Annasaheb Dange College of Engineering and Technology

Ashta- Maharashtra

Detailed Energy Audit Report

February 2023

Sharad Institute of Technology
College of Engineering
www.sitcoe.ac.in

Energy Audit as per Guidelines of-

BUREAU OF ENERGY EFFICIENCY
Government of India, Ministry of Power

Report on

ENERGY AUDIT

of

Annasaheb Dange College of Engineering and Technology

Ashta, Dist. Sangli, Maharashtra.

Conducted by

Dr. Sanjay A. Khot

BEE Accredited Energy Auditor (AEA-0312)

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Web: www.sitcoe.org.in

February 2023

I. Table of Content

A. List of Tables

B. List of Figures

C. List of Abbreviations

BEE	: Bureau of Energy Efficiency
MEDA	: Maharashtra Energy Development Agency
EB	: Electricity Board
DG	: Diesel Generator
ECM	: Energy Conservation Measures
GCV	: Gross Calorific Value
kWh	: kilo Watt hour
LT	: Low Tension
HT	: High Tension
MSEDCL	: Maharashtra State Electricity Distribution Co. Ltd.
MT	: Metric Ton
MTOE	: Metric Ton Oil Equivalent
kW	: Kilo Watt
TPA	: Tons per Annum
SEC	: Specific Energy Consumption
SPC	: Specific Power Consumption
TPH	: Tons Per Hour
VFD	: Variable Frequency Drive
DOL	: Direct On Line
Yr.	: Year
Kg	: Kilo Gram
W	: Watt
°C	: Celsius

II. Acknowledgement

Energy Audit Team of SITCOE expresses our sincere gratitude to management of Annasaheb Dange College of Engineering and Technology, Ashta, for providing us an opportunity to conduct an Energy Audit of their organization located in Ashta Dist. Sangli. We are grateful to **Hon. R. A. Kanai** Ex. Director, **Dr. V. S. Patil** Director **Prof. S. S. Mohite** Head Civil Engineering Department and other officials for showing keen interest in the study and for the help and co-operation extended to SITCOE Energy Audit Team during study.

We do hope that you will find the recommendations given in this report useful in helping you save energy. While we have made every attempt to adhere to high quality standards, in both data collection and analysis, as well as in presentation through the report, we should welcome any suggestions from your side as to how we can improve further.

In case of any suggestions or queries:

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III. Introduction

Project	Energy Audit
Client	Annasaheb Dange College of Engineering and Technology, Ashta
Segment	Academic Building
Contact	**Dr. V. S. Patil** (Director) **Prof. Santosh Mohite** (Head, Civil Engg. Department)
Site	Annasaheb Dange College of Engineering and Technology, Ashta, Dist. Sangli 416301, Maharashtra, India
Consultant	**Dr. Sanjay Khot (AEA-0312)** BEE Accredited Energy Auditor
Involved from ADCET college	Mr. Prakash Shrirang Kamble Mr. Desai Dilip Kashinath Mr. Siddha Anandrao Babaso Mr. Waghmare Rushikesh Dashrath Mr. Patil Sujit Sanjay
Involved faculty	Dr. M. M. Khade Mr. U. S. Patil Mr. C. S. Patil
Duration	February 2023
Project scope	Conducting energy audit as per Bureau of Energy Efficiency (BEE) New Delhi to establish energy consumption in the buildings of academic campus and estimate scope for energy saving and also to recommend energy efficient appliances in place of energy intensive with payback calculation.
Report	This document gives recommendations, details of survey and the way forward.
Notes	The suggestions/ alternatives in the audit report are based on the inventory, name plate details and usage of equipment systems. It is recommended to obtain vendor quotations before implementation.

IV. Executive Summary

❖ Highlights

Description	Units	Values
Total annual savings	₹	1599402
Total investments	₹	2926674
Payback period	Years	1.83
Annual electricity consumption	kWh	532101
Annual electricity cost/annum	₹	7851083

❖ Impact of Proposed Energy Conservation Measures

Description	Units	Values
Electricity Saving	kWh/annum	108803
	%	20.45
Estimated annual cost reduction	₹/annum	1599402
Simple Payback period	Years	1.83
Reduction in CO_2 emissions	MT/year	89.22

Dr. Sanjay Annaso Khot
BEE Accredited Energy Auditor (AEA-0312)

❖ Summary of Energy Conservation Measures

❖ Table 01: Summary of Energy Conservation Measures

Sr. No.	Energy Conservation Measures	Annual Saving		Investment	Simple payback period	Reduction in CO_2 emissions
		kWh	₹	₹	Years	MT/Year
1	Replace conventional ceiling fan with energy efficient fan (831 Nos.)	58999	867281.18	2400400	2.77	48.38
2	Replace conventional tube with energy efficient tube (630 Nos.)	16838	247513.19	141750.00	0.57	13.81
3	Replace conventional CFL bulb with energy efficient LED bulb (73 Nos.)	418	6147.19	7260.00	1.18	0.34
4	Replacement of old pumps with energy efficient pumps (08 Nos.)	32548	478460	377264	0.79	26.69
Total		**108803**	**1599402**	**2926674**	**1.83**	**89.22**

Table 02: Recommendation for nearly zero energy building

Name of Building	Annual Electriciy Consumption kWh	Daily Electricity Consumption kWh	Unit Charge	Solar PV System Required- kW_p	Annual Electricity Generated by Solar kWh	Monetary Saving ₹	Investment @60000/kw_p ₹	Simple Payback
Engg. College building	537476	1472.54	14.70	100	97500	1433250	6000000	4.19

*Already 110 kWp Solar PV system installed on Aeronautical building

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1. Energy and Utility System Description

Annasaheb Dange College of Engineering and Technology, Ashta, Dist. – Sangli

Major utilities in the campus are

1. General
2. Electrical

1.1 Brief Description of each Facility

This study is being done under the indicative scope of work for conduct of Energy Audit specified by MEDA (Maharashtra Energy Development Agency) & BEE (Bureau of Energy Efficiency). This study is mainly carried out to identify saving areas in Annasaheb Dange College of Engineering and Technology, Ashta with short term, medium term & long term investments, yielding significant savings. The study can be mainly divided into following groups.

2.1.1 General

Energy Audit focuses on study of correlation of electricity consumption on production. Opportunities for load factor improvement, power factor improvements, etc.

b. Electrical

It includes motor load study of 1 HP & above by measuring input parameters (Voltage, Current, P.F., & kW), performance analysis of water pumps having capacities above 1 HP, performance analysis and identification of energy efficiency opportunities in motors, pumps, air compressors, lighting, etc.

1.2 Instrument Used

Following instruments are used for the study:

a. Three phase power analyzer

b. Lux Meter

c. Measuring tape

d. Anemometer

e. Thermal imager

The site study was carried out from 15/02/2023 to 16/02/2023.

1.3 Energy Audit Team

Dr. Sanjay A. Khot

Dr. M. M. Khade

Mr. U. S. Patil

Mr. C. S. Patil

2. Description and Energy Consumption

2.1 About Annasaheb Dange College of Engineering and Technology, Ashta

The Annasaheb Dange College of Engineering and Technology (ADCET), Ashta is one of the iconoic public institutions of higher technical education in Western Maharashtra, distinguished by its compassion to produce engineers with competence for improving the human condition and building the nation. Established in 1999, ADCET, Ashta is an Autonomous institute affiliated to Shivaji University, Kolhapur, Maharashtra and approved by AICTE, New Delhi. The institute is NAAC accredited with "A" grade, ISO 9001:2015 certified and runs programmes accredited by NBA, New Delhi. The community and culture of ADCET, Ashta are enriched by active bright students, dedicated teachers, and commitment to impart quality education in Engineering.

ADCET's campus is spread over 25 acres in the heart of the city of Ashtha, Sangli, where 3000 undergraduate students build their lifelong friendships and connections while enjoying their educational journey. The College is a leader in academic excellence, with a particular focus on outcome based education by setting clear and unambiguous framework for curriculum planning along with clear standards for observable, measurable outcomes. ADCET continuously emphasizing on restructuring of curriculum, assessment and reporting practices in education to reflect the achievement of high order learning and mastery rather than the accumulation of course credits. College is focusing on "Student Centric Learning" by fostering close working relationships between faculty and students.

ADCET, Ashta incline students towards learning through conversation and collaboration, micro, mini and mega projects, community and social justice engagement, internships in industry, original research and experimentation. ADCET maintain relationship with IITs, NITs, and research organizations enlarges the academic opportunities for students and their social community. ADCET have active ties to engineering and allied industries further extend the employment opportunities available at ADCET, Ashta. At ADCET, Ashta, we certainly believe with full confidence that we can prepare the next generation for future.

2.2 Annual Energy Consumption

2.2.1 Electricity

Annasaheb Dange College of Engineering and Technology, Ashta is receiving electricity from MSEDCL. A part of the plant electricity is met by open access. Contract demand with MSEDCL is 200 kVA with a minimum billing demand 65% of contract demand during preceding 11 months.

2.2.2 Marginal Energy Cost

Marginal cost of electricity is calculated based on the energy cost of electricity from EB and DG. This marginal cost is considered for the cost benefit analysis of energy conservation measures.

Table 03: Marginal Energy Cost

Description	Unit	Marginal Cost
Average monthly EB energy consumption	kVAh	60527
Average monthly DG energy consumption	kVAh	2546
Diesel cost	₹/L	93
Average basic cost of energy from EB	₹/ kVAh	9.21
% of Electricity from EB	%	96.37
% of Electricity generated with DG	%	4.21
DG energy generation cost	₹/ kVAh	12.56
Marginal cost of electricity	₹/ kVAh	14.70

3. Energy Scenario

3.1 Electrical Systems

3.1.1 Electrical bill analysis

Annasaheb Dange College of Engineering and Technology, Ashta is getting electricity supply from Maharashtra State Electricity Distribution Co. Ltd. Major portion of the energy consumption is used for academics and hostel.

The observations made during the study are given in the following sections.

The Tariff Structure at the plant

Tariff structure of the facility is given below

- Tariff Code = 146 HT-VIII B
- Supply voltage = 11 kV
- Contracted demand = 200 kVA
- Minimum billing demand = 120 kVA
- Demand charges = ₹ 432 per kVA
- TOD = Opted
- Unit charge = 9.21/kVAh

1. Billing Demand

The billing demand during unrestricted period shall be minimum billing demand 65% contract demand or 75% highest billing demand during preceding 11 months, whichever is higher.

2. Power factor (PF)

It shall be the responsibility of the HT Consumer to determine the capacity of PF correction apparatus and maintain an average PF of not less than 0.90.

3. Time of Day Tariff

As per Maharashtra State Electricity Distribution Company Limited, HT consumers have an option to take Time of Day (TOD) tariff instead of the normal tariff. Under TOD tariff electricity consumption and maximum demand in respect of HT consumers for different periods of the day i.e. normal period, peak load period and off-peak load period could be recorded by installing TOD meter. The maximum demand and consumption recorded in different periods could be billed on the following rates of the tariff applicable.

Table 04: Time of Day Tariff (TOD)

S. No	Description	Energy Charge (₹/kVAh)
1	**Energy Charges**	
(i)	00.00 Hrs.-06.00 Hrs. & 22:00 Hrs-06:00 Hrs.	-1.50
(ii)	06:00 Hrs-09:00 Hrs. & 12:00 Hrs-18:00 Hrs.	0.00
(iii)	09:00 Hrs-12:00 Hrs.	0.80
(iv)	18:00 Hrs-22:00 Hrs.	1.10
2	**Demand Charges**	Normal rate of Demand Charges

The analysis of plant electricity consumption from EB and Open Access is given below. For the electricity consumption analysis, electricity bill for the last fourteen months (Feb-22 to Jan-23) is considered.

Table 05: Electrical Bill Analysis

Month	Contract Demand KVA	Billed Demand KVA	Maximum Demand kVA	Power Factor	Ideal PF	Consumption kWh	Consumption KVAH	Demand Charges	Wheeling Charge	Energy charges	TOD tariff EC	FAC	Electricity Duty	Tax on Sale	Incremental consumption Rebate	Charges for Excess demand	Total Bill
Jan-23	200	172	141	0.990	1	60978	61594	78088	33876.70	551882.24	-7455.50	107789.50	160478.00	11610.21	-2877.75	0.00	933391.40
Dec-22	200	174	174	0.993	1	69525	70015	78996	38508.25	627334.40	-9842.90	122526.25	180079.62	13237.56	-9324.75	0.00	1041514.43
Nov-22	200	172	163	0.993	1	60489	60915	78088	33503.25	545798.40	-8284.30	106601.25	158698.39	11517.11	-2499.75	0.00	923422.35
Oct-22	200	229	229	0.991	1	51505	51973	103966	28585.15	465678.08	-8055.40	90952.75	147183.87	9806.55	0.00	19749.00	857866.00
Sep-22	200	182	182	0.991	1	56737	57195	82628	31457.25	512467.20	-6971.50	100091.25	151131.16	10802.72	0.00	0.00	881606.08
Aug-22	200	171	171	0.992	1	57964	58159	77634	31987.45	521104.64	-9196.70	101778.25	151894.60	10984.94	-389.25	0.00	885797.93
Jul-22	200	187	187	0.991	1	58945	59480	84898	32714.00	532940.80	-7002.00	104090.00	157004.57	11223.13	-1336.50	0.00	914532.00
Jun-22	200	162	162	0.990	1	60035	60641	73548	33352.55	543343.36	-6990.50	106121.75	157368.78	11430.66	-2163.75	0.00	916010.85
May-22	200	159	159	0.986	1	58187	59013	72186	32457.15	528756.48	-10263.70	11802.60	133337.09	11078.80	-766.50	0.00	778587.92
Apr-22	200	198	198	0.987	1	67400	68288	89892	37558.40	611860.48	-9790.90	13657.60	156067.29	12832.96	-7767.00	0.00	904310.83
Mar-22	200	164	164	0.991	1	70152	70789	70848	39641.84	651966.69	-8618.60	14157.80	161279.10	13356.94	-9818.25	0.00	932813.52
Feb-22	200	128	127	0.987	1	47630	48257	55296	27023.92	444446.97	-5569.40	0.00	109451.47	9068.75	0.00	0.00	639717.71
Min	200	128	127	0.986	1	47630	48257	55296	27023.92	444446.97	-10263.7	0	109451.47	9068.75	-9818.25	0	639717.71
Max	200	229	229	0.993	1	70152	70789	103966	39641.84	651966.69	-5569.4	122526.25	180079.62	13356.94	0	19749	1041514.43
Average	200	175	171	0.990	1	59962	60527	78839	33389	544798	-8170	73297	151998	11413	-3079	1646	884131
Total						719547	726319	946068	400665.91	6537579.74	-98041.4	879569	1823973.94	136950.33	-36943.5	19749	10609571.02

Observation:

- Maximum consumption 70789 kVAh in month of March and minimum 48257 kVAh in month of February.
- The average energy consumption is 60257 kVAh..

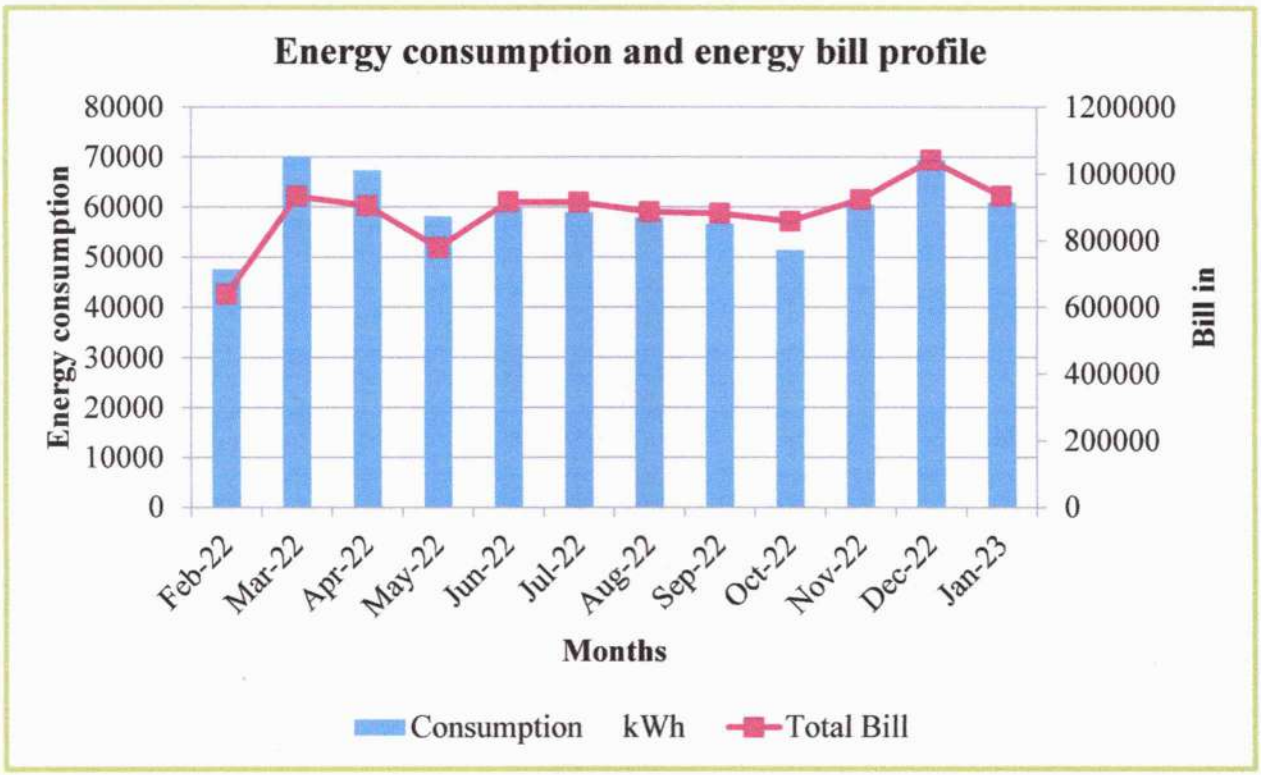


Figure 01: Consumption and Electricity bill profile

Observation:

- Energy consumption varies from 47630 to 70152 kVAh from February 2022 to January 2023.
- The bill as per MERC for last twelve months is ₹ 10609571.

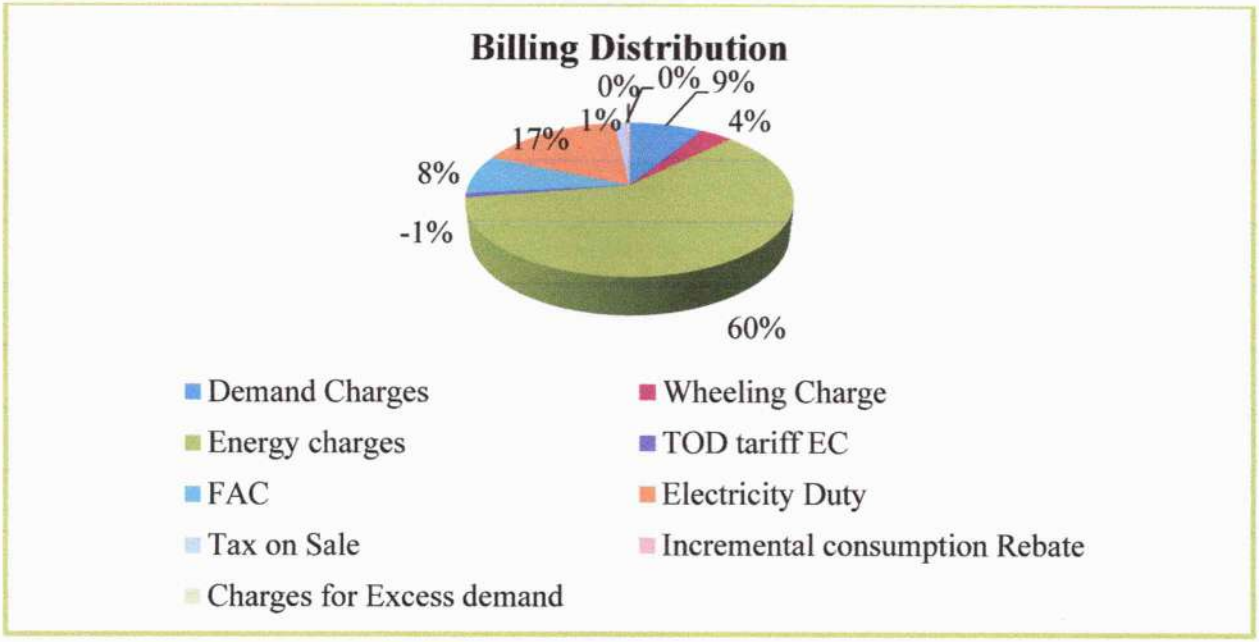


Figure 02: Billing Distribution

Observations

- Energy charges are 60 % of total bill.
- Demand charges are 9 % of total bill.

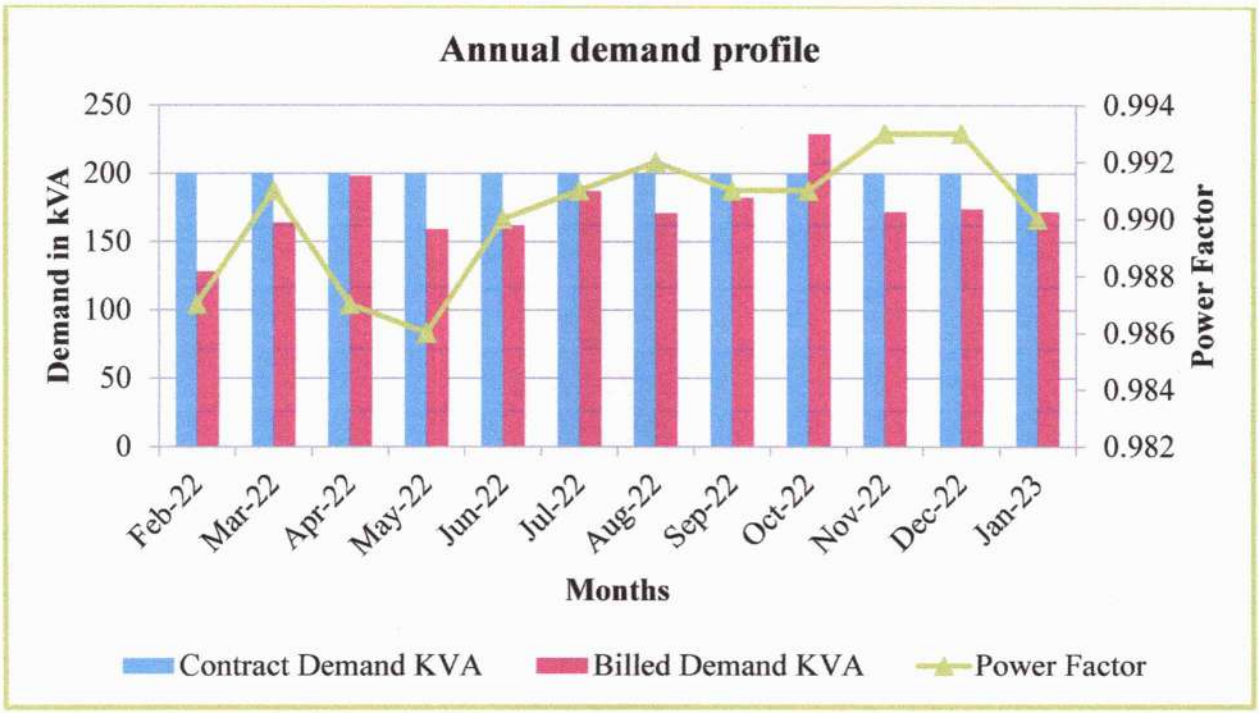


Figure 03: Contract Demand, Recorded Demand and PF Profile

Observation:

- The contract demand is 200 kVA and the minimum billing demand 60% contract demand or highest billing demand during preceding 11 months whichever is higher.
- Max demand recorded for is 229 kVA.
- The average demand recorded for twelve months; from February 2022 to January 2023 is 175 kVA.
- The lowest recorded demand in the month of February 2022 is 128 kVA & highest was 229 kVA in month of October 2022.
- The average energy consumption is 60527 kVAh.

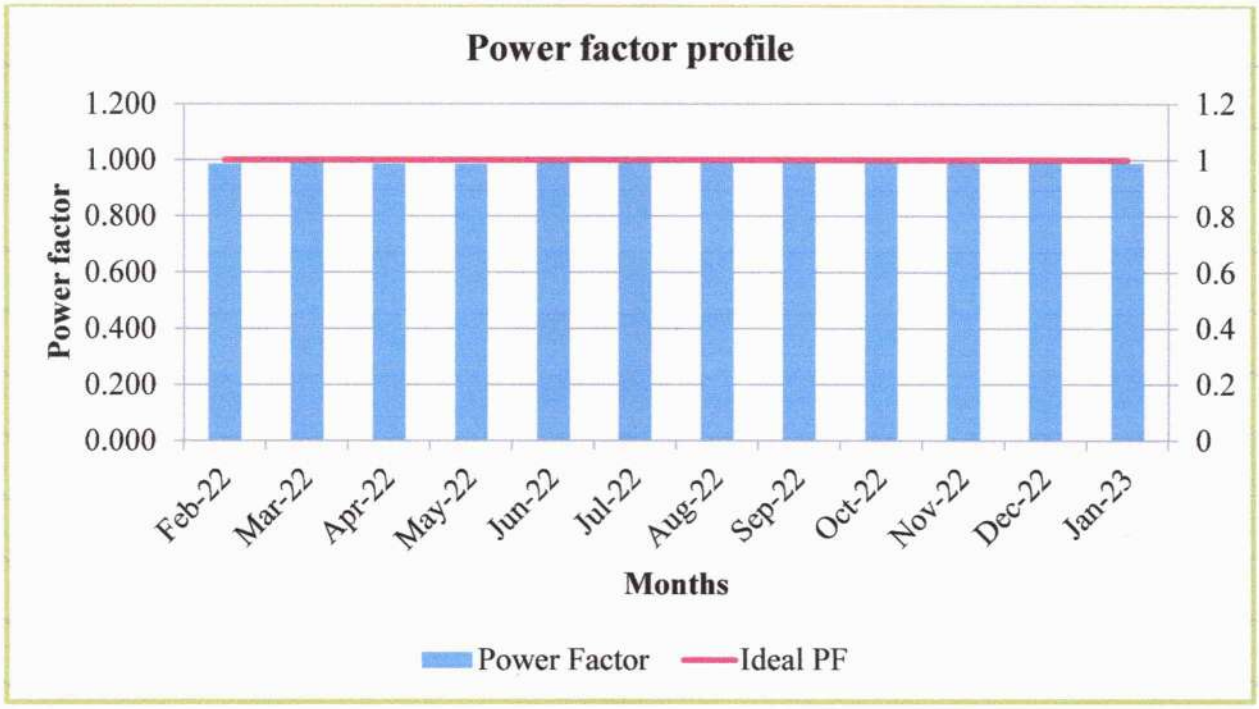


Figure 04: Power Factor Profile

Observation:

- Average power factor was 0.990
- The power factor is maintained.

3.1.2 Annual Energy Consumption Breakup

Table 06: Annual Energy Consumption

Consumption /Name of Building	B Pharmacy	D Pharmacy	ADCET
Consumption (kVAh)	108947.85	79895.09	537476.1

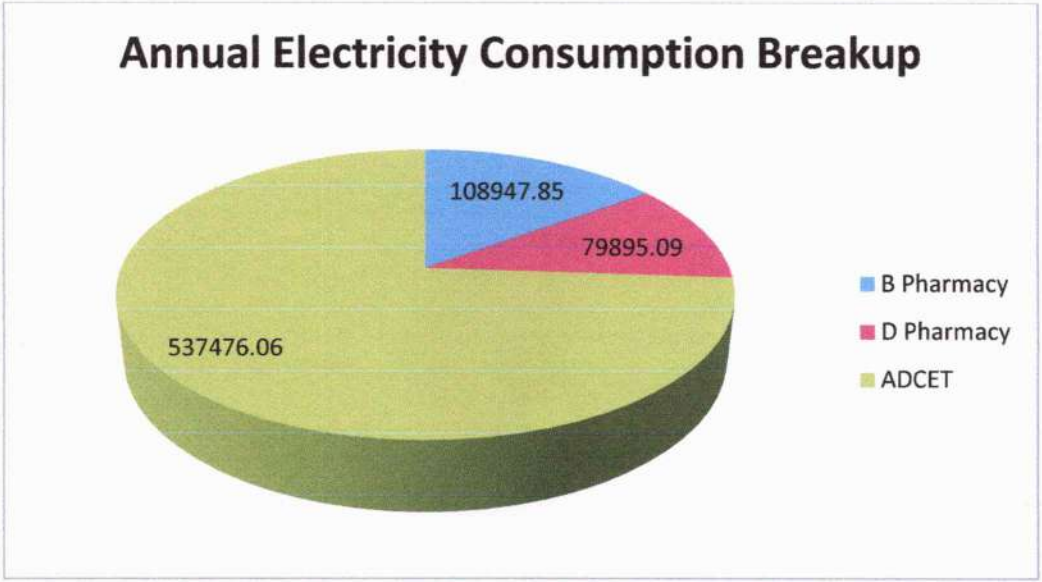


Figure 05: Annual Energy Consumption Breakup

3.1.3 Main power supply

Power profiles of main Power supply are as given below. Performance analysis of main power supply is as shown below.

Table 07: Main power supply Performance Analysis

Description	Units	Mains with solar	Mains without solar	Mains with only solar	Mains Pharmacy Building	Engg. Office and Aeronautical building	Mains Boys hostel, Sports complex	Mains Neutral
Voltage V1	Volts	424.2	423.6	424	421.6	412	416	4.8
Voltage V2	Volts	423.7	423	426.8	424.6	415.1	419.9	
Voltage V3	Volts	421.3	420.6	425.8	423.6	414.3	418.7	
Average Voltage	Volts	423.07	422.40	425.53	423.27	413.80	418.20	
Voltage Unbalance	%	0.3%	0.3%	0.3%	0.3%	0.3%	0.4%	
Current A1	Amps	129.9	228.7	78.6	23.77	48.5	80.2	91.6
Current A2	Amps	122.3	207.1	78.4	10.3	42.11	76.1	
Current A3	Amps	101.7	191.4	77.5	7.73	45.79	67.6	
Average Current	Amps	117.97	209.07	78.17	13.93	45.47	74.63	
Current Unbalance	%	10.12%	9.39%	0.55%	70.60%	6.67%	7.46%	
Power Factor	-	0.316	0.388	0.993	0.943	0.954	0.974	
Power	kW	27.27	59.36	57.32	9.42	31.08	52.67	

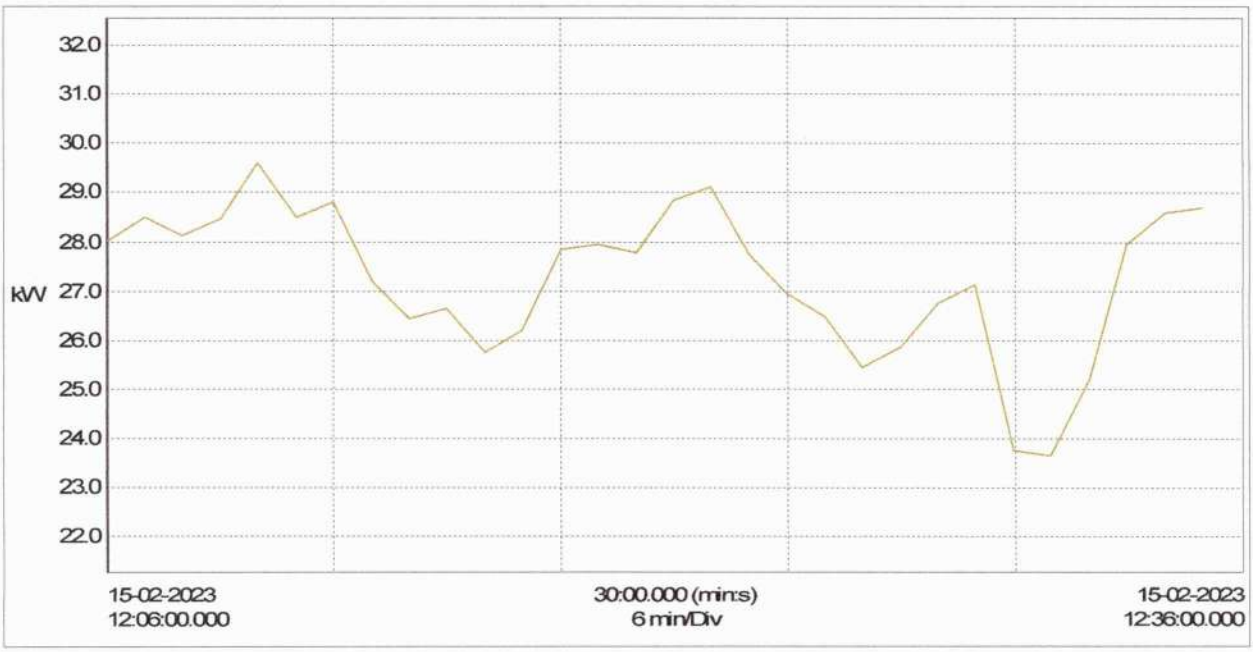


Figure 06: Power Profile of main supply with solar

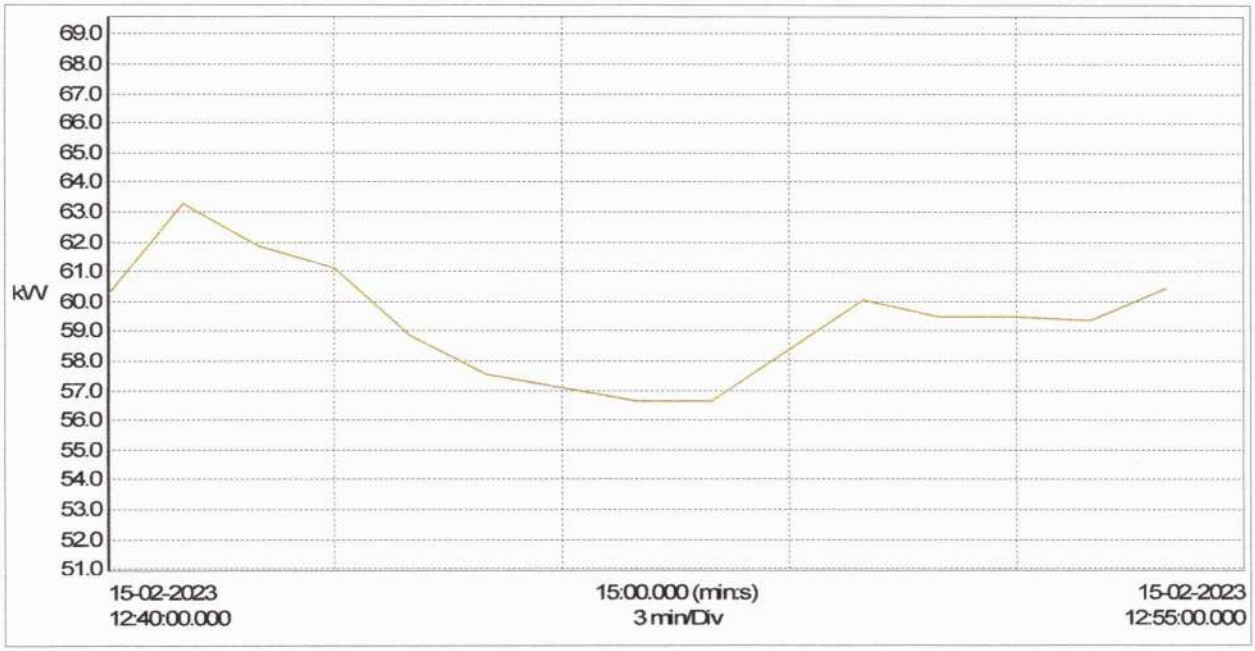


Figure 07: Power Profile of main supply without solar

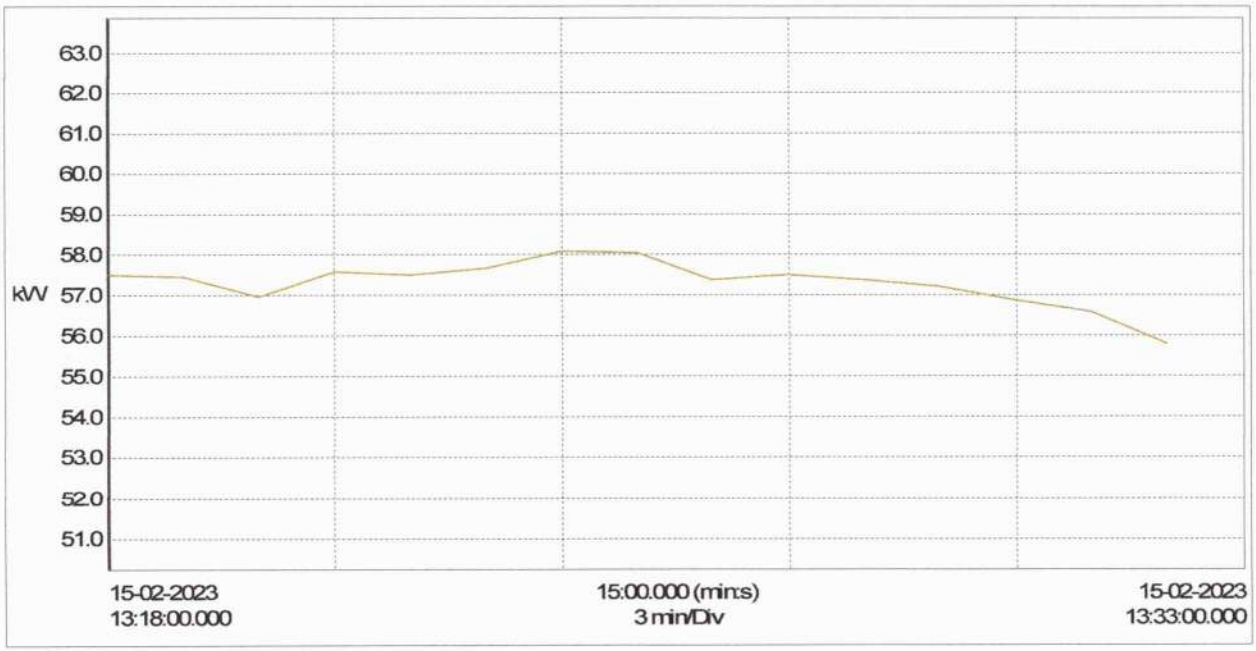


Figure 08: Power Profile of main supply with solar

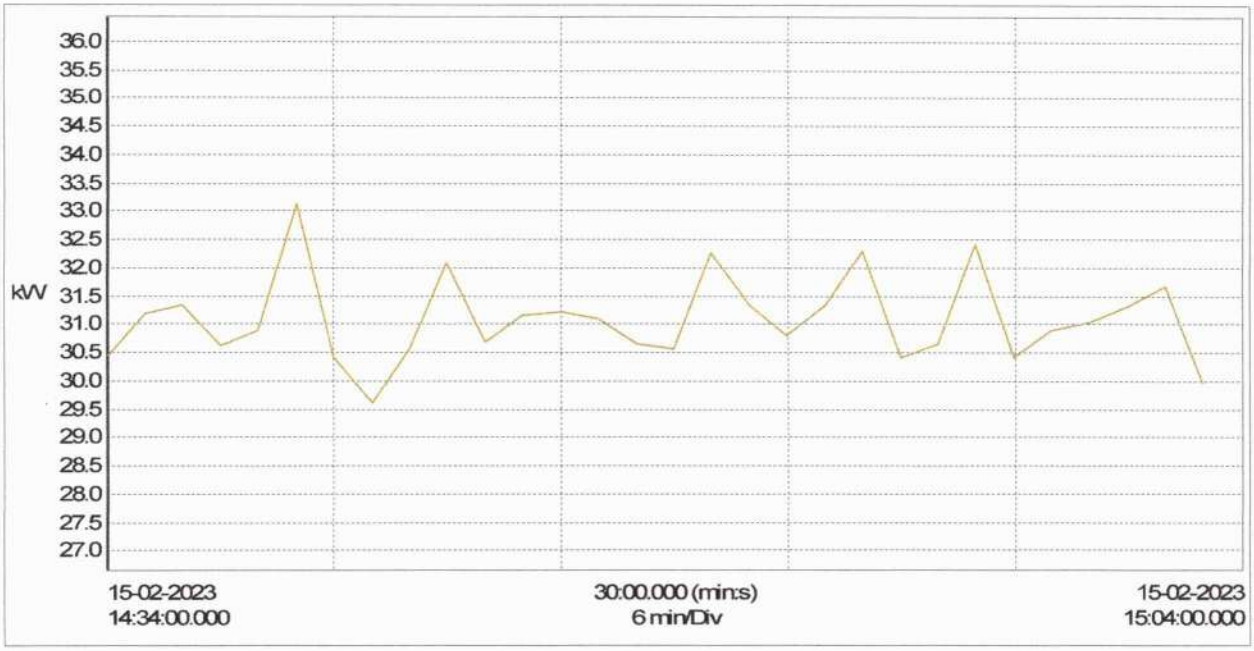


Figure 09: Power Profile of main supply of Engg. Office and Aeronautical Building

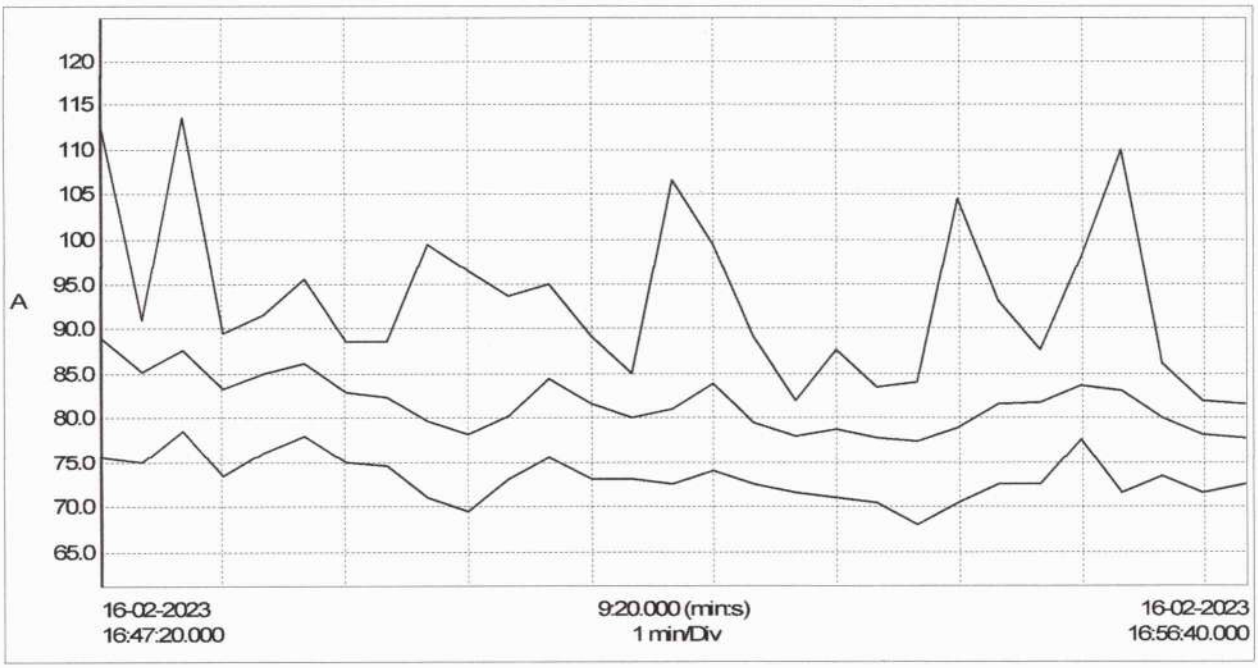


Figure 10: Current Profile of main supply Neutral

In three-phase four-wire electric systems with computers and nonlinear loads and current unbalance show excessive currents in the neutral. These neutral currents are fundamentally third harmonic and their presence is tied to wiring failures, elevating of neutral potentials, transformer overheating, etc. This current can be reduced by using active power filters.

3.1.4 Diesel Generator

In JNV there are 3 DG sets. Following table shows the details of DG set.

Table 08: DG sets details

Sr. No.	Name of DG set	Capacity in kVA	Usage (Lit)/week
1	02	125	272
2	01	63	24
3	01	40	48
Total	**04**	**228**	**344**

3.2 Water Pump

The performance analysis of the pumps used for water required for the institute is done based on the present operating parameters like water flow, head and power. Pumps of different capacities are installed based on the water flow requirement at different sections of the plant. The water supply of the institute is met by river and bore well. There are number of pumps are running mainly in the institute campus.

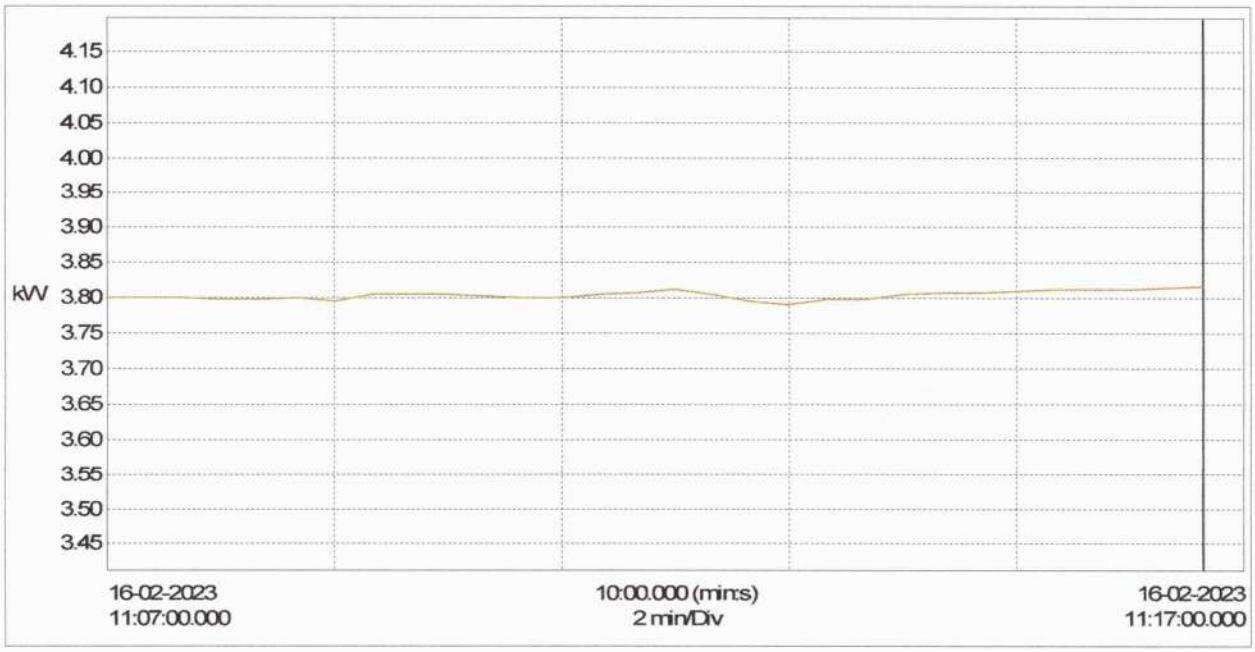


Figure 11: Power Profile of submersible Pump for new ladies hostel

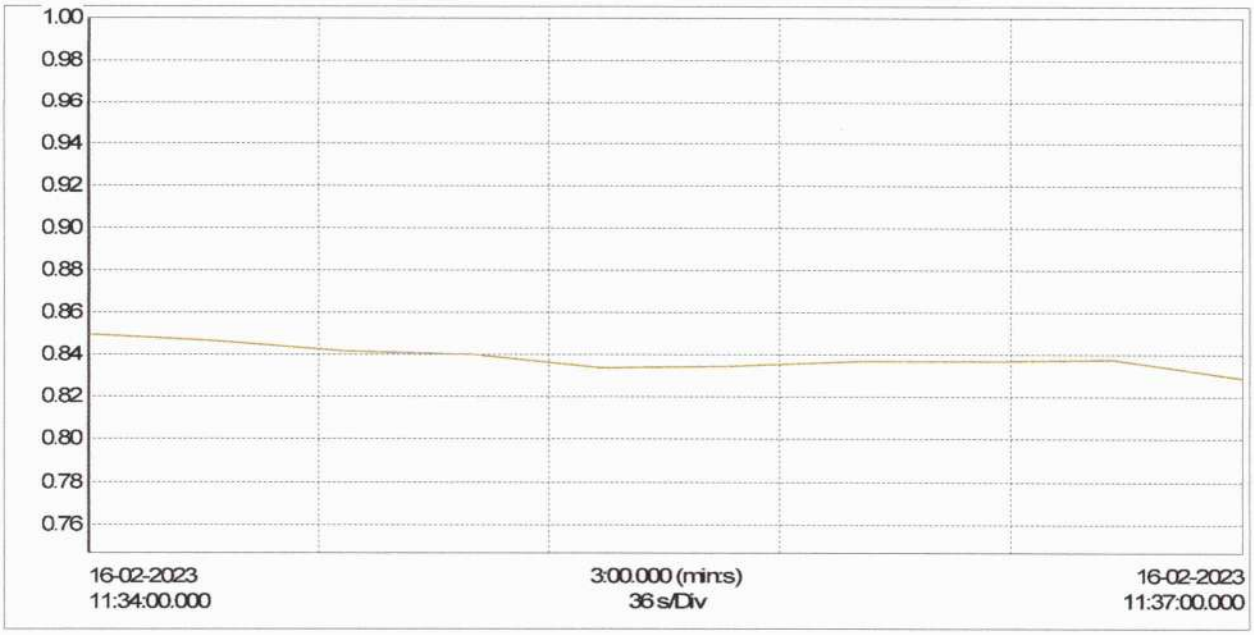


Figure 12: Power Profile submersible Pump for Old ladies hostel

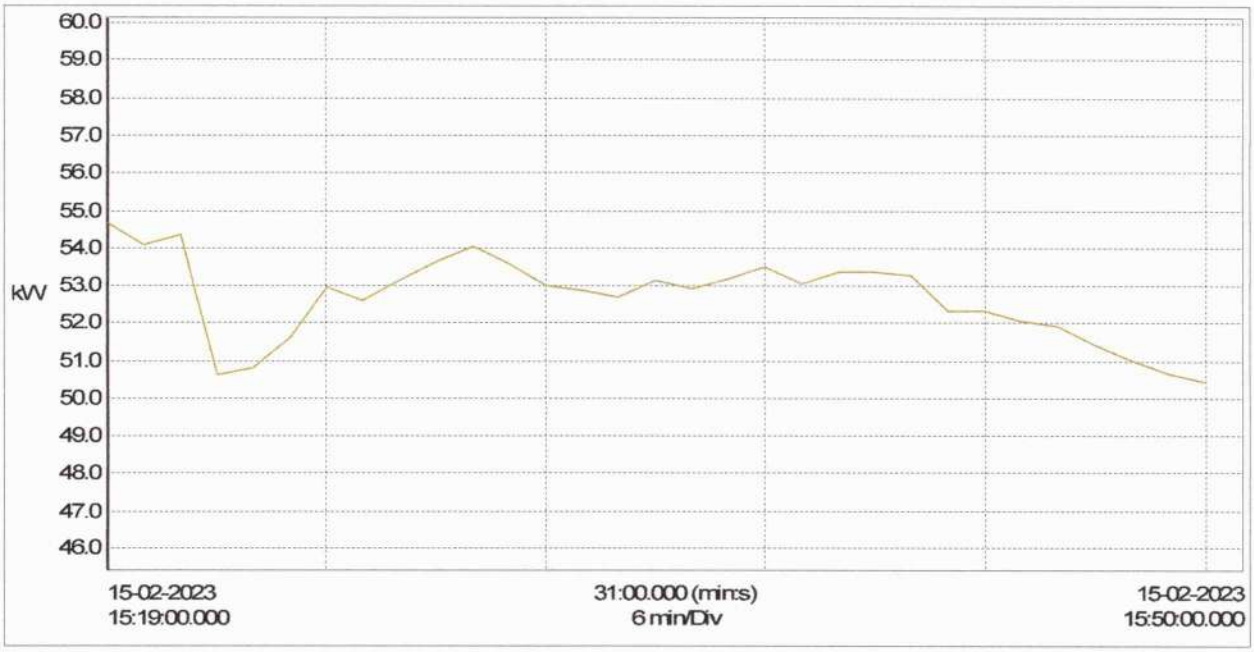


Figure 13: Power Profile of Boys Hostel, sorts complex and library

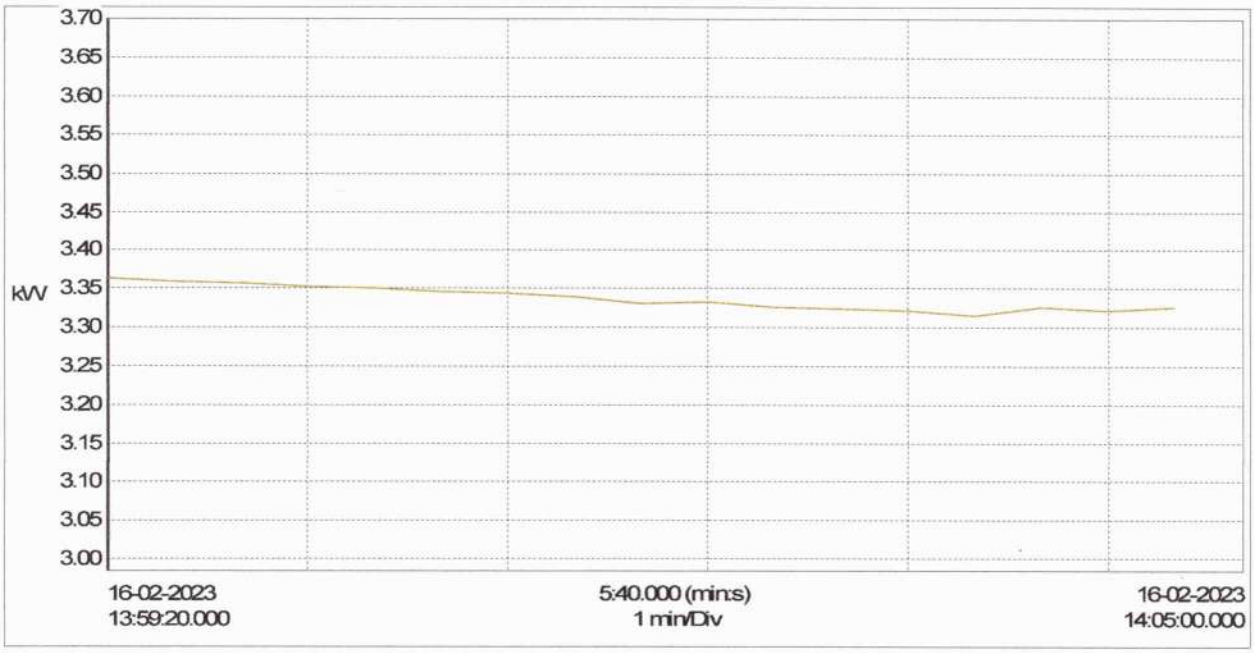


Figure 14: Power Profile of submersible pump for sump tank

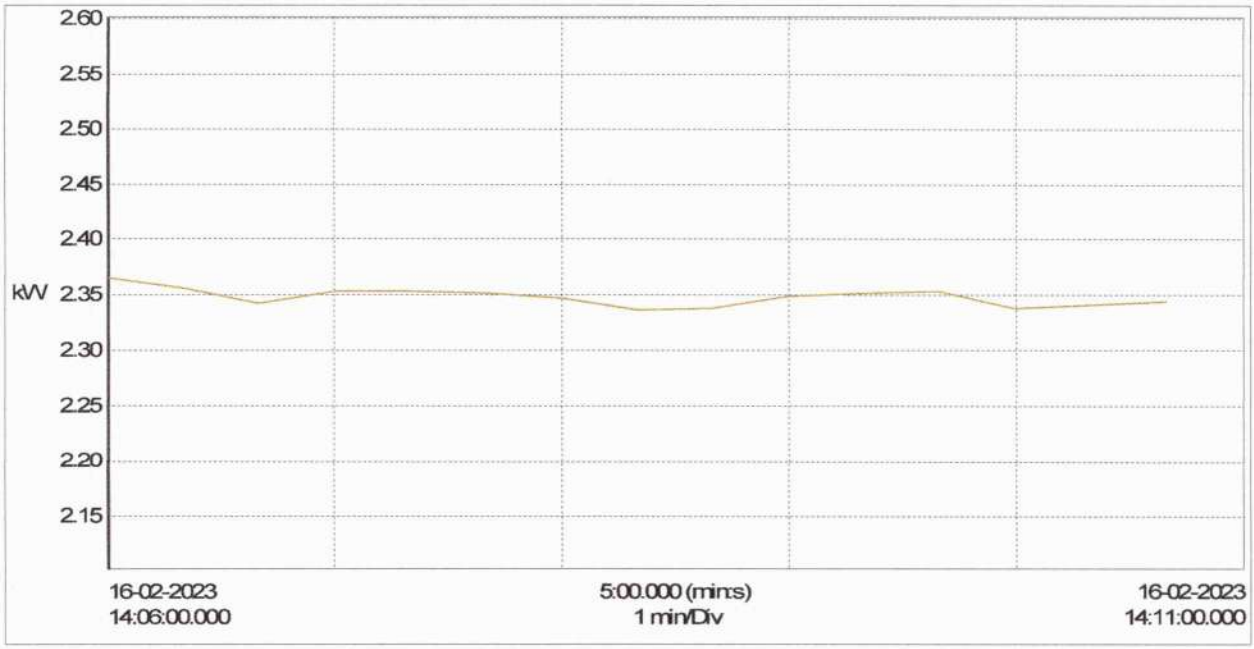


Figure 15: Power Profile of submersible pump of RO plant

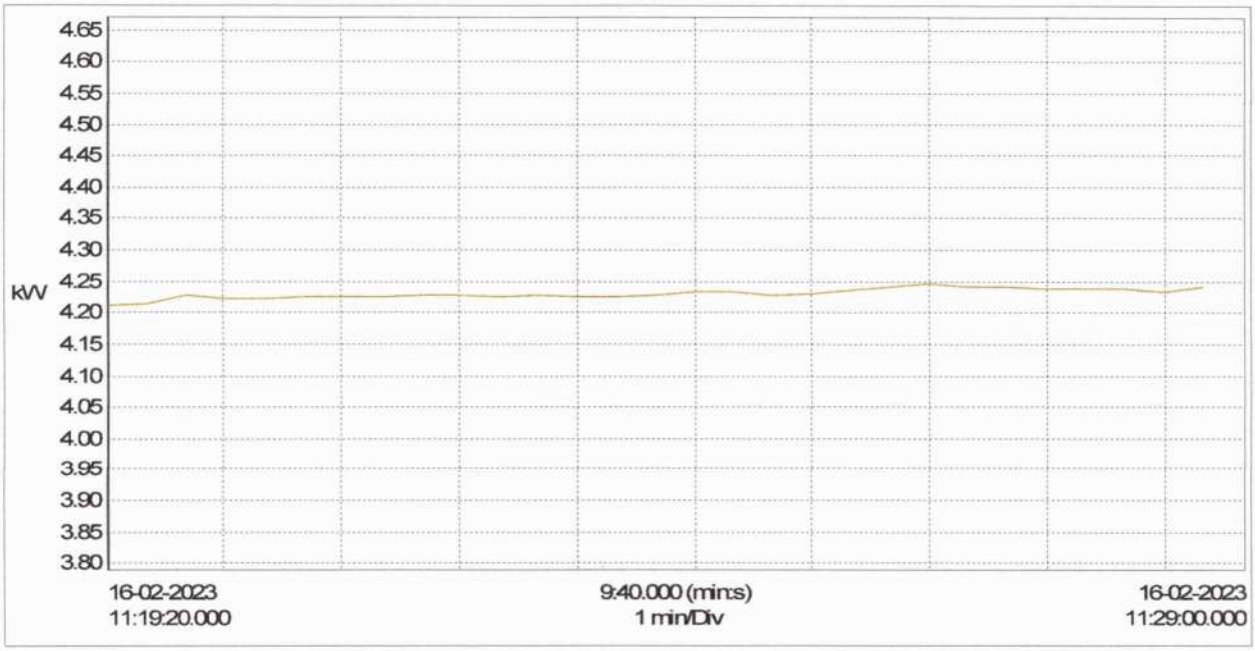


Figure 16: Power Profile of submersible pump of Aeronautical building

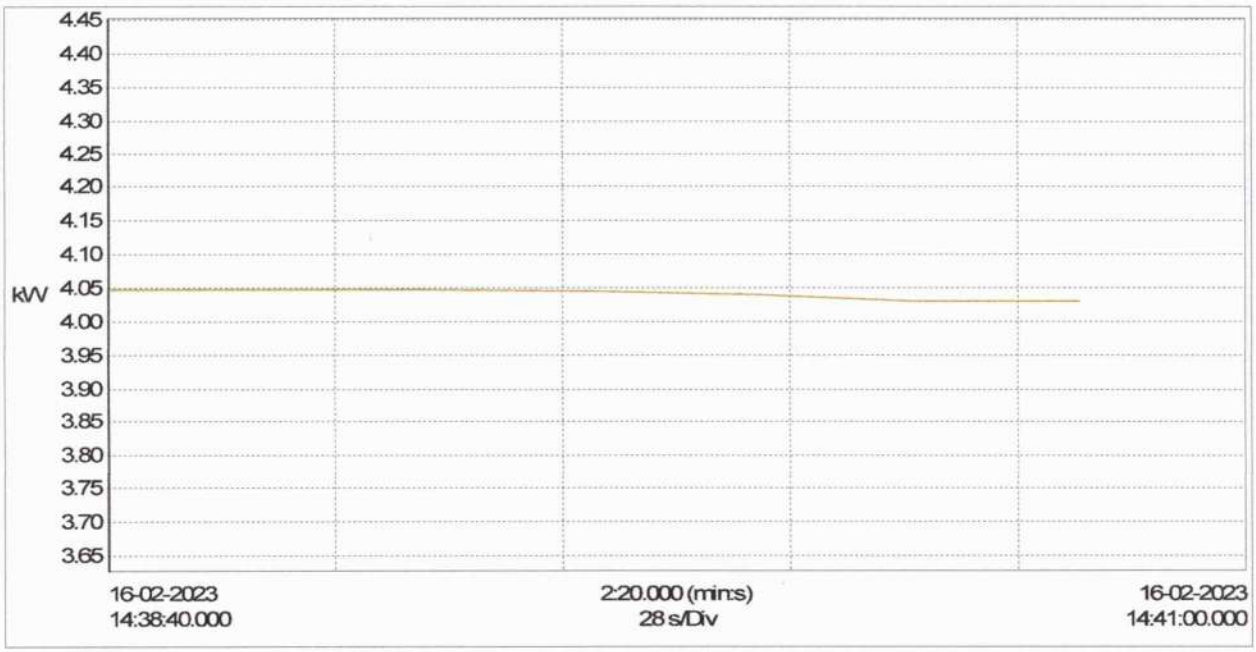


Figure 17: Power Profile of submersible pump of Guest house

The Performance Analysis of the Pumps is given below.

Table 09: Water Pump Performance Analysis

Description	Units	Pump for New ladies hostel	Aeronautical building	Old Ladies hostel	Sainik Shala	Pump for sump	RO plant	Pump for sump	Guest house
Design parameter									
Rated output	HP	5	6	3	4	3	2	5	5
	kW	3.73	4.48	2.24	2.98	2.24	1.49	3.73	3.73
Method of starting		DOL	DOL	DOL	DOL	DOL	DOL	DOL	DOL
Motor Efficiency	%	91.20%	91.20%	91.20%	91.20%	91.20%	91.20%	91.20%	91.20%
Measured parameter									
Voltage V1	Volts	394.4	398	367.8	400.9	393.4	390.9	384.6	392.9
Voltage V2	Volts	397.1	401.1	370.4	404.2	396	393.5	386.9	395.7
Voltage V3	Volts	396.8	400.4	396.3	402.9	396.5	394.4	388	394.6
Average Voltage	Volts	396.10	399.83	378.17	402.67	395.30	392.93	386.50	394.40
Voltage Unbalance	%	0.3%	0.3%	4.8%	0.4%	0.3%	0.4%	0.4%	0.3%
Current A1	Amps	6.81	7.11	6.86	5.45	6.76	5.47	9.95	7.06
Current A2	Amps	6.99	7.17	7.02	5.37	6.76	5.57	10.09	7.2
Current A3	Amps	7.15	7.21	6.89	5.65	6.42	5.24	9.41	6.49
Average Current	Amps	6.98	7.16	6.92	5.49	6.65	5.43	9.82	6.92
Power Factor	-	0.797	0.852	0.839	0.747	0.732	0.635	0.879	0.853
Power	kW	3.804	4.23	3.814	2.865	3.338	2.349	5.788	4.041
Loading	%	93%	86%	155%	88%	136%	144%	142%	99%

Observations:

- The pumps which are used are more than 5 years old.
- The motor input power is varying from 2.349 kW to 4.041 kW.
- Maximum efficiency of pump is usually near 75% of rated load.

The replacement options for the pumps with poor operating performance is given in the ECM section of the report.

3.3 Air Conditioning

Split AC are used for smart class room, computer lab & principal cabin. The list of AC is as follows.

Table 10: AC Details with Location

Sr. No.	Name	AC 1.5 ton	AC 2 ton	AC 20 Ton
1	Civil Building Seminar Hall	4		
2	Exe. Director Cabin	2		
3	Board Room	4		
4	Director Room 1	2		
5	Cabin	1		
6	Central Computing facility Lab-III	1		
7	Second Floor Meeting Room	2		
8	Office	4		
9	Chairman Office	2		
10	Guest room	1		
11	Guest Room 2	1		
12	Guest House (Blue Star) Inverter AC		03	
13	Guest House (Blue Star) central AC			01
	Total	**24**	**03**	**01**

Observation:

- All AC are three star labelled.
- Guest house AC are inverter type.

3.4 Lighting System

Lighting is provided in commercial buildings, indoor and outdoor for providing comfortable working environment. The primary objective is to provide the required lighting effect for the lowest installed load i.e. highest lighting at lowest power consumption. There are number of buildings in Campus. The details of inventories are shown in the table.

Table 11: Building Inventory

Name of Department	LED Panel (36W)	Spot Light (12W)	Hymus Tube Light (72W)	LED Tube (10 W)	LED Tube (20 W)	Tube (28 W)	Tube (40 W)	Fan	Wall fan	Exhaust Fan	CFL (12 W)	LED bulb (5W)	LED bulb (8W)	LED bulb (9W)	LED bulb (10W)	LED bulb (12W)	LED bulb (15W)	LED bulb (18W)	LED bulb (50W)	Pedestal Fan	Projector	Computer	Refrigerator	UPS	Cooler	Printer	Xerox Machine	Scanner	AC	Freezer	Sound System (250W)	LED Screen	Incandescent Bulb	Paper cutter (2 HP)
Civil Building Ground floor Surveying lab					6			6														2											
Basic Civil lab					6			6																									
Mechanics Lab					6			6																									
Geology Lab					6			6																									
Computer Lab					6			6														20				3							
Department Office								4								19	6																
Pantry										1				2								1				1							
Toilets										1				2																			
Corridor													29				10								2								
Class room (3 Nos.)					18			18													3												
Seminar Hall	30																				1	1							4				
Gents Toilet													2																				
Ladies Toilet													2																				
Department Library					4			3																									

Name of Department	LED Panel (36W)	Spot Light (12W)	Hymus Tube Light (72W)	LED Tube (10 W)	LED Tube (20 W)	Tube (28 W)	Tube (40 W)	Fan	Wall fan	Exhaust Fan	CFL (12 W)	LED bulb (5W)	LED bulb (8W)	LED bulb (9W)	LED bulb (10W)	LED bulb (12W)	LED bulb (15W)	LED bulb (18W)	LED bulb (50W)	Pedestal Fan	Projector	Computer	Refrigerator	UPS	Cooler	Printer	Xerox Machine	Scanner	AC	Freezer	Sound System (250W)	LED Screen	Incandescent Bulb	Paper cutter (2 HP)
Basement Corridor					5	6	1																		1									
Concrete Technology					6			4																										
Material testing lab					8			5																										
Geotechnical lab					15			7																	1									
Fluid Mechanics Lab						12		6																										
Environmental Lab					10			9																										
Material Lab						6		4																										
Plumbing Lab						4		4																										
Ladies Toilet						2																												
Gents Toilet						2																												
High voltage lab					10			6																										
Transport engg. Lab						6		4																										
First floor Corridor							1									6	20				2													
operating system lab						6		3														24												
Project lab					1	5		6														23				1								
Machine learning						6		6														22				1								
Data Base Engg.						6		6														24												
Department Office						6		6														2				2								
Programming lab						6		8														22				2								
Advanced computing lab						6		6														23												
Class room (3 Nos.)						18		18													3													

Name of Department	LED Panel (36W)	Spot Light (12W)	Hymus Tube Light (72W)	LED Tube (10 W)	LED Tube (20 W)	Tube (28 W)	Tube (40 W)	Fan	Wall fan	Exhaust Fan	CFL (12 W)	LED bulb (5W)	LED bulb (8W)	LED bulb (9W)	LED bulb (10W)	LED bulb (12W)	LED bulb (15W)	LED bulb (18W)	LED bulb (50W)	Pedestal Fan	Projector	Computer	Refrigerator	UPS	Cooler	Printer	Xerox Machine	Scanner	AC	Freezer	Sound System (250W)	LED Screen	Incandescent Bulb	Paper cutter (2 HP)
Gents Toilet													2																					
Ladies Toilet													2																					
Tutorial room (02 Nos.)						8		8																										
Second floor Corridor						1	1									6	20								1									
Class room (8 Nos.)						48		48													8													
Drawing hall						22		22													1													
Department Office								3								7						3				3								
Project lab						2		2																										
Gents Toilet						2																												
Ladies Toilet						2																												
Second floor Corridor							1									6	20																	
Chemistry Lab 1						14		13		3																								
Physics lab 1						6		6														1				1								
Dark room 1						2		2																										
Physics lab 2						8		8																										
Dark room 2						2		2														1												
Faculty room						5		4														1												
Tutorial room 1								10								20					1													
Language lab						3		2													1													
Class room no. 6						6		6																										
Language lab 2						13		13														38												

Name of Department	LED Panel (36W)	Spot Light (12W)	Hymus Tube Light (72W)	LED Tube (10 W)	LED Tube (20 W)	Tube (28 W)	Tube (40 W)	Fan	Wall fan	Exhaust Fan	CFL (12 W)	LED bulb (5W)	LED bulb (8W)	LED bulb (9W)	LED bulb (10W)	LED bulb (12W)	LED bulb (15W)	LED bulb (18W)	LED bulb (50W)	Pedestal Fan	Projector	Computer	Refrigerator	UPS	Cooler	Printer	Xerox Machine	Scanner	AC	Freezer	Sound System (250W)	LED Screen	Incandescent Bulb	Paper cutter (2 HP)
Computer Lab						6		6													1	20												
Ladies Toilet																	2								1									
Gents Toilet																	2								1									
Aeronautical building Controller of Exam					3			3														3					1							
Strong room					6			4														1					2							
IT cell & data center					6			4														6					1							
Coding & Decoding center					6			4														2				1								1
Storage area					6			4																										
Gents Toilet						2																												
Ladies Toilet						2																												
Corridor																	30								1									
Assessment Room (03 Nos.)					18			12																										
Examination Control Room					6			4														1												
AIDS Dept. Office					8			4													1	2												
Class room					6			4																										
Seminar Hall					30			20																										
Gents Toilet						2																												
Ladies Toilet						2																												
Food Technology Corridor																	30																	
Dept. Office automobile					7			4																										
Automotive vehicle maintenance					6			4																										

Name of Department	LED Panel (36W)	Spot Light (12W)	Hymus Tube Light (72W)	LED Tube (10 W)	LED Tube (20 W)	Tube (28 W)	Tube (40 W)	Fan	Wall fan	Exhaust Fan	CFL (12 W)	LED bulb (5W)	LED bulb (8W)	LED bulb (9W)	LED bulb (10W)	LED bulb (12W)	LED bulb (15W)	LED bulb (18W)	LED bulb (50W)	Pedestal Fan	Projector	Computer	Refrigerator	UPS	Cooler	Printer	Xerox Machine	Scanner	AC	Freezer	Sound System (250W)	LED Screen	Incandescent Bulb	Paper cutter (2 HP)
Dept. office food technology					6			4														2	2			1							
Food Engg. II Lab					8			4																									
Dept. Library					8			4																									
Tutorial Room					8			4																									
Class room (03 Nos.)					18			12													3												
Gents Toilet						2																											
Ladies Toilet						2																											
Corridor																	30							1									
Food Microbiology lab					7			2																									
Food biochemistry lab					6			4																									
Seminar Hall									6								35																
Class room (02 Nos.)					13			8														2				2							
Food Engg. Lab					6			4																									
CAD CAM					6			4																									
Thermal Engg. Lab					6			4														20											
Stationary					6			4																									
Unit operation Lab					5			4																									
Food Analysis lab					6			4														1											
Bakery Product unit					15			10																									
Aeronautical Engg. HoD Office					6			4														3				1							
Tutorial Room					3			2																									

Name of Department	LED Panel (36W)	Spot Light (12W)	Hymus Tube Light (72W)	LED Tube (10 W)	LED Tube (20 W)	Tube (28 W)	Tube (40 W)	Fan	Wall fan	Exhaust Fan	CFL (12 W)	LED bulb (5W)	LED bulb (8W)	LED bulb (9W)	LED bulb (10W)	LED bulb (12W)	LED bulb (15W)	LED bulb (18W)	LED bulb (50W)	Pedestal Fan	Projector	Computer	Refrigerator	UPS	Cooler	Printer	Xerox Machine	Scanner	AC	Freezer	Sound System (250W)	LED Screen	Incandescent Bulb	Paper cutter (2 HP)
Dept. Library					3			2																										
Project Lab					6			4														1												
Class room					6			4																										
Seminar hall					12			8													1													
Gents Toilet					4																													
Ladies Toilet					4																													
Corridor																	30								2									
Structural Dynamics Lab					12			8																										
CAD Lab					6			4														16		1										
Computational Aerodynamics Lab					6			4														15												
Class room 1, 2, 3, 5 (04 nos.)							24	16													4													
Aerodynamics Lab							6	4														1												
Flight Dynamic Lab							6	4																										
Class room 4							6	4																										
Dept. stationary							6	4																										
Thermodynamics Lab							6	4																										
Agriculture Engg. Staff room					6			3														1				1								
Gents Toilet					7																													
Ladies Toilet					6																													
Electrical Store					2			1																										
Store room					2			1																										

Name of Department	LED Panel (36W)	Spot Light (12W)	Hymus Tube Light (72W)	LED Tube (10 W)	LED Tube (20 W)	Tube (28 W)	Tube (40 W)	Fan	Wall fan	Exhaust Fan	CFL (12 W)	LED bulb (5W)	LED bulb (8W)	LED bulb (9W)	LED bulb (10W)	LED bulb (12W)	LED bulb (15W)	LED bulb (18W)	LED bulb (50W)	Pedestal Fan	Projector	Computer	Refrigerator	UPS	Cooler	Printer	Xerox Machine	Scanner	AC	Freezer	Sound System (250W)	LED Screen	Incandescent Bulb	Paper cutter (2 HP)
Noise & vibration Lab					6			4																									
Project lab					6			4																									
Gents Toilet					4																												
Ladies Toilet					4																												
Corridor																	42								2								
M.Q.C. Lab					6			4																		1							
Class room 1 to 10 (10 Nos.)					60			40																									
TPC HoD office								1									8					1											
TPC								1									15					1				1							
Principal Office					14			2														2											
Seminar Hall					12			8													1												
Office					2			2														2				1							
Aerospace propulsion lab					18			10														1											
Fluid Mechanics Lab					12			8														1											
Vehicle Performance lab					15			10																									
Store room					4																												
Workshop					12			9									8																
Central Library First floor				9	11	30		27	2													42		2							1		
Second floor						40		36																									
Third floor						41		40													3	118		2		1							
Ground Floor						65				1												2		2									

Name of Department	LED Panel (36W)	Spot Light (12W)	Hymus Tube Light (72W)	LED Tube (10 W)	LED Tube (20 W)	Tube (28 W)	Tube (40 W)	Fan	Wall fan	Exhaust Fan	CFL (12 W)	LED bulb (5W)	LED bulb (8W)	LED bulb (9W)	LED bulb (10W)	LED bulb (12W)	LED bulb (15W)	LED bulb (18W)	LED bulb (50W)	Pedestal Fan	Projector	Computer	Refrigerator	UPS	Cooler	Printer	Xerox Machine	Scanner	AC	Freezer	Sound System (250W)	LED Screen	Incandescent Bulb	Paper cutter (2 HP)
Staircase					4																												
Workshop							32		11 (180 W)	2																							
Engg. Building Administrative Wing																																	
Ladies Toilet														3																			
Gents Toilet					1					1																							
Handicapped Toilet					1																												
Central Store							4	2														1				1							
Pantry					2		2	2						1																			
Administrative Cell Cabin 1								1								8																	
Cabin 2								1								8						1				2							
Cabin 3								1								8						2				1							
Porch								2								10																	
Exe. Director Cabin										13						2						1				1	1		2				
Board Room										10											1			1					4				
Director Room 1					2		1	1	1		9	3										1				1			2				
NSS Cabin							2	2			5																						
Engg. Main office UPS Room														1										1								1	
Cabin 1						2		1		1	7											1				1	1		1				
Cabin 2						2					5			3																			
Cabin 3						2		1			8											1											

Name of Department	LED Panel (36W)	Spot Light (12W)	Hymus Tube Light (72W)	LED Tube (10 W)	LED Tube (20 W)	Tube (28 W)	Tube (40 W)	Fan	Wall fan	Exhaust Fan	CFL (12 W)	LED bulb (5W)	LED bulb (8W)	LED bulb (9W)	LED bulb (10W)	LED bulb (12W)	LED bulb (15W)	LED bulb (18W)	LED bulb (50W)	Pedestal Fan	Projector	Computer	Refrigerator	UPS	Cooler	Printer	Xerox Machine	Scanner	AC	Freezer	Sound System (250W)	LED Screen	Incandescent Bulb	Paper cutter (2 HP)
Office Lobby					3	1		11			18							16				9				7		1						
Record room					2			1																										
Cashier Room					1			1	1							1																		
Entry steps						1										5			1															
Xerox center								1														1				2	2							
Counseling Cell					1		2	1														1				1								
Central Computing facility Lab-II					1		6	6														54				1								
Lab-I								4														50												
Lab-III					1		1	4			1											24				2			1					
CAD CAM Lab							5	4														26				1								
Mechatronics Lab							4	5						4								2												
Ladies Common Room					1		2	2						1																				
ISO cell								1			9											2				1								
TOM Lab					1		7	6														1				1								
HoD Mechanical Cabin					2		2				1											3				3								
Class room I, II, III (03 Nos.)					3		9	15																										
Automobile Engg. Lab							5	5														2				1								
IHP Lab							4	2													1													
Gents Toilet							2																											
Staff room							4	4														3				1								
Metallurgy Lab							4	3														1												

Name of Department	LED Panel (36W)	Spot Light (12W)	Hymus Tube Light (72W)	LED Tube (10 W)	LED Tube (20 W)	Tube (28 W)	Tube (40 W)	Fan	Wall fan	Exhaust Fan	CFL (12 W)	LED bulb (5W)	LED bulb (8W)	LED bulb (9W)	LED bulb (10W)	LED bulb (12W)	LED bulb (15W)	LED bulb (18W)	LED bulb (50W)	Pedestal Fan	Projector	Computer	Refrigerator	UPS	Cooler	Printer	Xerox Machine	Scanner	AC	Freezer	Sound System (250W)	LED Screen	Incandescent Bulb	Paper cutter (2 HP)
Cabin I & II							4	4														2				2								
Fluid Mechanics Lab							9	3																										
FTM Lab					1		7	3																										
Heat & Mass Transfer Lab							10	5														2				1								
APTH Lab							9	4														1												
Dept. Library							3	2														1												
Electrical Engg. Class Room					3		5		3													1												
Machine Lab					4			4	1													1												
Power electronic Lab					1		7		4													4												
Dept. Store								3																										
Corridor								1																										
Old CSE Dept. Room 1								4	3																									
Old CSE Dept. Room 2								4	5																									
Old CSE Dept. Room 3					1		2	5													1													
Ladies Toilet							2																											
Cabin					2		3	4														1												
Room 4							3	5																										
Lab-I							13	14																										
Lab-II							13	13		2																								
Corridor					1		4																											
Ground Floor Office Corridor						54					45							1																

Name of Department	LED Panel (36W)	Spot Light (12W)	Hymus Tube Light (72W)	LED Tube (10 W)	LED Tube (20 W)	Tube (28 W)	Tube (40 W)	Fan	Wall fan	Exhaust Fan	CFL (12 W)	LED bulb (5W)	LED bulb (8W)	LED bulb (9W)	LED bulb (10W)	LED bulb (12W)	LED bulb (15W)	LED bulb (18W)	LED bulb (50W)	Pedestal Fan	Projector	Computer	Refrigerator	UPS	Cooler	Printer	Xerox Machine	Scanner	AC	Freezer	Sound System (250W)	LED Screen	Incandescent Bulb	Paper cutter (2 HP)
First Floor Data Structure							6	5														23				1							
Ladies Toilet							2																										
Java Lab							8	11														21											
Project lab							7	5														20											
Cabin-I							2	2																									
Cabin-II							7	9																									
Corridor							4																										
Hod Cabin CSE								6				24																					
Old HoD Cabin CSE							3	4				1										2				1							
Class room 1, 2, 3 (3 Nos.)							9	15													3												
Computer Lab							4	4														1				1							
Old CSE Dept. Library							4	4																									
Operating System Lab							3	3														20											
Drona Lab 1					3		2	5														1											
Drona Lab 2					3		2	3														8											
Museum					11																												
Electrical Engg. Dept. Tutorial Room							3	4														1											
Computer Lab					2		3	4														21											
Old Cotrols System Lab					1		2	5														1											
Class room II							4	5													1												
Class room III							4	5													1												

Name of Department	LED Panel (36W)	Spot Light (12W)	Hymus Tube Light (72W)	LED Tube (10 W)	LED Tube (20 W)	Tube (28 W)	Tube (40 W)	Fan	Wall fan	Exhaust Fan	CFL (12 W)	LED bulb (5W)	LED bulb (8W)	LED bulb (9W)	LED bulb (10W)	LED bulb (12W)	LED bulb (15W)	LED bulb (18W)	LED bulb (50W)	Pedestal Fan	Projector	Computer	Refrigerator	UPS	Cooler	Printer	Xerox Machine	Scanner	AC	Freezer	Sound System (250W)	LED Screen	Incandescent Bulb	Paper cutter (2 HP)
Class room-I					1		4	5													1												
HoD cabin Electrical							4	4														2				2							
Measurement & Instr. Lab							9	7														3				1							
Gents Toilet					1																												
Faculty cabin					1		6	7														8				2							
Power System Lab					2		3	4																									
Cabin 1, 2, 3, 4							4	3																									
Class room					1		6	4													1	1				1							
Research & Project Lab					1		6	7														11											
Basic Electrical Lab A					1		3	6														2											
Basic Electrical Lab B					1		2	2																									
Corridor					4		15																										
Second Floor Meeting Room							2	1			8	8								1									2				
Office									5			35				28				1							1		4				
waitng room								2								6																	
Chairman Office					1			3								8	8			1									2			1		
Guets room									1							6													1				1	
Storage					1		1	1																									
Guest Room 2							4	1			5	1																	1				
Corridor												18		15				12															
Second Floor Group Discussion Hall							2	4																									

Name of Department	LED Panel (36W)	Spot Light (12W)	Hymus Tube Light (72W)	LED Tube (10 W)	LED Tube (20 W)	Tube (28 W)	Tube (40 W)	Fan	Wall fan	Exhaust Fan	CFL (12 W)	LED bulb (5W)	LED bulb (8W)	LED bulb (9W)	LED bulb (10W)	LED bulb (12W)	LED bulb (15W)	LED bulb (18W)	LED bulb (50W)	Pedestal Fan	Projector	Computer	Refrigerator	UPS	Cooler	Printer	Xerox Machine	Scanner	AC	Freezer	Sound System (250W)	LED Screen	Incandescent Bulb	Paper cutter (2 HP)
Auditorium Hall					6		16	17											2															
Classroom 1,2,3,4 (04 Nos.)							20	26													1													
Store room							4	4																										
Stairs							12																											
Computer Lab-II							4	4														21												
Computer Lab-III							4	4														21												
Faculty cabins (old)							5	5																										
Computer lab 4					2		1	4														11												
Room							3	4																										
Multimedia and database Engg. Lab							5	4														1												
Corridor							6																											
Dept.Library							5	5														1												
Toilets							2																											
Class room IV							3	5																										
Class room V, VI							6	10													1													
Tutorial room							5	5																										
Guest House First Floor Meeting Hall												16				9															1			
Waiting Room								2				5				8													2					
Gallery															2																			
Kitchen								1				2				5																		
Toilet				1								8																						

Name of Department	LED Panel (36W)	Spot Light (12W)	Hymus Tube Light (72W)	LED Tube (10 W)	LED Tube (20 W)	Tube (28 W)	Tube (40 W)	Fan	Wall fan	Exhaust Fan	CFL (12 W)	LED bulb (5W)	LED bulb (8W)	LED bulb (9W)	LED bulb (10W)	LED bulb (12W)	LED bulb (15W)	LED bulb (18W)	LED bulb (50W)	Pedestal Fan	Projector	Computer	Refrigerator	UPS	Cooler	Printer	Xerox Machine	Scanner	AC	Freezer	Sound System (250W)	LED Screen	Incandescent Bulb	Paper cutter (2 HP)
Corridor				1								20			2	4																		
Second Floor Porch & corridor								2				27				4													1					
Room (04 Nos.)								4				20				16																		
Toilet				4								16																			4			
Gallery															4																			
Third Floor Corridor				1								9			2																			
Room (03 Nos.)				3				3				24			6	12																		
VIP room								2				5			1	8																1		
Gallery															4																			
Fourth Floor Corridor				1											2																			
Porch												9																						
VIP room				1				2				8				8																		
Gallery															2																			
Room (03 Nos.)				3				3				24			6	12																		
Terrace															3			1											2					
Entrance												5			10	2																		
Canteen swad aswad							17	8		1													2							2				
Generator room					2			2	1																								1	
Sports Complex Sports Hall Badminton		10	30							10																								
Table Tennis								1									52																	
Gymnasium	24																													2				

Name of Department	LED Panel (36W)	Spot Light (12W)	Hymus Tube Light (72W)	LED Tube (10 W)	LED Tube (20 W)	Tube (28 W)	Tube (40 W)	Fan	Wall fan	Exhaust Fan	CFL (12 W)	LED bulb (5W)	LED bulb (8W)	LED bulb (9W)	LED bulb (10W)	LED bulb (12W)	LED bulb (15W)	LED bulb (18W)	LED bulb (50W)	Pedestal Fan	Projector	Computer	Refrigerator	UPS	Cooler	Printer	Xerox Machine	Scanner	AC	Freezer	Sound System (250W)	LED Screen	Incandescent Bulb	Paper cutter (2 HP)
Wash room																	10																	
Viewing Gallery Sports Hall								6									18																	
Music& Yoga	24																4														1			
Staircase					8												30					1												
Office					3												3					1												
Old Boys Hostel					99			66																	3									
New Boys Hostel					186			78						78											3									
Old Mess					5			3		2													1											
New Mess						20		10		1													1		1									
Old Girls Hostel					179	15		85						88											3									
New Girls Hostel					224			112				224					66																	
Corridor																	24								5									
Mess					20			6																	1									
Total	**78**	**10**	**30**	**24**	**1424**	**532**	**518**	**1573**	**33**	**49**	**121**	**512**	**37**	**198**	**44**	**242**	**523**	**30**	**3**	**3**	**46**	**878**	**6**	**9**	**29**	**64**	**9**	**1**	**29**	**2**	**3**	**8**	**3**	**1**
Solar Panel light (15 W) 25 Nos.																																		
High mast lamp (150 x 8) 08 Nos.																																		
Workshop Lathe Machine 42 Nos. , Drill Machine 02 Nos. , Welding Machines 02 Nos.																																		

3.5 Purpose of the Performance Test

Most interior lighting requirements are for meeting average luminance on a horizontal plane, either throughout the interior, or in specific areas within the interior combined with general lighting of lower value. The purpose of performance test is to calculate the installed efficacy in terms of lux/watt/m² (existing or design) for general lighting installation. The calculated value can be compared with the norms for specific types of interior installations for assessing improvement options. The installed load efficacy of an existing (or design) lighting installation can be as follows

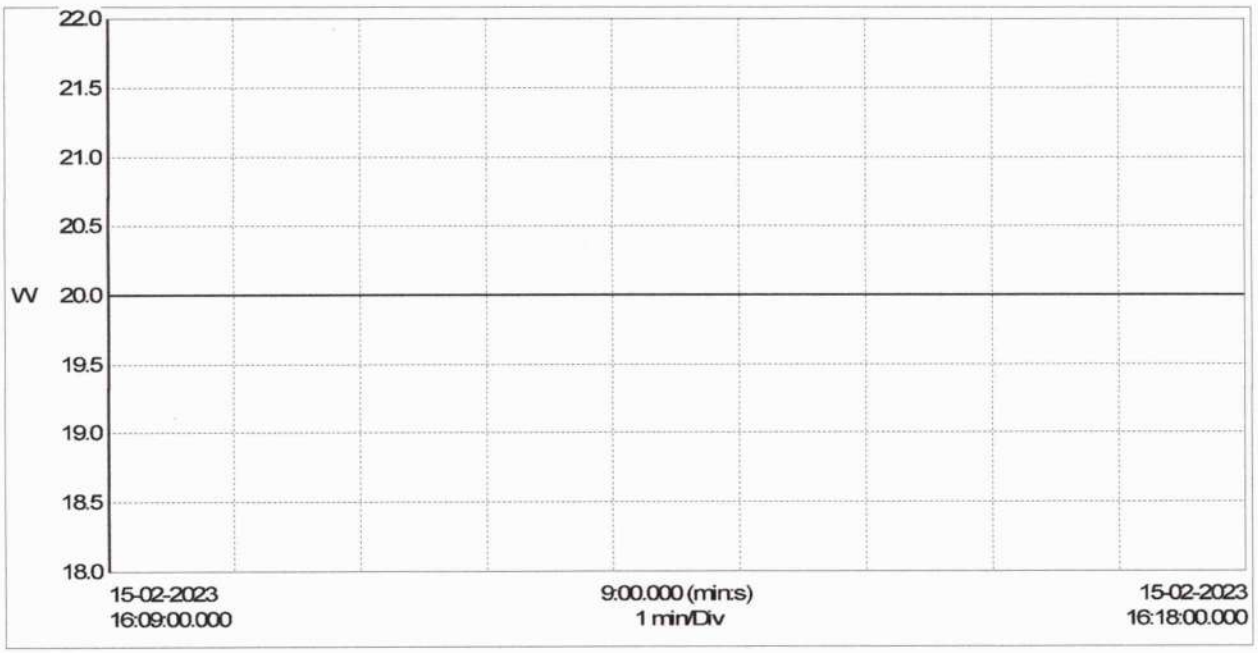


Figure 18: Power profile of LED tube light

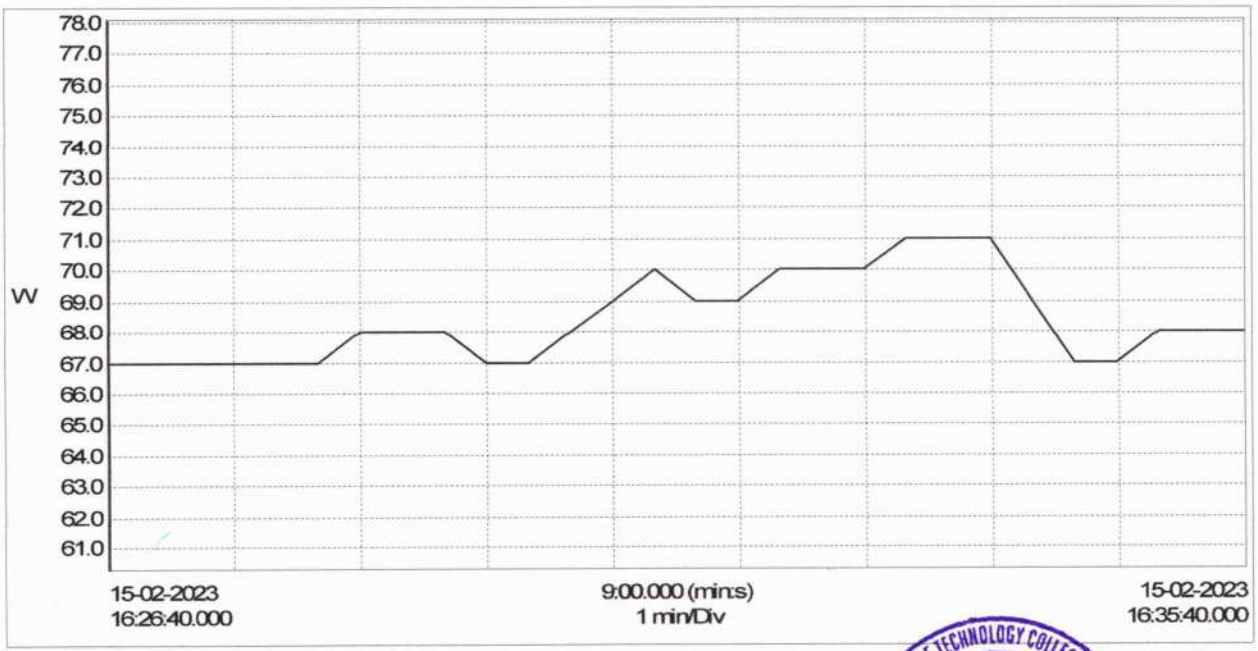


Figure 19: Power profile of fan (Luminous)

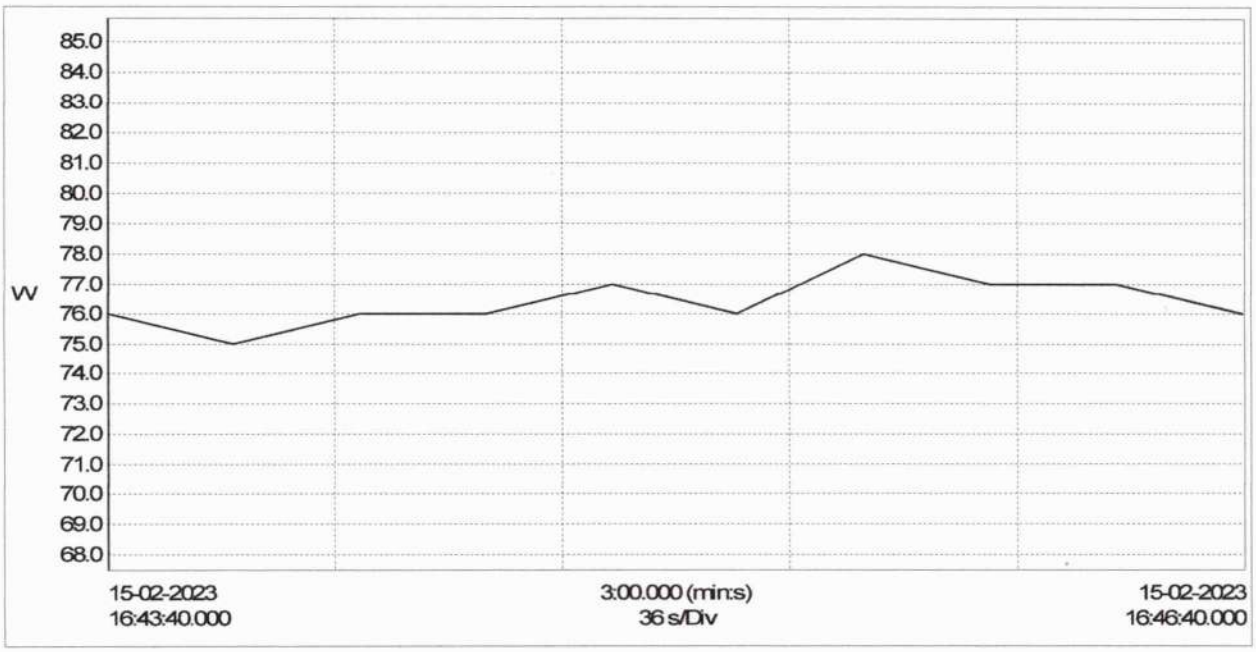


Figure 20: Power profile of fan (Crompton)

3.6 Calculation of Installed Load Efficiency Ratio

Table 12: Calculation of ILER

Existing System

Title	Units	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
Name of Lab		Transport Engg. Lab	Plumbing Lab	Geotechnical Engg. Lab	Language Lab 2	Tutorial room no. 1	Chemistry Lab 1 & 2	Drawing Hall 2	Class room 4	Operating s/m lab	machine learning lab	Class room 3	Tutorial room	Geology lab	Engg. Mechanics lab	Project Lab
Length of interior	Meter	9.2	8.5	15	15	15	21.1	24.01	9.1	9	9	9	8.7	9	9	9
Width of interior	Meter	8.5	6	8.5	8.5	10.4	8.5	10.5	9	9	8.5	8.7	5.9	8.5	8.5	8.8
Mounting height	Meter	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Floor area of interior	Meter²	78.20	51.00	127.50	127.50	156.00	179.35	252.11	81.90	81.00	76.50	78.30	51.33	76.50	76.50	79.20
Room Index	No	1.77	1.41	2.17	2.17	2.46	2.42	2.92	1.81	1.80	1.75	1.77	1.41	1.75	1.75	1.78
No of light fittings	No	6	4	15	13	12	14	22	6	6	6	6	4	6	6	2
Total circuit watts	Watt	168	112	300	364	240	28	616	168	168	168	168	112	120	120	56
Watts per square meter	W/m²	2.1	2.2	2.4	2.9	1.5	0.2	2.4	2.1	2.1	2.2	2.1	2.2	1.6	1.6	0.7
Average maintained luminance	Lux	71.50	71.44	85.55	198.00	109.20	114.88	115.17	86.30	99.89	75.23	105.93	179.70	86.56	84.45	224.56
Actual lux per watt per meter square	Lux/W/m²	33.28	32.53	36.36	69.35	70.98	735.82	47.14	42.07	48.16	34.26	49.37	82.36	55.18	53.84	317.59
Target lux/W/m² lux for type of the type of interior	Lux/W/m²	44.62	41.92	46.68	46.7	47.84	47.68	49.68	44.86	44.8	44.5	44.62	41.9	44.5	44.5	224.556
Installed load efficiency ratio	ILER	0.75	0.78	0.78	1.49	1.48	15.43	0.95	0.94	1.08	0.77	1.11	1.97	1.24	1.21	1.41

- ILER ratio is satisfactory above 0.75 value.
- ILER ratio varies from 0.75 to 15.43

4. Energy Conservation Measures

4.1 Replacing the Conventional fan with energy efficient fan

Findings:

The conventional fan consumes average 65 W energy.

Recommendations:

Replace the conventional fan with energy efficient fan which consume less energy.

Benefits:

The cost benefit analysis of replacing energy efficient fan is given below.

Table 13: Cost benefit analysis of replacing the energy efficient fan

Description	Units	Value	Value	Value	Value
Present system					
Type of fan	-	**Ceiling fan**	**Wall fan**	**Pedestal fan**	**Exhaust fan**
Number of existing fan	Nos	1573	33	3	49
Wattage /fan	Watt	65	65	65	65
Usage of fan per day	Hrs	8	8	8	8
Working days per annum	Days	240	240	240	240
Annual Energy consumption	kWh	196310	4118	374	6115
Proposed system					
Recommended for replacement	%	50%	50%	100%	50%
Recommended of EE fan	Nos	787	17	3	25
Wattage of EE fan	Watt	28	28	28	28
Annual Energy consumption	kWh	42282	887	161	1317
Annual Power saving	kWh	55873	1172	213	1740
Energy tariff	₹	14.7	14.7	14.7	14.7
Monitory saving	₹	821332.51	17230.75	3132.86	25585.06
Investment/fan	₹	2800	5440	5440	3760
Total investment	₹	2202200	89760	16320	92120
Simple Payback period	Years	2.68	5.21	5.21	3.60
Reduction in CO_2 emissions	MT/year	45.82	0.96	0.17	1.43

4.2 Replacing the Old Tube with LED tube

Findings:

Current existing tube light consumes 40 W which is replaced by LED tube.

Recommendations:

Replace the current tube light with LED tube which consumes less energy.

Benefits:

The cost benefit analysis of replacing current tube light with LED tube is given below.

Table 14: Cost benefit analysis of replacing the current tube light with LED tube

Description	Units	Value	Value
Present system			
Type of tube	-	28 W	40 W
Number of existing tube lights(T12/T8)	Nos	532	518
wattage /tube	Watt	28	40
Total wattage	Watt	14896	20720
Daily usage	Hrs/day	8	8
Annual working days	days/yr	240	240
Annual Energy consumption	kWh	28600	39782
Proposed system			
Recommended for replacement	%	60%	60%
Recommended of LED tube light	Nos	319	311
Wattage of LED tube light	Watt	20	20
Annual Energy consumption	kWh	12257	11935
Annual Power saving	kWh	4903	11935
Energy tariff	₹	14.7	14.7
Monitory saving	₹	72072.81	175440.38
Investment/LED tube light	₹	225	225
Total investment	₹	71820.00	69930.00
Simple Payback period	Years	1.00	0.40
Reduction in CO_2 emissions	MT/year	4.02	9.79

4.3 Replacing the old bulb with LED bulb

Findings:

Current existing old CFL bulb consumes maximum 12 W which is replaced by LED bulb.

Recommendations:

Replace the current old bulb with LED bulb which consumes less energy.

Benefits:

The cost benefit analysis of replacing current old bulb with LED bulb is given below.

Table 15: Cost benefit analysis of replacing the current old bulb with LED bulb

Description	Units	Value
Present system		
Number of existing CFL/Incandescent bulb	Nos	121
wattage /Bulb	Watt	12
Total wattage	Watt	1452
Daily usage	Hrs/day	8
Annual working days	days/yr	240
Annual Energy consumption	kWh	2788
Proposed system		
Recommended for replacement	%	60%
Recommended of LED bulb	Nos	73
Wattage of LED bulb	Watt	9
Annual Energy consumption	kWh	1255
Annual Power saving	kWh	418
Energy tariff	₹	14.7
Monitory saving	₹	6147.19
Investment/LED bulb	₹	100
Total investment	₹	7260
Simple Payback period	Years	1.18
Reduction in CO_2 emissions	MT/year	0.34

4. 4 Water Pumping System

Findings:

The submersible pump is use to supply the water for institute are more than 5 years old & power consumption of the pump is more than rated.

Recommendations:

Replace the existing pump with Energy Efficient water pump.

Benefits:

The cost benefit analysis is given below

Table 16: Cost benefit analysis of replacing EE water pump

Description	Unit	Pump for New ladies hostel	Aeronautical building	Old Ladies hostel	Sainik Shala	Pump for sump	RO plant	Pump for sump	Guest House
Present System									
Make	-	Texmo	Texmo	Texmo	Texmo	Texmo	Texmo	Texmo	Texmo
Power	HP	5	5	3	3	3	2	5	5
	kW	3.73	3.73	2.238	2.238	2.238	1.492	3.73	3.73
Measured power	kW	3.804	4.23	3.814	2.865	3.338	2.349	5.788	3.83
Type	-	Submer sible	Submersible	Submer sible	Submer sible	Subme rsible	Submer sible	Subme rsible	Subme rsible
Proposed System									
Proposed power	kW	2.2	2.2	1.32	1.32	1.32	1.32	2.2	2.2
Daily usage	Hr/day	8	15	13	14	11	4	1	5
Annual working days	Days/yr	240	241	240	241	240	240	241	240
Estimated power saving	kWh	1.604	2.03	2.494	1.545	2.018	1.029	3.588	1.63
Annual power saving	kWh	3080	7338	7781	5213	5328	988	865	1956
Energy tariff	₹/kWh	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
Monetary saving	₹	45271	107875	114385	76629	78315	14521	12711	28753
Total investment	₹	57248	57248	41124	41124	41124	41124	41124	57148
Simple payback period	Yr	1.26	0.53	0.36	0.54	0.53	2.83	3.24	1.99
Reduction in CO_2 Emission	MT/Yr.	2.53	6.02	6.38	4.27	4.37	0.81	0.71	1.60

4.5 Design Solar PV Grid Rooftop System

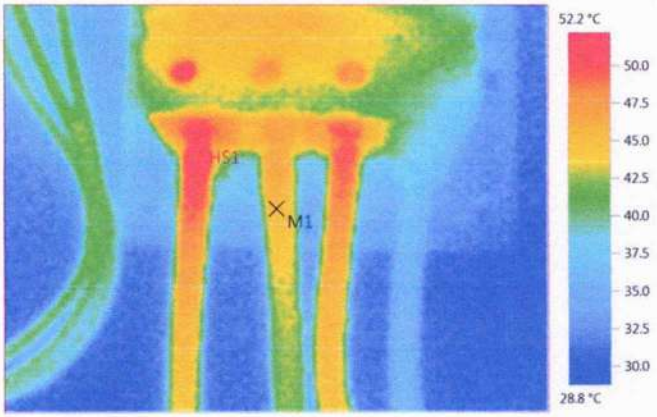
Table 17: Solar PV Grid Rooftop System

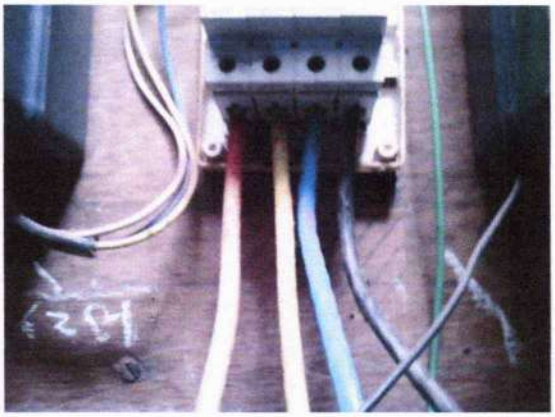
Name of Building	Annual Electricity Consumption kWh	Daily Electricity Consumption kWh	Unit Charge	Solar PV System Required-kW_p	Annual Electricity Generated by Solar kWh	Monetary Saving ₹	Investment @60000/kw_p ₹	Simple Payback
Engg. College building	537476	1472.54	14.70	490	477750	7022925	29400000	4.19

Suppliers of Energy Efficient Appliances/Renewable Energy Product

Sr. No.	Product Name	Vendor Details
1	LED tube light	**Syska LED**
		Syska House Plot No. 89-91, Lane No. 4 Sr. No. 232, 1/2, Airport Road, Sakore Nagar, Lohegaon, Pune, Maharashtra 411014
		Email : support@syska.co.in
		Website : https://syska.co.in/
2	Energy Efficient Fan	**Atomberg Technologies**
		Plot No. 130 B, TTC industrial area, Shirawane, Navi-Mumbai, Maharashtra - 400706
		Email : sandeepencon@gmail.com
		Website : https://atomberg.com/
3	Water Pump	**Grundfus**
		Vakratund Enterprises
		P-12, Shop No. 3/4 SAMK Building, Shiroli, Kolhapur, Maharashtra - 416122
		Email: kishor.u@vakratundent.com
		Mobile : +91 9922959080
4	Solar Water Heater/ Solar PV system	**Affordable Solar Energy Pvt. Ltd**
		202, B Wing, Anant Park, Main Kalewadi Road, Rahatni, Pune, Maharashtra, 411029, India
		Email: info@affordableenergy.in
		Website: www.affordableenergy.in
		Mobile: 8380014555, 7020389630, 9158509935
		Photon Energy Systems Limited
		Plot 26, Rd Number 10, Krishnapuram Colony Singada Kunta, Banjara Hills, Hyderabad, Telangana - 500034
		Email : pradeep@photonsolar.in
		Website : https://photonsolar.in/
		Jain Irrigation Systems Limited
		Jain Plastic Park, N.H.No. 6 Bambhori Jalgaon, Maharashtra - 425001
		Email : sandeepencon@gmail.com
		Website : https://www.jains.com/
5	Air-conditioning	**Neptune Engineers**
		Ram prasad complex, Miraj road Near Chandani Chowk, Sangli, Maharashtra - 416416
		Email : cak@hvacneptune.com
		Mobile : +91 8308000299
6	Heat Pump	**AO Smith**
		Vakratund Enterprises
		P-12, Shop No. 3/4 SAMK Building, Shiroli, Kolhapur, Maharashtra - 416122
		Email: kishor.u@vakratundent.com
		Mobile : +91 9922959080

Annexure





Picture parameters:

Emissivity: **0.99**

Refl. temp. [°C]: **20.0**

Picture markings:

Measurement Objects	Temp. [^{0}C]	Emiss.	Refl. Temp. [^{0}C]	Remarks
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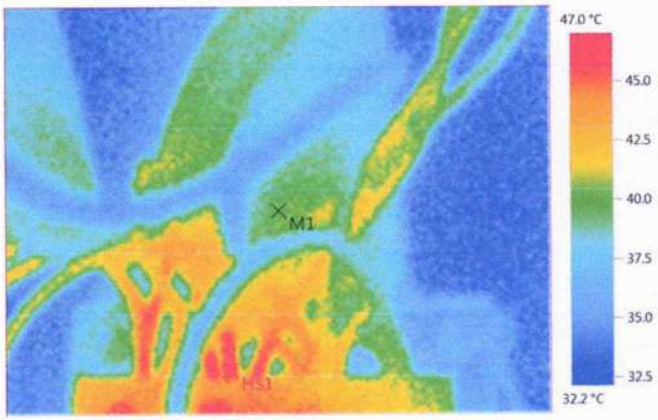
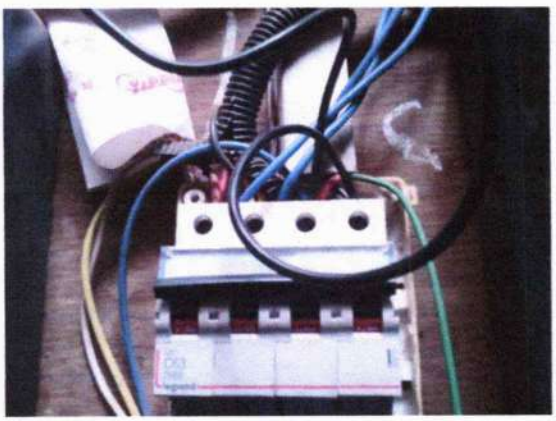
Hot Spot 1	52.2	0.99	20.0	-





Picture parameters:

Emissivity: **0.99**

Refl. temp. [°C]: **20.0**

Picture markings:

Measurement Objects	Temp. [^{0}C]	Emiss.	Refl. Temp. [^{0}C]	Remarks
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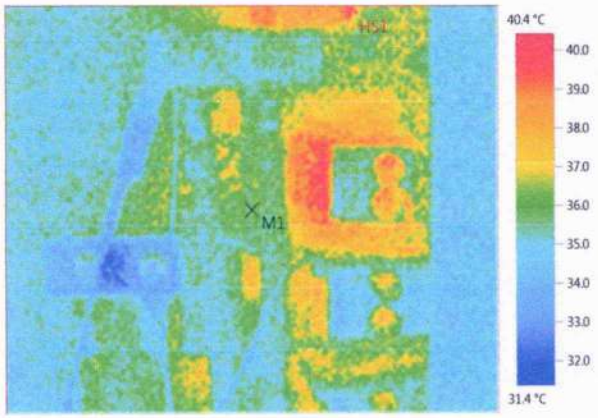
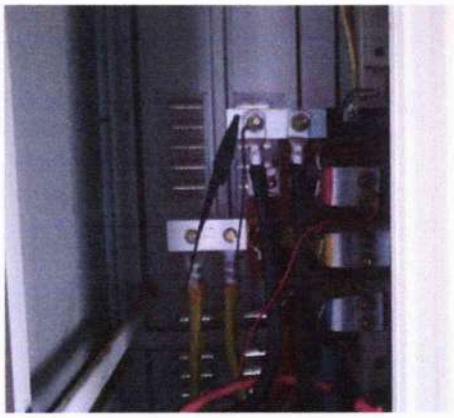
Hot Spot 1	47.0	0.99	20.0	-





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Refl. temp. [°C]: **20.0**

Picture markings:

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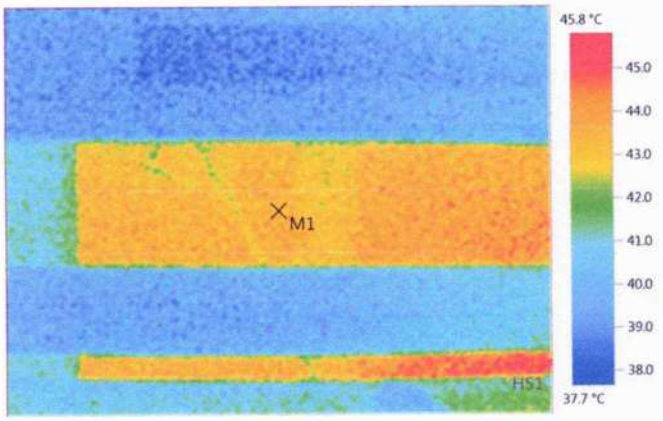
Hot Spot 1	40.4	0.99	20.0	-



Picture parameters:

Emissivity: **0.99**

Refl. temp. [°C]: **20.0**

Picture markings:

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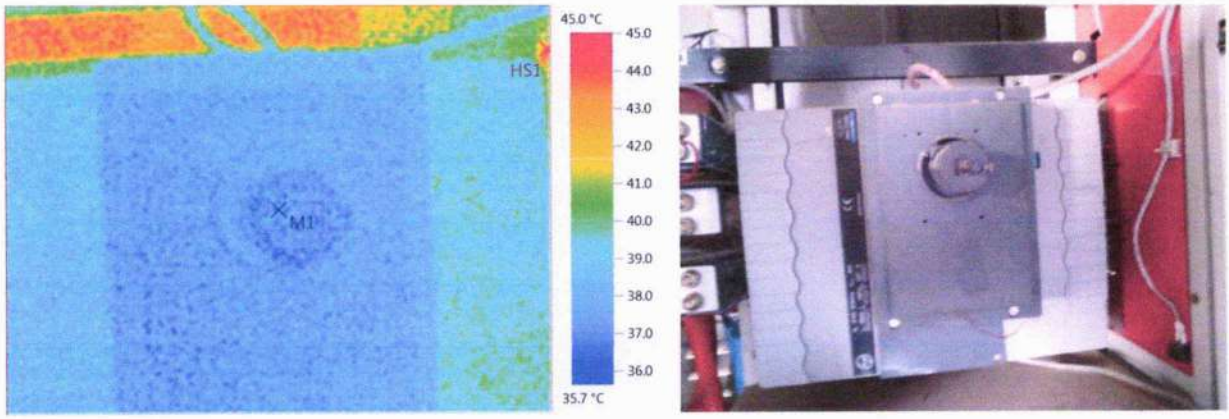
Hot Spot 1	45.8	0.99	20.0	-



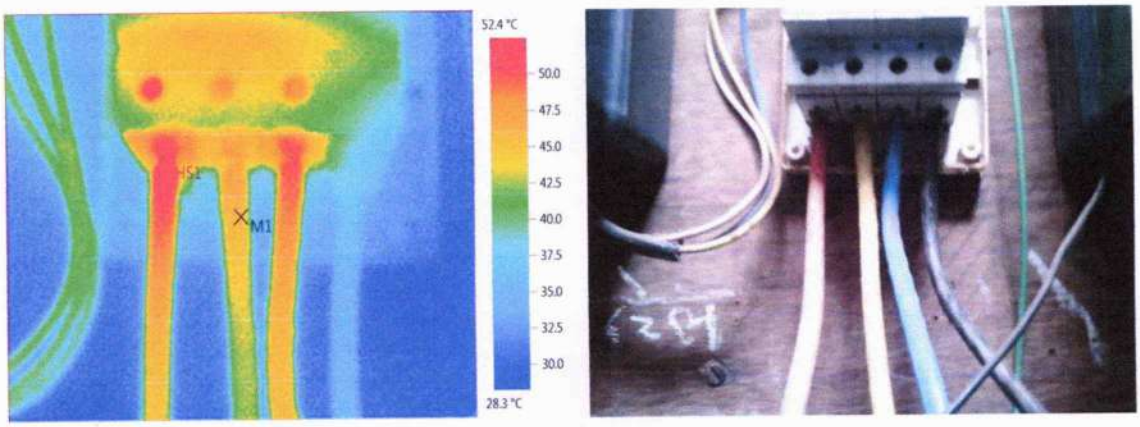
Picture parameters:

Emissivity: **0.99**

Refl. temp. [°C]: **20.0**

Picture markings:

Measurement Objects	Temp. [^{0}C]	Emiss.	Refl. Temp. [^{0}C]	Remarks
Measure point 1	37.3	0.99	20.0	Center Spot
Hot Spot 1	45.0	0.99	20.0	-



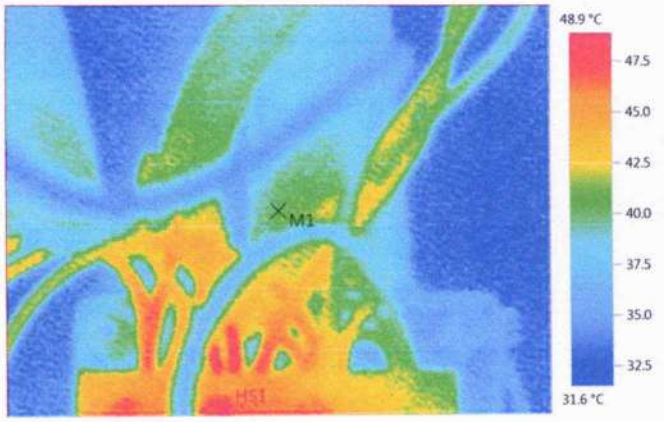
Picture parameters:

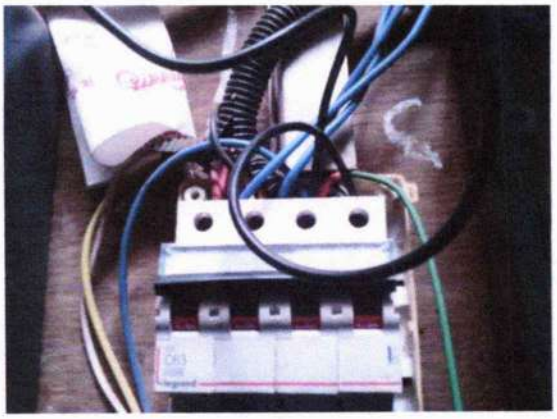
Emissivity: **0.99**

Refl. temp. [°C]: **20.0**

Picture markings:

Measurement Objects	Temp. [^{0}C]	Emiss.	Refl. Temp. [^{0}C]	Remarks
Measure point 1	44.8	0.99	20.0	Center Spot
Hot Spot 1	52.4	0.99	20.0	-





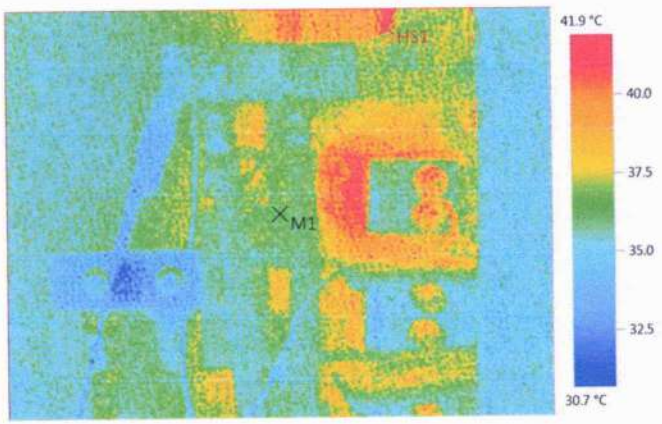
Picture parameters:

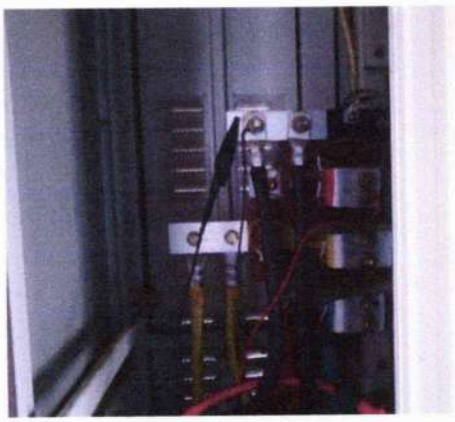
Emissivity: **0.99**

Refl. temp. [°C]: **20.0**

Picture markings:

Measurement Objects	Temp. [^{0}C]	Emiss.	Refl. Temp. [^{0}C]	Remarks
Measure point 1	39.6	0.99	20.0	Center Spot
Hot Spot 1	48.9	0.99	20.0	-





Picture parameters:

Emissivity: **0.99**

Refl. temp. [°C]: **20.0**

Picture markings:

Measurement Objects	Temp. [^{0}C]	Emiss.	Refl. Temp. [^{0}C]	Remarks
Measure point 1	36.5	0.99	20.0	Center Spot
Hot Spot 1	41.9	0.99	20.0	-