✓ Solar power is far less expensive than diesel power, the latter of which comes from generators that produce carbon emissions and high costs.
- ✓ Power from renewable sources possesses greater reliability and flexibility and requires little maintenance
- ✓
- ✓ Solar systems are often used to save costs, but we are discovering that they provide a unique educational opportunity for students as well.
- ✓ Since solar panels are a highly visible addition to an institute, they provide an ideal starting point for showing students how their studies apply to everyday life
- ✓ The cost of solar power is fixed for the next 25 years, as opposed to diesel power which increases each year.

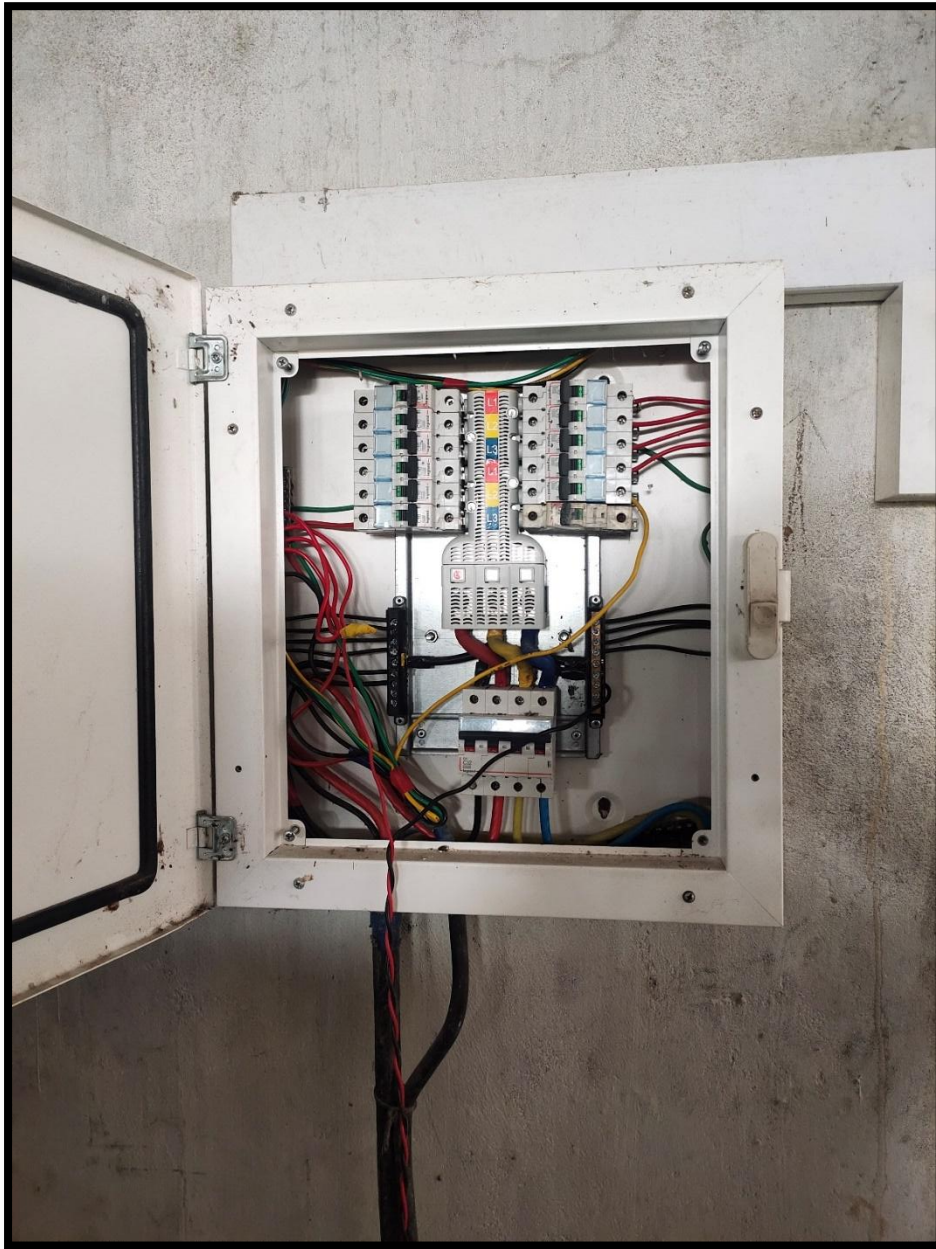
- ✓ Using this hybrid system we will be utilizing the unused roof space and generating 100% Green Energy.
- ✓ Additionally, we will organize an awareness event for students to encourage them to get involved and help make the environment as carbon-free as possible and make future generations breathe easier through renewable energy.

- ✓ Students get to know more about the sustainable source of energy, which will help to find more new technology to improve this field of energy.
- ✓ Apart from this, our problem statement would be solved and the employees can efficiently continue their work and get things done.



Fig 3.4: Powerhouse (evening snap)

Fig 3.5: Main MCB of Powerhouse



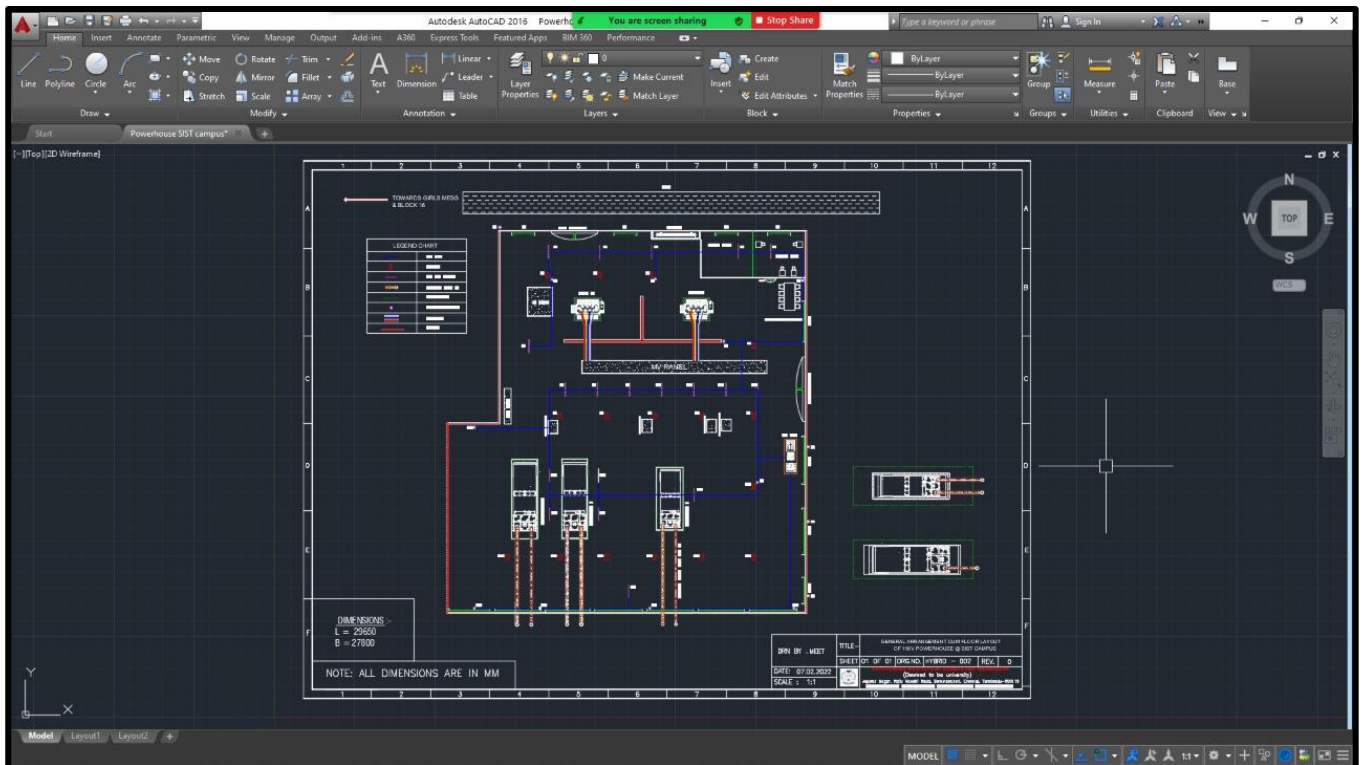
CHAPTER 4 DESCRIPTION OF THE PROJECT

Here we are describing the data which we got from the software analysis of **DIALUX** and **AUTOCAD**. **DIALUX** is software for professional lighting design, using that we got crystal clear idea on lighting fixture installation. On the other hand we used the **AUTOCAD** software to design whole powerhouse layout in order to map the area.

4.1 SOFTWARE SIMULATION

4.1.1 DESIGN – AUTOCAD (2D LAYOUT)

Fig: 4.1: 2D design of powerhouse.



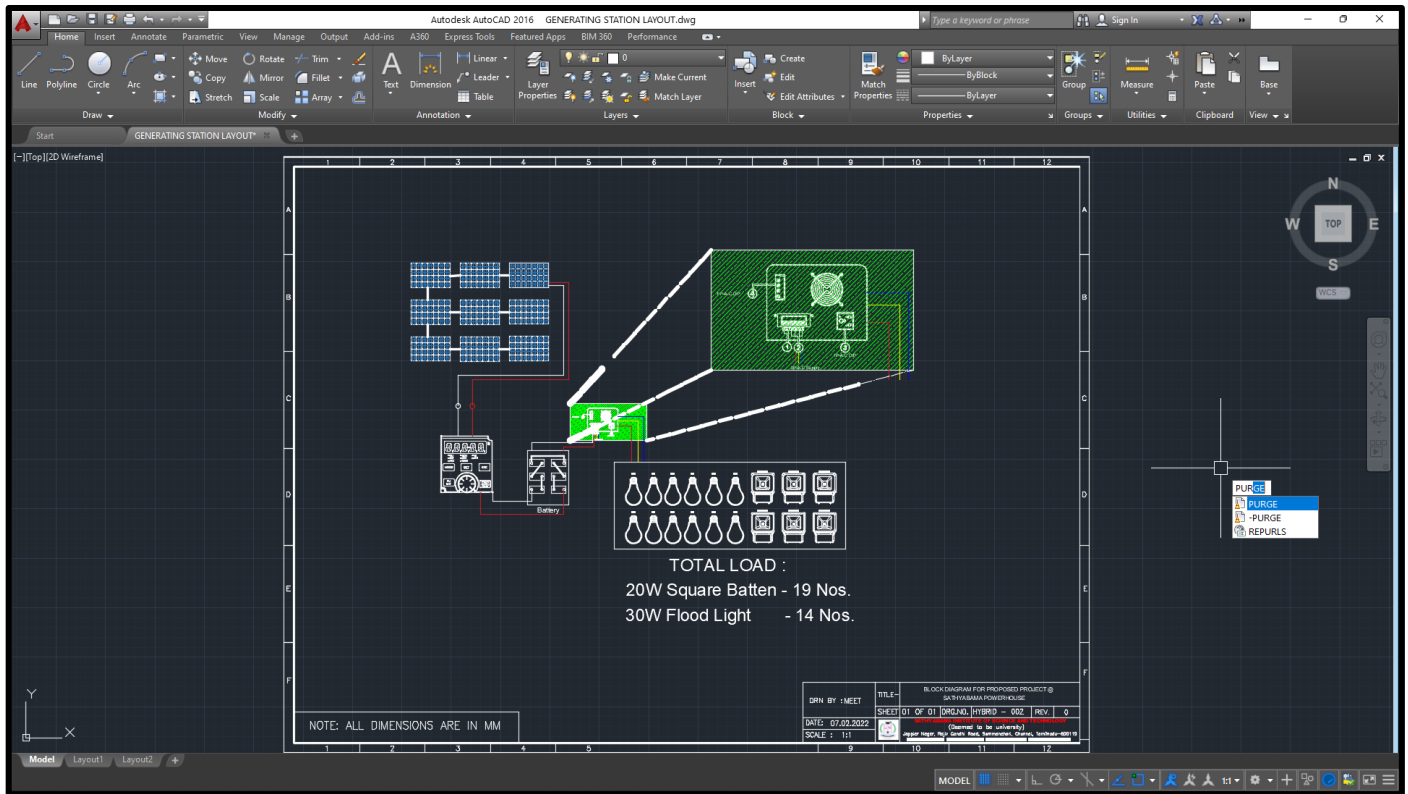


Fig 4.2: DESIGN – AUTOCAD (BLOCK DIAGRAM)

4.1.2 DIALUX(LUX LEVEL CALCULATIONS (IS-6665))

- We have calculated lux level as per bureau of **INDIAN STANDARDS** is **6665**
- After going through bis 6665, we have calculated the further lux level for our venue (i.e. sist powerhouse)
- For achieving lux level as per the given standard we have done the placement of luminaries or lighting fixtures in a field and line arrangement.
- Keeping the luminaries in field and line arrangement will reduce the dungeon effect thereby providing us the desired lux level.
- Moreover we have analyzed the beam angle and angle of inclination ensuring proper positioning of all C

IS : 6685 - 1972

(Reaffirmed 2005)

Indian Standard

**CODE OF PRACTICE FOR
INDUSTRIAL LIGHTING**

(Fifth Reprint May 1997)

UDC 628'977'1

© Copyright 1973

**BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI-110002**

Gr 7

April 1973

TABLE 2 RECOMMENDED VALUES OF ILLUMINATION AND LIMITING VALUES OF GLARE INDEX — *Contd*

SL No.	INDUSTRIAL BUILDINGS AND PROCESSES	AVERAGE ILLUMINATION lux	LIMITING GLARE INDEX
	b) Bottle inspection	Special lighting	—
	c) Bottle filling	450	25
18.	<i>Die Sinking</i>		
	a) General	300	—
	b) Fine	1 000	19
19.	<i>Dye Works</i>		
	a) Reception, 'grey' perching	700	—
	b) Wet processes	150*	28
	c) Dry processes	200*	28
	d) Dyers' offices	700†	19
	e) Final perching	2 000†	—
20.	<i>Electricity Generating Stations: Indoor Locations</i>		
	a) Turbine halls	200	25
	b) Auxiliary equipment; battery rooms, blowers, auxiliary generators, switchgear and transformer chambers	100	—
	c) Boiler houses (including operating floors) platforms, coal conveyors, pulverizers, feeders, precipitators, soot and slag blowers	70 to 100	—
	d) Boiler house and turbine house	100	—
	e) Basements	70	—
	f) Conveyor houses, conveyor gentries, junction towers	70 to 100	—
	g) Control rooms:		
	i) Vertical control panels	200 to 300	19
	ii) Control desks	300	19
	iii) Rear of control panels	150	19
	iv) Switch houses	150	25
	h) Nuclear reactors and steam raising plants:		
	i) Reactor areas, boilers, galleries	150	25
	ii) Gas circulator bays	150	25
	iii) Reactor charge/discharge face	200	25
21.	<i>Electricity Generating Stations: Outdoor Locations</i>		
	a) Coal unloading areas	20	—
	b) Coal storage areas	20	—
	c) Conveyors	50	—

*Supplementary local lighting should be used where necessary.

†Special attention should be paid to the colour quality of the light.

(Continued)

20. Electricity Generating Stations: Indoor Locations		
a) Turbine halls	200	25
b) Auxiliary equipment; battery rooms, blowers, auxiliary generators, switchgear and transformer chambers	100	—
c) Boiler houses (including operating floors) platforms, coal conveyors, pulverizers, feeders, precipitators, soot and slag blowers	70 to 100	—
d) Boiler house and turbine house	100	—
e) Basements	70	—
f) Conveyor houses, conveyor gentries, junction towers	70 to 100	—
g) Control rooms:		
i) Vertical control panels	200 to 300	19
ii) Control desks	300	19
iii) Rear of control panels	150	19
iv) Switch houses	150	25
h) Nuclear reactors and steam raising plants:		
i) Reactor areas, boilers, galleries	150	25
ii) Gas circulator bays	150	25
iii) Reactor charge/discharge face	200	25
21. Electricity Generating Stations: Outdoor Locations		
a) Coal unloading areas	20	—
b) Coal storage areas	20	—
c) Conveyors	50	—

4.1.2.1 LUX LEVEL CALCULATIONS (DIALux)

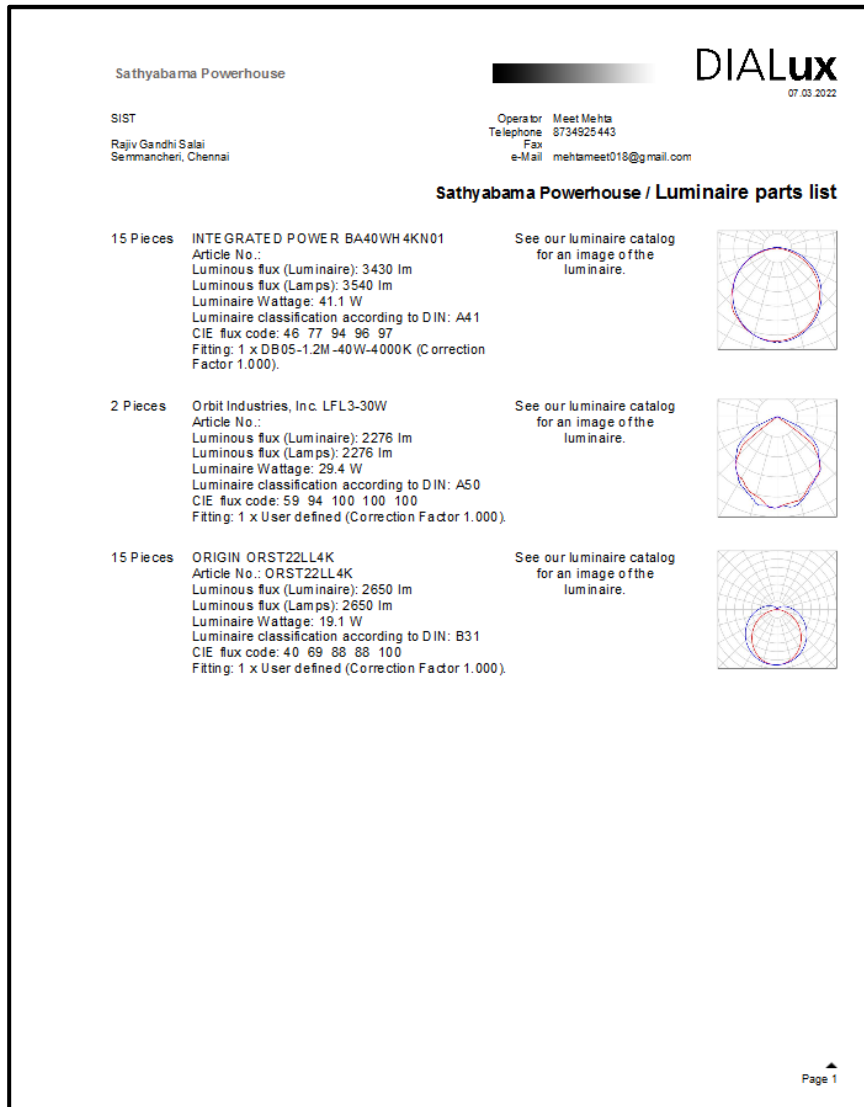


Fig 4.3 : Luminaries Datasheet

LUMINARIES DATA SHEET-This sheet consist of all the vital information about the components that are used for maintaining lux level. The data mentioned in the above sheet shows the luminaries flux with wattage in adherence to DIN:A41. Correction factor is also included which is considered as 1.00. Moreover luminary spread area is shown in the sheet, using which we can determine the inclination angle and degree at which the fixture will give maximum lumens

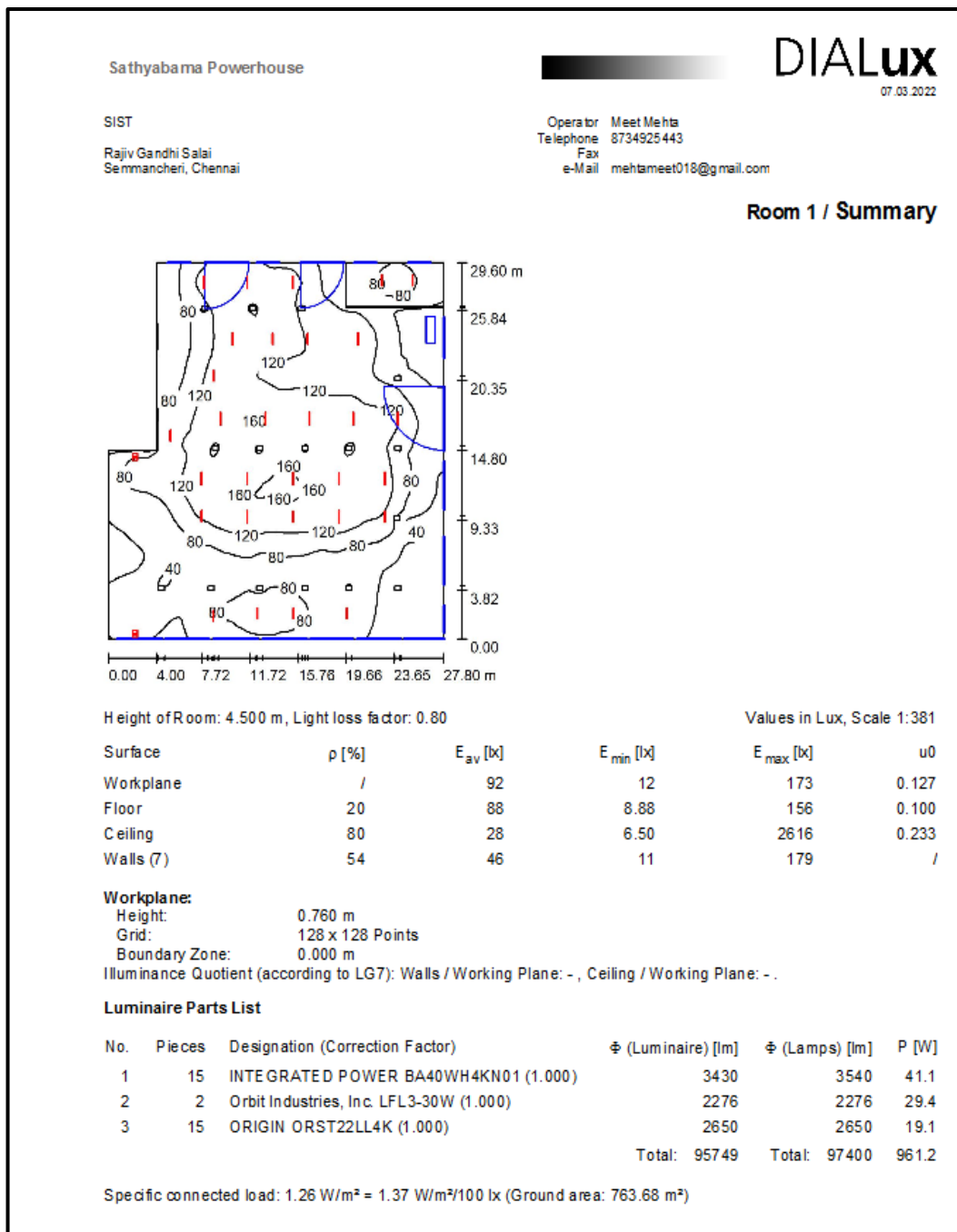


Fig 4.4: SUMMARY

Summary - this sheet shows the exact value of lux falling on all surfaces of the room which is analysed.

Other datas like room height, light loss factor, natural light, artificial light etc are analysed and accordingly fixtures will be suggested by software. wattage of the luminaries are also shown along with the total area of the room.

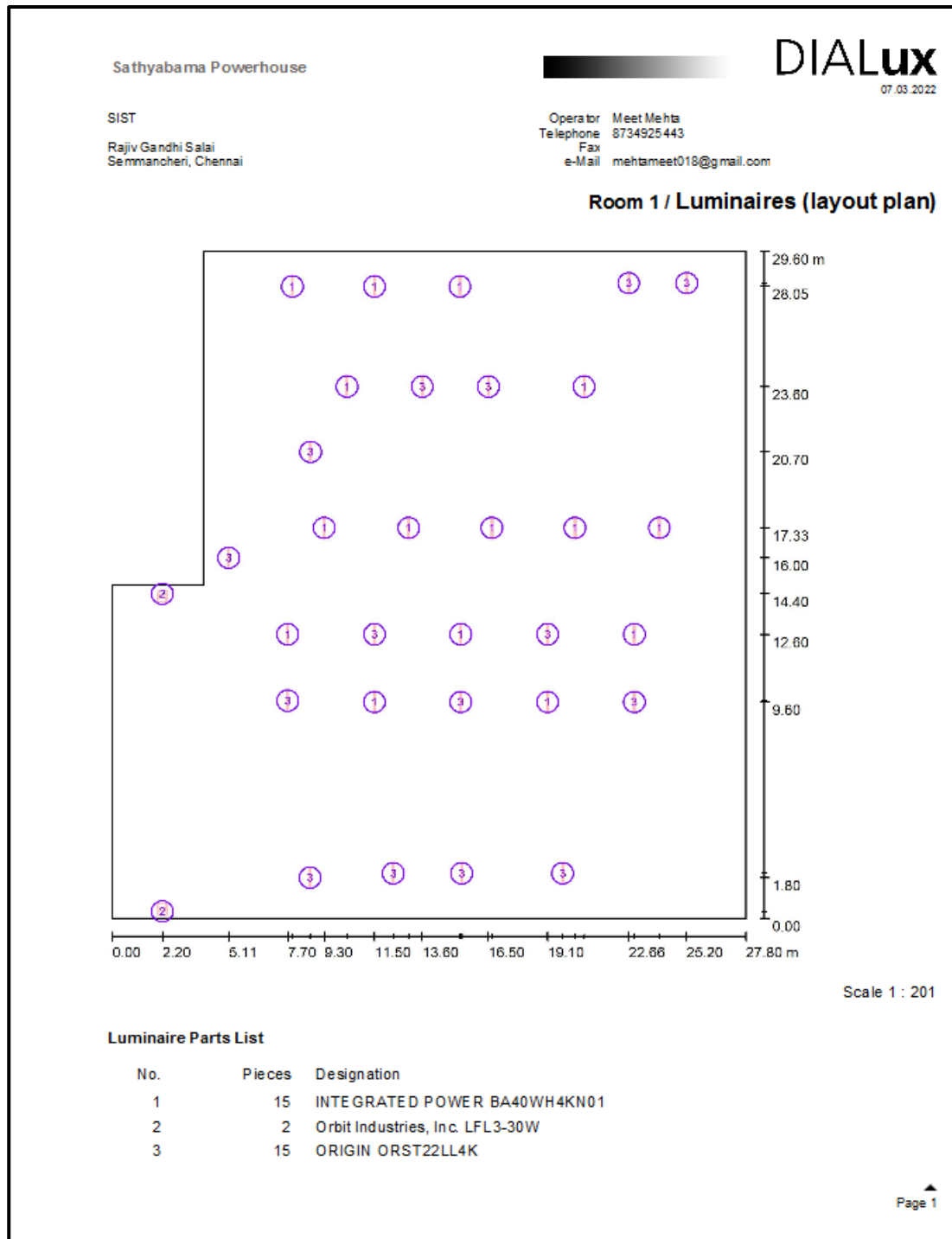


Fig 4.5 : LUMINARIES LAYOUT PLAN

Focuses on the analysis on different angles and projection providing a 3D view for clear understanding and analysis of the lux level which is to be calculated in such a way to avoid mistakes.

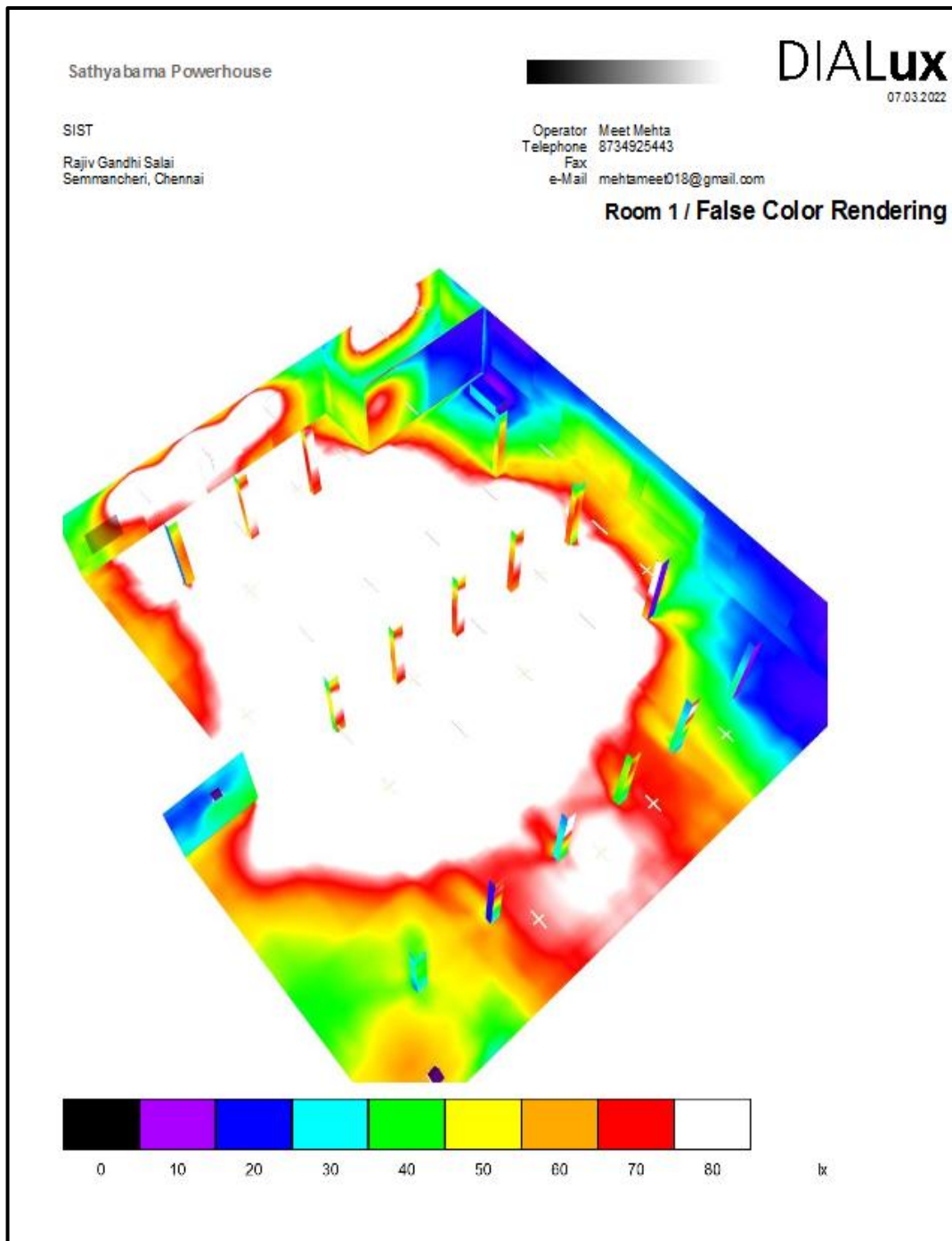


Fig 4.6 :FALSE COLOR RENDERING

False colour rendering is provided as an output after fixing the luminaries at the suggested location. The false colour view helps to interpret the calculation results quickly and easily. The settings of the false colour values apply to the entire project. They are therefore also called "global false colours". The colour set for a value is used in all diagrams and views.

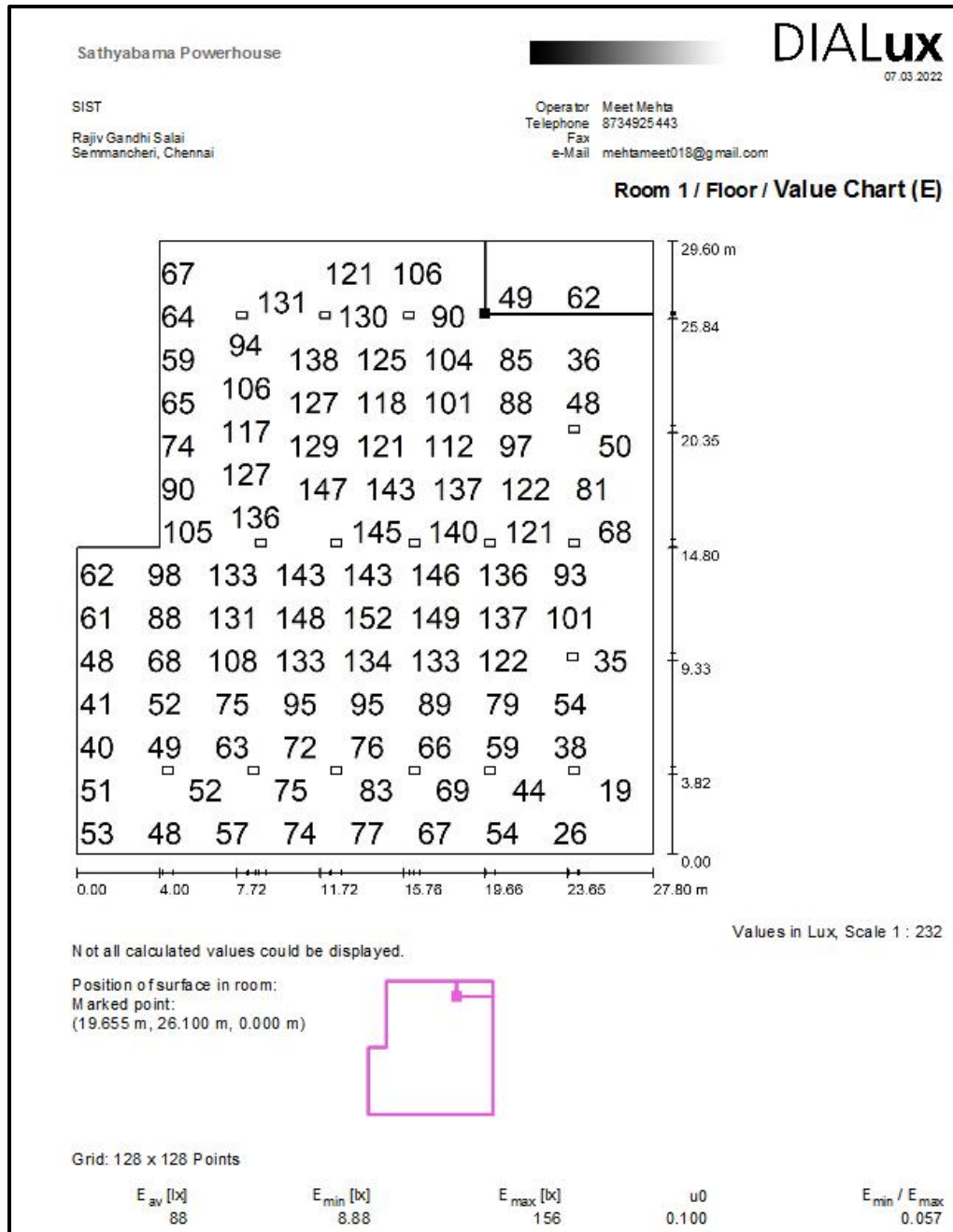


Fig 4.7: LUX LEVEL FOR FLOOR

It shows the level of lumens per sqft area without any obstacles coming into consideration. It gives us minimum and maximum value along with ratio of E_{min}/E_{max} . The values mentioned in the above figure shows the particular area being infused by lux so we can analyse and make necessary changes in the positions of luminaries.

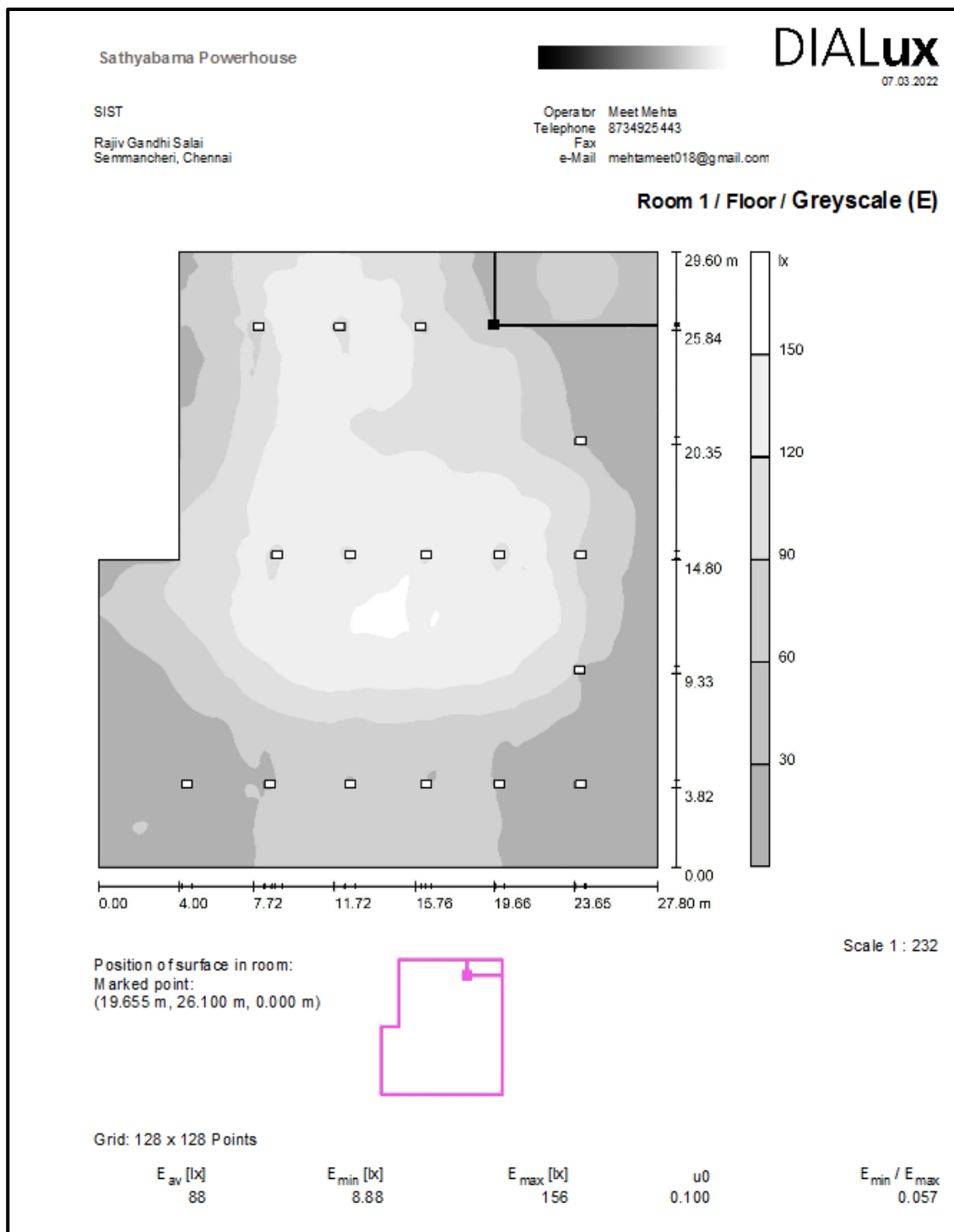


Fig 4.8 :GREYSCALE FOR FLOOR

Grayscale images, a kind of black-and-white or gray monochrome, are composed exclusively of shades of gray. The contrast ranges from black at the weakest intensity to white at the strongest. It shows us the same value by grayscale representation.

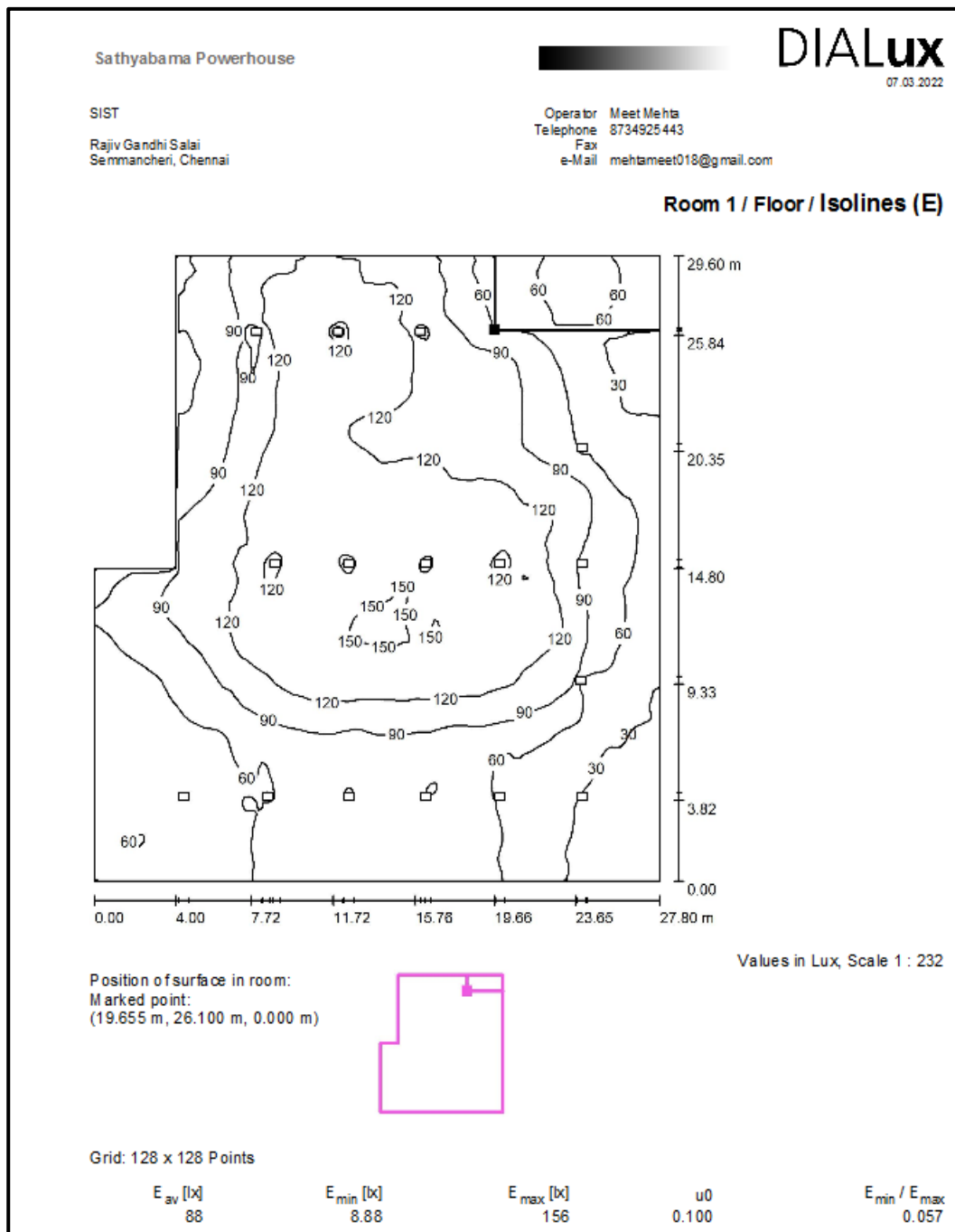


Fig 4.9 :ISOLINES FOR FLOOR

It represents the 3D graph of the particular analysis in isoline form. So that it is easier to understand and analyse the data.

LUX LEVEL CALCULATIONS (DIALUX) – 3D ANALYSIS

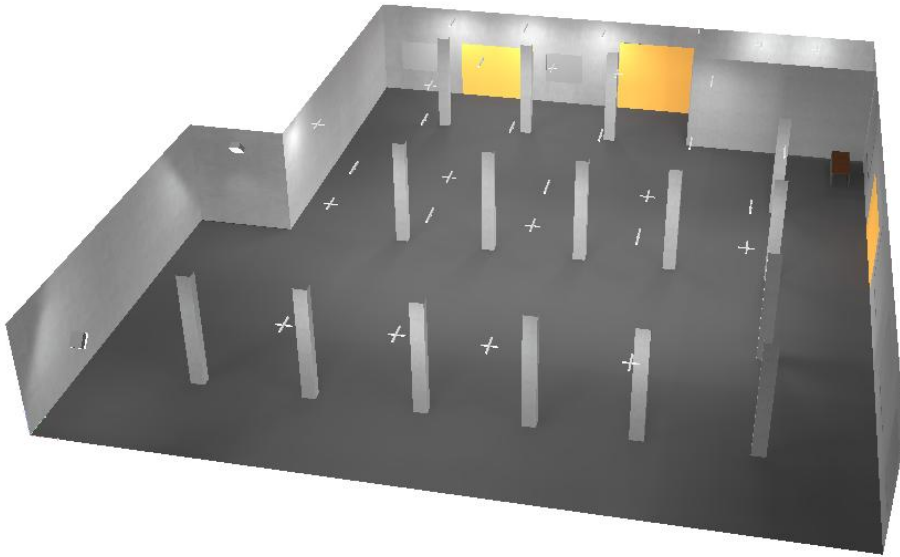
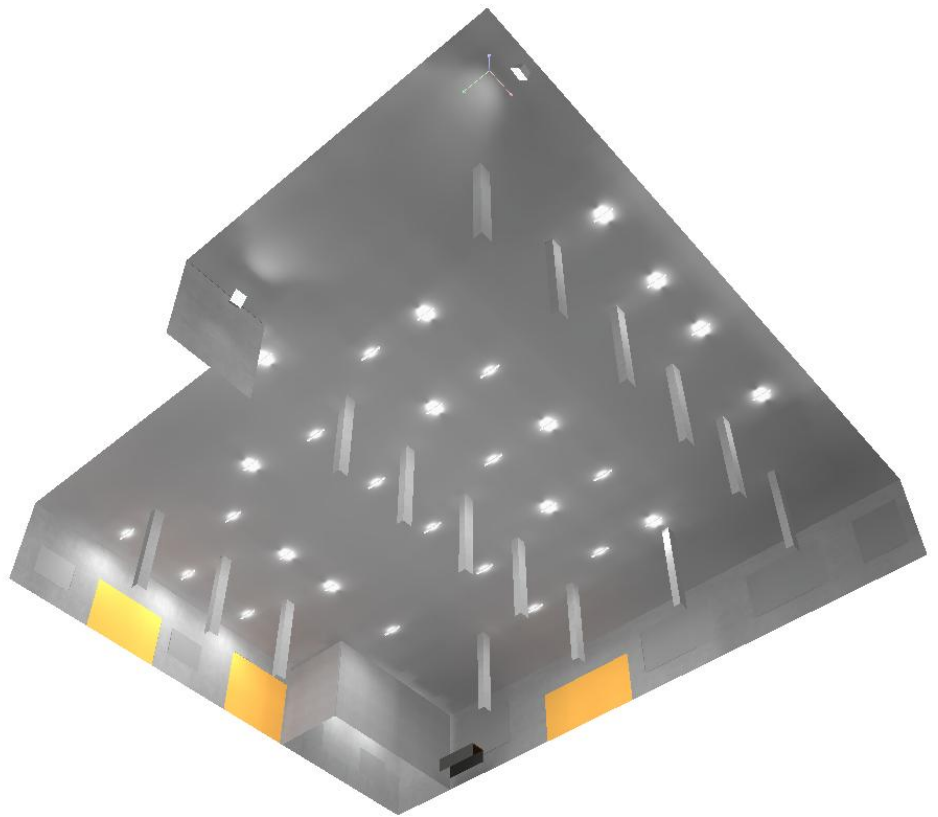


Fig 4.10: Top View of Powerhouse

Fig 4.11: Bottom View of Powerhouse

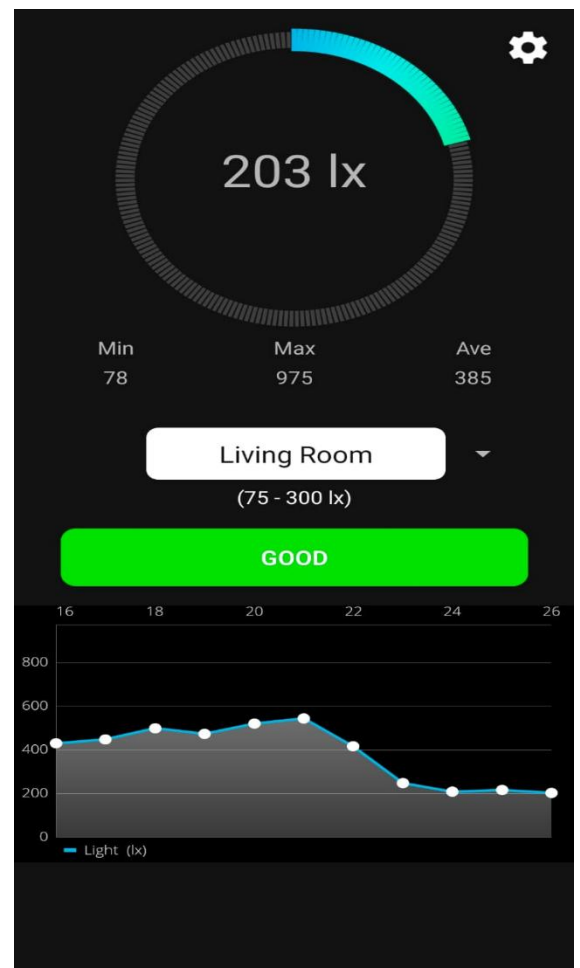


PRACTICAL LUX LEVEL TAKEN



Fig 4.11 :LUX LEVEL MEASURED FOR 20W LIGHT

Fig 4.12 :LUX LEVEL MEASURED FOR 40W LIGHT



4.2 CALCULATIONS

In this project, we use only lights as load. The details of the load are mentioned below

<u>TYPE</u>		<u>Quantity</u>
TUBE LIGHT(20W)	→	15
TUBE LIGHT(40W)	→	15
FLOOD LIGHT(50W)	→	09

Now for the Total load required is calculated below

- TUBE LIGHT

$$20W \rightarrow 20 * 15 = 300W$$

$$40W \rightarrow 40 * 15 = 600W$$

$$\text{TOTAL LOAD-1} = 900W$$

- FLOOD LIGHT

$$50W \rightarrow 50 * 9 = 450W$$

$$\text{TOTAL LOAD-2} = 450W$$

$$\text{TOTAL LOAD} = \text{LOAD-1} + \text{LOAD-2} = (900+450)W = 1350W$$

Now that we know the total load, we need to know the rating of the inverter that we are going to use in the project. But before that, we need to know that the inverter ratings are in VA not in Watt.

So to convert VA to Watt, we need to divide the load by power factor(0.8) and it is shown below

- 20W tube light = $(20 * 15)/0.8 = 375 \text{ VA}$
- 40W tube light = $(40 * 15)/0.8 = 750 \text{ VA}$
- 50W Flood light = $(50 * 9)/0.8 = 562.5 \text{ VA}$

$$\text{TOTAL} = 1687.5 \text{ VA} = 1.6875 \text{ KVA}$$

We will be using a 2KVA rating inverter for the smooth flow of power to avoid any power regulations that may cause damage to the load.

Now that we have calculated the load and the rating of the inverter, we should calculate the backup time.

We used a pair of batteries specified below

SOLAR TUBALAR EXIDE BATTERIES OF 150AH, 12V EACH At C10

But before that we have to calculate the DC current required for the load i.e

$$P=1380\text{W} \quad , \quad V = 12+12 = 24\text{V}$$

DC Current required for load

$$\text{WKT} \quad P = V * I$$

$$1350 = 24 * I$$

$$I = 56.25 \text{ A}$$

Backup time is calculated with the formula

Total Ah/ Amps = 150 / 56.25

= 2.67 hrs → approx 160 minutes of backup.

4.3 COMPONENTS DESCRIPTION

❖ SOLAR PANELS

- We used Poly-crystalline solar panels to reduce the cost of the solar panels and these panels are readily available in the market.
- The rating of each panel is 330W. We used 3 solar panels.
- The Nameplate details are shown below.



Fig 4.1: Nameplate details

❖ INVERTER

- As we calculated and mentioned above in chapter 4.2, we should use a 2KVA rating inverter.
- So we used an MPPT (Maximum Power Point Tracker) inverter so that we get the maximum voltage from the solar panels at any point in time.



Fig 4.2: MPPT Inverter

❖ BATTERIES

- We used solar tubular batteries as these batteries are specially designed for photovoltaic applications.

- We used a pair of 150AH,12V rating batteries each at C10.
- The above C10 specifies that the battery can discharge its charge continuously for 10 Hours.



Fig 4.3: Batteries

❖ CHARGE CONTROLLER

- Here charge controller is inbuilt into our inverter. So, no need for an additional charge controller to control and stimulate the output power.



Fig 4.4: Inverter with inbuilt charge controller.

❖ LOAD (Lighting fixtures)

- As mentioned in the calculation chapter we are going to install



Fig 4.5: Lighting fixture received



Fig 4.6: Lighting fixtures(20W batten, 40W batten and 50W Floodlight)

❖ D1 VCR1 :

Single Phase Under & Over voltage, Auto Reset, Adjustable under / over voltage settings, 2 CO output relay.

Supply Voltage System Supply 220/230/240 V AC (+ 20% - 30%), 50/60 Hz

Output Contacts:

Output Relay Contacts 2C/O

Trip settings:

Under Voltage 75 - 95%

Over Voltage 105 - 120%

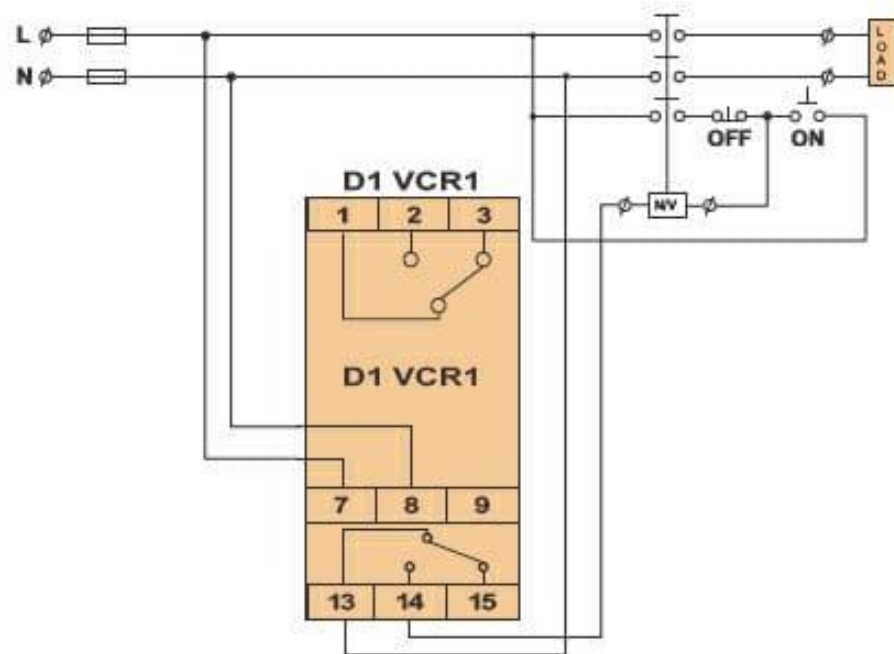
Trip Time Delay 2- 5 Sec (Fixed) (UV/OV)

Power on Delay

Reset / Auto Reset



It is a voltage sensing relay used for sensing the availability of AC mai



- ❖ MCB: MCB stands for Miniature Circuit Breaker. It automatically switches OFF electrical circuit during any abnormal condition in the electrical network such as overload & short circuit conditions. However, fuse may sense these conditions but it has to be replaced though MCB can be reset.



- ❖ POWER CONTACTORS

A contactor is an electromechanical switch whose function is to make or break the connection between the power supply and the load. The contactor is electrically controlled and usually powered at a much lower level than the switched circuit.



❖ **Timer:**

Easy interface with text LCD for daily / weekly programming.

12 / 24 hour clock mode display selection.

High accuracy of timing with low drift.

Flexibility of writing 25 programs for Crono.

Simple Reset & easy Manual Override.

DST Feature.

6 years battery reserve.

Weekend Exclusion Programming (FRI-SAT, SAT- SUN)

FRONT VIEW & FUNCTION OF KEYS :

A - LCD

B - Keypad

C - Relay 'ON/OFF' LED Indication.

D - Program Number

E - Relay Status

F - Mode

G - HR : MIN

H - Day

PRG - Programming

D+ - Day Increment

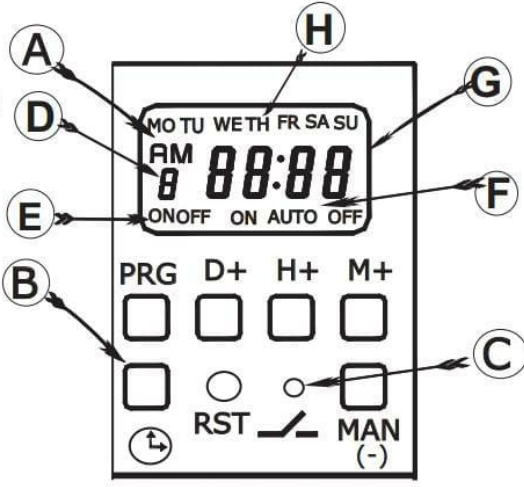
H+ - Hour Increment

M+ - Minute Increment or used to set pulse duration in Pulse Time Switch.

 - Clock Key, to set the clock & change the time format.

RST - Reset programs or settings in the device.

MAN (-) - It has four usages:
 1. Manual key for overriding.
 2. Decrement key to decrement D/H/M in PRG mode.
 3. Used with  key to select clock format.
 4. Used to toggle DST in DST mode.



CHAPTER 5

INSTALLATION AND RESULTS

5.1 PANEL INSTALLATION



Fig 5.1: Unloading the Panels and components

MOUNTING THE STRUCTURE

STEP-1

Firstly we have seen the best place to mount the solar panels on the rooftop of Sathyabama Powerhouse without any obstruction of the shade and finalized the location.

STEP-2

We tracked the positions of the sunlight during the daytime for the best use of the solar radiation for the Mounting of solar panels.

STEP-3

we used the Roof-Ground Mount technique for mounting of structure so that we can use the best efficient method for more radiation.

STEP-4

We have installed the structure in such a way that the panel position is from north to south for the effective use of the sun's radiation with an angle of 36 degrees deviation from the plane.



Fig: 5.2. Mounting the structure for solar panel (Technical team at work)



Fig: 5.3.: Drilling for Anchor fastening



Fig 5.4.: Close up view

Fig 5.5: Chemical fixing



Fig 5.6: Anchor fastener



Fig 5.7: Technical team mounting the structure.

Fig 5.8 : Mounted structure



Fig 5.9: Complete structure mounted

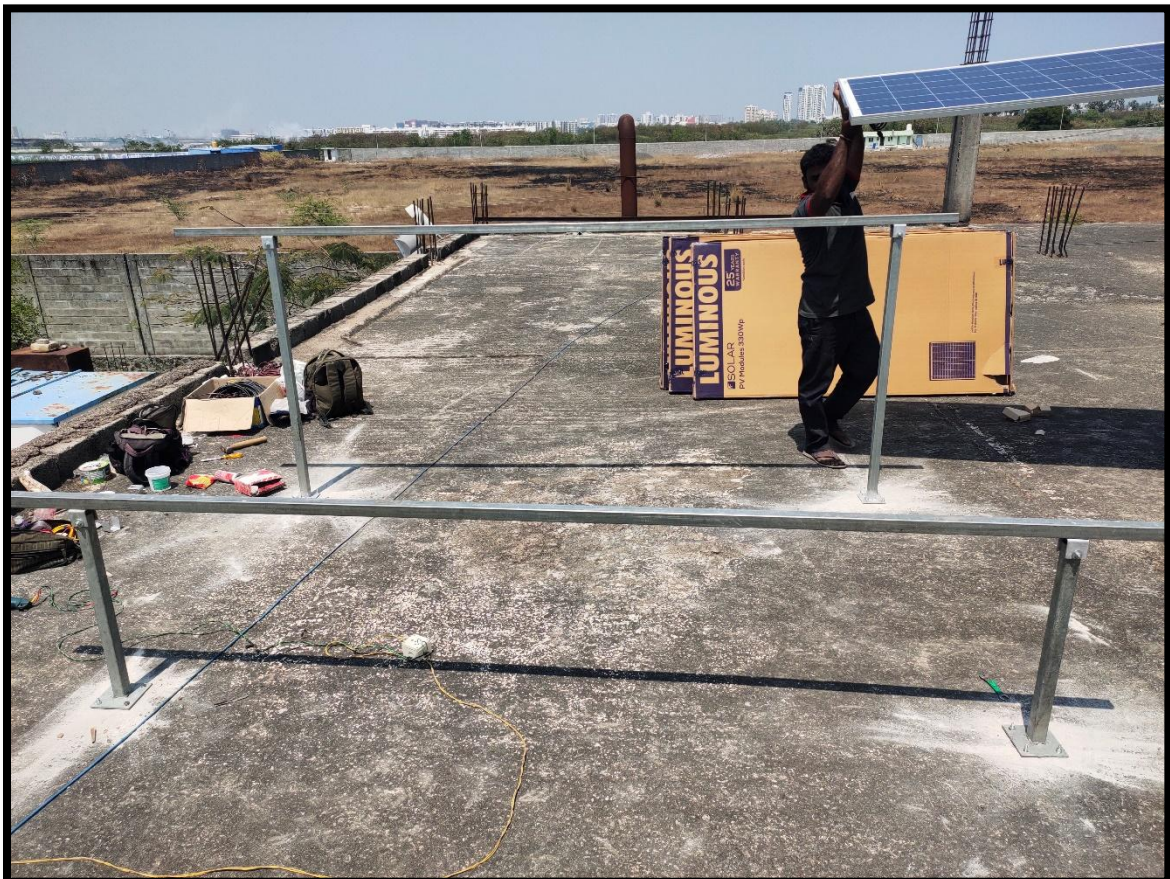




Fig 5.10: Mounting and Inspection

INSTALLING SOLAR PANELS

STEP-1

Clean the solar panels and look for any damage.



Fig 5.11: Panel Installation on powerhouse rooftop and inspection.



Fig 5.11: Panel installation



Fig 5.12 Panel installation

STEP-2

Fixing the solar panels on the mounting structure by tightening the nuts and bolts.

5.2 ASSEMBLING COMPONENTS AND CONNECTION

STEP-1

We used MC4 Universal Connectors for the wiring from solar panels.

STEP-2

Connect the solar panels in series with each other i.e Connect the positive end of one panel to the negative end of another panel.

5.3 LOGIC CIRCUITS PANEL



Fig 5.13: Logic panel

5.3.1 Components included in Logic circuit panel



Fig 5.14: Logic panel components



A	INCOMER		1	FEEDER QTY
SR. NO.	BOQDESCRIPTION	MAKE	CATALOG NUMBER	QTY
1	20A 2P 10kA C-Curve MCB	L&T	BB20200C	2
2	9A Power Contactor, Coil: 230V AC	L&T	CS94106B000	4
3	Add-on Block : 2NO+2NC	L&T	CS941140000	1
4	Add-on Block : 1NO+1NC	L&T	CS941180000	3
5	Digital Time 240V AC	GIC	67DDT0	4
6	Auxiliary Contactor, Coil: 230V AC, Aux. Contact: 2NO+2NC	L&T	CS94020	1
7	10A 2P 10kA C-Curve MCB	L&T	BB20100C	6
8	6A 1P 10kA C-Curve MCB	L&T	BB10060C	1
9	High Voltage Relay Minilec D1 VCR1 Voltage Monitoring Relays	Minilec	D1 VCR1	1
10	6A 2P 2 Way 2 Position With OFF AC Selector Switch	Kaycee	2R26B	1
11	Red LED Indicator 22.5 mm, Voltage: 240V AC	SCHNEIDER		4
12	Yellow 22.5mm Flush Type Spring Return Non-Illuminated (Metallic) Push Button	SCHNEIDER	XB5AA51N	1
13	Contact Element 1 NC	SCHNEIDER		1
14	Black 22.5mm Flush Type Spring Return Non-Illuminated (Metallic) Push Button	SCHNEIDER	XB5AA21N	1
15	Contact Element 1 NO	SCHNEIDER		1
16	Hooter 240V AC	Viral		1
17	25 Sq.mm Feed Through Terminal (Std. Color),Type: KUT 6	ELMEX	KUT 25	4
18	6 Sq.mm Feed Through Terminal (Std. Color),Type: KUT 6	ELMEX	KUT 6	20
19	NEUTRAL LINK	REPUTED		1
20	WIRE	RR CABLE		1
21	LUGS	3D		1
22	ON DEALY TIMER 230V AC	GIC	120DT4CR8	1

Table : BOM- BILL OF MATERIAL

A bill of materials (BOM) is a centralized source of information used to manufacture a product. It is a list of the items needed to create a product as well as the instructions on how to assemble that product. Manufacturers that build products start the assembly process by creating a BOM.

- DIVCR1 - voltage sensing replay with 2C/O contacts.
- 20A DP MCBs
- 9A CONTACTORS (C1, C1A, C2, C2A)
- Programmable digital timer with clock inbuilt. (T1 TO T3)
- RED INDICATING LAMPS (L1, L2....)
- Normal timer (T4)
- BUSBARS (phase and neutral)
- RELAYS (BC AND R1)

- This drawing and design is the property of AKSHAR GROUP and must not be copied or lent without their permission.
- 1 2 3 4 5 6 7 8 9 10 11 12
- A
- B
- C
- D
- E
- F
- LHS VIEW
- FRONT VIEW (EXTERNAL)
- FRONT VIEW (INTERNAL)
- RHS VIEW
- DETAIL 'A'
- FRONT
- EARTHING BUSH
- 40x40x5mm M.S. ANGLE STAND
- 1300
- 700
- 600
- 800
- 450
- ACRYLIC GLASS
- INVERTER
- BATTERY-1
- BATTERY-2
- 1300
- 700
- 600
- 800
- 450
- 40x40x5mm M.S. ANGLE STAND
- 5mm THK FRP SHEET
- FRONT
- 5mm THK FRP SHEET
- 40x40x5mm M.S. ANGLE STAND
- 463
- 202
- 187
- 187
- 427
- 432
- 500
- INVERTER
- BATTERY
- 300
- 1300
- 800
- 450
- GLAND PLATE
- BATTERY-1
- BATTERY-2
- 187
- 187
- TABLE
- | | |
|-------------|--|
| FABRICATION | 14G/16G (2MM/1.6MM), CRCA SHEET STEEL, IP-55 PROTECTION, DOUBLE DOOR, OUTDOOR TYPE, (40x40x5mm, M.S. ANGLE STAND MOUNTED) (10G (3mm) CRCA SHEET STEEL GLAND PLATE) |
| PAINT SHADE | SIEMENS GREY RAL 7032 |
| CABLE ENTRY | I/C & O/G FROM BOTTOM |
| NOTE | ALL DIMENSION ARE IN MM |
- CLIENT : M/s. AKSHAR ELECTRIC PANEL BOARD
- CONSULTANT : ---
- PROJECT : ---
- CONTRACTOR : ---
- W.O. NO : ---
- DRN : DRN
- VPUL : VPUL
- CKD : CKD
- APPD : APPD
- TITLE : GA DRAWING SHEET FOR PDB PANEL
- SHEET : 01 OF 04
- DATE : 23.03.2022
- SCALE : ---
- QTY :- 01 No
- DB DIMENSION
- H = 800+450mm
- W = 700mm
- D = 350mm
- DOOR PROFILE DETAIL: (DETAILS - A)
- 310.GDC IND. ESTATE MANUSARITA SAVILUST-VADODARA
 PIA 02667-264132,TELEFAX-02667-264131,CTC09879599462
 vinay.mehra@akshar-group.com|anil@akshar-group.com
- 1 2 3 4 5 6 7 8 9 10 11 12

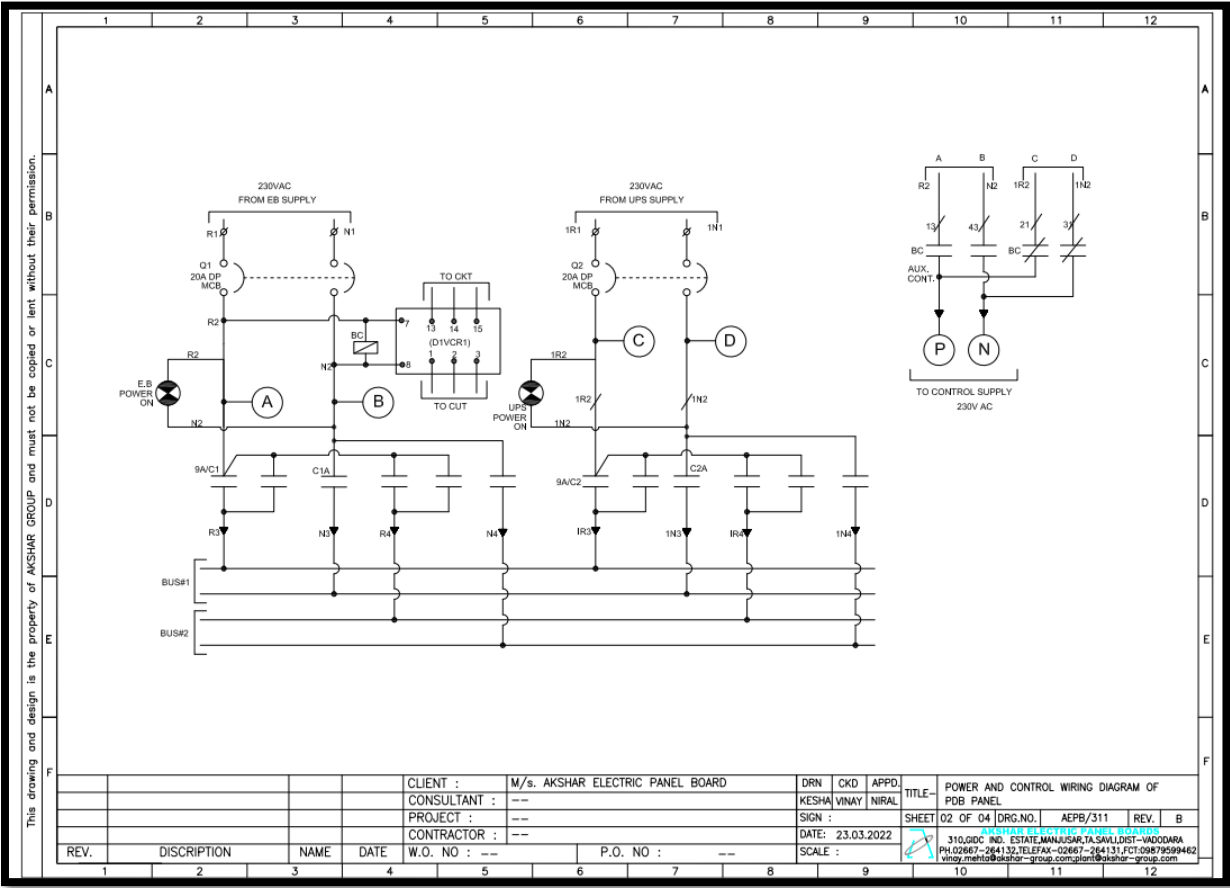
A GA Drawing stands for General Arrangement Drawing; it is used to communicate the important overall relationship between the main elements of the

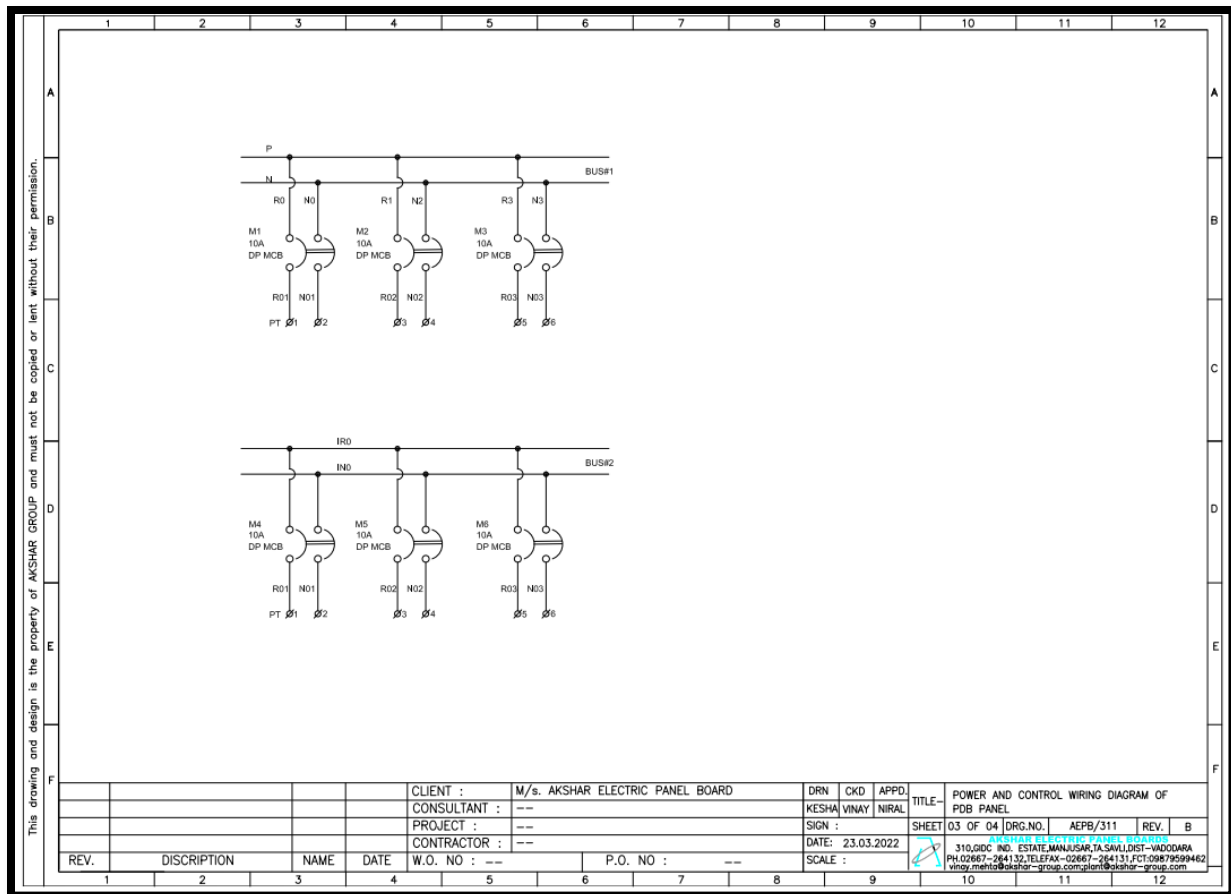
product and key dimensions. This drawing acts as a gateway between the designer and the customer.

here we can see the gauge of metal as per the thickness provided. Incoming and outgoing cable entries along with ingress protection and MOC.

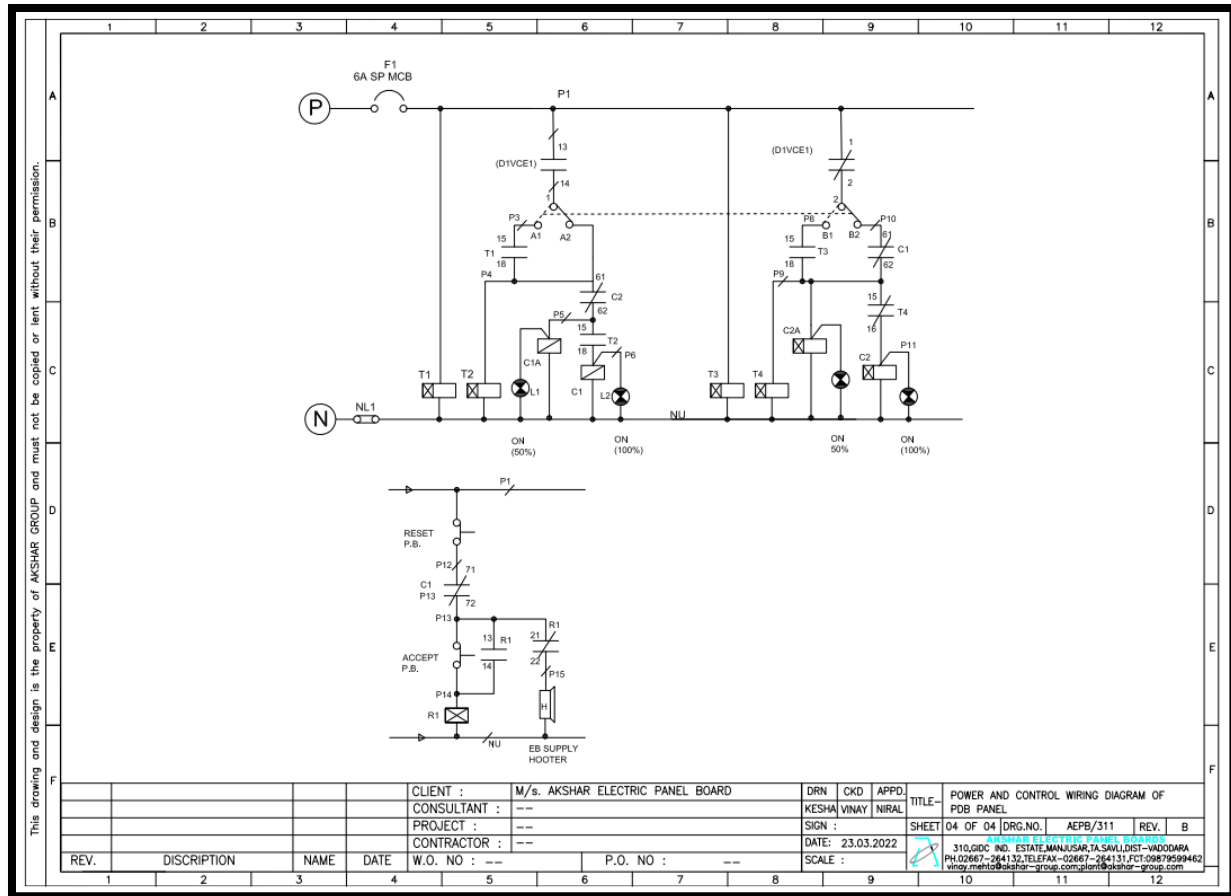
different views of the panel is also available for reference.

POWER AND CONTROL WIRING.





The major purpose of a control wiring is to transfer information or to do the communication in an electrical system. The control wiring can be seen in heating and air condition system, low voltage control systems are used for residential and commercial applications. Line voltage control system is used in large commercial and industrial applications. Special control systems such as electric, pneumatic and electronic control systems are used to control large industrial systems. By using the control wiring we can regulate, or control a device in an electrical system.



We use the power wiring to do the power transfer if we look at the power distribution panel in any industry then we can see the power wiring and control wiring. We can see an incoming bus bar and the power will be connected to MCCB and it is then distributed so all these wiring is power wiring. In the same panel we could see a multifunction meter it is a control wiring.

5.4 INSTALLING LIGHT FIXTURES



Fig 5.15:Installing fixtures

Fig 5.16



**Fig
5.17**

5.5 WORKING and Commissioning of Logic Circuit:

- 1) 230VAC power supply is given as input to the circuit.
- 2) Mains and UPS (solar power) both are feeded on Q1 & Q2 respectively.
here Q1 and Q2 are 20A DP MCB with 10Ka short circuit capacity.
- 3) From same Phase and neutral (Defined as P and N respectively hereby)
control supply is connected.
- 4) BUS COUPLER (BC)
- 5) BC contactor is used for coupling 2 buses (EB AND UPS) respectively.
- 6) Contactors: there are 4 power contactors namely C1, C1A, C2, C2A.
- 7) C1: It is responsible for switching on 100% load by using EB supply.
- 8) C1A: it is responsible for turning off the 50% load (FROM EB SUPPLY)
and changing over of the load from 100% to 50%.
- 9) C2: It is responsible for switching on 100% load by using UPS supply.
- 10) C2A: it is responsible for turning off the 50% load (FROM UPS SUPPLY)
and changing over of the load from 100% to 50%.

- 11) So here, C1 works same as C2 and C1A works the same as C2A. only difference is that C1 series of contactors work on EB SUPPLY while C2 series works on Solar/ UPS POWER AS BACKUP.
- 12)Timers: There are 4 timers in the circuit namely T1, T2, T3, T4. T1 to T3 are programmable range of timers whole T4 is normal time delay timer.
- 13)T1 is responsible for switching on the load for 12 hrs. it triggers contactor C1. similarly, T2 triggers C1A after 3 hrs. after C1A is triggered, it switches off the load by 50%.
- 14)T3 acts as backup timer and it's in ON position all the time.... timer T3 trigger contactor C2 and C2A at same time. it happens as soon as EB power fails and hooter is alarming. Both C2 and C2A are in ON position for 30 mins after the EB is failed.
- 15)Incase, EB power is retained, then system resets automatically to normal clock time and acts accordingly. If EB power is not retained within 30 mins then timer T4 triggers contactor C2 and shuts it down. resulting in immediate switchover to 50% load initiating power saving concept.
- 16)Selector switch- selector switch is used for Swift changeover from auto to manual mode. incase there is a failure in any If the logic or control corcuit components then we can manually operate whole load by one click manual transfer.

CHAPTER 6

CONCLUSION

We as students are very keen to learn and execute this project. Many corporates have also actively supported us on this project by providing components and technical guidance. Our project focuses and appeals on the environmental values by reducing carbon footprints and initiating more ideas and innovations in field of sustainable energy. Our idea was observe the problem and look favourable solution.

REFERNCES

- (1) <https://mnre.gov.in/solar/current-status/>
- (2) <https://ieeexplore.ieee.org/document/1601640>
- (3) <https://www.ibef.org/industry/renewable-energy>
- (4) Moazam Mahmood. "The Three Regularities in Development" , Springer Science and Business Media LLC, 2018
- (5) <http://www.globalscientificjournal.com>
- (6) [Submitted to CSU, San Jose State University](#)