ISO 17021 Certified

GREEN AUDIT REPORT

Submitted for year 2022-23

Submitted to

Hindi Vidya Prachar Samiti's

Ramniranjan Jhunjunwala College of Arts, Science & Commerce

(R.J. College of Arts, Science & Commerce)

Ghatkopar West, Mumbai – 400086

in **May, 2023.**

Prepared by

Roshni Udyavar & Associates

Wadala East, Mumbai

RU&A

ROSHNI UDYAVAR

& ASSOCIATES

ARCHITECTURE . INTERIORS . ENERGY . ENVIRONMENT

Green Audit Team: (Roshni Udyavar & Associates)

- **Dr. Roshni U. Yehuda** – (CEO)
  B.Arch., M.Arch., Ph.D. (Resource Management)

- **Ar. Aditi Mane**- Green Building Analyst
  B.Arch., IGBC AP, ASSOCHAM GEM CP

- **Mr. S. Kale** - BEE-certified Energy Auditor
  B.E. (Electrical) – AAR Consulting and Services

- **Mr. Jeevan Davari**- Audit Assistant
  Senior Engineer (M.Tech. Electrical) – AAR Consulting and Services

- **Mr. Roshan Jadhav -** Audit Assistant
  (B.E. Electrical) – AAR Consulting and Services

- **Mr. Suhas Risbood -** ISO 17021 Auditor - ISOQAR.

Preface

A Green Audit is the first step to reducing a **building's water, waste, energy and carbon footprint and environmental impact**. The analysis of consumption of water and energy as well as generation of waste is used to provide recommendations on solutions such as rainwater harvesting, water and waste management, energy management including the addition of renewable energy. *The objective of the green audit is to transform to be self-reliant and self-sustainable in water and energy and create a zero-waste campus.*

In the long run, such a building will have greatly reduced its operating costs, carbon footprint and impact on the city's infrastructure. Upcoming and future regulations for buildings will require to follow green norms and energy-efficient measures including the Energy Conservation Building Code (ECBC). Hence, Green Audits will help buildings to achieve the norms.

The methodology of the Green Audit involves evaluation of the **water, energy and waste** consumption in the building or premises through online surveys, walk-throughs and detailed audits (where required). The results are analysed against existing Indian and international benchmarks and standards.

An **Environmental Management Plan** is prepared as an outcome of the audit based on a detailed analysis of data collected. This has the potential to reduce the consumption of resources through the use of appropriate technologies, design and planning without affecting the process or quality of an Institute's functioning. The investment and payback calculations are provided such that the plan can be implemented in whole or phases as desired.

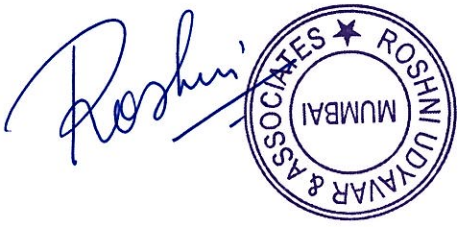
The benefits of conducting a green audit are a better understanding of the building systems, along with recommendations for improvement with a goal of self-reliance on resources and reducing the load on public infrastructure.

Through the audit report, we endeavour to provide cost-effective and long-term solutions in a continuous process of conservation of resources. The data collected for a month has been presented through appropriate visual representations for easy understanding of the technical information. Glossary, abbreviations, units of measurements and references are

provided for those who are further interested. Any suggestions or edits in the report are welcome and can be sent to **roshniudyavar@gmail.com**

This Green Audit Report is meant for academic and research purposes only. For legal issues, a separate study is required, and hence the results of this report cannot be used as evidence for any legal case within India or abroad.

Roshni Udyavar & Associates has been conducting green audits in and around Mumbai since 2019. The team has skilled professionals viz. having Green Accredited Professionals and BEE certified Energy Auditors. In partnership with ISOQAR, an ISO 1021 certified to UKAS, it provides the service of third-party certification for green audit conducted by it.



Acknowledgement

We extend our sincere thanks to Hindi Vidya Prachar Samiti, the Management of Ramniranjan Jhunjhunwala College for taking up the initiative to conduct a Green Audit, We are grateful to the Director of Hindi Vidya Prachar Samiti Trust, Dr Usha Mukudan for her support and enthusiasm in taking up this venture. We acknowledge the initiative of the College, especially Incharge Principal, Dr Himanshu Dawda, Dr Bhushan Arekar - IQAC Co-ordinator, Dr Karishma Rajbhar (Green Audit College Co-ordinator), IQAC team in assessing the conduct and feasibility of the green audit.

We extend our sincere thanks to the teaching staff, Vice Principal - Captain Pravin Nayak, Dr Kiran Kolwankar, Mr Deviprasad Shetty, and non-teaching staff – Mr K Somnath, Mr Bahadur Agri, Electrician – Mr Yuvraj and A.C. technician – Jawar electricals for providing us with detailed information for the Audits and their presence during the days of the visit.

We would also like to thank the support staff for their help as and when required during the audit visits.

Green Audit Team

Roshni Udyavar & Associates

Abbreviations

- **BEE** - Bureau of Energy Efficiency
- **BLDC** - Brushless Direct Current
- **BUA** - Built-up area
- **CFL** - Compact Fluorescent Lamps
- **CMH** - Cubic Meters Per Hour
- **DBT** - Dry Bulb Temperature
- **DEF** - Daylight extent factor
- **DG** - Diesel Generator
- **EER** - Energy efficiency ratio
- **ECBC** - Energy Conservation Building Code
- **ECMs** - Energy Conservation Measures
- **EPI** - Energy Performance Index
- **FTLs** - Fluorescent Tube Lights
- **HT** - High Tension
- **HVAC** - Heating, ventilation, and air conditioning
- **LED** - Light Emitting Diodes
- **LPD** - Lighting Power Density
- **LPG** - Liquefied petroleum gas
- **MNRE** - Ministry of New and Renewable Energy
- **MRT** - Mean Radiant Temperature
- **NAAC** - The National Assessment and Accreditation Council
- **NBC** - National Building Code
- **NCEF** - National Clean Energy Fund
- **PPA** - Power Purchase Agreement

- **RA CHARGE -** Regulatory Asset Charge
- **RPM -** Revolutions Per Minute
- **RH -** Relative Humidity
- **SEC -** Specific Energy Consumption
- **SECI -** Solar Energy Corporation of India
- **Solar PV -** Solar Photovoltaic
- **TOD -** Time of Day
- **TR -** Tons of refrigeration
- **WBT -** Wet Bulb Temperature
- **WWR -** Window to Wall Ratio

Units of Measurements

- **C-** Celsius
- **cm -** Centimetre
- **Ft -** Foot
- **H -** Hour
- **kW -** Kilowatt of electricity
- **kWh -** kilowatt-hour
- **kWh/m²/year-** kilowatt per square meter per year
- **kVA -** kilovolt-ampere
- **lm -** Lumens
- **lm/W -** Lumens per Watt
- **lux -** Illuminance
- **m -** Meter
- **mm -** Millimetre
- **W -** Watt
- **W/m² -** Watts per square meter
- **Wh -** Watthour

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Executive Summary

The Hindi Vidya Prachar Samiti's Ramniranjan Jhunjhunwala College of Arts, Science & Commerce (R.J. College of Arts, Science & Commerce) premises has an energy consumption of **2,78,564 kWh** for the academic year 2022-2023 as per metered electricity bill. The main areas of electricity consumption are Lighting, Fans, Air Conditioning and Equipment. Of this, **Equipment load** is the highest at **40% (1,06,076 kWh)** followed by **Lighting load** at **24% (64,106 kWh)**, **AC load** at **19%, (51,705 kWh)**, and **Fans** at **17% (45305.4 kWh)**. Only 12% of the College space is air-conditioned. The building is mostly naturally ventilated with minimal conditioned spaces. The building also has a 10 KWp Solar PV system installed on its terrace which can generate an output of **10,393 kWh** or 4% of total electricity consumed. Currently college in is the process of net metering by the Utility – Adani.

The Energy Performance Index (EPI) of the building is **33.68 kWh/sq. m/ year** which is well below the Bureau of Energy Efficiency (BEE), Govt. of India's national benchmark of **150 kWh/ sq. m/ year** for institutional buildings in warm-humid climate. The BEE's benchmark for nearly zero energy buildings is **15.00 kWh/sq. m/ year** which is achievable by energy-efficiency measures.

94 % of spaces within the college comply with the maximum allowable Lighting Power Density (LPD) as per the **Space Function method of ECBC 2017**. However, the lighting levels meet the NBC standard in most of the spaces.

The water bill shows that the average monthly consumption is around **515.67 KLD** which comes to about **26.9 KLD** per day which is around 9% as compared to the standards prescribed by the NBC.

The **organic waste** generated by the college can be composted in the on-site organic waste facility created by them, which can be used as organic fertiliser for gardening. E-waste and Multi-layer plastic (MLP), recycling facility has been provided for collection and an incentive-based credit system has been generated for awareness among the students and faculty.

The college is certified as ISO 14001:2015 which demonstrate the commitment of college management towards environment sustainability.

The college is adjacent to a major suburban Railway station (Ghatkopar) and like most station areas it is highly congested with noise and air pollution issues. However, the college has made an effort by planting trees in the front open spaces within and outside the college along the compound wall.

A summary of the key recommendations from the green audit are provided in the Table 1 here along with savings, cost and simple payback period.

Recommended Measure	Savings per year (kWh/ Litres/ kg)	Financial Savings Per year (Rs)	Capital Investment* (Rs)	Simple Pay Back Period (Years)
ENERGY				
Replacement of T8 (36W/ 40 W/ 72 W/ 80W) Fluorescent Tube Lights (FTLs) along with electromagnetic ballast with 18W LED Tube Lights having lumen output of 1800 (efficacy = 100 Lumens per Watt)	12,805.32	1,32,919	94,500	7 months
Replacement of plane light 40 W in passage area with 18 W sensor-based and dimmable lights	700.48	7,270.98	5,865	8 months
Replacement of LED light 24 W in passage area with 18 W sensor-based and dimmable lights	505.92	5,251.45	15,180	2 years and 8 months
Replacement of regular fans with BEE star rated fans and Brushless Direct Current (BLDC) fans	22,467	2,33,206	12,08,236	5 years and 2 months
TOTAL	36,479	3,78,648	13,23,781	3 years and 6 month
WATER				
Wash basin faucet to water saving aerators	50%	NA	-	NA
RENEWABLE ENERGY				
Net metering to be arranged with Utility - Adani	NA	NA	-	NA

*Note: This is an estimated cost table; detail cost will be calculated as per design.

Table 1: Key Recommendations for improving environment at Jhunjhunwala College

1. Introduction

Hindi Vidya Prachar Samiti's Ramniranjan Jhunjhunwala College came into existence in 1963, enabling a larger section of the society to take advantage of the facilities provided for higher education. From 1999-2000 the College added several self-financing courses like BMS, B.B.I, B.Sc. in C.S., I.T., Biotechnology, and M.Sc. in Computer Science and Biotechnology which further hone the special skills of the students. In 2014 they started a skill-based program supported by the University Grants commission known as Bachelor in Vocation.

The college has been reaccredited with 'A' Grade by NAAC in 2014 with a CGPA of 3.50 and received the Best College Award (2007-2008) of the University of Mumbai. The College has been bestowed with IMC **RAMKRISHNA BAJAJ PERFORMANCE EXCELLENCE TROPHY, 2010.** The principal of the college was awarded **"Best Teacher"** by the Government of Maharashtra in 2011. Government of Maharashtra conferred the college with **"JAAGAR JAANIVANCHA"** (First in Mumbai Suburban- in 2013 and second in Mumbai Suburban- in 2014) for the safety of girls.

The College has been granted Autonomous Status by the University Grants Commission (UGC) for a period of Ten Years w.e.f. 2018-2019 to 2027-2028. However, the college will remain affiliated to University of Mumbai with an autonomous status.

The College has been awarded a **Certificate of Responsible Recycling** by E-Incarnation Recycling Private Limited (for E-waste Management) and **Safai Bank of India** by the Kulkarni Foundation (for Multi-layer plastic Management (MLP)) for proactively contributing to the waste management. They have devised a module in which students are given credits for the amount and size of MLP they collected. They also have a compost pit for leaf and canteen waste (Wet waste).

The college has also a QR code all the trees on the campus, to create awareness about the types of trees and their benefits amongst the students and the visitors.

1.1 Objectives of the Green Audit

The objective of the green audit are as follows

- Quantify energy, water and waste consumption;
- Identify energy saving opportunities resulting in lowered energy bills, less use of fossil fuel-based energy and lower carbon footprint;
- Identify wastages in use – and devising solutions such as smart / automated equipment to reduce consumption;
- Introduction of renewable energy to reduce operational energy cost (if required)
- Introducing measures to reduce water consumption and optimise rain water harvesting potentials.
- Suggesting measures to waste management.

1.2 Scope of Work

Energy:

- Overview of existing facilities and electric appliances (lights, fans, heater, air conditioner etc.), operating system like electrical distribution system, metering system, tariff, electricity and Power consumption etc. by use of appropriate instrumentation.
- Establishing a baseline of energy consumption and identify major causes of low operating efficiency and recommended improvements / better operating practices.
- Summary of findings and recommendations and energy conservation measures (ECMs).
- Assessment of Building Envelope energy efficiency and possible retrofit solutions.
- Estimation of the costs associated with the implementation of each of the proposed energy conservation measures (ECMs).
- Quantifying the extent of energy savings/performance improvement that can be achieved by upgrading and/or replacing the existing electrical appliance with the best efficiency electrical appliance available in the market and other energy efficiency/conservation measures based on the analysis of the measurements.
- Scope of renewable energy applications.

Water:

- Data collection on water usage, storage capacity, daily consumption patterns, infrastructure and equipment.
- Data analysis to provide scope of improvement in water usage.
- Solutions for rainwater harvesting – storage or ground water recharge.
- Possibility of waste water (black or grey water recycling).

Solid Waste:

- Survey of waste in the premises – categorization and quantification.
- Analysis and research on possible methods of waste disposal and treatment (of organic waste).
- Solutions for recycling – E-waste and recyclables.

Environmental Quality:

- Assessment of IEQ - Visual, Thermal and Acoustic comfort, IAQ (Ventilation).
- Survey of noise and vegetation in the premises – levels and extent.
- Analysis and possible solutions to reduce the noise levels and enhance the greenery and biodiversity within the campus.

1.3 Understanding of the Audited Area

The total built up area of **89,018 sq. ft. (8270 sq. m)**, is considered for the audit, was evaluated on the basis of existing drawings, information as well as on-site measurements as this data, forms the basis of assessment of the energy, water and waste consumption with respect to existing benchmarks.

The campus basically includes 2 buildings namely the school building and College building having Ground to sixth floors. The audit was conducted for college building only.

Categorization of the spaces as administrative spaces (offices, staff rooms, etc.), common spaces (Toilets, storage, common classrooms, library, etc.), circulation spaces (staircase, corridors) and conditioned vs. non-conditioned spaces (classrooms and computer labs) was then carried out.

The analysis shows that 26% of the total built-up area of the college are common passage. The college building has classrooms for Junior and Senior Degree college, computer labs, admin offices, staff rooms, conference rooms, auditorium, library, common passages, staircase, lift etc.

The description of facilities and activities on each floor are given in Table 2:

S. No.	Floor	Name of the Facility
1	Ground Floor	Chemistry labs, Gymnasium, Canteen, Seminar Hall Toilets
2	First Floor	Accounts office, Principal's cabin, Conference room, Girls common room, Classrooms, Biology labs, Toilets
3	Second Floor	Classrooms, Staffroom, Physics labs, Toilets
4	Third Floor	Computer lab, Library, Classroom, Biotechnology lab, Toilets
5	Fourth Floor	Staff room, Class room, Maths lab, Toilets
6	Fifth Floor	Statistics lab, Classrooms, Staff room, Toilets, computer lab
7	Sixth Floor	Classrooms, Staff room

Table 2: Floor-wise facility distribution in the college

Some sample photographs taken during the audit showing different spaces and equipment are provided in the following pages.

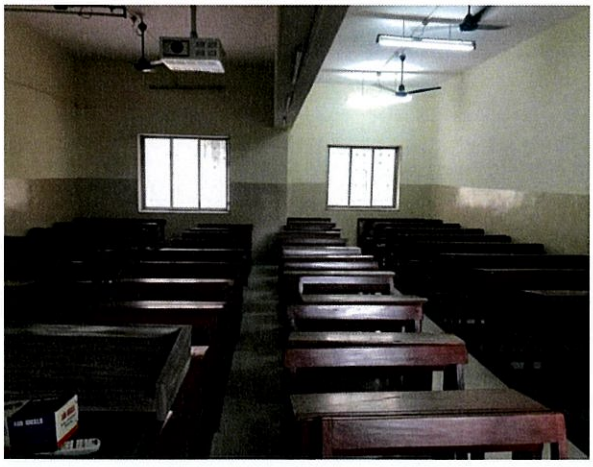


Plate 1 : Fourth floor classroom

Plate 2: Library

Plate 3: Biotechnology lab

Plate 4: Staffroom

Plate 5: Chemistry lab

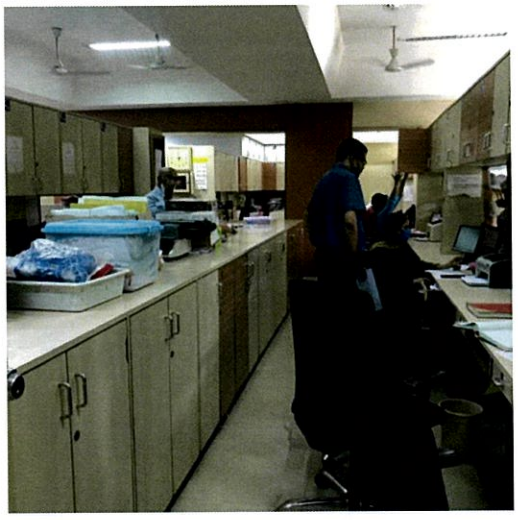


Plate 6: Office area

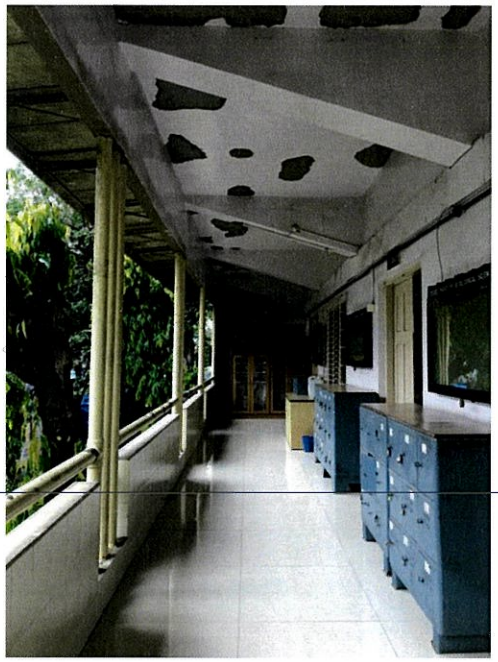


Plate 7: First floor Corridor

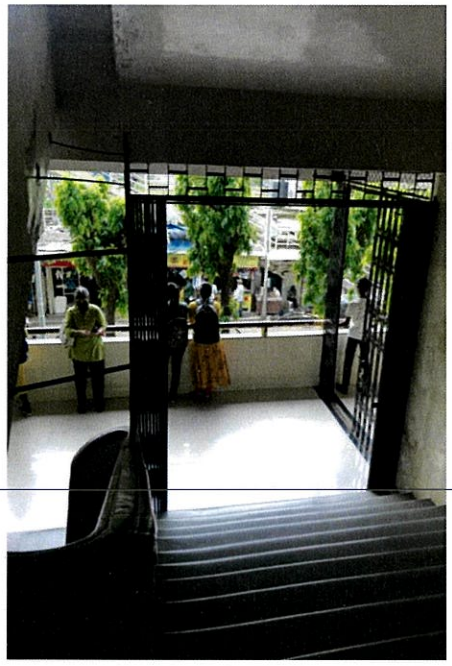


Plate 8: Staircase mid landing and flight

Plate 9: Drinking water cooler in corridor corner

Plate 10: Lab

2. Audit Methodology

Six steps involved in the audit process are as follows:

Step	Objective	Activities
Step 1	Audit of historical data	• Online data collection • Using online data for screening survey and detail audit. • Building drawings, utility bills
Step 2	Screening survey or walk-through audit	• A random check of inventory of all electrical and electro-mechanical devices including lights, fans, motors, pumps, ACs, water equipment, • Inspection of the site for water, waste and environmental information
Step 3	On-site investigations	• Verification of online data submitted through ground survey and observations • Measurement of various equipment efficiencies, specific power consumption (SPC) kW/TR of equipment w.r.t. manufacturer's data. • Monitoring of actual energy consumption of AC and other electrical loads • Observe operation of equipment and evaluate their performance w.r.t. manufacturer's data • Conduct random lighting audit of habitable spaces and compare with National Building Code (NBC) 2016 standards. • Study of air conditioning loads and performance • Study of illumination system – LUX levels, Lighting Power Density (LPD) • Inspection of water, waste and environmental issues including flooding, stormwater system
Step 4	Data Analysis	• Analysis of all criteria and comparison with standards and benchmarks • Recommendations
Step 5	Documentation and Report	• Preparation of detailed report with documentation, calculation and all technical information, summary and recommendations
Step 6	ISO 17021 3rd Party Audit	• Visit by an ISO 17021 Accredited auditor and final certification.

Table 3: Steps in the Green Audi

A diagrammatic representation of the methodology is provided in flow chart below:

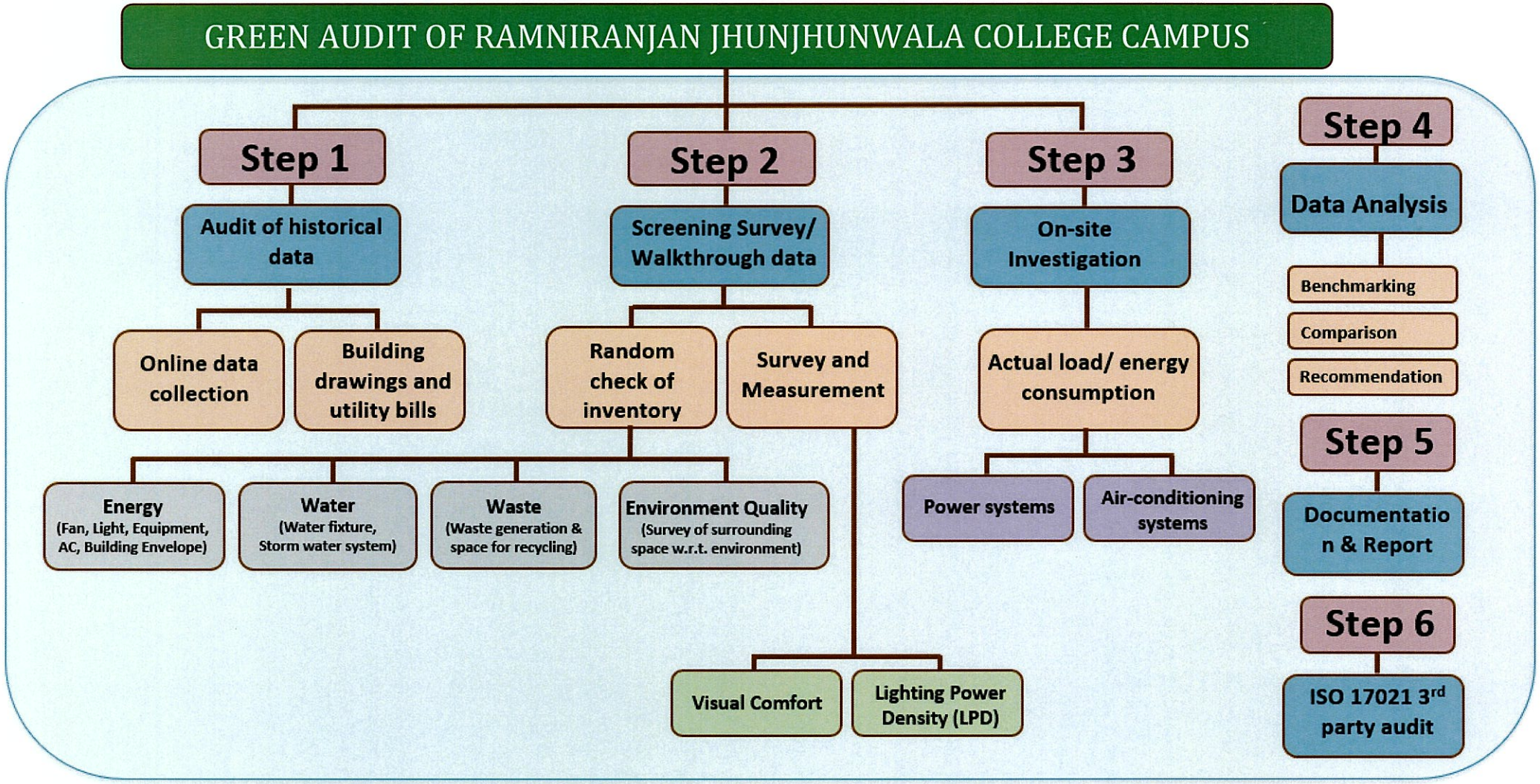


Figure 1: Methodology of the Green Audit at Jhunjhunwala College

2.1 Data Collection

General Data collection such as year of establishment of the college, number of students and staff, inclusion and exclusion of spaces and equipment for the audit were obtained through one-to-one interviews and discussions with key informants who also assisted in the collection of building drawings and electricity bills for the past 1 years (March 2022 – February 2023).

Walk-through Audit

A walk-through Audit was conducted by the team which was followed by a detailed site visit. A special guided visit of the campus was organized for the team by Dr Usha Mukundan, IQAC member and Mr K Somnath.

Detailed Audit and Measurements

Detailed audit of the air conditioning system (window and spit units) as well as the electrical system was conducted by BEE certified energy auditor team. The indoor and outdoor units of the AC's were tested for refrigerant flow and pressure, refrigerant temperature, actual energy consumption and cooling capacity. These are elaborated in section 3.1.3 and compared with standards in the analysis section.

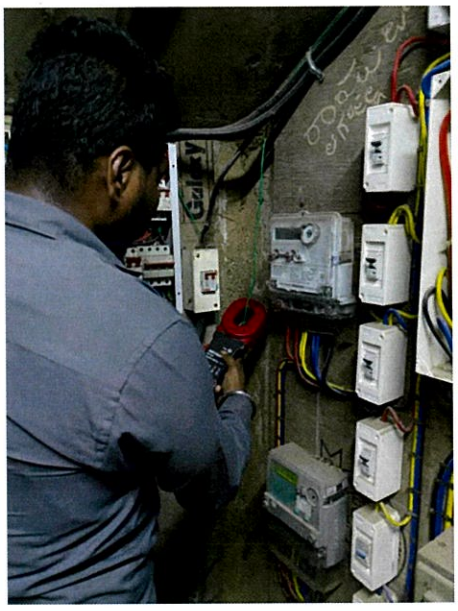


Plate 11: Energy Audit conducted a R.J. College

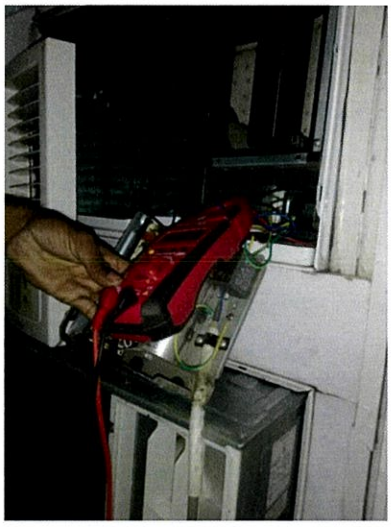


Plate 3: Audit of AC in process

Plate 2: Audit of pump in process

Observation Check-list was used during the walk-through audits to gather information on location of windows, Window Wall Ratio (WWR), number and type of lights, fans, air conditioners and equipment.

Instruments Used

For the energy audit, the following instruments were used:

Instrument	Name
	Clamp – on type Power/Energy meter
	Clamp On Earth Tester Meggar Make.

	Thermal Imager Fluke Make Tis-10 Series.
	Anemometers – to measure velocity of gases Luthron Make.
	Digital Thermometers for liquid /surface temperature.
	Lux meter Luthron Make.

Table 4: Instruments used for the study

Measurement of Illuminance

Lux levels were measured at 37 different spaces by using a Lux Meter over a grid of 9 points measured at working plane height with artificial light between 1100 to 1700 hours. The average reading was then compared with the mid-point reading of the recommended levels in the National Building Code, 2016.

Schedule of Data Collection

S. No.	Audit Activity	Person	Date
1.	Online data form link provided to college	**Dr. Roshni U. Yehuda**	**23.03.2023**
2.	Online data submission	**Dr Usha Mukudan**	**24.04.2023**
3.	Walk through and detailed audit	**Ar. Aditi Mane**	**28.04.2023**
4.	A detailed audit of air conditioning, meters and power systems	**Mr. Jeevan Davari and Mr. Roshan Jadhav**	**28.04.2023 & 29.04.2023**

Table 5: Schedule of data collection based on actual visits

2.2 Data Analysis

The collected data was analysed and visually represented using pie-charts, bar graphs, tabulations in each of the audit areas. They were assessed against existing benchmarks and standards such as Energy Performance Index (EPI), Lighting Power Density (LPD) as per ECBC 2007, appropriate illuminance levels (Lux) for visual comfort, and Specific Energy Consumption (SEC) as specified by National Building Code 2016, Window Wall Ratio (WWR) and several others.

Calculation of Wattage

Wattage of lights, fans, AC and equipment were made on the basis of data submitted online by the college verified through random survey during on-site investigation. The complete consolidated data is provided in the Annexure A.

Information on Population and Area for Energy Performance Index (EPI) and Specific Energy Consumption (SEC)

Information on number of people using a specific space was obtained from the online questionnaire and interpolated to obtain occupancy for fresh air calculations. For area calculations, total built up area provided in online questionnaire and building drawings were utilized. As per online data submitted, approximate total population of the college is **6950 persons.** This will be used for SEC calculation. The total built up area of the college considered for EPI is **89,017.54 sq. ft. (8270 sq. m).**

Sr no.	Category	No. of Person
1	Students	6666
2	Teachers	134
3	Non-Teaching Staff	125
4	Administrative Staff	25
Grand total		**6950**

Table 6 : Break up of total population of college

3. Analysis and Benchmarking

3.1 Energy

3.1.1 Overall Energy Consumption

The overall electricity load at Jhunjhunwala College can be divided into four major sections viz. Lights, Fans, Air conditioners and Equipment. The break-up of energy consumption among the four major contributors end-use-wise, floor-wise and as per connected load is shown in Figure 2, Figure 3, and Figure 4 respectively.

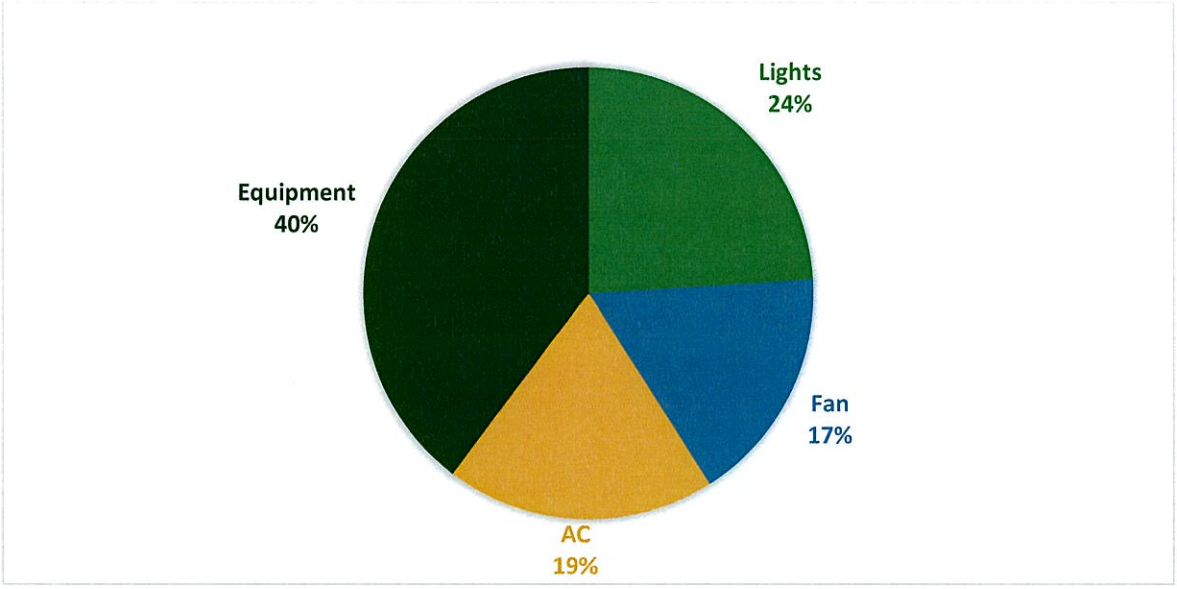


Figure 2: Distribution of Annual Energy Consumption based on end-use

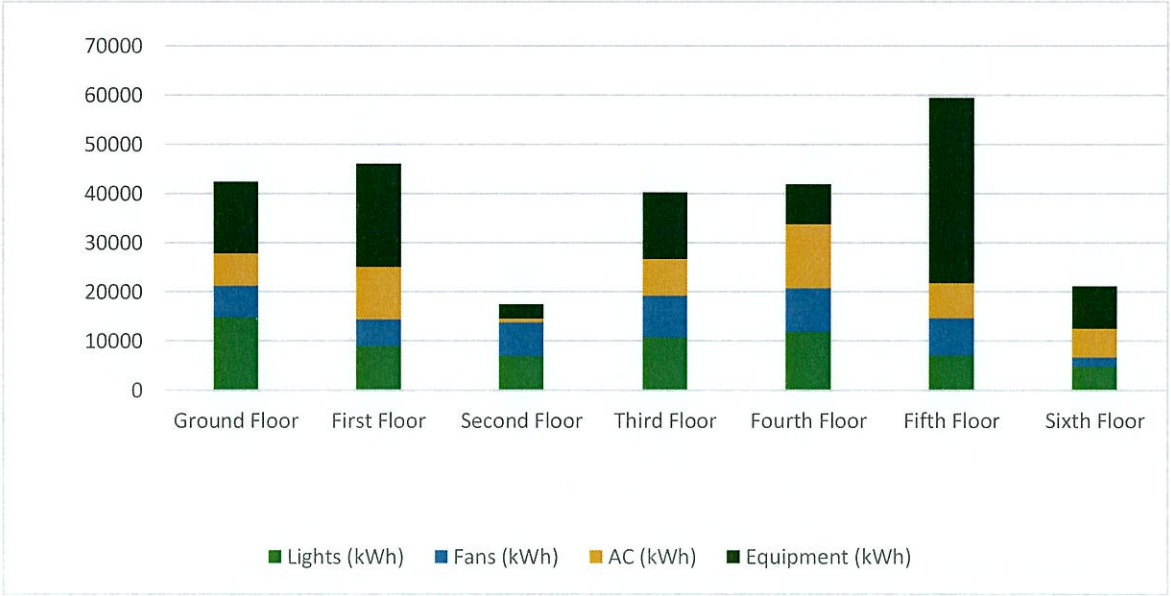


Figure 3: Distribution of Annual Energy Consumption Floor-wise

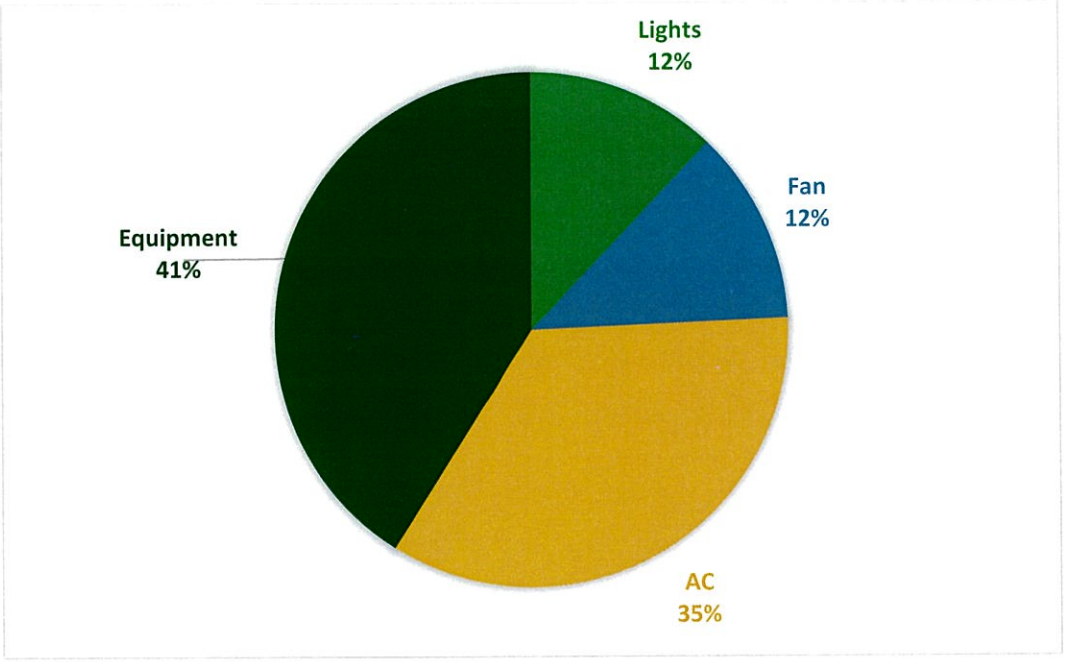


Figure 4 : Distribution of Annual Energy Consumption as per Connected Load

3.1.1.1 Summary of observations – overall energy consumption:

1. The total calculated annual energy consumption of the campus is **2,67,193.8 kWh**.
2. The total billed electricity for the college for June 2021 to May 2022 is **2,78,564 kWh**.
3. Diversity factor is **0.9**
4. The contribution of **Equipment load is 1,06,076 kWh (40%) followed by Lighting load at 64,106.8 kWh (24%), AC load at 51,705.96 kWh (19%), and Fans at 45,305.4 kWh (17%).**
5. As per the total connected load, contribution **of Equipment is 41%, AC is 35%, Lights is 12% and Fan is 12%.**
6. **The total conditioned area in the college is 12%** while the overall **AC load corresponding to this conditioned area is 19%**
7. The floor-wise consumption shows that fifth floor has majority consumption as compared to all other floors. This was mainly due the IT labs and computer science department situated on fifth floor.
8. The Jhunjhunwala College has office area, conference room, principal room, computer labs which are fully air conditioned and have high number of computers and lights. Most spaces are unconditioned including the passages, classrooms.

9. **Circulation spaces** i.e., corridors and staircases, attribute to **26% of the area while consuming minimal energy**. Circulation spaces are also naturally ventilated with a parapet wall.

3.1.2 Lighting Energy Consumption

3.1.2.1 Artificial lighting

Artificial lighting contributes to **24% of the total consumption** in Jhunjhunwala College – mainly due to the longer duration of usage (due to working in 3 shifts). The types of lamps used in the campus are shown in Fig. 5. The number and wattage of lamps used is shown in Table 7.

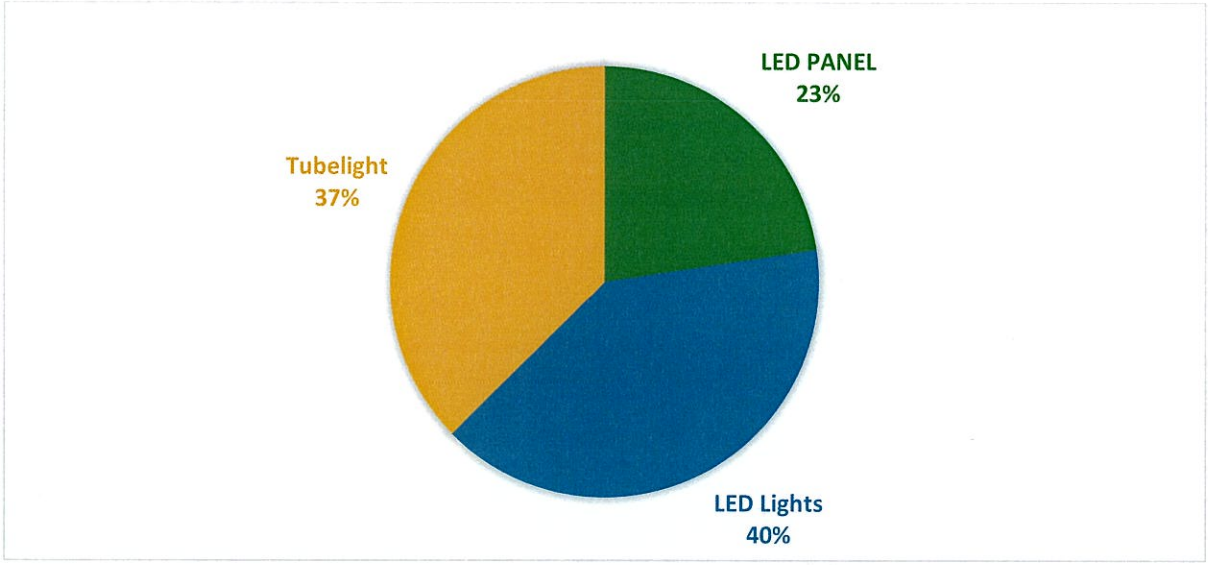


Figure 5: Types of lights and their wattage

S. No.	Lamp Type	Approximate wattage per lamp (W)	Numbers	Total Consumption (kWh)
1.	LED Panel	24	362	14829.6
2.	LED Lights	24	528	26218.8
3.	Tube light	40	332	24556

Table 7: Number and kWh distribution of all Lights

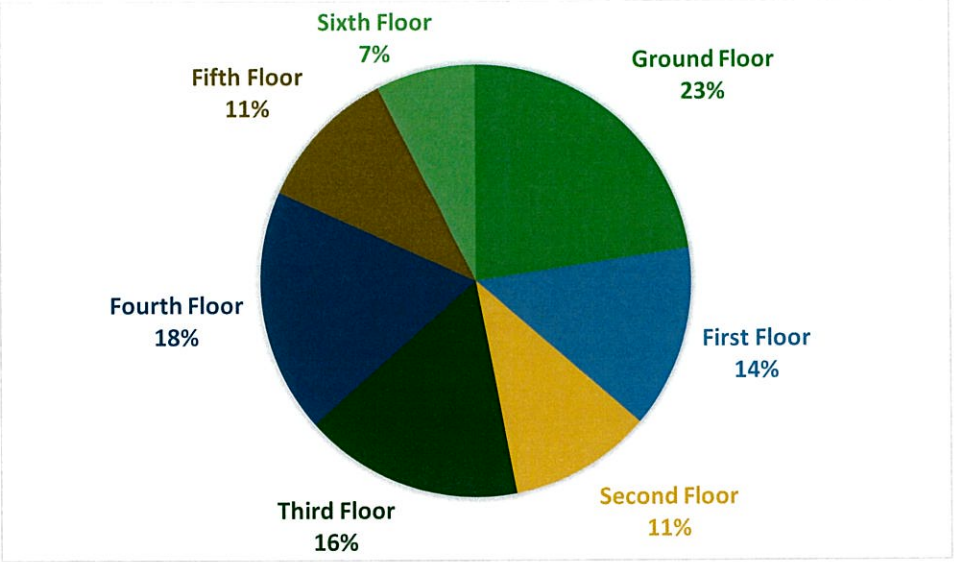


Figure 6: Percentage breakup of Floor-wise Annual Energy Consumption of Lights

Sr no	Floor	Sum of Total usage kWh/year
1	Ground Floor	14819.12
2	First Floor	9013.76
3	Second Floor	7008.64
4	Third Floor	10819.2
5	Fourth Floor	11961.6
6	Fifth Floor	7080.32
7	Sixth Floor	4901.76
	Grand Total	**64,106.8**

Table 8: Total floor-wise Light Consumption (kWh)

3.1.2.2 Lighting Power Density (LPD)

The Energy Conservation Building Code 2017 defines Lighting Power Density (LPD) as the maximum lighting power per unit area of a space as per its function or building as per its classification.

LPD is a benchmark for the maximum allowable light per unit area provided in the ECBC 2017 and has been used here to compare with the lighting power allowance of each area in the college. The LPD using the 'Space Function Method' for some important activity areas has been calculated and compared with ECBC 2017 in Table 9.

S. No.	Space	LPD as per ECBC 2017 (W/sq. m)	Calculated LPD (W/sq. m)	Meeting with ECBC Standard
1.	Library – reading Area	10.00	10.14	Yes
2.	Classroom	13.8	9.11	Yes
3.	Lab- Physics, chemistry	15.1	8.5	Yes
4.	Computer lab	15.1	17.18	No

Table 9: LPD for some important activity areas using 'Space Function Method'

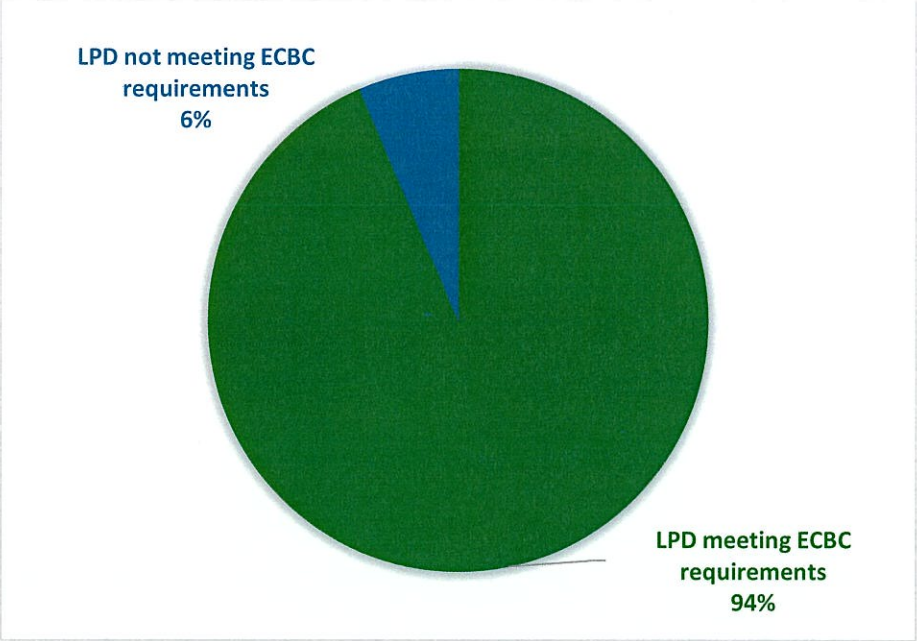


Figure 7: Percentage of areas complying with LPD norms as per ECBC using Space Function Method

3.1.2.3 Efficacy of Lamps

The Efficacy of a lamp is defined as the lumens produced by a lamp plus ballast system divided by the total watts of input power (including the ballast), expressed in lumens per watt. The higher the efficacy, lesser is the energy consumed by the lamp.

The comparative efficacies and environmental impacts of the lamps is provided in the table below:

Sr. No.	Lamp Type with Wattage	Efficacy Range (Lumens/ Watt)	Rated Life (Hours)	EOL Toxic effects
1.	Fluorescent Tube Lights (T12 & T8)	34 – 57	5000-10000	Mercury
2.	Compact Fluorescent Lamps	25 - 70	10000	Mercury
3.	Light Emitting Diode	60 - 76	Upto 50000	NIL
4.	Incandescent Halogen filament (low voltage)	31 – 35	2000-3000	NIL
5.	Incandescent Tungsten filament	6 – 15	1000	NIL

Table 10: Comparative efficacies and environmental impacts of lamps

3.1.2.4 Wall Window Ratio and Day lighting

The overall **Wall to window ratio (WWR) is observed to be 25%.** During detail energy audit, Daylight was measured in some rooms randomly, to verify weather lighting level are in accordance to NBC.

The results of the survey of Lux levels are shown below:

Sr. No	Floor	Space	Lux	Lux level as per NBC	Is the LUX level matching with standard? Yes/ No
1	Ground Floor	Chemistry Staff Room	210	200 – 300 - 500	Yes
2	Ground Floor	Seminar Hall	220	200 – 300 - 500	Yes
3	Ground Floor	Gymkhana	210	200 – 300 - 500	Yes
4	Ground Floor	Store Room	205	200 – 300 - 500	Yes
5	Second Floor	Physics Lab 2	215	200 – 300 - 500	Yes
6	Third Floor	Maths Lab	216	200 – 300 - 500	Yes
7	Third Floor	English Lab	198	200 – 300 - 500	No
8	Third Floor	Biotechnology Lab	205	200 – 300 - 500	Yes
9	Third Floor	Microbiology lab	215	200 – 300 - 500	Yes
10	Third Floor	Library	230	200 – 300 - 500	Yes

11	Fourth Floor	Staff Room	180	200 – 300 - 500	No
12	Fourth Floor	Research Lab. DST	160	200 – 300 - 500	No
13	Fourth Floor	Statistics Lab	154	200 – 300 - 500	No
14	Fourth Floor	Room-44	180	200 – 300 - 500	No
15	Fourth Floor	Room-36 BBI	210	200 – 300 - 500	Yes
16	Fourth Floor	BMS Room	220	200 – 300 - 500	Yes
17	Fifth Floor	Room-55	230	200 – 300 - 500	Yes
18	Fifth Floor	Room-56	205	200 – 300 - 500	Yes
19	Fifth Floor	Computer Science Lab 3	270	200 – 300 - 500	Yes
20	Fifth Floor	Lab-2 Bsc 5th Flr	280	200 – 300 - 500	Yes
21	Fifth Floor	Lab-2 Bsc 5th Flr	195	200 – 300 - 500	No
22	Fifth Floor	Staff Room 5th Flr	330	200 – 300 - 500	Yes
23	Fifth Floor	Lab-1 5th Flr	320	200 – 300 - 500	Yes
24	Fifth Floor	It Staff Room	340	200 – 300 - 500	Yes
25	Fifth Floor	It Lab-1 5thflr	305	200 – 300 - 500	Yes
26	Fifth Floor	It Lab-2 5thflr	295	200 – 300 - 500	Yes
27	Fifth Floor	Room 53	280	200 – 300 - 500	Yes
28	Fifth Floor	Room 54	270	200 – 300 - 500	Yes
29	Fifth Floor	Room 55	264	200 – 300 - 500	Yes
30	Sixth Floor	Staff Room	380	200 – 300 - 500	Yes
31	Sixth Floor	Room 63	280	200 – 300 - 500	Yes
32	Sixth Floor	Computer Lab	320	200 – 300 - 500	Yes
33	Second Floor	Studio	350	200 – 300 - 500	Yes
34	Fourth Floor	Staff Room	340	200 – 300 – 500	Yes
35	First Floor	Trust Office 1st Floor	290	200 – 300 – 500	Yes

36	First Floor	Conference Room	310	200 – 300 – 500	Yes
37	First Floor	Principal Office	285	200 – 300 – 500	Yes

Table 11: Summary of lux levels comparison with NBC

- **Summary of Observations: Lighting**
  1. There are in all 1163 lamps (artificial light sources) in the campus amounting to annual energy consumption of **64,106.8 kWh** constituting **24 % of total energy consumption**.
  2. **63% of lighting consumption is from LED lamps.**
  3. As per the recommendation of previous green audit report, the college has replaced few old luminaries to LED.
  4. Building envelope has **Window Wall Ratio (WWR) of 25%,** which is within ECBC's allowable norms of up to 60%.
  5. **94%** of the spaces comply with the LPD norms of ECBC. By the Space Function method, most of the key activity spaces meet the ECBC norms.
  6. The highest lighting consumption is by the **Ground floor (23%)**, **Fourth floor lights (18%)**, followed by **Third** and **First floor (16% and 14%)** respectively.
  7. Currently there are 82 outdoor lights manually switched off and switched on.

3.1.3 Energy Consumption for Thermal Comfort

Fans and Air Conditioning together consume **36%** of the energy consumption of the campus. Both these are required for thermal comfort of occupants. Only **12%** of the college space is conditioned.

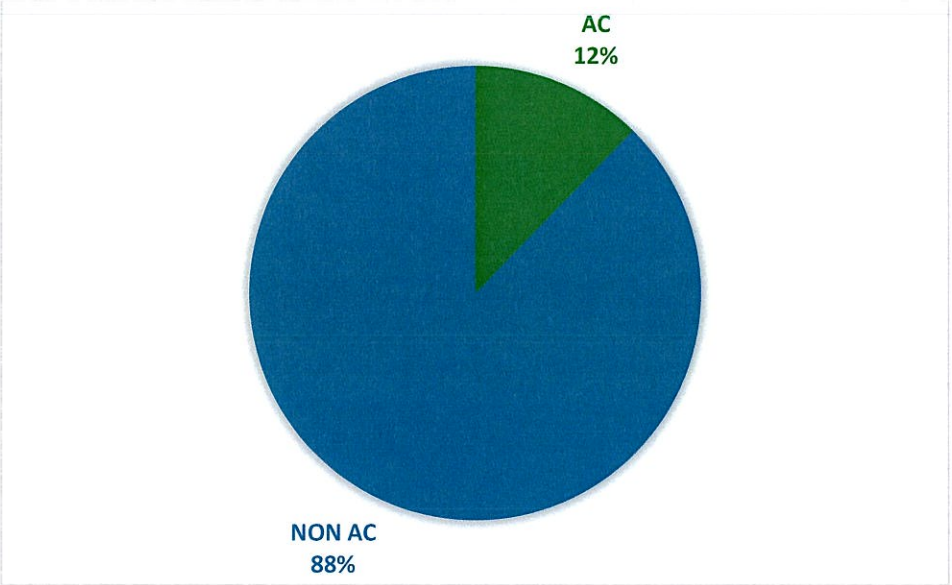


Figure 8: Conditioned and un-conditioned areas in Jhunjhunwala College

There are a total 529 ceiling fans fitted along with 60 exhaust fans and 5 wall mounted fan.

Fans contribute **17%** of the energy consumption. Break up of energy consumed by fans is provided in Fig. 9 and Table 12. The floor wise break up of fan consumption is provided in Figure 10 and Table 13.

Figure 9: Types of Fans

S. No.	Fan Type	Numbers	Total Consumption (kWh)
1.	Ceiling Fan	529	39647.4
2.	Exhaust fan	60	5271.6
3.	Wall Mounted Fan	5	386.4
	Grand Total	**594**	**45,305.4**

Table 12: Types of Fans and their wattages Consumption (kWh)

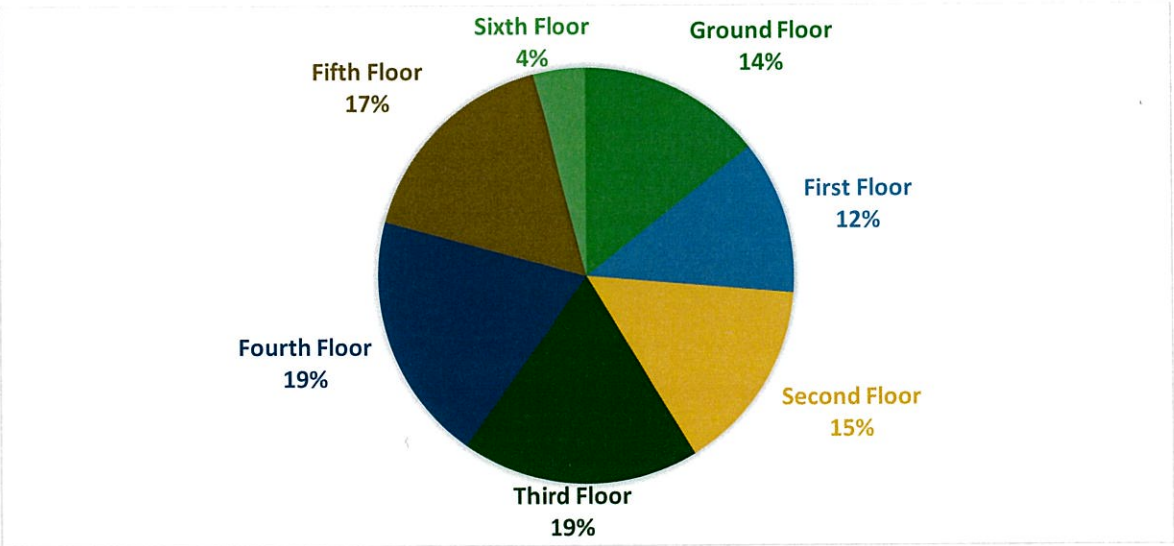


Figure 10: Percentage breakup of Floor-wise Annual Energy Consumption of Fans

Sr. No.	Floor	Total Consumption (kWh)
1	Ground Floor	6527.4
2	First Floor	5409.6
3	Second Floor	6789.6
4	Third Floor	8390.4
5	Fourth Floor	8776.8
6	Fifth Floor	7590
7	Sixth Floor	1821.6

Table 13: Total floor-wise Fans consumption (kWh)

Air conditioning is the third largest consumption for the overall college amounting to 19% of total energy consumption, 111.8 TR of refrigeration and 51,705.6 units of electricity annually (2022-2023). The comfort air-conditioning system at college mainly comprises of split and window units. The breakup of different indoor units and the floor wise consumption of AC is shown in Fig 11, Table 14 and Table 15.

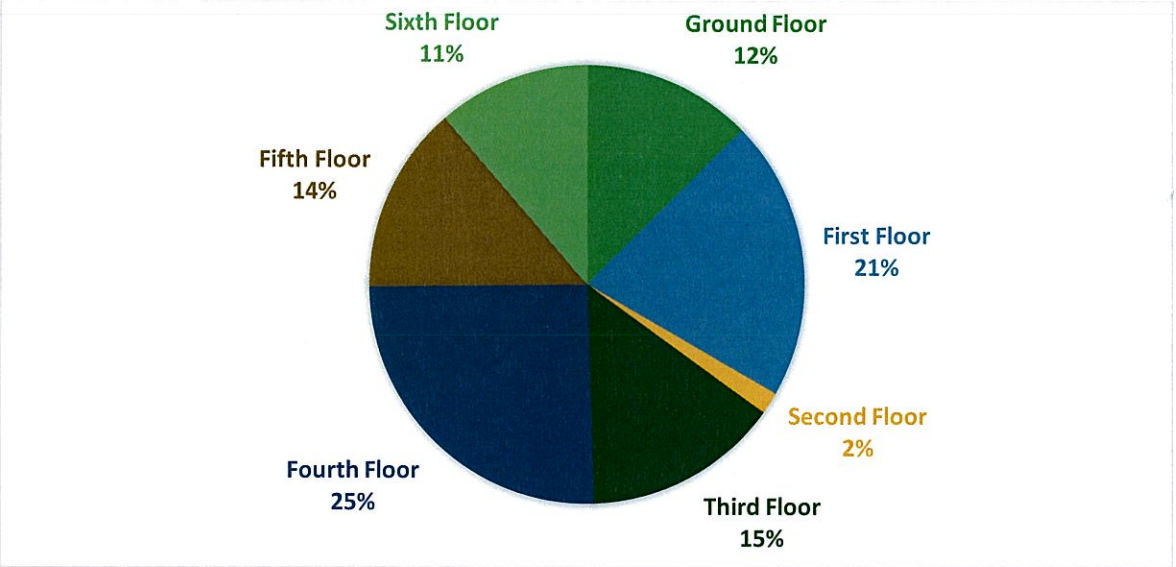


Figure 11: Percentage breakup of Floor-wise Annual Energy Consumption of AC

Sr. No.	Building	Total Consumption (kWh)
1	Ground Floor	6507
2	First Floor	10711
3	Second Floor	837
4	Third Floor	7542
5	Fourth Floor	13102
6	Fifth Floor	7162
7	Sixth Floor	5844

Table 14: Total floor-wise AC consumption (kWh)

Split AC- Ground floor						
Sr. No.	Parameters	Units	Chemistry Research Lab	Chemistry Staff Lab	Seminar Hall	Seminar Hall
1	Make	-	Mitsubishi	Daikin	Daikin	Mitsubishi
2	Capacity	TR	1.5	2	2	1
3	Specific volume of Air	m3/kg	0.85	0.85	0.85	0.85
4	Air Flow rate	m3/sec	0.2695	0.334475	0.381695	0.20
5	Power Consumption	kW	1.39	1.67	1.86	0.90
6	Overall kW/TR	kW/TR	1.444	1.635	1.596	1.44
7	Energy Efficiency Ratio	kW/kW	2.4305	2.1464	2.1992	2.44

3rd and 4th floor					
Sr. No.	**Parameters**	**Units**	**4th floor - Windows**	**4th floor statistics lab**	**3rd floor- Mathematics**
1	Make	-	Mitsubishi	Mitsubishi	Daikin
2	Capacity	TR	1.5	1.5	1.5
3	Specific volume of Air	m3/kg	0.85	0.85	0.85
4	Air Flow rate	m3/sec	0.17017	0.2405	0.2183
5	Power Consumption	kW	1.78	1.46	1.65
6	Overall kW/TR	kW/TR	3.276	1.988	2.476
7	Energy Efficiency Ratio	kW/kW	1.0715	1.7653	1.4179

Table 15: Details of AC units with their design parameters

The campus also has 67 ACs in total which include 46 split units and 21 window units installed in principal's cabin, computer lab, director's cabin, server room and Gymkhana etc.

- **Summary of Observations: HVAC**

1. Ceiling fans account for almost **87% and exhaust fans amount for 12% and wall mount fans account for 1% of the total energy consumed by fans.**
2. The overall fan consumption shows that **third & fourth floor uses highest number – 19% followed by fifth floor 17%, second floor 15%, first floor – 12%, all the other floors below 14 & 4%.**
3. The overall air conditioning consumption shows that maximum usage is by the **Fourth floor – 25%, First floor– 21%, followed by Third floor-15%, Fifth floor -14%, Ground floors -12%.**
4. As per the audit conducted, few AC units as marked in table 15 are working below required EER and immediate maintenances is required.

3.1.4 Equipment Energy Consumption

Equipment contributes 40% of the total energy consumption. Major equipment includes CPU, UPS, lifts, copier, projector, xerox machine, water pump, TV, computer desktops. The detailed break up of energy consumed by equipment is shown below.

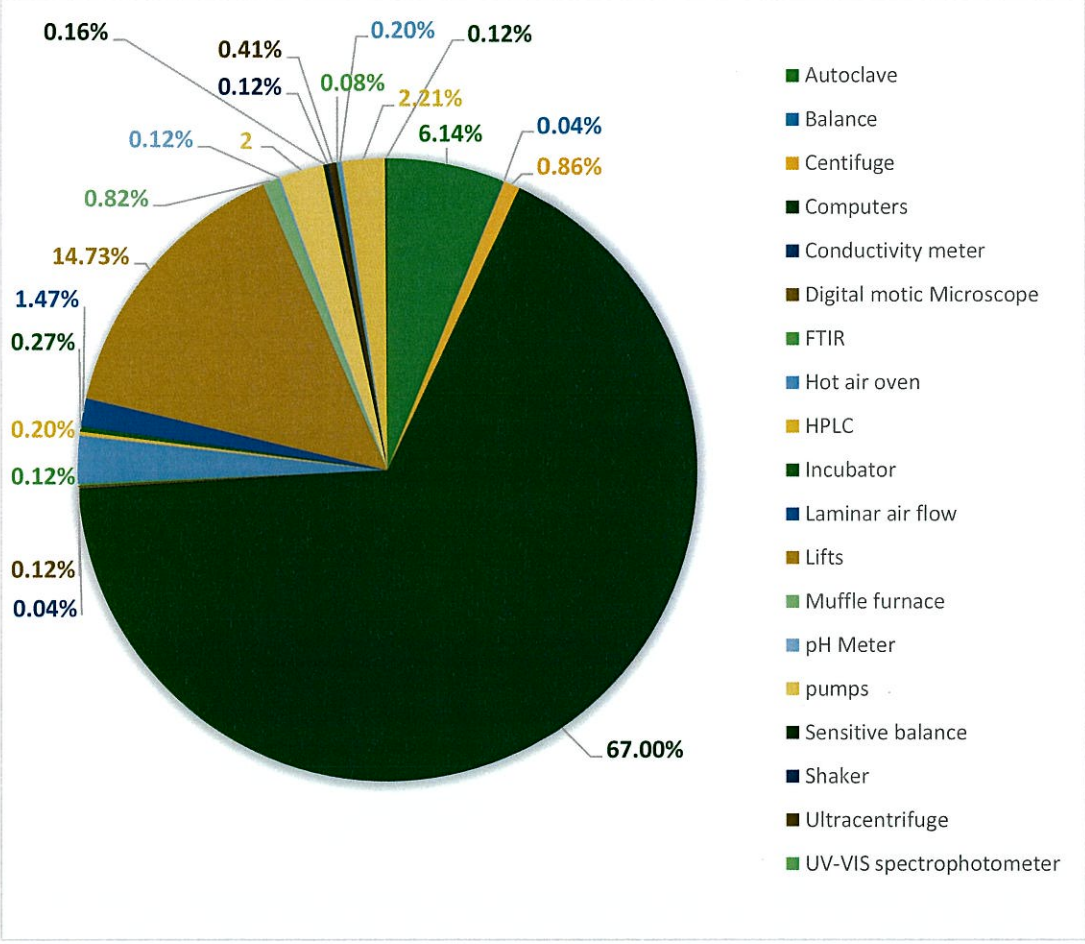


Figure 12: Types of equipment

S. No.	Equipment	Number	Wattage (kWh)
1	Autoclave	3	6900
2	Balance	1	46
3	Centifuge	3	966
4	Computers	562	75348
5	Conductivity meter	1	46
6	Digital motic Microscope	1	138
7	FTIR	1	138
8	Hot air oven	4	2760

9	HPLC	1	230
10	Incubator	2	299
11	Laminar air flow	8	1656
12	Muffle furnace	1	920
13	pH Meter	3	138
14	Sensitive balance	4	1725
15	Shaker	1	184
16	Ultracentrifuge	1	138
17	UV-VIS spectrophotometer	2	460
18	Vaccum oven	1	92
19	Water cooler	9	230
20	Zeiss Microscope	1	2484
21	Lift	2	11040

Table 16: Type of Equipment and their Wattage

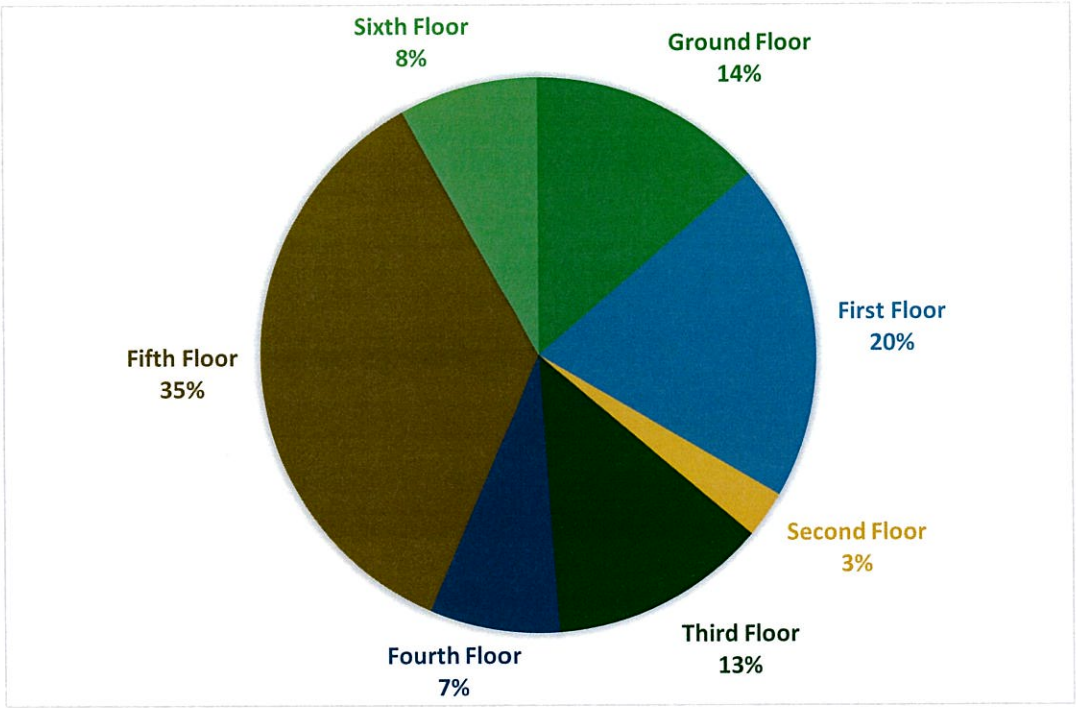


Figure 13: Percentage breakup of Floor-wise Annual Energy Consumption of Equipment

S. No.	Building	Total Consumption (kWh).
1	Ground Floor	14559
2	First Floor	20907
3	Second Floor	2898
4	Third Floor	13478
5	Fourth Floor	8004
6	Fifth Floor	37674
7	Sixth Floor	8556
Grand Total		**106076**

Table 17: Total floor-wise Equipment consumption (kWh)

Summary of Observations: Equipment

1. Total energy consumption by equipment is **40%**.
2. The energy consumption by equipment is primarily through **computers at 67% followed by Lift at 15% and Autoclave is 6%, Lamination machine is 4%, projector Is 4%, monitor is 3%, water pumps is 3%, microwave is 2%, and AV system, blowers, server, Wi-Fi routers is 1%.**
3. The largest consumption of energy with respect to equipment is **Fifth floor -35%,** followed by **First Floor – 20%.** This was mainly due to the administration and research areas have a greater number of working hours than classrooms.

   Some of the equipment used in the college are shown in the pictures below:

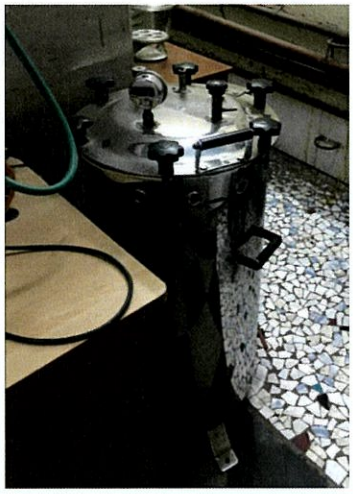


Plate 5: Autoclave machine

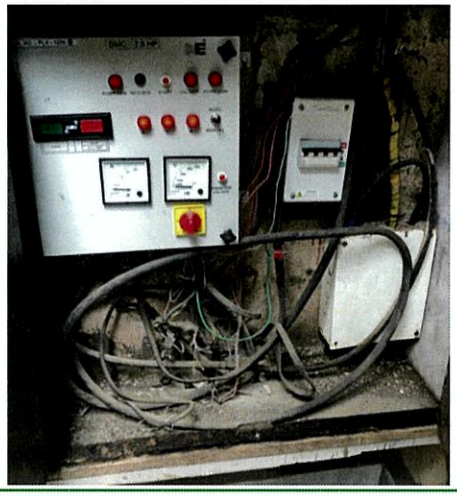


Plate 4: Pump Panel

Plate 7: Hot air oven of chemistry lab

Plate 6: Incubator shaker

3.1.5 Electrical system study, Earthing and leakage currents

Thermal imaging was applied to the electrical power distribution to detect hot spots – likely to cause failures. Temperature readings above 40°C, are of concern and repairs to those spots are necessary.

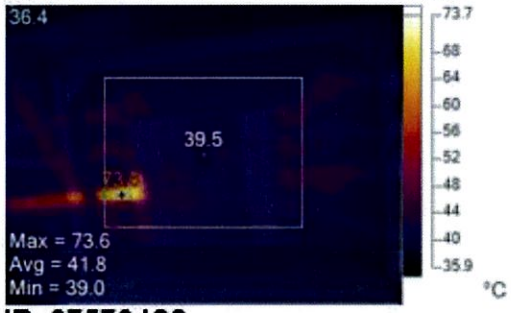
Thermography Summary				
Sr. No	Image No	Description	Temp °C	Remark
1	7576	MAIN MCB- METER NO. 5118667	73.6	Temperature Above Permissible Limit
2	7577	MAIN MCB- METER NO. 5118654	41.8	Temperature Above Permissible Limit
3	7578	MAIN MCB- 125A MCB- B SECTION+ LAW COLLEGE- METER NO. 5118677	42.1	Temperature Above Permissible Limit
4	7579	MAIN MCB 40A DP- CANTEEN METER NO. 8422768	41.2	Temperature Above Permissible Limit
5	7580	MAIN MCB- 40A DP- XEROX MACHINE- METER NO. 8716305	37.3	Temperature Within Permissible Limit
6	7581	MAIN MCB- 63A MCB-4P- LIFT+ PUMP, METER NO. 7697082	41.8	Temperature Above Permissible Limit
7	7582	1ST FR- OFFICE+ SEMINAR HALL- MAIN MCB- METER NO. 5118662	58.4	Temperature Above Permissible Limit
8	7583	MPS HALL+ LIFT+ SHABU HALL+ COLLEGE LIFT+ GR FR, 2ND FR, 3RD FR METER NO. 079992507	38.1	Temperature Within Permissible Limit
9	7584	5TH FR- COLLEGE- METER NO. 07901619	50.7	Temperature Above Permissible Limit
10	7585	COLLEGE OFFICE BUILDING- METER NO. 07723865 MAIN MCB- 100A MCB	34	Temperature Within Permissible Limit
11	7586	MAIN INCOMER- 63A MCB- COLLEGE- 3RD FR, 4TH FR, 5TH FR METER NO. 07859703	40.1	Temperature Above Permissible Limit

12	7587	GYMKHANA+ SEMINAR HALL- 100A BUSBAR	55.1	Temperature Above Permissible Limit
13	7588	GR FR- RESEARCH LAB+ CHEMISTRY LAB- 100A BUSBAR	81.3	Temperature Above Permissible Limit
14	7589	PUMP+ BACK SIDE OFFICES- 100A BUSBAR	33.9	Temperature Within Permissible Limit
15	7590	MAIN MCB- 100A BUSBAR- BIOLOGY DEPT- 1ST FR, GR FR- CHEMISTRY LAB	33	Temperature Within Permissible Limit
16	7591	1ST FR- MAIN MCB- 32A MCB- BIOLOGY DEPT.	34.3	Temperature Within Permissible Limit
17	7592	2ND FR- LEFT SIDE- PHYSICS DEPT MAIN 32A DP MCB	33.4	Temperature Within Permissible Limit
18	7593	2ND FR- RIGHT SIDE- CLASSROOM AREA- MAIN DB- 32A MCB	33.4	Temperature Within Permissible Limit
19	7594	3RD FR- LEFT SIDE- BUSBAR- 100A BUSBAR	44.8	Temperature Above Permissible Limit
20	7595	3RD FR- RIGHT SIDE- NEW BUILDING- BIOTECH DEPT- 32A 4P MCB+ 40A, 300mA- ELCB	37.2	Temperature Within Permissible Limit
21	7596	MAIN DB SOLAR SYSTEM- 32A MCB- 2NOS.	36.1	Temperature Within Permissible Limit
22	7597	4TH FR- BUSBAR- SOLAR BUSBAR- 100A	42.8	Temperature Above Permissible Limit
23	7598	LIFT NO.1 COLLEGE MAIN GATE LIFT- 40A, 100mA- ELCB	36.9	Temperature Within Permissible Limit
24	7599	LIFT NO.03- ICTP SWITCH 63A FUSES.	37.3	Temperature Within Permissible Limit

Table 18: Results of thermal imaging of distribution panels

Below are few images of thermography applied to the electrical power distribution to detect hot spots which can cause failures, and need immediate attention.

MAIN MCB- METER NO. 5118667



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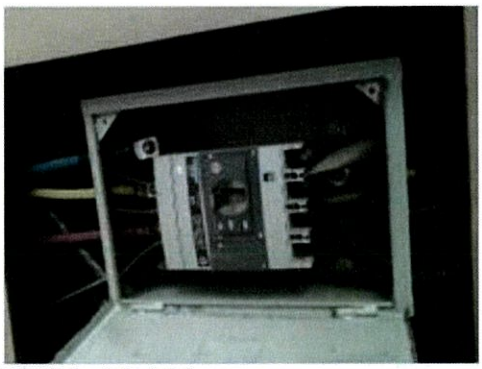
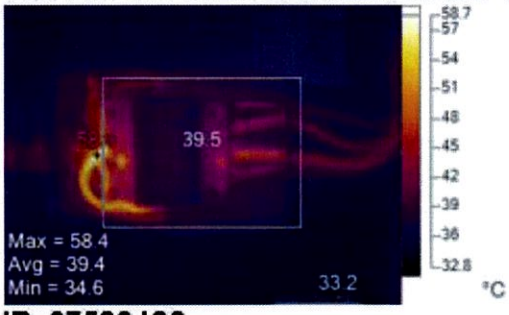
4/28/2023 2:05:01 PM
Temperature Above Permissible Limit



Visible Light Image

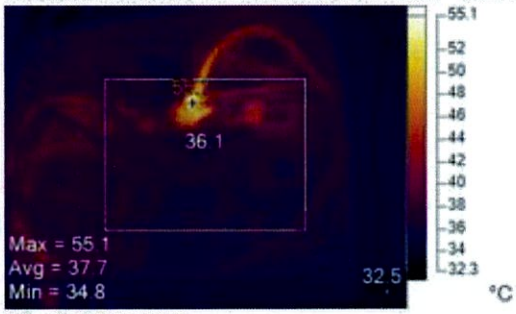
1ST FR- OFFICE+ SEMINAR HALL- MAIN MCB- METER NO. 5118662



IR_07582.IS2
4/28/2023 2:17:37 PM
Temperature Above Permissible Limit

Visible Light Image

GYMKHANA+ SEMINAR HALL- 100A BUSBAR



IR_07587.IS2
4/29/2023 11:13:03 AM
Temperature Above Permissible Limit

Visible Light Image

The Neutral Earth Voltage was checked in the following locations, few was found to be within permissible limit and few were found above permissible limit, which needs to be repair at earliest.

N-E Voltage Details			
Sr. No	**Description**	**N-E voltage (Volt)**	**Remark (Acceptable limit is less than 2 Volts)**
	5th Floor-		
1	Computer Lab	1.9	Within Permissible Limit
2	Computer Lab-1	2.1	Above Permissible Limit
3	Computer Room near to staff Room	1.8	Within Permissible Limit
4	IT staff Room	2.2	Above Permissible Limit
5	IT Computer Room	2.3	Above Permissible Limit
6	Class Room-52	1.7	Within Permissible Limit
	4th Floor-		
7	BBI Staff Room	1.8	Within Permissible Limit
8	BMS Staff Room	2.2	Above Permissible Limit
9	Statistic Staff Room	2	Within Permissible Limit
10	Teacher Staff Room	1.9	Within Permissible Limit
	3rd Floor-		Within Permissible Limit
11	Computer Lab	1.8	Within Permissible Limit
12	Mathematics Staff Room	1.9	Within Permissible Limit
13	Library	1.7	Within Permissible Limit
14	Biotechnology	1.9	Within Permissible Limit
	2nd Floor-		Within Permissible Limit
15	Physics Room-3	2.7	Above Permissible Limit
16	Physics Staff Room	1.3	Within Permissible Limit
17	Biology Staff Room	0.3	Within Permissible Limit
18	Biology Lab-3	2.1	Above Permissible Limit

19	Class Room- 11	1.8	Within Permissible Limit
20	Class Room- 12	1.7	Within Permissible Limit
	First Floor-		Within Permissible Limit
21	Pantry	2.2	Above Permissible Limit
22	Admin Office	2.6	Above Permissible Limit
23	Admin Office	2.2	Above Permissible Limit
24	Admin Office	2.3	Above Permissible Limit
25	Biology Lab	1.9	Within Permissible Limit
26	Biology Lab	2.1	Above Permissible Limit
27	Biology Lab	2.6	Above Permissible Limit
28	Principal Office	1.5	Within Permissible Limit
	Ground Floor-		Within Permissible Limit
29	Labrary-4 Chemistry and physics	1.5	Within Permissible Limit
30	Labrary-3 Chemistry	2.2	Above Permissible Limit
31	Chemistry Store Room	1.8	Within Permissible Limit
32	Chemistry Lab-1	1.7	Within Permissible Limit
33	Chemistry Staff Room	1.6	Within Permissible Limit
34	Main MCB - Meter No. 5118667	1.7	Within Permissible Limit
35	Main MCB - Meter No. 5118654	0.5	Within Permissible Limit
36	Main MCB - 125a MCB - B Section+ Law College- Meter No. 5118677	1.3	Within Permissible Limit
37	Main MCB 40a Dp- Canteen Meter No. 8422768	1.7	Within Permissible Limit
38	Main MCB - 40a Dp- Xerox Machine- Meter No. 8716305	1.9	Within Permissible Limit
39	Main MCB - 63a Mcb-4p- Lift+ Pump, Meter No. 7697082	1.4	Within Permissible Limit

40	1st Fr- Office+ Seminar Hall- Main MCB - Meter No. 5118662	1.6	Within Permissible Limit
41	MPS Hall+ Lift+ Shabu Hall+ College Lift+ Gr Fr, 2nd Fr, 3rd Fr Meter No. 079992507	0.8	Within Permissible Limit
42	5th Fr- College- Meter No. 07901619	1	Within Permissible Limit
43	College Office Building- Meter No. 07723865 Main MCB - 100a MCB	0.7	Within Permissible Limit
44	Main Incomer- 63A MCB - College- 3rd Fr, 4th Fr, 5th Fr Meter No. 07859703	0.8	Within Permissible Limit
45	Gymkhana+ Seminar Hall- 100a Busbar	2.1	Above Permissible Limit
46	Gr Fr- Research Lab+ Chemistry Lab- 100a Busbar	2	Above Permissible Limit
47	Pump+ Back Side Offices- 100a Busbar	1.8	Within Permissible Limit
48	Main MCB 100a Busbar- Biology Dept- 1st Fr, Gr Fr- Chemistry Lab	1.8	Within Permissible Limit
49	1st Fr- Main MCB - 32a MCB - Biology Dept.	2.2	Above Permissible Limit
50	2nd Fr- Left Side- Physics Dept Main 32a Dp Mcb	2.3	Above Permissible Limit
51	2nd Fr- Right Side- Classroom Area- Main Db- 32A MCB	1.8	Within Permissible Limit
52	3rd Fr- Left Side- Busbar- 100a Busbar	2.2	Above Permissible Limit
53	3RD FR- RIGHT SIDE- NEW BUILDING- BIOTECH DEPT- 32A 4P MCB+ 40A, 300ma- ELCB	1.8	Within Permissible Limit
54	Main Db Solar System- 32A MCB- 2nos.	2.2	Above Permissible Limit
55	4th Fr- Busbar- Solar Busbar- 100A	2.3	Above Permissible Limit
56	LIFT NO.1 COLLEGE MAIN GATE LIFT- 40A, 100ma- ELCB	1.8	Within Permissible Limit
57	Lift No.03- ICTP Switch 63A Fuses.	1.9	Within Permissible Limit

Table 18: Earth- Neutral Voltage

3.1.5.2. Earthing and Leakage Currents

Earthing And Leakage Currents were also measured during the Audit. As per observations of audit, most of the earth pit resistance were above permissible limit as shown in table 20

	Description	Resistance Ω	Current mA	Remark
1	MAIN MCB- METER NO. 5118667	12.4	15.3	Earthing Above Permissible Limit
2	MAIN MCB- METER NO. 5118654	8.3	10.6	Earthing Above Permissible Limit
3	MAIN MCB- 125A MCB- B SECTION+ LAW COLLEGE- METER NO. 5118677	2.6	4.85	Earthing Above Permissible Limit
4	MAIN MCB 40A DP- CANTEEN METER NO. 8422768	3.4	6.25	Earthing Above Permissible Limit
5	MAIN MCB- 40A DP- XEROX MACHINE- METER NO. 8716305	4.6	7.05	Earthing Above Permissible Limit
6	MAIN MCB- 63A MCB-4P- LIFT+ PUMP, METER NO. 7697082	3.5	4.5	Earthing Above Permissible Limit
7	1ST FR- OFFICE+ SEMINAR HALL- MAIN MCB- METER NO. 5118662	6.1	4.65	Earthing Above Permissible Limit
8	MPS HALL+ LIFT+ SHABU HALL+ COLLEGE LIFT+ GR FR, 2ND FR, 3RD FR METER NO. 079992507	0.74	53.7	Leakage Value Above Permissible Limit
9	5TH FR- COLLEGE- METER NO. 07901619	0.42	204	Leakage Value Above Permissible Limit
10	COLLEGE OFFICE BUILDING- METER NO. 07723865 MAIN MCB- 100A MCB	0.41	192	Leakage Value Above Permissible Limit
11	MAIN INCOMER- 63A MCB- COLLEGE- 3RD FR, 4TH FR, 5TH FR METER NO. 07859703	35.3	3.35	Earthing Above Permissible Limit

12	GYMKHANA+ SEMINAR HALL- 100A BUSBAR	0.084	10.3	Earthing Within Permissible Limit
13	GR FR- RESEARCH LAB+ CHEMISTRY LAB- 100A BUSBAR	0.085	10.4	Earthing Within Permissible Limit
14	PUMP+ BACK SIDE OFFICES- 100A BUSBAR	1.8	5.65	Earthing Within Permissible Limit
15	MAIN MCB- 100A BUSBAR- BIOLOGY DEPT- 1ST FR, GR FR- CHEMISTRY LAB	180	3.45	Earthing Above Permissible Limit
16	1ST FR- MAIN MCB- 32A MCB- BIOLOGY DEPT.	15.3	8.2	Earthing Above Permissible Limit
17	2ND FR- LEFT SIDE- PHYSICS DEPT MAIN 32A DP MCB	OPEN	0	Earthing Above Permissible Limit
18	2ND FR- RIGHT SIDE- CLASSROOM AREA- MAIN DB- 32A MCB	OPEN	2.3	Earthing Above Permissible Limit
19	3RD FR- LEFT SIDE- BUSBAR- 100A BUSBAR	215	3.4	Earthing Above Permissible Limit
20	3RD FR- RIGHT SIDE- NEW BUILDING- BIOTECH DEPT- 32A 4P MCB+ 40A, 300mA- ELCB	0.49	10.65	Earthing Within Permissible Limit
21	MAIN DB SOLAR SYSTEM- 32A MCB- 2NOS.	0.23	42.7	Leakage Value Above Permissible Limit
22	4TH FR- BUSBAR- SOLAR BUSBAR- 100A	2.1	177	Earthing Above Permissible Limit
23	LIFT NO.1 COLLEGE MAIN GATE LIFT- 40A, 100mA- ELCB	5.3	15.75	Earthing Above Permissible Limit
24	LIFT NO.1- 5 HP MOTOR	0.69	6.25	Earthing Within Permissible Limit
25	LIFT NO.03- ICTP SWITCH 63A FUSES.	1.1	6.5	Earthing Within Permissible Limit

26	LIFT NO.03- 7.5 HP MOTOR	0.37	0.55	Earthing Within Permissible Limit

Table 20: Earth Resistance measurement

Poor insulation in electric devices and equipment's is the cause of earth leakage currents. Earth leakage currents are a major source of two very common electrical hazards:

- Risk of fire
- Risk of electrocution

In addition to the above, continuous undetected earth leakage currents also result in waste of electricity.

3.1.6 Benchmarking - Energy Performance Index (EPI)

The **Energy Performance Index (EPI) of Jhunjhunwala College is 33.68 kWh/sq. m/year in 2022-2023as the billing data**. As per the **Bureau of Energy Efficiency's (BEE) EPI benchmark for institutional** buildings in **warm-humid climate zone (such as Mumbai) is 150 kWh/sq. m/year.** The energy consumption of the college is well below this benchmark.

Climate Zone	EPI (kWh/m²/yr)
Warm & Humid	150
Composite	117
Hot & Dry	106
Moderate	129

Table 21: EPI bench mark by BEE for Institutes

3.1.7 Benchmarking – Specific Energy Consumption (SEC)

Specific Energy Consumption (SEC) is defined as the energy consumption per unit product. The specific energy consumption taking into account students, faculty and staff members were calculated to form a benchmark of **33.68 kWh/ person/ year** and **Rs. 416 per person per annum (considering 2022-2023 data).**

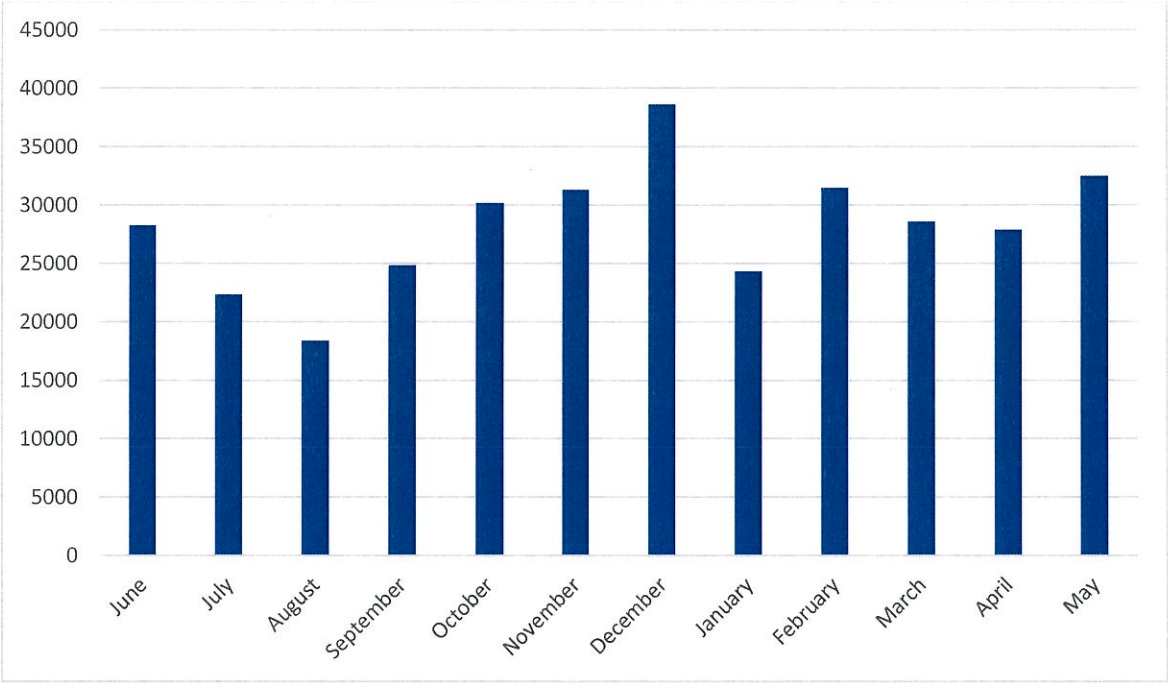
3.1.8 Billing Analysis and Metering system

1. The energy consumption in the college is mainly in the form of electricity which is supplied through **Adani Electricity Utility company** and 10 KW solar PV panels on the terrace
2. The College is billed under category **LT IV (B)** for all 9 meters. This category is applicable for public services which includes Government and private hospitals and educational institutions.
3. The Monthly electricity bill for all the meters with **LT IV (B)** has the basic rate of energy as **Rs. 6.00 per unit (kWh)** in addition to fixed demand charge of **Rs. 425** per connection per month, **Wheeling charge of Rs. 1.74 per unit. Additional Fix charge of Rs 250 per 10 KW for three phase connection.** The Tariff Structure of Adani Electricity Utility company along with additional Time of Day (TOD) tariff is summarized in tables below:

Tariff Category	Fixed Demand charge ₹/Month	Energy charge ₹/Unit	Electricity duty	Wheeling charge ₹/Unit	RA charge ₹/Unit	FAC rate Paise / Unit
LT IV B	Rs. 425 per connection per month	6.00	@21%	1.74	0.43	50.63

Table 19: Tariff Structure as per the Adani for FY 2021 – 22

4. The overall per unit charge is Rs**. 11 per unit.**
5. It is **observed** that the annual energy consumption of the college as per electricity bills is **2,78,564 kWh for the Year March 2021– February 2023.** The average monthly consumption is approximately **23,213.7 units.** It can be seen that the months of December and May have the highest consumption. This could be attributed to excessive discomfort and use of fans and ACs due to higher insolation and relative humidity. It may also be related to activities in the college.



3.1.9 Pumps and Motors

The college has 3 main water pumps in the passage of ground floor. Two pumps are used to pump the water from UG tank and ring well to OHT. At present the pumps are run in auto mode of 5 hp capacity each as controllers are installed for running of the pump. The photos of the Pumps and their performance is provided in Plates 8 and Table 23

Sr no	Location of the Pumps & Lift Motors	Capacity in (hp)	Number	Time	Days	KW	Total usage Kwh/year
1	Passage of Ground floor	5 hp	3	2 hours	300	7.5	2250

Table 20: Performance details of pumps

Plate 8: Underground water pump

3.1.10 Renewable Energy- Rooftop Solar PV

The College has 34 nos. of Solar PV panels installed on the Rooftop in 2017 which have capacity of 10 kWp. These panels were installed by Hon. MP Dr. Kirti Somaiya as per the guidelines of MPLADS Administrative Approval in 2016-17. These panels are laid on the Sloping roof, based on the slope of the roof and not as per the best orientation for higher solar gain. A separate energy meter and inverter is also attached to the system.

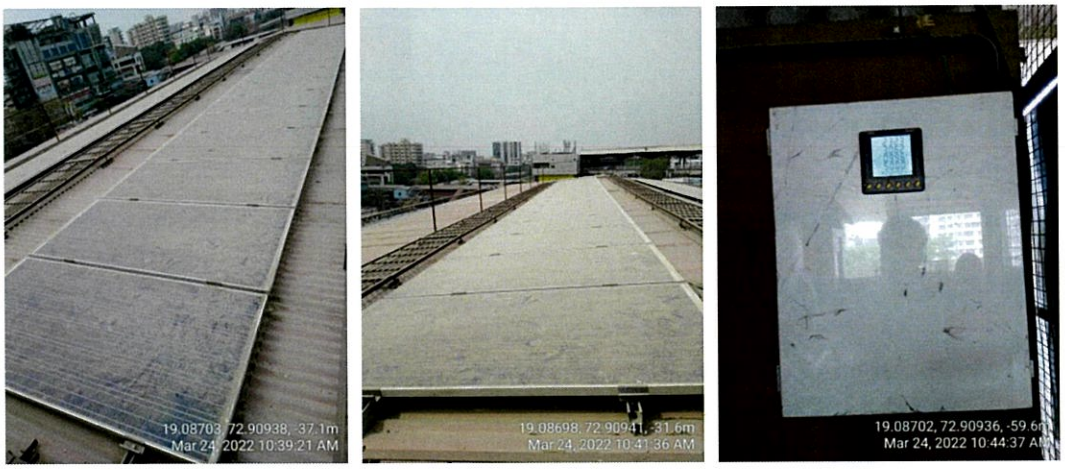


Plate 9 : Installed Solar PV panels on the sloping roof and Solar meter of the college

1. Based on meter readings from Energy meter recorded from **March 2022 to Febuary 2023, it was recorded that power generated is 28.47 kWh per day**. The total electricity generated throughout the year was **10,393kWh**.
2. College collaborated with Utility (Adani) and introduce a net metering system so that they wheel the power back to the Grid. The invoice of this system installed is attached in Annexure H.
3. The solar PV manufacturing data could not be obtained and hence it is not possible to comment on the deterioration rate considered on Y-O-Y basis for ageing of the Solar Panels.
4. As being given to understand this Solar power is consumed fully on fourth floor wherein considerable power demand is present at any given point of time.

3.2 Water

The College has an OHT of capacity **1,000 litres** and an UGT of capacity **5,000 litres**. There 135 wash basins (some located in labs and others are in washrooms), 8 WC have single flush type flushing tank while the rest of the toilet units have only ablution taps, and a total of 12 drinking water coolers. There are around 9 individual taps, of which 7 are used for gardening (on ground floor and terrace),
and 2 are near temple.

Considering 6950 persons at the rate of 45 litres per person per day (as per NBC), the maximum total **daily** requirement of the college is **312.75** kilo litres. This is shown in table no. 26. Monthly requirement should be **6,255 kilo litres** considering **20 days** of operation per month.

However, as per water bills submitted by the college, average monthly water consumption is **516 kilo litres**, which means daily consumption is around **26.9 kilo litres.** This amounts only **9%** of the calculated daily water consumption.

The college pays Rs. 5.94 per kilo litres of water in addition to the 70% of water charges as sewerage charges according to the tariff specified in the water bills.

The College campus water bill shows that the average **monthly water charges are Rs. 5,749/-,** accordingly the **per litre** of water cost is around **Rs. 11.15/-.** Table no. 25 gives details of the faucets, flushing devices and water coolers in the college.

S. No	Building	Floor	Total No.	Total No. of Toilet Blocks	Drinking Water/ Cooler	Wash Basin	Wash basin taps	Type of Flushing Tank (Dual Flush/ Single Flush)
1	Garden	Campus	6				Tap	
2	Chem Lab 1	Ground floor	17			Basin Tap		
3	Chem Lab 2	Ground floor	21			Basin Tap		
4	Chem Lab 3	Ground floor	9			Basin Tap		
5	Research lab	Ground floor	2			Basin Tap		
6	Chem Jr lab	Ground floor	14			Basin Tap		
7	Canteen	Ground floor	5			Basin Tap		
8	Canteen	Ground floor	2		Water cooler			
9	Ground floor	Ground floor	2		Water cooler			
10	LCR	1st Floor	5				Tap	

11	1st floor	1st Floor	2		Water cooler			
12	Office Toilet	1st Floor	3					Single Flush
13	Office toilet	1st Floor	3			Basin Tap		
14	Pantry	1st Floor	1			Basin Tap		
15	Panty	1st Floor	2		Water cooler			
16	Biology Lab	1st Floor	9			Basin tap		
17	Biology Lab	1st Floor	3		Water cooler			
18	2nd floor	2nd floor	4		Water cooler			
19	Physics	2nd floor	9			Basin tap		
20	Boys Washroom	2nd floor	3					Single Flush
21	Boys Washroom	2nd floor	4			Basin tap		
22	Boys Washroom	2nd floor	2				Tap	
23	3rd floor	3rd floor	2		Water cooler			
24	Boys Washroom	3rd floor	3	3 push			Tap	
25	Boys Washroom	3rd floor	2			Basin tap		
26	Boys Washroom	3rd floor	1				Tap	
27	Library	3rd floor	1			Basin tap		
28	Biotech Lab	3rd floor	24			Basin tap		
29	Biotech	3rd floor	3		Water cooler			
30	Stats	4th floor	1			Basin tap		
31	Research lab	4th floor	2			Basin tap		
32	Staff room	4th floor	2		Water cooler			
33	Staff room Gents washroom	4th floor	6				Tap	
34	Staff room Ladies washroom	4th floor	4				Tap	
35	Girls washroom	4th floor	2				Tap	
36	Lunch room	4th floor	1			Basin tap		
37	Lunch room	4th floor	2		Water cooler			

38	Temple	4th floor	2				Tap	
39	Research preparation room	4th floor	2			Basin tap		
40	4th floor	4th floor	2		Water cooler			
41	BMS Washroom	4th floor	1					Single Flush
42	BMS Washroom	4th floor	1			Basin tap		
43	5th floor	5th floor	3		Water cooler			
44	CS Washroom	5th floor	1					Single Flush
45	CS Washroom	5th floor	3			Basin tap		
46	BVOC Washroom	5th floor	2				Tap	
47	BVOC Washroom	5th floor	1			Basin tap		
48	61-62 room no.	5th floor	1				Tap	
49	Garden	Terrace	1				Tap	
50	Beauty parlour	Terrace	2			Basin tap		

Table 25: Toilet details in college

Category	Number of Occupants	Water requirement per person (LPCD)			Total water requirement (LPCD)		
		Domestic	Flushing	Total	Domestic	Flushing	Total
Students	6666	20	25	45	133320	166650	299970
Teachers	134	20	25	45	2680	3350	6030
Non-teaching staff	125	20	25	45	2500	3125	5625
Administrative staff	25	20	25	45	500	625	1125
Total	6950				139000	173750	312750
					139	**173.75**	**312.75**

Table 21: Total water usage of the Campus

College has installed a water recycling unit to treat the waste water from drinking water cooler for reuse i.e., watering plants or gardening. This is an initiative to further reduce

the water for landscaping is commendable, as institution already have mist irrigation for terrace garden.

Plate 20: Waste water recycling unit being installed at the campus

3.2.1. Rain Water Harvesting

The college has successfully installed a rainwater harvesting system collecting water from the rooftop catchment through down take pipes fitted with filter which is used to recharge a 20 feet deep ring well. This water is used for cleaning the campus, landscaping and watering the plants as the quality of water is not feasible for drinking.

Plate 21: Rainwater harvesting down-take pipe and Recharge Ring well provision in campus

3.3 Solid Waste

The college generates approximately half kg of waste per day which amounts to 100 kg/year, which is organic / food waste from canteen. The waste is not segregated at source as per information submitted by college. There is scope to include various

segregation, recycling and composting concepts in the campus. The college has already marked out a place on campus for a compost pit.

Plate 22: Compost pit provided in campus

The college has developed an E-waste collection system in collaboration with Eincarnation Recycling Pvt Ltd. that collects the E-waste periodically.

Around 1400 kg of paper waste generated during the academic year is stored properly and then sold to the paper mart who send the paper for recycling. The acknowledgement is attached in Annexure F.

College has devised a credit based waste collection module. This not only creates the awareness amongst the student but motivates them to collect and deposit multi layer, in the process cleaning the surrounding environmetal from a type of plastic waste, allowing systematic recycling of the same. In accordance to this, Kulkarni foundation has nominated them as branch of Safai Bank of India. Letter forms the Annexure E.

An incinerator for medical waste is provided in one of the toilets on 3rd and 4th floor.

3.4 Environment Quality

As the college is located right next to the major railway station (Ghatkopar), there are several sources of noise and air pollution due to food stalls, railway line and associated activities. However, the college has created green buffer within and outside college along the compound. They have also created a green house on the roof top which has mist

irrigation and hydroponic technology of growing plants. These efforts taken by the college are commendable. The college already has identified and listed the number of trees on campus. As they have botany department all the trees are listed by their scientific name and the information is already. All identified trees in the campus have QR code plate, scanning which the basic information of the tree can be read.

The list of trees along with their location submitted and displayed in the college is given below:

Sr. No	Common name	Scientific name	Type of plant	No. of Trees	Location
1	Sacred Fig	*Ficus religiosa*	*Tree*	2	Ground floor
2	Cluster Fig	*Ficus racemosa*	*Tree*	1	Ground floor
3	Mango tree	*Mangifera indica*	*Tree*	4	Ground floor
4	Yellow flametree	*Peltophorum pterocarpum*	*Tree*	4	Ground floor
5	Kasah	*Sterculia alata*	*Tree*	1	Ground floor
6	Indian Beech	*Ponngamia pinata*	*Tree*	1	Ground floor
7	Rain tree	*albizia saman*	*Tree*	1	Ground floor
8	Indian mast tree	*Polyalthia longifolia*	*Tree*	49	Ground floor
9	Pinwheel Flower tree	*Tabernaemontana divaricata*	*Shrub*	1	Ground floor
10	Areca palm	*Dypsis lutescens*	*Shrub*	9	Ground floor
11	Dumb cane	*Dieffenbachia seguine*	*Shrub*	5	Ground floor
12	Indian screw tree	*Helecteris isora*	*Tree*	1	Ground floor
13	Wild plantain	*Heliconia sp.*	*Shrub*	4	Ground floor
14	Crane Flower	*Sterlitzia reginae*	*Shrub*	2	Ground floor
15	Flame of woods	*Ixora coccinea*	*Tree*	3	Ground floor
16	Chinese chaste tree	*Vitex negundo*	*Tree*	2	Ground floor
17	Sandpaper vine	*Petrea volubilis (Liana)*	*Creeper*	1	Ground floor
18	Sago Palm	*Cycas sp.*	*Tree*	1	Ground floor
19	Rangoon Creeper	*Combretum indicum*	*Creeper*	1	Ground floor
20	Monkey brush vine	*Combretum rotundifolium*	*Creeper*	1	Ground floor
21	Ceylon Ironwood	*Messua ferrea*	*Tree*	1	Ground floor
22	Bitter cassava	*Manihot esculanta*	*Shrub*	1	Ground floor
23	White frangipani	*Plumeria alba*	*Tree*	1	Ground floor
24	Bridal Bouquet	*Plumeria pudica*	*Tree*	1	Ground floor

Table 22: List of Trees Species in the Campus

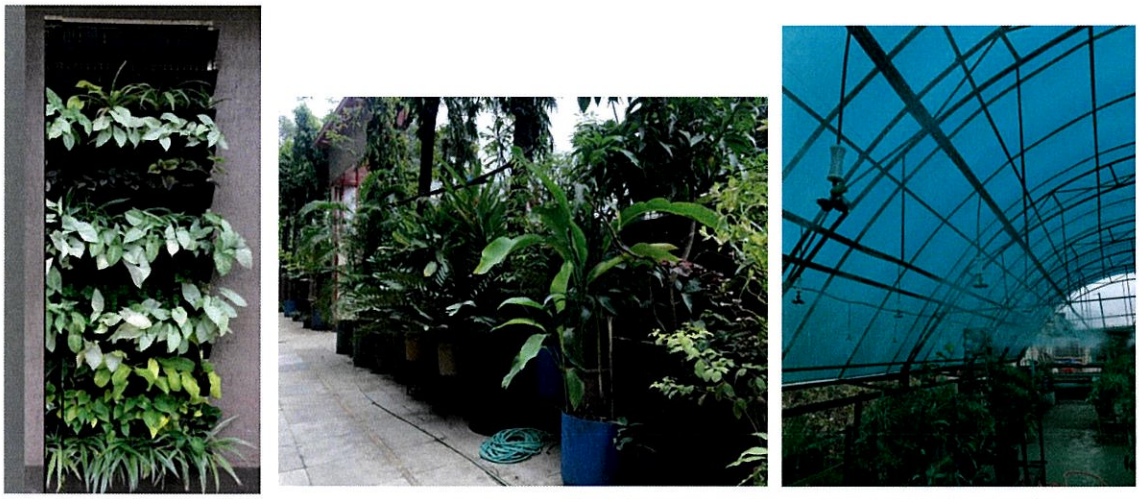


Plate 23: Trees and Shrubs in the campus

3.4.1. Beyond the Campus

<u>Activity 1:</u> Mega Beach Clean-up at Mahim (Celebrating World Environment Day)

Volunteers of Pavo Nature Club participated in Mega Beach Clean-up Drive at Mahim beach, which was conducted in collaboration with Muskurate Raho Foundation on account of World Environment Day. Volunteers were guided about the importance of beach clean-up. Volunteers separated Dry and wet waste from beach shore. It was with an aim to promote Safe Beaches for Marine Ecosystem.

<u>Activity 2:</u> Vruksha Bandhan

The Vruksha Bandhan was celebrated in collaboration with Atulya Shuruaat. The main motive behind this event was to make understand students about how we need to protect the trees to let them protect us. It was celebrated near the Ramniranjan Jhunjhunwala College's First gate. The event made us realize that our brother trees also need protection to protect us and we should do the need.

<u>Activity 3:</u> Department of Environmental Science and Disaster Management- Elasmobranchs and their conservation

A seminar was conducted by the Department of Environmental Science and Disaster Management on account of International Whaleshark Day on 30th August 2022. For the event, Ms. Dhanashree Bagade from Mangrove Foundation was invited to give a talk on 'Elasmobranchs and their conservation in Maharashtra'. She was accompanied by Mr. Jayesh Vishwakarma, Scientific Officer from Mangrove Foundation. 4 teachers and 28 students attended the seminar.

Activity 4: Tree Plantation Drive

The Tree Plantation Drive was conducted with an aim to control Global Warming, make Environment Pollution free and spread awareness on the importance of keeping a clean and green environment. Pavo nature club volunteers of RJ College participated in Tree Plantation Drive conducted on 19 June in collaboration with Muskurate Raho Organisation at Aarey Forest. Total 22 students participated in the drive students planted the tree saplings and learned new techniques about plantation. It was aimed for our future in order to make Mumbai Greener and pollution free.

The college has conducted more than 15 activities like tree plantations, beach clean-up drives, ecofriendly lantern making workshop, eco friendly colours, home waste composting workshop and many seminars on water and tree conservation. Details and images of few of the workshop is given as above. The college is also awarded the work of making QR codes for the trees along the main roads and parks in the jurisdiction of BMC. All the activities and awareness regarding environment well-being which is done by this college is remarkable.

3.5 Carbon Footprint

The total energy carbon footprint of the college is **220.06t** for one year. Majority college students and faculty use public transport like BEST buses and local trains to reach the college. The nearest railway station is Ghatkopar railway station for students and faculty.

4. Recommendations for Green Campus and Feasibility for Jhunjhunwala College

4.1 Visual Comfort and Energy Efficiency

The LPD values in educational spaces such as classrooms are found to be meeting the maximum norms as prescribed by ECBC 2017. However, few spaces correspond to lower illumination levels as measured during the random lux level survey of spaces. The overall lighting consumption is meeting the ECBC norms. It is therefore prescribed to improve the illumination levels in some spaces which have low illumination levels.

4.1.1 Replacement of T8 (40W) Fluorescent Tube Lights (FTLs) along with electromagnetic ballast with 18W LED Tube Lights having lumen output of 1800 (efficacy = 100 Lumens per Watt)

Since 40W Fluorescent Tube Lights (FTLs) are the largest source of lighting energy consumption, they should be replaced with efficient 18W LED T8 tube lights of 1800 lumens output (efficacy of 100 L/W) with long life of 40,000 hours, diffused uniform light output, better color rendering (CRI>83) suitable for learning spaces and built in protection circuit.

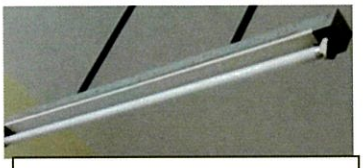


Plate 24: Existing 40W Fluorescent Tube Lights

Plate 25: Proposed 18W LED Tube Lights of 1800 Lumens output (efficacy = 100 L/ W)

Replacement of Non LED 40 W Tubelight to 18 W LED Tubelight										
Existing Type of Light	Existing Quantity	Existing Consumption (kWh)	Proposed type of Light	Proposed Quantity	Estimated Consumption (kWh)	Rate per unit (Rs)	Total Cost (Rs)	Annual Savings (kWh)	Annual Savings* (Rs)	Payback in years
40W Fluorescent tube light	315	23282.4	18W LED (t8) of 1800 Lumens	315	10477.08	₹ 300.00	₹ 94,500.00	12805.32	₹ 1,32,919.22	0.71

Table 28: Table for calculation of Replacement of tube lights and LED lights

4.1.2 Replacement of T8 (40W) Fluorescent Tube Lights (FTLs)and LED lights with sensor based dimmable lights in passages

Replacement of Non-LED 40 W Tube light to 18 W LED Tube light - Sensor based & Dimmable (Corridor Area)										
Existing Type of Light	Existing Quantity	Existing Consumption (kWh)	Proposed type of Light	Proposed Quantity	Estimated Consumption (kWh)	Rate per unit (Rs)	Total Cost (Rs)	Annual Savings (kWh)	Annual Savings* (Rs)	Payback in years
40W Fluorescent tube light	17	1273.6	18W LED (t8) of 1800 Lumens	17	573.12	345.00	5,865.00	700.48	7,270.98	0.81
24W LED lights	44	2023.68	18W LED (t8) of 1800 Lumens	44	1517.76	345.00	15,180.00	505.92	5,251.45	2.89

Table 23: Table for calculation of Replacement of tube lights and LED lights with dimmable motion sensor-based LED lights in passage area

4.1.3 Optimization of outdoor lights operation based on Astronomical timer

ECM No.	Energy efficiency improvement measures	Investment Rs. In Lakh	Estimated saving Electricity kWh	Estimated Savings Rs. In Lacs	Estimated Payback Years
4	Optimization of street light operation based on Astronomical timer	0.10	735	0.08	1.2

Table 30: Energy efficiency improvement measures

At many of the switching points, Analog and digital times are provided to switch ON and OFF the lighting system. At most of the place's timings are in the range as per table mentioned below

Sr No	Season	Switch ON time	Switched OFF time
1	Summer	6.30 PM	6.00 AM
2	Winter	5.30 PM	7.00 AM
3	Monsoon	6.00 PM	6.30 AM

Time Switches are used to control events with respect to real time clock (RTC) whereas timers are used to control processing times. Therefore, RTC forms the basic difference between timer and time switch functionality.

With the help of Time switches it is possible to switch ON and OFF devices like lights, heaters, etc. automatically at desired time of the day / night thereby giving the advantage of convenience and reduction in power wastage or substantial energy savings. The need of automation in street light system is for accurate switching of lights at sunset or twilight sunset and switch OFF at sunrise or twilight sunrise with energy savings.

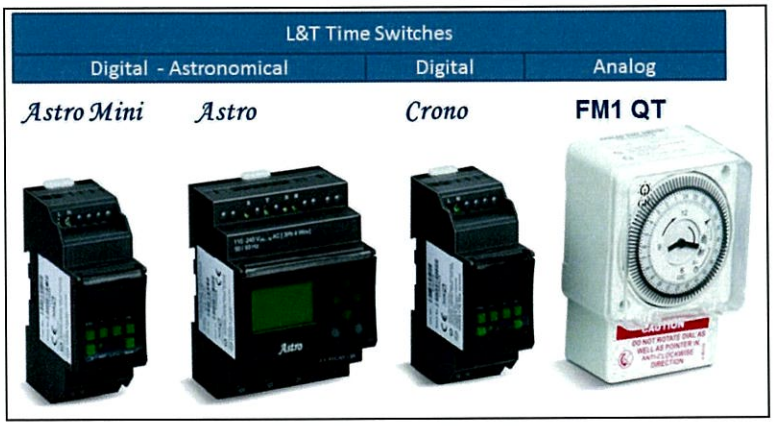


Figure 14 Time Switches

4.2 Thermal Comfort and Energy Efficiency

4.2.1 Replacement of regular fans with BEE star rated fans and Brushless Direct Current (BLDC) fans

Replacement Details: Regular fans with BEE star rated fans or Brushless Direct Current (BLDC) fans										
Existing Type of Fan	Existing Quantity	Existing Consumption (kWh)	Proposed type of Fan	Proposed Quantity	Estimated Consumption (kWh)	Rate per unit based on exchange policy of Utility (Rs)	Total Cost (Rs)	Annual Savings (kWh)	Annual Savings* (Rs)	Payback period (Year)
Ceiling Fans 60W	529	39,647	Bajaj Energyos 26W regular	529	17,181	₹ 2,284.00	₹ 12,08,236.00	22,467	₹ 2,33,206.01	5.2

Table 31: Replacement of Regular fans with BEE star rated fans and Brushless Direct Current (BLDC) fans

The Power Utility Adani under its DSM Scheme provides for exchange of old fans with energy efficient fans at subsidized rates. Below is the table of rates as provided on their website.

Brand	Models***	power Consumption (watts)**	Price Rs. (Inclusive of Delivery & Installation)				
			MRP	With Exchange	Discount %*	New Purchase	Discount %*
Usha	Energia 32	32	3750	2290	39	2390	36
Atomberg	Gorilla	32	3600	1880	48	2048	43
Versa (Superfan)	Super E1	35	3570	1870	48	1990	44
	Super X1	35	3690	2070	44	2170	41
	Super A1	35	4050	2820	30	2920	28
* Actual discount will be more considering free delivery and installation.							
** Conventional ceiling fan consumes 75 - 80 watts.							
*** Prices & Models subject to change							

Table 32: Rates of Brushless Direct Current (BLDC) fans

However, an enquiry will need to be made with the utility to understand whether the policy is still in place, the subsidized cost and the number of fans that could be replaced under the Policy and the process for exchange.

In case, DSM policies are not applicable or partially applicable, the college can purchase fans directly. Cost and payback period will be double for fans directly purchased from vendor. Vendor list is provided in the Annexure G.

Plate 11: Existing Ceiling Fan of 60 W

Plate 107: Existing Ceiling Fan of 60 W Proposed Ceiling Fan of Atomberg Gorilla 32W

4.2.2 AC maintenance

Currently few of the ACs are performing below the EER during the audit hence regular maintenance is necessary. In case any AC is being replaced or new ACs are purchased, the college should opt for BEE 3 or 5-star rated ACs only for superior performance and energy efficiency. We recommend the use of Airtron AC energy saving devices for all split and window AC units, especially those which are being used frequently. With its patented dual-sensor driver microprocessor technology, it can save up to 35% of energy consumption of an AC unit. Details of vendor are provided in Annexure H.

4.3 Recommendations for Solar PV system

- Cables of the solar panels should be properly ducted through a PVC pipe with openings to inspect connectors. This is required from fire safety point of view.
- Manual or sprinkler cleaning is essential to maintain efficiency of the solar panels.
- Painting and maintenance of the structure supporting the solar panels and the gangway is important from the safety perspective.

Plate 15: Picture showing the current gangway and open cables of the Solar PV panels

- College should contact the supplier and do health check-up of the entire system (Panel and Inverter).
- Clean the panels regularly.
- Check the Energy meter's calibration (Energy meter may show incorrect reading due to drifting of accuracy over period of time).
- Get further clarity on the distribution of the Solar power in the Electrical power distribution system in the college.

- The college can appoint a vendor for maintenance of Solar panels. Details are attached in Annexure J.

4.4 General Recommendations and best practices for energy conservation

General recommendations:

- **A separate energy meter** for each floor is also recommended. In the long run separate meter for light, fan, equipment and AC is recommended. This can also be connected to an IOT system to make it online so that energy consumption can be monitored on real-time basis. Vendor details are shared in Annexure H
- **Clean the AC filter** at least once a fortnight. A choked filter means poorer quality of cooling and more power consumed.
- **Replace old regulators with electronic regulators** to help reduce electricity consumption significantly
- Whenever existing AC units are replaced or new ones to be purchased**, BEE 3-star or 5-star rated machines** should be purchased.
- For lights, fans and other equipment, it is recommended to engage with a service provider rather than purchase individual lights and fans. An **AMC Contract** should be signed with the service provider with clause on **'Performance Guarantee'** with penalty / incentive clause for maintaining the System's output. This will result in bringing in accountability from Project Developer/ service provider.

Best Practices:

- Consider **Using the AC optimally** – for an hour or two less every day. An AC switched off for an hour can keep a 20 W tube light on for 100 hours!
- **Maintain the A/c Temperature around 24°C - 25°C** (human comfort level).
- **Keep windows shut** after switching off the AC to keep the room cool for some more time. You would be saving significantly on power consumption.
- Switch off the PCs when not in use.
- Switch off lights and fans when leaving a room.
- The above points may also be displayed in important spaces such as classrooms, computer labs, staff rooms, etc.

4.5 Recommendations for Electrical system and Earthing

Earth pit maintenance and tightening of earthing joints is required. Please refer Table 33 to do the rectifications to avoid any shock hazards.

Sr. No.	Observations	Recommendations	Risk category
1	Leakage current is observed above permissible limits at following locations- MAIN DB SOLAR SYSTEM- 32A MCB- 2NOS.- 42.7 mA, 4th floor Busbar- Solar System- 100A- 177 mA.	Need to attend the same. (It should beless than 30.0mA)	Medium
2	Earthing resistance value found higher than the standard limits of earth pit resistance specified inIndian Electricity Act 2003. (Up to 2 ohm) for Main Incomer- MAIN INCOMER- 63A MCB- COLLEGE- 3RD FR, 4TH FR, 5TH FR METER NO. 07859703- 35.3 ohms, MAIN MCB- METER NO. 5118667- 12.4 ohms.	Suggest to provide coal and salt in earth pits to improve earth pit resistance value.	Medium
3	Earth Neutral Voltage is observed high in below locations- IT Computer Room- 2.3 V, Physics Room- 3- 2.7 V, Main MCB - Meter No. 5118654- 5V.	Need to attend the same (It should be less than 2 V. Looping wiring need to be tightened	Medium
4	Rubber mat is not provided in front of main DBs of all floor and main meter Room.	Need to be provided.	Medium
5	Unwanted Material Storage observed in electrical areas which should be avoided as a good risk mitigation measure. Dust observed in meter room.	Need to remove unwanted material and Dust.	Medium
6	Emergency lighting system is not available in the premises.	Provision of emergency lighting at critical locations is required, separate battey backups Inverter is recommended and at least 10% of the total lighting load should be on these inverters.	Medium
7	Personal Protective Equipments- As per observation PPE kits are not available in Maintenance department and also in the main electrical Room Electrician and Supervisor does not wear any safety shoes. Insulated earthing / discharge rod, insulated safety hand gloves are not available with the operating team Shock treatment charts and sand buckets are not provided in electrical areas.	Following PPE Kits should be required- Arc Flash Suit, Electrical Safety Hand gloves- 11 kV, Safety Shoes, First aid Box.	Medium

Table 33: Issues in electrical system w.r.t to their risk category and recommendation

4.6 Carbon Footprint Reduction

The total carbon footprint inform of energy is **220.06t.** If the college can follow the recommendation mentioned above it can reduce up to **191.25t** of energy carbon

footprint. Also, with optimum utilization of Solar PV panels installed, the college can reduce more carbon footprint and can achieve zero energy carbon footprint.

4.7 Retrofit of Water Efficient Equipment

Replacement with water efficient equipment can lead to considerable water savings:

Plate 29: Existing Single Flush

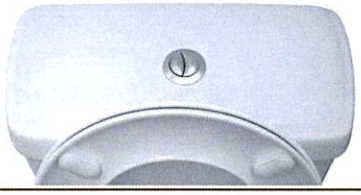


Plate 30: Proposed Dual Flush

Replacement with water efficient equipment can lead to considerable water savings:

Plate 31: Proposed water saving aerators for the wash basin faucets

S. No.	Existing equipment	Replacement of existing equipment with energy efficient equipment	No. of units	Current Water consumption (liters)	Projected Water savings with efficient equipment (liters) - Annual	Unit rate (Rs)	Total Cost (Rs)	Payback period (Year/ Months)
1	Single Flush	Dual Flush	8	5,07,35,000	3,55,14,500	3840	30720	NA

2	Regular Wash basin faucet	Water saving aerator faucet	134	134	67	8.5/-	1139	NA

Table 24: Retrofit for Water Efficient Equipment

4.8 Waste Segregation and Composting

Waste segregators to be provided in the lobby of each floor for wet / organic waste, metal, wood, paper, glass.

Plate 32: Waste segregator to be installed at each floor level

Organic composting and maintenance of the same can be undertaken by contract with NGO such as Stree Mukti Sanghatana (contact details provided in appendix H).

4.9 Indoor Air Quality

Since the building is naturally ventilated, indoor air quality is not a major concern. Indoor plants can be added in administrative areas and hanging pots in corridors can be added to increase biodiversity improve air quality can be provided in the administrative areas on all floors.



Plate 33: Indoor plants - Dieffenbachia amoena, Chlorophytum comosum and Epimnum auries

4.10 Environment Improvement

Plant and tree species that attract birds and butterflies can be planted to increase biodiversity of the campus.



Plate 34: Plant species attracting birds and butterflies

4.11 Green Rating

The college can apply for following green building rating for evaluating performance and getting green rated:

Sr. No.	Rating	Provided by	Performance Evaluation	Registration / Rating fees
1.	EDGE	IFC, World Bank	Water, Waste and Energy	Pre-certification plus final EDGE certification – INR 1,20,000 + INR 9 per each additional sq m above 5,000 sq m.
2.	IGBC – Existing buildings	CII, IGBC	Whole building	Registration fees – INR 25,000 and certification fees – INR 50,000

3.	BEE star rating	BEE, Govt. of India	Energy	Application to BEE
4.	GRIHA – Existing buildings	Green Rating for Integrated Habitat Assessment (GRIHA) Council	Whole Building	INR 2,00,000 + INR 3.5 per additional sq. m over 5,000 sq. m
5.	GEM Sustainability (Green) Certification Program - Campus (Educational/Corporate and Others)	ASSOCHAM Green & Eco-friendly Movement (GEM)	Site Area (Acres) - Less than 10 Acres	Pre-certification fee INR 1,75,000 + ASSOCHAM Certification fee INR 2,50,000

Table 25: Green Building Rating Systems

4.12 ISO Management Systems:

In order to demonstrate its commitment towards sustainable environment, the college can adopt for certifications of management systems such as ISO 21001 which represents its quality commitments and ISO 50001 for energy management. The college is already certified as ISO 14001:2015 which demonstrates the commitment of college management towards the environmental sustainability.

ISO 21001

ISO 50001
ENERGY MANAGEMENT

5. Glossary

- **Ballast:** A device used in conjunction with an electric-discharge lamp to cause the lamp to start and operate under proper circuit conditions of voltage, current, waveform, electrode heat, etc.
- **Built up area (BUA):** Sum of the covered areas of all floors of a building, other than the roof, and areas covered by external walls and parapet on these floors.
- **Common area:** Areas within a building that are available for use by all users in a building (i.e., lobbies, corridors, restrooms, etc.).
- **Connected load:** The sum of the rated wattage of all equipment, appliances and devices to be installed in the building or part of building or building complexes, in terms of kilowatt (kW) that will be allocated to all applicants for electric power consumption in respect of the proposed building or building complexes on their completion.
- **Contract demand:** The maximum demand in kilo Volt Ampere (kVA) (within a consumer's sanctioned load) agreed to be supplied by the electricity provider or utility in the agreement executed between the user and the utility or electricity provider.
- **Colour Rendering Index (CRI):** Colour Rendering Index (CRI) — Measure of the degree to which the psychophysical colour of an object illuminated by the test illuminant conforms to that of the same object illuminated by the reference illuminant, suitable allowance having been made for the state of chromatic adaptation.
- **Correlated Colour Temperature (CCT) (K):** The temperature of the Planckian radiator whose perceived colour most closely resembles that of a given stimulus at the same brightness and under specified viewing conditions.
- **Demand:** Maximum rate of electricity (kW) consumption recorded for a building or facility during a selected time frame.
- **Demand factor**: Is the ratio of the sum of the maximum demand of a system (or part of a system) to the total connected load on the system (or part of the system) under consideration. Demand factor is always less than one.
- **Diversity factor**: The ratio between the actual power (Pact) and the rated power (P max) of systems.

- **Dry Bulb Temperature:** The temperature of the air, read on a thermometer, taken in such a way so as to avoid errors due to radiation.
- **Efficacy:** The lumens produced by a lamp plus ballast system divided by the total watts of input power (including the ballast), expressed in lumens per watt.
- **Energy:** Power derived from renewable or non-renewable resources to provide heating, cooling and light to a building or operate any building equipment and appliances. It has various forms such as thermal (heat), mechanical (work), electrical, and chemical that may be transformed from one into another. Customary unit of measurement is watts (W).
- **Energy Conservation Building Code (ECBC):** The Energy Conservation Building Code as updated from time to time by the Bureau and displayed on its website. (www.beeindia.gov.in).
- **Energy Efficiency Ratio (EER):** the ratio of net cooling capacity in watt to total rate of electric input in watts under design operating conditions.
- **Energy Performance Index (EPI):** of a building means its annual energy consumption in kilowatt-hours per square meter of the area of the building which shall be calculated in the existing or proposed building as per the formula annual energy consumption in kWh/total built–up area (excluding storage area and the parking in the basement) in m^2
- **EPI Ratio:** of a building means the ratio of the EPI of the Proposed Building to the EPI of the Standard Building.
- **Equipment:** Mechanical, electrical or static devices for operating a building, including but not limited to those required for providing cooling, heating, ventilation, lighting, service hot water, vertical circulation.
- **Equipment, existing:** Equipment previously installed in an existing building.
- **Illuminance:** At a point on a surface, the ratio of the luminous flux incident on an infinitesimal element of the surface containing the point under consideration to the area of the element.
- **Interior Lighting Power**: LPD x Gross Lighted Floor Area.
- **Kilowatt (kW):** The basic unit of electric power, equal to 1000 W.
- **Lighting system:** A group of luminaires circuited or controlled to perform a specific function.

- **Lighting power allowance:**

  (a) Interior lighting power allowance: the maximum lighting power in watts allowed for the interior of a building

  (b) Exterior lighting power allowance: the maximum lighting power in watts allowed for the exterior of a building

- **Lighting Power Density:** Maximum lighting power per unit area of a space as per its function or building as per its classification.
- **Lumen (lm) :** SI unit of luminous flux. The luminous flux emitted within unit solid angle (one steradian) by a point source having a uniform intensity of one candela.
- **Luminaires:** A complete lighting unit consisting of a lamp or lamps together with the housing designed to distribute the light, position and protect the lamps, and connect the lamps to the power supply.
- **Lux:** The unit of illuminance (the measurement of illumination) is lux which is 1 lumen per m^2.
- **National Building Code 2016 (NBC):** model building code that provides guidelines for design and construction of buildings. In this code, National Building Code 2016 refers to the latest version by the Bureau of Indian Standards.
- **Reflectance:** The ratio of the light reflected by a surface to the light incident upon it.
- **Space:** An enclosed area within a building. The classifications of spaces are as follows for purpose of determining building envelope requirements:

  (a) Conditioned space: a cooled space, heated space, or directly conditioned space.

  (b) Semi-heated space: an enclosed space within a building that is heated by a heating system whose output capacity is greater or equal to 10.7 W/m2 but is not a conditioned space.

  (c) Non-conditioned space: an enclosed space within a building that is not conditioned space or a semi-heated space. Crawlspaces, attics, and parking garages with natural or mechanical ventilation are not considered enclosed spaces.

- **Specific Energy Consumption:** The Specific Energy Consumption (SEC) is defined as the energy consumption per unit of product output.
- **Unconditioned buildings:** Building in which more than 90% of spaces are unconditioned spaces.
- **Unconditioned space:** Mechanically or naturally ventilated space that is not cooled or heated by mechanical equipment.
- **Uniformity Ratio:** Minimum illuminance divided by average illuminance levels.
- **Ventilation:** The process of supplying or removing air by natural or mechanical means to or from any space. Such air is not required to have been conditioned.
- **Watt:** The unit of power.
- **Wall Window Ratio:** The ratio of vertical fenestration area to gross exterior wall area. Gross exterior wall area is measured horizontally from the exterior surface; it is measured vertically from the top of the floor to the bottom of the roof.
- **Wet Bulb Temperature:** The steady temperature finally given by a thermometer having its bulb covered with gauze or muslin moistened with distilled water and placed in an air stream of not less than 4.5 m/s.
- **Working Plane:** A horizontal plane at a level at which work will normally be done.

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7. Annexure

A. Usage data collection template

S. No	Name of the Space	Floor	Area	Height	Type of Light (LED/ Halogen/ Tubelight/ Twin tubelight/ Incandescent)	LED/NON-LED	Total no.	Approximate Wattage(W)	Ballast wattage	Usage hours/ day	Total no. of days used	Total usage Wh/year	Total usage KWh/year	Total wattage	LPD	Connected Load
1	Chemistry Lab 2	Ground floor	198.19	3.5	Tubelight	NON-LED	35	40	14	10	180	3402000	3402	2034	10.2629	1.89
	Chemistry Lab 2	Ground floor			LED light	LED	6	24	0	10	180	259200	259.2			0.144
2	Chemistry Lab 1	Ground floor	113.46	3.5	Tubelight	NON-LED	12	40	14	10	180	1166400	1166.4	744	6.55738	0.648
	Chemistry Lab 1	Ground floor			LED light	LED	4	24	0	10	180	172800	172.8			0.096
3	Staff room	Ground floor	35.34	3.5	Tubelight	NON-LED	5	40	14	8	180	388800	388.8	270	7.64007	0.27
4	Balance room	Ground floor	21.3	3.5	Tubelight	NON-LED	2	40	14	8	100	86400	86.4	108	5.07042	0.108
5	Store room	Ground floor	28.48	3.5	Tubelight	NON-LED	6	40	14	8	200	518400	518.4	324	11.3764	0.324
6	Chem Lab 3	Ground floor	35.65	3.5	Tubelight	NON-LED	6	40	14	8	180	466560	466.56	372	10.4348	0.324
	Chem Lab 4	Ground floor	44.15	3.5	LED light	LED	2	24	0	8	180	69120	69.12			0.048
7	Chem Lab 4	Ground floor			Tubelight	NON-LED	9	40	14	8	180	699840	699.84	486		0.486
8	Research Lab	Ground floor	21.4	3.5	Tubelight	NON-LED	6	40	14	4	100	129600	129.6	324	15.1402	0.324
9	Canteen	Ground floor	74.8	3.5	Tubelight	NON-LED	10	40	14	5	60	162000	162	924	12.3529	0.54
10	Seminar Hall	Ground floor	58.5	3.5	LED light	LED	16	24	0	4	100	153600	153.6			0.384
11	Gymkhana	Ground floor	139	3.5	Tubelight	NON-LED	60	40	14	5	100	1620000	1620	3240	23.3094	3.24
12	Gymnasium	Ground floor	139	3.5	Tubelight	NON-LED	4	40	14	4	60	51840	51.84	216	1.55396	0.216
13	Hindi centre, counselling room, Extension activities, Mcom centre NSS, NCC,	Ground floor	25.88	3.5	Tubelight	NON-LED	6	40	14	2	100	64800	64.8	780	30.1391	0.324
14	Passage	Ground floor	169.42	3.5	LED light	LED	19	24	0	8	300	1094400	1094.4			0.456
	Passage	Ground floor			Tubelight	NON-LED	2	40	14	8	300	259200	259.2	108		0.108
15	Office	First floor	201.13	3.5	Tubelight	NON-LED	103	40	14	8	300	13348800	13348.8	6378	31.7108	5.562
	Office	First floor			LED light	LED	34	24	0	8	300	1958400	1958.4			0.816
16	Bio Lab 1	First floor	151.64	3.5	LED light	LED	6	24	0	8	300	345600	345.6	1116	7.35954	0.144
	Bio Lab 1	First floor			Tubelight	NON-LED	18	40	14	8	300	2332800	2332.8			0.972
17	Bio Lab 2	First floor	70.67	3.5	Tubelight	NON-LED	9	40	14	8	180	699840	699.84	486	6.87703	0.486
18	Bio Lab 3	First floor	67.53	3.5	Tubelight	NON-LED	11	40	14	8	180	855360	855.36	834	12.3501	0.594
19	Bio Lab 4	First floor	30.25	3.5	LED light	LED	10	24	14	8	180	547200	547.2		0	0.38
20	Bio Staff Room	First floor	33.1	3.5	Tubelight	NON-LED	8	40	0	8	180	460800	460.8	640	19.3353	0.32
21	Bio Lab 5	First floor	56.53	3.5	Tubelight	NON-LED	8	40	14	8	180	622080	622.08	480	8.49107	0.432
	Bio Lab 5	First floor			LED light	LED	2	24	18	8	180	120960	120.96			0.084
22	LCR	First floor	89.22	3.5	Tubelight	NON-LED	18	40	14	8	180	1399680	1399.68	972	10.8944	0.972
23	Room 12	First floor	122.52	3.5	Tubelight	NON-LED	12	40	14	8	180	933120	933.12	648	5.28893	0.648
24	Room 11	First floor	110.88	3.5	Tubelight	NON-LED	11	40	14	8	180	855360	855.36	594	5.35714	0.594
25	Passage	First floor	180	3.5	LED light	LED	8	24	0	8	180	276480	276.48	192	1.06667	0.192
26	Room 21A	Second floor	47.03625	3.5	Tubelight	NON-LED	6	40	14	8	300	777600	777.6	324	6.8883	0.324
27	Room 21B	Second floor	47.03625	3.5	Tubelight	NON-LED	6	40	14	8	180	466560	466.56	324	6.8883	0.324
28	Room 22	Second floor	47.421	3.5	Tubelight	NON-LED	8	40	14	8	180	622080	622.08	432	9.10989	0.432
29	Room 23	Second floor	79.94	3.5	Tubelight	NON-LED	8	40	14	8	180	622080	622.08	432	5.40405	0.432
30	Room 24	Second floor	51.39	3.5	Tubelight	NON-LED	8	40	14	8	180	622080	622.08	432	8.4063	0.432
31	Room 26	Second floor	85.324	3.5	Tubelight	NON-LED	7	40	14	8	180	544320	544.32	402	4.71145	0.378
	Room 26	Second floor			LED light	LED	1	24	0	8	180	34560	34.56			0.024
32	Phy Lab 1	Second floor	151.64	3.5	Tubelight	NON-LED	17	40	14	8	180	1321920	1321.92	918	6.05381	0.918
33	Phy Dark Room	Second floor	28.19	3.5	Tubelight	NON-LED	6	40	14	8	180	466560	466.56	324	11.4934	0.324
34	Phy Lab 2	Second floor	69.94	3.5	Tubelight	NON-LED	11	40	14	8	180	855360	855.36	594	8.49299	0.594
35	Phy staff room	Second floor	28.19	3.5	Tubelight	NON-LED	7	40	14	8	180	544320	544.32	378	13.409	0.378
36	Phy Lab 3	Second floor	160	3.5	Tubelight	NON-LED	19	40	14	8	180	1477440	1477.44	1026	6.4125	1.026
37	Passage	Second floor	180	3.5	Tubelight	NON-LED	6	40	14	8	180	466560	466.56	324	1.8	0.324
38	Biotechnology Dept	Third floor	200.44	3.5	Tubelight	NON-LED	39	40	14	8	180	3032640	3032.64	2106	10.5069	2.106
39	Room 38	Third floor	78.3412	3.5	Tubelight	NON-LED	8	40	14	8	180	622080	622.08	432	5.51434	0.432
40	Room 39	Third floor	79.94	3.5	Tubelight	NON-LED	9	40	14	8	180	699840	699.84	486	6.07956	0.486
41	Study Room	Third floor	45.505	3.5	Tubelight	NON-LED	9	40	14	8	180	699840	699.84	486	10.6801	0.486
42	Library 01	Third floor	94.0725	3.5	Tubelight	NON-LED	15	40	14	8	180	1166400	1166.4	954	10.1411	0.81

S. No	Name of the Space	Floor	Type of Fan (Ceiling/ Exhaust/ Wall Mounted Fan/ Pedestal Fan)	Total no. of Fans	Approximate Wattage	Usage Hours per day	Total no. of days used	Total usage Wh/year	Total usage Kwh/year
1	Chemistry Lab 2	Ground floor	Ceiling fan	3	72	4	180	155520	155.52
	Chemistry Lab 2	Ground floor	Exhaust fan	14	50	4	180	504000	504
2	Chemistry Lab 1	Ground floor	Ceiling fan	1	72	4	180	51840	51.84
	Chemistry Lab 1	Ground floor	Exhaust fan	13	50	4	180	468000	468
3	Chem library	Ground floor	Ceiling fan	1	72	4	180	51840	51.84
4	Staff room	Ground floor	Ceiling fan	2	72	8	180	207360	207.36
6	Store room	Ground floor	Ceiling fan	2	72	4	180	103680	103.68
	Store room	Ground floor	Exhaust fan	1	50	4	180	36000	36
7	Chem Lab 3	Ground floor	Ceiling fan	3	72	4	180	155520	155.52
	Chem Lab 3	Ground floor	Exhaust fan	1	50	4	180	36000	36
8	Chem Lab 4	Ground floor	Ceiling fan	5	72	4	180	259200	259.2
9	Research Lab	Ground floor	Ceiling fan	1	72	4	180	51840	51.84
	Research Lab	Ground floor	Exhaust fan	1	50	4	180	36000	36
10	Canteen	Ground floor	Ceiling fan	8	72	4	180	414720	414.72
11	Seminar Hall	Ground floor	Ceiling fan	7	72	4	180	362880	362.88
12	Gymkhana	Ground floor	Ceiling fan	8	72	4	180	414720	414.72
13	Gymnasium	Ground floor	Exhaust fan	3	50	4	180	108000	108
14	Hindi centre, counselling	Ground floor	Ceiling fan	1	72	2	180	25920	25.92
15	Passage	Ground floor	Ceiling fan	2	72	2	180	51840	51.84
16	Office	First floor	Ceiling fan	39	72	8	180	4043520	4043.52
	Office	First floor	Exhaust fan	2	50	8	180	144000	144
17	Bio Lab 1	First floor	Ceiling fan	11	72	4	180	570240	570.24
18	Bio Lab 2	First floor	Ceiling fan	6	72	4	180	311040	311.04
19	Bio Lab 3	First floor	Ceiling fan	4	72	4	180	207360	207.36
20	Bio Lab 4	First floor	Wall mounted fan	2	50	4	180	72000	72
21	Bio Staff Room	First floor	Ceiling fan	3	72	4	180	155520	155.52
22	Bio Lab F	First floor	Ceiling fan	8	72	4	180	414720	414.72
23	LCR	First floor	Ceiling fan	8	72	4	180	414720	414.72
	LCR	First floor	Exhaust fan	1	50	4	180	36000	36
24	Room 12	First floor	Ceiling fan	7	72	8	180	725760	725.76
25	Room 11	First floor	Ceiling fan	7	72	8	180	725760	725.76
26	Room 21A	Second floor	Ceiling fan	7	72	8	180	725760	725.76
	Room 21A	Second floor	Exhaust fan	2	50	8	180	144000	144
27	Room 21B	Second floor	Ceiling fan	7	72	8	180	725760	725.76
	Room 21B	Second floor	Exhaust fan	2	50	8	180	144000	144
28	Room 22	Second floor	Ceiling fan	7	72	8	180	725760	725.76
	Room 22	Second floor	Exhaust fan	1	50	8	180	72000	72
29	Room 23	Second floor	Ceiling fan	7	72	8	180	725760	725.76
30	Room 24	Second floor	Ceiling fan	7	72	8	180	725760	725.76
31	Room 26	Second floor	Ceiling fan	7	72	8	180	725760	725.76
32	Phy Lab 1	Second floor	Ceiling fan	7	72	4	180	362880	362.88
	Phy Lab 1	Second floor	Exhaust fan	1	50	4	180	36000	36
	Phy Lab 1	Second floor	Wall mounted fan	1	50	4	180	36000	36
33	Phy Dark Room	Second floor	Ceiling fan	2	72	4	180	103680	103.68
	Phy Dark Room	Second floor	Exhaust fan	1	50	4	180	36000	36
34	Phy Lab 2	Second floor	Ceiling fan	4	72	4	180	207360	207.36
	Phy Lab 2	Second floor	Exhaust fan	1	50	4	180	36000	36
35	Phy staff room	Second floor	Ceiling fan	3	72	8	180	311040	311.04

S. No	Name of the Space	Floor	Name of the Equipment	Total no. of Equipment	Approximate Wattage	Usage hours/ day	Total no. of days used	Total usage Wh/year	Total usage Kwh/year	Connected Load
1	Passage	Ground floor	Water coolor	1	100	12	180	216000	216	0.1
2	Passage	First floor	Water coolor	1	100	12	180	216000	216	0.1
3	biology lab	First floor	Autoclave	1	6000	2	180	2160000	2160	6
4	biology lab	First floor	Hot air oven	2	1500	2	180	1080000	1080	3
5	biology lab	First floor	Incubator	1	300	2	180	108000	108	0.3
6	biology lab	First floor	Muffle furnace	1	2000	2	180	720000	720	2
7	Central facilty lab	First floor	Ultracentrifuge	1	1000	2	180	360000	360	1
8	Central facilty lab	First floor	HPLC	1	500	2	180	180000	180	0.5
9	Central facilty lab	First floor	Digital motic Microscope	1	300	2	180	108000	108	0.3
10	Central facilty lab	First floor	FTIR	1	300	2	180	108000	108	0.3
11	Central facilty lab	First floor	Centifuge	2	700	2	180	504000	504	1.4
12	Central facilty lab	First floor	Sensitive balance	2	100	2	180	72000	72	0.2
13	Central facilty lab	First floor	Laminar air flow	1	450	2	180	162000	162	0.45
14	Central facilty lab	First floor	pH Meter	2	100	2	180	72000	72	0.2
15	Central facilty lab	First floor	Conductivity meter	1	100	2	180	36000	36	0.1
16	Passage	Second floor	Water coolor	2	100	12	180	432000	432	0.2
17	Passage	Third floor	Water coolor	2	100	12	180	432000	432	0.2
18	biotechnology lab	Third floor	Hot air oven	1	1500	2	180	540000	540	1.5
19	biotechnology lab	Third floor	Incubator	1	350	2	180	126000	126	0.35
20	biotechnology lab	Third floor	Autoclave	1	6000	2	180	2160000	2160	6
21	biotechnology lab	Third floor	Shaker	1	300	2	180	108000	108	0.3
22	biotechnology lab	Third floor	Laminar air flow	3	450	2	180	486000	486	1.35
23	research lab	Fourth floor	Autoclave	1	3000	2	180	1080000	1080	3
24	research lab	Fourth floor	Hot air oven	1	1500	2	180	540000	540	1.5
25	research lab	Fourth floor	Vaccum oven	1	500	2	180	180000	180	0.5
26	research lab	Fourth floor	Laminar air flow	2	450	2	180	324000	324	0.9
27	research lab	Fourth floor	Zeiss Microscope	1	300	2	180	108000	108	0.3
28	research lab	Fourth floor	UV-VIS spectrophotomete	2	100	2	180	72000	72	0.2
29	research lab	Fourth floor	Centifuge	1	700	2	180	252000	252	0.7
30	research lab	Fourth floor	Sensitive balance	2	100	2	180	72000	72	0.2
31	research lab	Fourth floor	Laminar air flow	2	450	2	180	324000	324	0.9
32	research lab	Fourth floor	pH Meter	1	100	2	180	36000	36	0.1
33	research lab	Fourth floor	Balance	1	100	2	180	36000	36	0.1
34	Passage	Fourth floor	Water coolor	2	100	12	180	432000	432	0.2
35	Passage	Fifth floor	Water coolor	1	100	12	180	216000	216	0.1
36	entire college	all five floor	Computers	562	100	6	180	60696000	60696	56.2
	Pumps	ground floor	pumps	3	7500	1	300	2250000	2250	7.5
	Lift	all five floor	Lifts	2	4000	6	300	14400000	14400	8
								91404000	**91404**	**106.25**

B. Floor Layouts

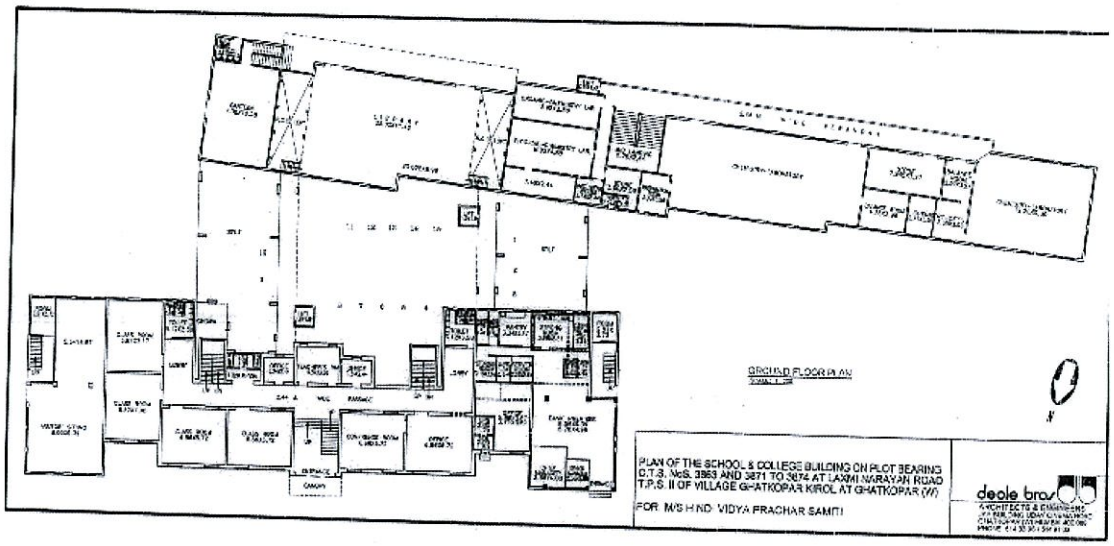
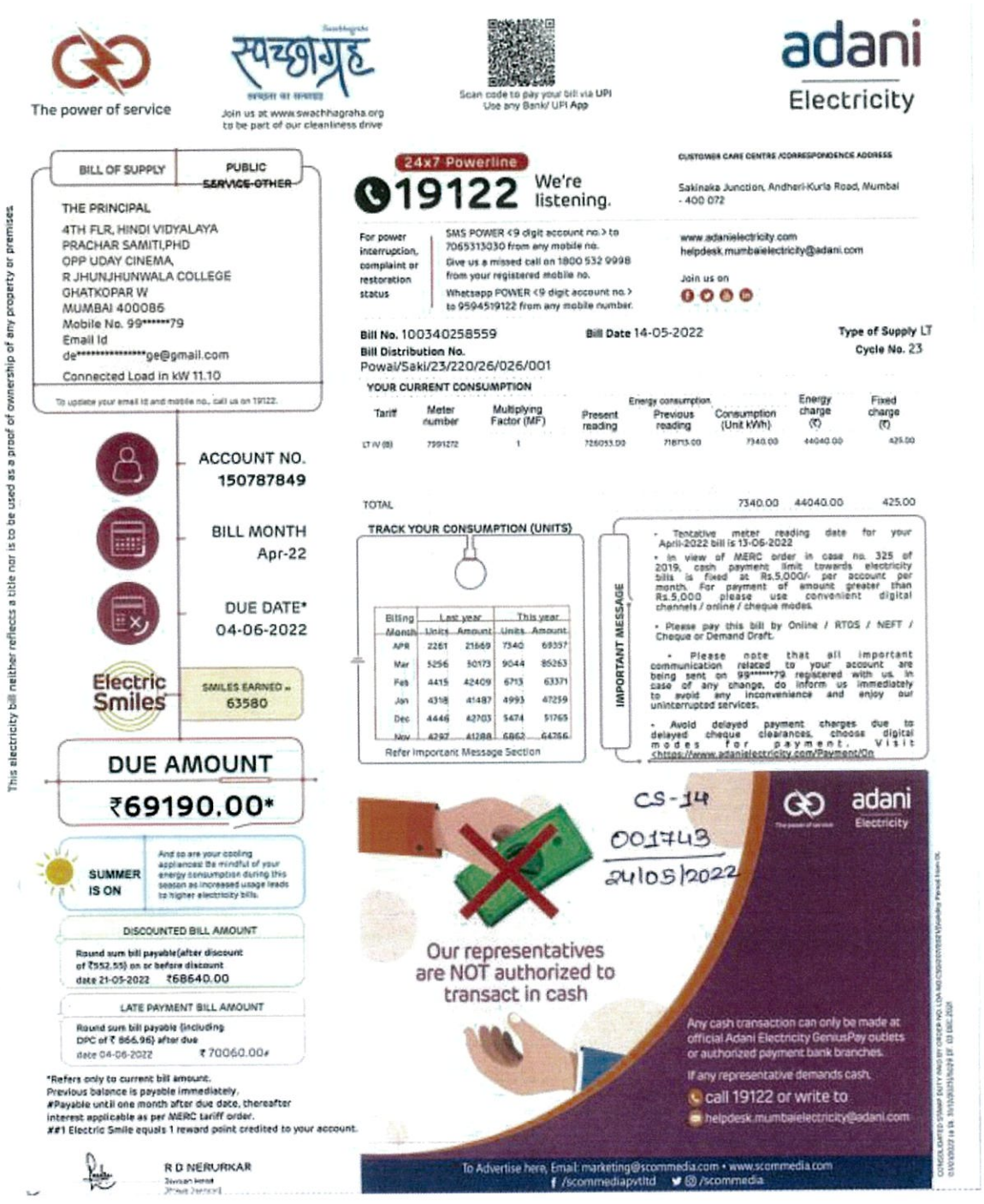


Figure 16: Campus Layout

C.Sample Electricity bill of Jhunjhunwala College



The power of service

स्वच्छाग्रह

Join us at www.swachhagraha.org to be part of our cleanliness drive

Scan code to pay your bill via UPI Use any Bank/ UPI App

adani Electricity

This electricity bill neither reflects a title nor is to be used as a proof of ownership of any property or premises.

BILL OF SUPPLY | PUBLIC ~~SERVICE-OTHER~~

THE PRINCIPAL
4TH FLR, HINDI VIDYALAYA
PRACHAR SAMITI,PHD
OPP UDAY CINEMA,
R JHUNJHUNWALA COLLEGE
GHATKOPAR W
MUMBAI 400086
Mobile No. 99******79
Email Id
de**********ge@gmail.com
Connected Load in kW 11.10

To update your email id and mobile no., call us on 19122.

ACCOUNT NO. 150787849

BILL MONTH Apr-22

DUE DATE* 04-06-2022

Electric Smiles | SMILES EARNED » 63580

DUE AMOUNT ₹69190.00*

SUMMER IS ON — And so are your cooling appliances! Be mindful of your energy consumption during this season as increased usage leads to higher electricity bills.

DISCOUNTED BILL AMOUNT
Round sum bill payable(after discount of ₹552.55) on or before discount date 21-05-2022 ₹68640.00

LATE PAYMENT BILL AMOUNT
Round sum bill payable (including DPC of ₹ 866.96) after due date 04-06-2022 ₹ 70060.00#

*Refers only to current bill amount.
Previous balance is payable immediately.
#Payable until one month after due date, thereafter interest applicable as per MERC tariff order.
¥#1 Electric Smile equals 1 reward point credited to your account.

R D NERURKAR

24x7 Powerline 19122 We're listening.

For power interruption, complaint or restoration status:
SMS POWER <9 digit account no.> to 7065313030 from any mobile no.
Give us a missed call on 1800 532 9998 from your registered mobile no.
Whatsapp POWER <9 digit account no.> to 9594519122 from any mobile number.

CUSTOMER CARE CENTRE /CORRESPONDENCE ADDRESS
Sakinaka Junction, Andheri-Kurla Road, Mumbai - 400 072

www.adanielectricity.com
helpdesk.mumbaielectricity@adani.com
Join us on

Bill No. 100340258559 Bill Date 14-05-2022 Type of Supply LT
Bill Distribution No. Powai/Saki/23/220/26/026/001 Cycle No. 23

YOUR CURRENT CONSUMPTION

Tariff	Meter number	Multiplying Factor (MF)	Energy consumption: Present reading	Previous reading	Consumption (Unit kWh)	Energy charge (₹)	Fixed charge (₹)
LT IV (B)	7391272	1	726053.00	718713.00	7340.00	44040.00	425.00
TOTAL					7340.00	44040.00	425.00

TRACK YOUR CONSUMPTION (UNITS)

Billing Month	Last year Units	Last year Amount	This year Units	This year Amount
Apr	2261	21669	7340	69357
Mar	5256	50173	9044	85263
Feb	4415	42409	6713	63371
Jan	4318	41487	4993	47259
Dec	4446	42703	5474	51765
Nov	4297	41288	6862	64766

Refer Important Message Section

IMPORTANT MESSAGE

- Tentative meter reading date for your April-2022 bill is 13-05-2022
- In view of MERC order in case no. 325 of 2019, cash payment limit towards electricity bills is fixed at Rs.5,000/- per account per month. For payment of amount greater than Rs.5,000 please use convenient digital channels / online / cheque modes.
- Please pay this bill by Online / RTGS / NEFT / Cheque or Demand Draft.
- Please note that all important communication related to your account are being sent on 99******79 registered with us. In case of any change, do inform us immediately to avoid any inconvenience and enjoy our uninterrupted services.
- Avoid delayed payment charges due to delayed cheque clearances, choose digital modes for payment. Visit <https://www.adanielectricity.com/Payment/On

CS-14
001743
24/05/2022

adani Electricity

Our representatives are NOT authorized to transact in cash

Any cash transaction can only be made at official Adani Electricity GeniusPay outlets or authorized payment bank branches.
If any representative demands cash,
call 19122 or write to
helpdesk.mumbaielectricity@adani.com

To Advertise here, Email: marketing@scommedia.com • www.scommedia.com
/scommediapvtltd /scommedia

D.Sample Water bill

बृहन्मुंबई महानगरपालिका

SAC:999111 | -:जल आकार देयक:- | GSTIN:27AAALM0042L3Z4

जलजोडणी धारकाचे नाव आणि पत्ता :-	PRINCIPAL RAMNIRANJAN JHUJUNWALLA COLLEGEGHATKOPAR WESTMUMBAI400086
जीएसटी आय एन :	
SAC/UID No.	
नोंदणीकृत मोबाईल क्रमांक :	
नोंदणीकृत ई-मेल आय डी :	

विभाग (Ward)	N-ward
जलजोडणी क्र. (CCN)	NXA6170008
पुस्तक / पृष्ठ क्र. (Binder/Folio)	N 46 / 185
मनपा अधिनियम क्र. MMC Act Sec No	169
देयक क्रमांक (Bill No.)	2122HEW0988695
देयक दिनांक (Bill Date)	11-12-2021

देयक कालावधी (Bill Period)	24-08-2021 to 23-11-2021
देय दिनांक (Due Date)	10-01-2022
विद्यमान देयक रक्कम (Current Bill Amount) ₹	1530
देयक निर्मिती दिनांकास जादा जमा रक्कम (Excess Credit Amount as on Date)	₹ 0
Bill Process Date -	12/9/21 2:22 PM
* Available Security Deposit (उपलब्ध अनामत रक्कम :)	₹

दैनिक गरज (लिटर) (Daily Requirement)	संख्या :- सदनिका / गाळे/झोपडी (No-Flat/Gala/Slum)	जलजोडणी आकार (मि.मी.) (Connection Size MM)
1	0	40

जलमापक मालकी (Meter Ownership)	जलमापक क्रमांक (Meter Number)	जलमापक उत्पादकाचे नाव (Meter Make)	जलमापक आकार (मि.मी.) (Meter Size MM)
Private	312476	Kranti	40

मागील वाचन दिनांक / वाचन (कि.ली.) Previous Reading Date/Reading(KL)	विद्यमान वाचन दिनांक /वाचन (कि.ली.) Current Reading Date/Reading (KL)	दिवस (Days) / Frequency
24-08-2021	23-11-2021	91
12	35	B

विद्यमान वापर (कि.ली.) (C1)Current Consumption(KL)	दुय्यम / संमिश्र वापर सूट (कि.ली.) (C2) Sub Meter /CP use (KL)	प्रत्यक्ष वापर (कि.ली.) (C1-C2)Actual Consumption(KL)
(C1) 23	(C2) 0	(C1-C2) 23

जलमापक स्थिती / आधार (Meter Status/Base)	जलजोडणी प्रकार (Connection Type)	दर प्रति (कि.ली.) Rate (Per KL)
MOK / NOG	MB01	5.94

देयक तपशील (Bill Details)	₹
जलआकार (Water Charges)	900
मलनिःसारण आकार- जलआकाराच्या ७० % Sewerage Charges - (70%) of WaterCharges	630
जलमापक भाडे (Meter Rent)	0
अतिरिक्त आकार (Additional Charges)	0
अधिभार (Surcharge)	0
विद्यमान देयक रक्कम (Current Bill Amount)	1530
मागील बाकी (Previous Outstanding)	0
जमा रक्कम (Credit Amount)	0
एकूण देय रक्कम (Total Payable Amount)	1530

मागील देयक कालावधी (Previous Bill Period)	वापर (कि.ली.) (Consumption KL)
21-05-2021 to 24-08-2021	7
23-02-2021 to 21-05-2021	4
23-11-2020 to 23-02-2021	0
24-08-2020 to 23-11-2020	0
20-05-2020 to 24-08-2020	0
24-02-2020 to 20-05-2020	2096
21-11-2019 to 24-02-2020	2315
21-08-2019 to 21-11-2019	2241
21-05-2019 to 21-08-2019	2241
22-02-2019 to 21-05-2019	2144
26-11-2018 to 22-02-2019	2144
21-08-2018 to 26-11-2018	2363

	T1	T2	T3	T4
(KL)	0	0	0	0

महत्वाच्या सूचना

१. देयक प्राप्त झाले नाही म्हणून देयकाचा भरणा केला नाही हे कारण ग्राह्य धरले जाणार नाही.

२. https://aquaptax.mcgm.aqua.gov.in येथे तसेच मोबाईलवर My BMC 24X7 या app द्वारे देयकातील जलजोडणी क्रमांकाची नोंद करून देयकाची दुय्यम प्रत उपलब्ध होते, तसेच थकबाकीसह जलदेयकाचा भरणा करता येतो.

३. देयक आणि त्याचा भरणा केल्याची माहिती विहित वेळेत मिळण्याकरिता ग्राहकाने मोबाईल नंबर व ई-मेल, संबंधित विभागीय सहाय्यक अभियंता (जलकामे) यांच्याकडे नोंदवावा.

४. मालमत्तेचा SAC/UID क्रमांक विभाग कार्यालयातील सहाय्यक अभियंता (जलकामे) यांच्याकडे अर्जाद्वारे नोंदवावा.

५. देय दिनांकापर्यंत देयकाचा भरणा न केल्यास सदर देयक नोटीस समजण्यात येऊन मुंबई महानगरपालिका अधिनियम कलम २७१ अन्वये जलजोडणी खंडित करण्यात येईल. ह्या नोटीसमुळे पूर्वीची नोटीस रद्द होत नाही.

६. झोपडपट्ट्यांमधील निवासी जलजोडण्यांवरील खराब जलमापक, १२ महिन्यांपेक्षा व इतर सर्व जलजोडण्यांवरील खराब जलमापक ६ महिन्यांपेक्षा जास्त कालावधीसाठी नादुरुस्त (EXM,RVS,MMR,TPR) असल्यास पाण्याची दैनंदिन गरज किंवा मागील कालावधीतील प्रत्यक्ष वापर यापैकी जो जास्त असेल तो व त्या वापरावर २५ % अधिक वाढीव वापर लावण्यात येतो.

७. आपले जलमापक कायम चालू स्थितीत राहील तसेच जलमापक चेंबर, पाईप फिटिंग सुस्थितीत राहतील याची खबरदारी घेण्यात यावी.

मलबार हिल (शहर विभाग) ०२२-[illegible]
पार्ले कांदिवली (प. उप.विभाग) ०२२-[illegible]
घाटकोपर (पू.उप.विभाग) ०२२-[illegible]

जलदेयकांच्या अधिदानाकरिता (Payment)सूचना

१."Brihanmumbai Mahanagarpalika"या नावाने धनादेश काढावा व धनादेशाच्या पाठीमागे जलजोडणी क्रमांक व मोबाईल नंबर लिहावा.

2. To make Payment through NEFT -
IFSC Code - SBIN0000300
A/C.No. - MCGMWCNXA6170008
Name - MCGM Water Charges
Branch - SBI - Mumbai Main

Meter Reading Image

[illegible]
१) "दिनांक १ जानेवारी २०२२ रोजी वयाची १८ वर्षे पूर्ण [illegible] मतदार यादीत नाव नोंदवावे [illegible]"
२) "मतदार यादी [illegible] पुनरीक्षण कार्यक्रम दि.०१ ते ३० नोव्हेंबर २०२१."

नाव व टपालाचा पत्ता :-
NXA6170008 N 46 / 185
PRINCIPAL
RAMNIRANJAN JHUJUNWALLA COLLEGEGHATKOPAR
WESTMUMBAI400086

पत्रव्यवहारासाठी पत्ता :-
Asst. Engineer (Water Works) N Ward Municipal Office Bldg.,(Annex), Jawahar Road, Ghatkoper (E),Mumbai-400 077.

दूरध्वनी क्र.	25010161/65
ई-मेल आयडी	aeww.n@mcgm.gov.in

हे जलदेयक जागेचा अथवा मालमत्तेचा मालकी हक्क सिद्ध करण्यासाठी तसेच पुरावा म्हणून ग्राह्य धरू नये.

पाणी जपून वापरा. चूक भूल द्यावी - घ्यावी

E. A Branch of Safai Bank of India - Multi Layer Plastic collection

R. J. COLLEGE of Arts, Science & Commerce (AUTONOMOUS)
(Hindi Vidya Prachar Samiti's RAMNIRANJAN JHUNJHUNWALA COLLEGE of Arts, Science & Commerce)
Opposite Ghatkopar Railway Station, Ghatkopar (West), Mumbai 400086, Maharashtra, INDIA.
Website: www.rjcollege.edu.in Email: rjcollege@rjcollege.edu.in Tel No: +91 22 25151763 Fax No: +91 22 25150957
College is recognized under Section 2(f) & 12(B) of the UGC Act, 1956
Affiliated to UNIVERSITY OF MUMBAI || NAAC Re-Accredited 'A' Grade (CGPA: 3.50)

SAFAI BANK OF RJ COLLEGE (SAFAI WARRIORS)

The Safai Bank of R J College as a part of Swacchta Ambassadors and in association with the Safai Bank of India has been formed since October 2018 but became active since January 2019. In the year 2019-20 about 4-5 Departments and now presently in 2020-21 there are about 16 Departments of our college associated with this initiative. From the Department there are Teachers who have volunteered to be a part of this initiative and also involved in guiding and helping the students in the systematic collection and deposition of Plastic, especially Multi-laminated Plastic (MLPs). There are core student representatives appointed who constantly interact and keep records with the Class representatives. These class representatives are the ultimate important part of the ladder who are in direct contact with the student volunteers who collect and submit their MLPs.

During the lockdown since March 2020, student volunteers, the core representatives and also teachers from various departments have been continuing with their drive and depositing the MLPs at the college as when possible. **Till now, the Safai Bank unit of R J college has deposited about 113515 with the central depository of Safai Bank of India and placed within the top 10 depositor institutions involved with Safai Bank of India.** Many student volunteers have collected the MLPs in their house but due to restrictions in travelling as well as the infection rate has held them back in coming to the college but nevertheless, these warriors have been making efforts to deposit in the college by some way or the other. **Since August 2020, the Safai Bank unit of R J College has deposited with the central depository about 21,186 MLPs and another around 8,000 MLPs have been collected** within the college and its deposition with central depository is pending.

Est. 1963 AUTONOMOUS NAAC Re-accredited 'A' Grade

PRINCIPAL
RAMNIRANJAN JHUNJHUNWALA COLLEGE
OF ARTS, SCIENCE & COMMERCE (AUTONOMOUS)
Ghatkopar (W), Mumbai-400 086, Maharashtra, INDIA

2019: Star College Status by DBT
2008: Best College by University of Mumbai 2010: IMC RBNQ Award 'Performance Excellence' for the year 2009
2011: 'Best Teacher Award' by Government of Maharashtra 2013: DST-FIST 2014: DBT STAR College
2013 & 2014: 'Jagar Jaanivancha Award' by Govt. of Maharashtra 2016: ISO 14001:2015 2016: ISO 9001:2015 2017: ISO 27001:2013
2018: Autonomous Status by University Grants Commission (No. F. 22-1/2018(AC) - 29.05.2018) & by University of Mumbai (No.AR.ICD/18-19/440 - 05.06.2018)

F. Paper waste send to recycling.

LAXMI PAPER MART

Ranade Road, Dadar (West), Mumbai - 400028

All kinds of Waste paper, Old Iron Scrap, old metals like Aluminium, Brass, Copper, Zinc etc. Buying/Selling Merchant. We also buy Wooden furniture items etc. at Resonable Rate. We also buy old Computers & other Electronic Items

TO WHOMSOEVER IT MAY CONCERN

This is to certify that we have collected 1171.5 Kg of answer books from Hindi Vidya Prachar Samiti's Ramniranjan Jhunjhunwala College of Arts, Science and Commerce (Autonomous) on 11/10/2022, which will be directly sent into the mill for pulping/ recycle purpose only. The secrecy of all your items i.e. old scrap or written matter of old waste paper is also taken into consideration.

LAXMI PAPER MART
Ranade Road, Dadar (W), Mumbai - 28.

G. MOU for E-waste Recycling

R. J. COLLEGE of Arts, Science & Commerce (AUTONOMOUS)
(Hindi Vidya Prachar Samiti's RAMNIRANJAN JHUNJHUNWALA COLLEGE of Arts, Science & Commerce)
Opposite Ghatkopar Railway Station, Ghatkopar (West), Mumbai 400086, Maharashtra, INDIA.
Website: www.rjcollege.edu.in Email: rjcollege@rjcollege.edu.in Tel No: +91 22 25151763 Fax No: +91 22 25150957
College is recognized under Section 2(f) & 12(B) of the UGC Act, 1956
Affiliated to UNIVERSITY OF MUMBAI || NAAC Re-Accredited 'A' Grade (CGPA: 3.50)

Memorandum of Understanding (MOU)

Between

Rashmi Joshi

Environment Consultant

4/B, 141, Yoganand Society, Vazira Naka, Borivali (West), Mumbai-400092

And

Ramniranjan Jhunjhunwala College, Ghatkopar (West), Mumbai-400086

For "Environment Projects"

This MOU has been made for the period of one year from the 11th day of January 2021 to 10th day of January 2024.

Ramniranjan Jhunjhunwala College, Ghatkopar (West), Mumbai and Rashmi Joshi Environment Consultant, Mumbai

Roles and Responsibilities of Ms. Rashmi Joshi:

1. Conduct awareness sessions as well as activities amongst youth and students about the use of waste as well as water as resource and its relationship with climate change and global warming.
   (Promote knowledge and provide training for segregation at source and composting among students, faculty and non-teaching staff.)
2. Encourage and promote environment related activities such as Composting, E-waste Collection, Seed balls and Rainwater Harvesting.
3. Sensitize and involve students from the college / institute for promoting the concept of the environment related projects.
4. I will conduct periodic supervision of once in a week in the first month & then once in a fortnight for a period of three months from the initiation of composting project.

Roles and Responsibilities of College

1. The college will make arrangements for the awareness lectures.
2. The students & staff will actively participate in the recycling of the waste as well as water.
3. Environment projects are a part of college environmental activity and hence it will be monitored on a regular basis by NCC / NSS students and faculty members. I expect the college to continue the projects for at least for one year.
4. College will nominate a contact person to whom the activity report will be submitted in the second week of every month.

IN WITNESS WHERE OF, the Parties hereto have duly executed this Agreement as on the day, month and year first herein above written.

For Environment Consultancy	**For R J College**
(Authorized Signatory)	(Authorized Signatory)
Name: Ms. Rashmi Joshi	**Name: Dr. Himanshu Dawda**
Designation: Environment Consultant	**Designation: I/C Principal**
Place: Ghatkopar (W)	**Place: Ghatkopar(W)**
Date: 11/01/2021	**Date: 11/01/2021**
Stamp:	**Stamp:**

PRINCIPAL
RAMNIRANJAN JHUNJHUNWALA COLLEGE OF ARTS, SCIENCE & COMMERCE (AUTONOMOUS)
Ghatkopar (W), Mumbai-400 086, Maharashtra, INDIA

Est. 1963 AUTONOMOUS NAAC Re-accredited 'A' Grade

H. Invoice of metering system installed

S. C. MALHOTRA AND SONS

Address: Office no. 19, Opp. Bldg. no. 184, Jawahar road, Ghatkopar (East), Mumbai-400075.
Tel. no.: 022-2122420/022-2120158

BILL

No. 268	Date: 09-01-2023

Hindi Vidya Prachar Samiti
Ramniranjan Jhunjhunwala College
Mumbai
GST no.: 27AAATH0417Q1ZI

T-686

Sr. No	Particulars	Qty	Rate	Amount	SAC Code	GST 18%		Sum
						9% SGST	9% CGST	
1.	Providing 16 Sq. mm. cable	80 mtrs	333	26640	8544	2397.6	2397.6	31435.2
2.	GI strip	80 kg	139.5	11160	7308	1004.4	1004.4	13168.8
3.	Copper strip	40 kg	634.5	25380	7409	2284.2	2284.2	29948.4
4.	Earthing electrode	3	2925	8775	7409	789.8	789.8	10354.6
5.	Providing 100 amp 4 pole MCB	1	11250	11250	8547	1012.5	1012.5	13275
			Sum	**83205**		**7488.5**	**7488.5**	**98182**
							Total Amount	**98,182/-**
	Total Amount - Rupees Ninety Eight thousand One hundred and eighty-two Only							

GST No. 27ACRPM3866H1Z0
PAN-ACRPM3866H

98182
-1664
96518/-

NS - 7
111055
21/01/2023.

For S. C. Malhotra and Sons

Malhotra

S. C. MALHOTRA AND SONS

Address: Office no. 19, Opp. Bldg. no. 184, Jawahar road, Ghatkopar (East), Mumbai-400075.
Tel. no.: 022-2122420/022-2120158

BILL

No. 269 — **Date: 09-01-2023**

Hindi Vidya Prachar Samiti
Ramniranjan Jhunjhunwala College
Mumbai
GST no.: 27AAATH0417Q1ZI

T-675

Sr. No	Particulars	Qty	Rate	Amount	SAC Code	GST 18%		Sum
						9% SGST	9% CGST	
1.	Liasoning charges to provide solar reverse power electric meter by liasoning from the electric supply companies for proving required electric meters and being installed	1	13500	13500	995461	1215	1215	15930
2.	Installing 16 Sq. mm. cable	80 mtrs	256.5	20520	995461	1846.8	1846.8	24213.6
3.	Installing strips	120 meters	99	11880	995461	1069.2	1069.2	14018.4
4.	Installing 100 amp 4 pole MCCB	1	1125	1125	995461	101.3	101.3	1327.6
			Sum	**47025**		**4232.3**	**4232.3**	**55489.6**
							Total Amount	**55,490/-**
	Total Amount - Rupees Fifty five thousand four hundred and ninety Only							

GST No. 27ACRPM3866H1Z0
PAN: ACRPM3866H

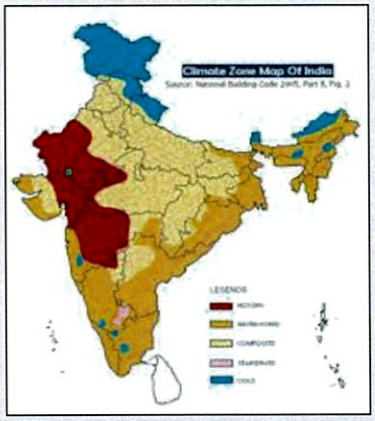
55490
(-) 941
54549/-

NS-7
111044
21/01/2023.

For S. C. Malhotra and Sons

Malhotra

I. Energy benchmarks for Commercial Buildings



Based on the data collected from different categories of commercial buildings, the following tables show the indicative EPI benchmarks.

EPI benchmarks for Office Buildings

Climate Zone	Less than 50% AC	More than 50% AC
EPI (kWh/m²/yr)		
Warm & Humid	101	182
Composite	86	179
Hot & Dry	90	173
Moderate	94	179

EPI benchmarks for Shopping Malls

Climate Zone	EPI (kWh/m²/yr)
Warm & Humid	428
Composite	327
Hot & Dry	273
Moderate	257

EPI benchmarks for Hospitals

Climate Zone	EPI (kWh/m²/yr)
Warm & Humid	275
Composite	264
Hot & Dry	261
Moderate	247

EPI benchmarks for Hotels

Climate Zone	Upto 3 star	Above 3 star
EPI (kWh/m²/yr)		
Warm & Humid	215	333
Composite	201	290
Hot & Dry	167	250
Moderate	107	313

EPI benchmarks for Institutes

Climate Zone	EPI (kWh/m²/yr)
Warm & Humid	150
Composite	117
Hot & Dry	106
Moderate	129

EPI benchmarks for BPOs

Climate Zone	EPI (kWh/m²/yr)
Warm & Humid	452
Composite	437
Hot & Dry	-
Moderate	433

Disclaimer : The EPI benchmarks should be considered as an Indicative figure as it largely depends upon the operating hours, energy efficiency measures, sample size, climatic zone and lack of detailed information by building owners.

Energy benchmarks for Commercial Buildings

Bureau of Energy Efficiency
4th Floor, Sewa Bhawan, R.K. Puram, New Delhi – 110066
Website : www.beenet.in

J. List of Vendors

Solid Waste Management

Ms. Jyoti Mhapsekar,
President,
Stree Mukti Sanghatana (SMS)
Mobile: +91 9867724529

Chembur Center
Room No. 14 Santiniketan Chawl,
Postal colony, Next to BD Shukla school
Chembur, Mumbai - 400071
Phone: 022 65745837/022 25274588
Email: smspv123@gmail.com

Govandi Office
Ahilyabai Holkar Marg, Near Jafri High School bus stop,
Govandi- Mumbai - 400043
Phone: 022 65745840
Email: smspbvs@gmail.com

Solar PV panels

Avesta Solar
Dossabhoy Manison A,
Ground floor plot no. 796, Jame Jamshed Road,
Dadar East, Mumbai - 400014
Phone: 09819867196

K. Solar Photo Voltaic System: Inspection and Maintenance Process Document

1. General Checks and Inspections

a. Roof drainage to be adequately designed and maintained to allow the Rainwater to Flow out from the Solar PV System area.
b. Check for ground erosion near the footings of the System
c. Electrical enclosures to be accessible to authorised personnel only
d. Inspect for corrosion on the Array Structures & outside of enclosures.
e. Check for cleanliness throughout the site to ensure that there is no Grime and dust in and around the inverter pad area or elsewhere
f. Ensure No loose hanging wires in the array
g. Check for signs of Bird's dropping infestation over the array and attend to it immediately by cleaning.

2. Modules

Condition Based Monitoring is the Best Management Practice for Maintenance of Solar Array. Modules need the maximum amount of preventive maintenance, and cleaning activities are majorly concentrated around them.

a. Frequency of cleaning: Ideally Once a Week an inspection of Array to be carried out. Cleaning frequency to be decided upon the location and seasonal variation.
b. Water Quality: The cleaning of the modules is done keeping in mind the TDS (total dissolved solids) levels, water specifications and certain wiping details. In India, the TDS level of the water needs to be at least below 250 parts per million (ppm). The chlorine (less than 250 ppm) and calcium (less than 250 ppm) level of the water, as well as the electrical conductivity, is kept in mind while carrying out the cleaning. Water quality is tested after every six months to ensure that set standards are maintained.

c. Quality of cleaning equipment: Fibre cloth / Soft Brushes to be used to avoid abrasion on the Glass surface. For Bird Droppings / Stubborn Stains consult OEM for approval of cleaning chemicals.

d. Drying of Washed Surface : is of prime importance to avoid leaving Wash marks and dust getting stuck to the wet surface.

e. Automated Cleaning System saves 50% of Water used and improves system's Efficacy @ 5-7%. Cleaning is programmed on daily basis.
As the system is costly it is slowly gaining acceptance in the industry. Cost justification is challenging for Smaller Capacity systems

3. Inverter

a. Inverter is hi-Tech device in the entire PV System. Follow the instruction of the OEM and leave Checking and Servicing to the OEM or their approved Service Vendor.

b. Annual Health Check-up of Inverter is strongly recommended.

c. Continuous (daily) Online Monitoring of the Data @ Inverter will convey the health of the Inverter. In case of any change in Generation pattern to be immediately communicated to OEM for check-up.

d. Installation of the Inverter to be done as per the OEM's guidelines and ensure it's protection from Rain Water, Lightning. Proper Protection to be ensured.

e. ACDB (Alternate Current Distribution Board) is a unit which is installed & integrated with Inverter for Solar Power Output to the Premise. It's protection protocol should be similar to that of Inverter.

f. Annual Health Check-up should include but not limited to following

   i. Checking connection of Wires at Terminals
   ii. Testing Voltage / Current through the Array strings
   iii. Inspection of moisture ingress in the Terminal boxes etc.
   iv. Functional Testing of online communication devices like routers, metrological devices.
   v. Setting at the Inverter

4. **Cabling & Connector**
    a. Ensure that there is no gap between the male and female connector pipes. Any gap, irrespective of the size, could cause a fire and damage the modules.

5. **Lightning Protection**
    a. There shall be the required number of suitable Lightning Arrestors installed in the Array field. Lightning protection shall be provided by use of 'Surge Protection Device' (SPD) and suitable Earthing such that induced transients are routed through the Earthing path and not impact the Solar Inverter system.

6. **Earthing Protection**
    b. Each array structure of the PV system should be properly grounded in addition to Lightning arrestor grounding. Provision to be kept for shorting and grounding of PV array at the time of Maintenance work.

7. **Rain Protection**

    a. Inverter and ACDB are installed besides the Solar Array on the open Terrace.
    b. Rain cover Shade or better to provide Enclosure over the Inverter and ACDB to avoid direct exposure to Rain Water and also help avoid Dust Ingress.
    c. All the Enclosures should be IP 65
    d. Sealing (Water proofing) of Inverters, ACDB, Terminal Boxes to be thoroughly check prior to onset of Monsoon.

8. **Remote Metering: Monitoring the solar PV panels consistently is the cornerstone of the O&M of a solar power plant**

a. A "check meter" of equal or higher accuracy with reference to the main meter to cross-check the production level on a regular basis is highly desirable. All readings must be, more or less equal, with a 2-3% correction allowance.

b. A solar power plant constantly needs to be monitored to detect breakdowns and optimise its operation. Online Monitoring System will go a long way in ensuring the 'Operational Efficiency' of the system.

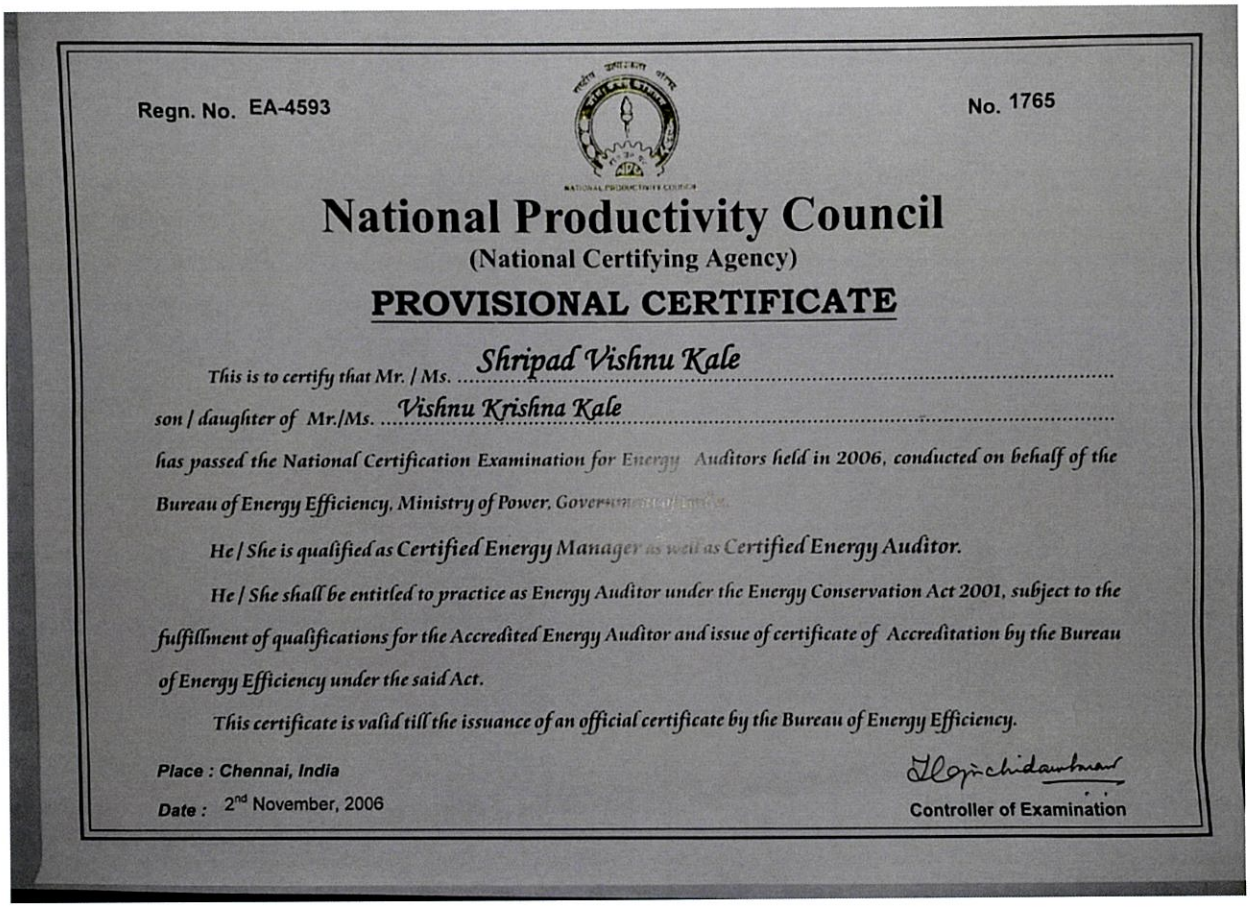
c. System should be capable of executing following function

   i. Individual Array Monitoring
   ii. Measurement and Recording of Energy and other Allied parameters
   iii. Operating state monitoring and failure indication

9. Safety

a. Operations, Inspection & Maintenance work to be carried out by Authorized Trained Personnel ONLY
b. High Voltages are prevalent at the Arrary and Inverter.
c. Before Initiating any work on Electrical Device (Inverter, ACDB, Terminals at Solar Array) Switch OFF the System.
d. Do not open the inverter when Powered ON. To be done by authorized person only.
e. All the wiring and connectors to be properly harnessed and routed through Cable Trays.

L. Energy Auditor's Certificate



Regn. No. EA-4593

No. 1765

National Productivity Council

(National Certifying Agency)

PROVISIONAL CERTIFICATE

This is to certify that Mr. / Ms. Shripad Vishnu Kale

son / daughter of Mr./Ms. Vishnu Krishna Kale

has passed the National Certification Examination for Energy Auditors held in 2006, conducted on behalf of the Bureau of Energy Efficiency, Ministry of Power, Government of India.

He / She is qualified as Certified Energy Manager as well as Certified Energy Auditor.

He / She shall be entitled to practice as Energy Auditor under the Energy Conservation Act 2001, subject to the fulfillment of qualifications for the Accredited Energy Auditor and issue of certificate of Accreditation by the Bureau of Energy Efficiency under the said Act.

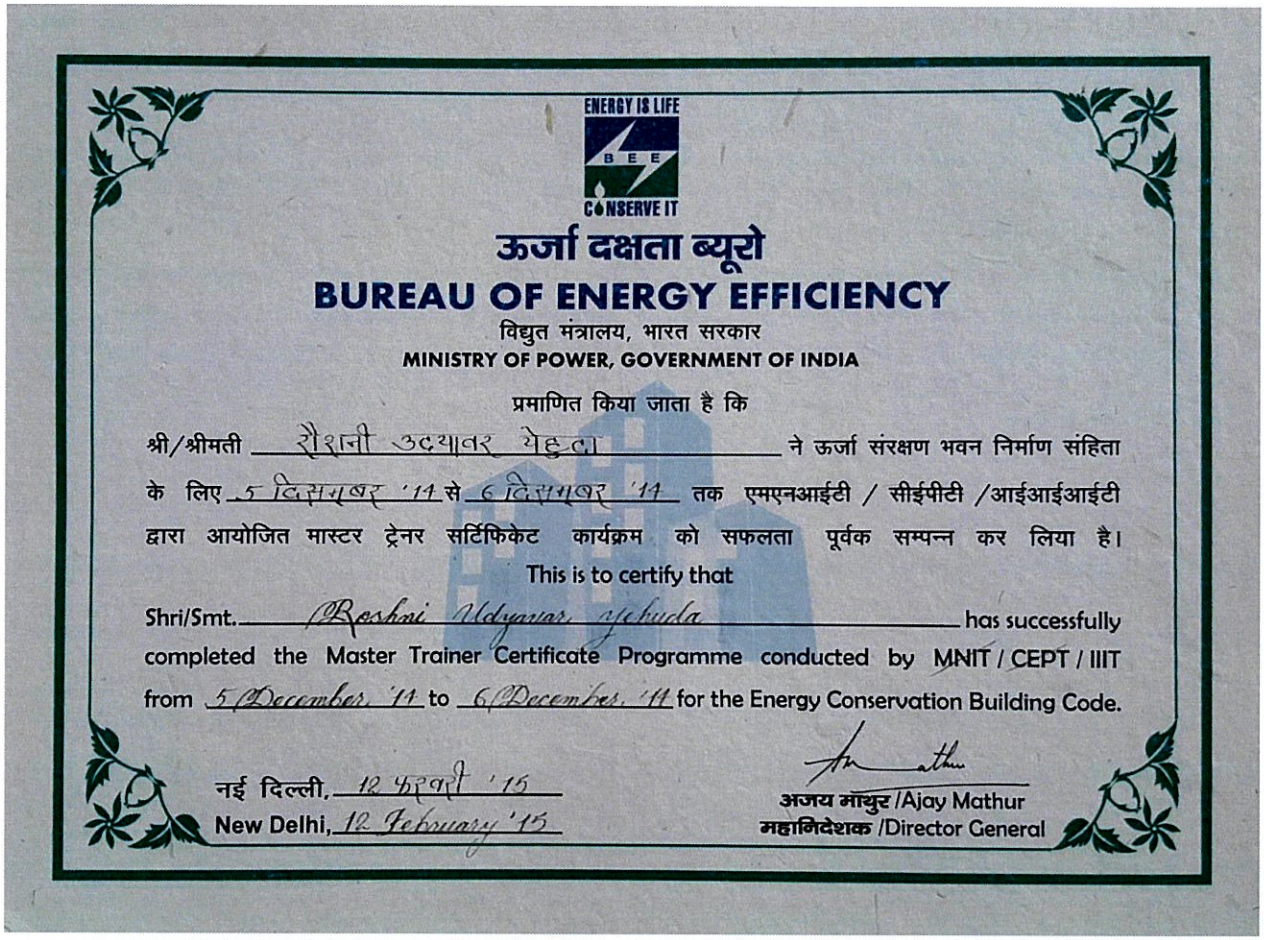
This certificate is valid till the issuance of an official certificate by the Bureau of Energy Efficiency.

Place : Chennai, India

Date : 2nd November, 2006

Controller of Examination

M. BEE Master Trainer Certificate



ENERGY IS LIFE
CONSERVE IT

ऊर्जा दक्षता ब्यूरो

BUREAU OF ENERGY EFFICIENCY

विद्युत मंत्रालय, भारत सरकार

MINISTRY OF POWER, GOVERNMENT OF INDIA

प्रमाणित किया जाता है कि

श्री/श्रीमती रौशनी उदयावर येहुदा ने ऊर्जा संरक्षण भवन निर्माण संहिता के लिए 5 दिसम्बर '11 से 6 दिसम्बर '11 तक एमएनआईटी / सीईपीटी /आईआईआईटी द्वारा आयोजित मास्टर ट्रेनर सर्टिफिकेट कार्यक्रम को सफलता पूर्वक सम्पन्न कर लिया है।

This is to certify that

Shri/Smt. Roshni Udyavar Yehuda has successfully completed the Master Trainer Certificate Programme conducted by MNIT / CEPT / IIIT from 5 December '11 to 6 December '11 for the Energy Conservation Building Code.

नई दिल्ली, 12 फरवरी '15
New Delhi, 12 February '15

अजय माथुर /Ajay Mathur
महानिदेशक /Director General

N.BEE Empaneled Expert professional

ENERGY IS LIFE
BEE
CONSERVE IT

ऊर्जा दक्षता ब्यूरो
(भारत सरकार, विद्युत मंत्रालय)

SPEED POST

BUREAU OF ENERGY EFFICIENCY
(Government of India, Ministry of Power)

F.No.09/06/07/IMPL/ECBC/11744

28th March, 2016

Ms. Roshni Udyavar Yehuda
Rachana Sansad's Institute of Environmental Architecture
278, Shankar Ghanekar Marg, Prabhadevi
Mumbai – 400 025

Sub: Energy Conservation Building Code – Shortlisting of Architects/ Consultant reg.

Dear Madam,

This has reference to your application for shortlisting of Architects/Consultants for implementing the Energy Conservation Building Code (ECBC). We are pleased to inform you that you have been shortlisted to act as the resource person of the Bureau of Energy Efficiency (BEE) for helping in building technical capacity and develop compliance procedures and tools for the effective implementation of the ECBC. In addition, you would also be expected to advise design professionals in modifying the standard specifications so as to correspond with the Code requirements.

We would like you to send in your acceptance to being associated with the BEE in providing technical assistance to all those seeking to adopt Energy Conservation Building Code.

Yours faithfully,

(Sanjay Seth)
Energy Economist

स्वहित एवं राष्ट्रहित में ऊर्जा बचाएँ Save Energy for Benefit of Self and Nation
चौथा तल, सेवा भवन, आर० के० पुरम, नई दिल्ली-110 066 वेबसाईट/Website : www.beeindia.in
4th Floor, Sewa Bhawan, R.K. Puram, New Delhi-110 066 टेली/Tel.: 26179699 (5 Lines) फैक्स/Fax 91 (11) 26178352

O. Renewable Energy Mashav Course Certificate

Arava Institute

MASHAV 60

This certifies that

Dr. Roshni Udyavar Yehuda

India

successfully completed a course on

Renewable Energy as a Catalyst for Regional Development

November 18th – December 7th, 2018

Ambassador Peleg Lewi
Director of training and capacity building
MASHAV
Ministry Of Foreign Affairs

Dr. Tareq Abu Hamed
Academic Director
Director of Center for Renewable Energy, AIES

Dr. Shmuel Brenner
Director of the Arava Center for Sustainable Development, AIES

P.ISO Certificate

Alcumus ISOQAR

ISOQAR (India) Private Limited

26 June 2023

Hindi Vidya Prachar Samiti's
Ramniranjan Jhunjunwala College of Arts, Science & Commerce
Ghatkopar West
Mumbai 400 086
Maharashtra

To the attn. of Dr. Himanshu Dawda, Principal

Independent Limited Assurance Report on Hindi Vidya Prachar Samiti's (HVPS's) Ramniranjan Jhunjunwala College of Arts, Science and Commerce Green Audit Report

Introduction

We were engaged by Roshni Udyavar & Associates to perform a limited assurance engagement on HVPS's Ramniranjan Jhunjunwala College of Arts, Science and Commerce Green Audit Report for the Reporting Period from 1 April 2022 to 31 March 2023.

Management's responsibilities

Jhunjhunwala College of Arts, Science & Commerce has decided to implement the NAAC accreditation requirements. The management is responsible for the preparation and public disclosure of the Green Audit Report in accordance with the NAAC Accreditation Criteria *"Guidelines for the Creation of the IQAC and Submission of Annual Quality Assurance Report (AQAR) by Accredited Institutions (AQAR format in line with the revised manual of Autonomous Colleges, with effect from the academic year 2020-21)"*. This responsibility includes submission of report as per above criteria. The management has appointed Roshni Udyavar & Associates to conduct an audit and prepare the Green Audit report, in conformance with Criterion 7.

Our responsibility

Our responsibility is to carry out a limited assurance engagement in order to express a conclusion based on the work performed by Roshni Udyavar & Associates. We conducted our assurance engagement in accordance with International Standard on Assurance Engagements ISAE 3000 Assurance Engagements other than Audits or Reviews of Historical Financial Information issued by the International Auditing and Assurance Standards Board and the guidance set out in the Criterion 7 of NAAC assessment criteria (Audit Guidance).

Limited assurance procedures performed

We have planned and performed our work to obtain all the evidence, information and explanations considered necessary in relation to the above scope. These procedures included:

- Enquiries of management to gain an understanding of Jhunjhunwala College processes and initiatives

United Kingdom (Head Office)
Alcumus ISOQAR Limited
Cobra Court,1, Blackmore Road

Ground floor, Dossabhoy Mansion,
Plot no 796, Jame Jamshed Road,
Dadar (East), Mumbai-400014

303, MATRIX, Behind Divya Bhaskar Press,
Off. S. G. Highway, Makarba, Ahmedabad- 380 051, Gujarat, India

- On-site visit to the College premises to interview personnel from the management, operations and administration that are directly linked with facility management
- Enquiries of staff and external agency responsible for the preparation of the College Green Report
- Review of policies, procedures and internal controls that Jhunjhunwala College has in place to conform to the NAAC Accreditation Criteria 7 Guidelines
- Review of a selection of the supporting documentation
- Review of the Green Audit Report, prepared by Roshni Udyavar & Associates, Mumbai

We believe that the evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

Our independence

We have complied with the Code of Ethics for Auditors issued by ISO 17021, which includes independence and other requirements founded on fundamental principles of integrity, objectivity, professional competence and due care, confidentiality and professional behavior. In conducting our engagement, we confirm that we satisfy the criteria for assurance providers as set out by ISO 17021 to carry out the engagement.

Opinion

Based on the limited assurance procedures performed, as described above, we conclude that HVPS's Ramniranjan Jhunjunwala College of Arts, Science and Commerce Green Audit Report for the period from 1 April 2022 to 31 March 2023 describes the activities undertaken by the management to fulfill the best practices and sustainability measures in all respects, and are found to be in accordance with the guidelines in NAAC Assessment Criteria 7.

Yours sincerely

ISOQAR (India) Private Limited

Burgis Bulsara
ISOQAR India Pvt Ltd.

United Kingdom (Head Office)
Alcumus ISOQAR Limited
Cobra Court,1, Blackmore Road,

Ground floor, Dossabhoy Mansion,
Plot no 796, Jame Jamshed Road,
Dadar (East), Mumbai-400014

303, MATRIX, Behind Divya Bhaskar Press,
Off. S. G. Highway, Makarba, Ahmedabad- 380 051, Gujarat, India

ISOQAR (India) Private Limited

To Whomsoever it may Concern

This is to certify that we have conducted a third-party assessment of the Green Audit conducted by Roshni Udyavar and Associates in accordance with the International Standard on Assurance Engagements ISAE 3000 Assurance Engagements other than Audits or Reviews of Historical Financial Information issued by the International Auditing and Assurance Standards Board and the guidance set out in the Criterion 7 of NAAC assessment criteria (Audit Guidance).

We have complied with the Code of Ethics for Auditors issued by ISO 17021, which includes independence and other requirements founded on fundamental principles of integrity, objectivity, professional competence and due care, confidentiality and professional behaviour. In conducting our engagement, we confirm that we satisfy the criteria for assurance providers as set out by ISO 17021 to carry out the engagement.

Based on the limited assurance procedures performed, as described above, we conclude that HVPS's Ramniranjan Jhunjunwala College of Arts, Science and Commerce Green Audit Report for the period from 1 April 2022 to 31 March 2023 describes the activities undertaken by the management to fulfil the best practices and sustainability measures in all respects, and are found to be in accordance with the guidelines in NAAC Assessment Criteria 7.

Yours sincerely,

ISOQAR (India) Private Limited

Burgis Bulsara
ISOQAR India Pvt. Ltd.

United Kingdom (Head Office)
Alcumus ISOQAR Limited
Cobra Court 1, Blackmore Road

Ground floor, Dossabhoy Mansion,
Plot no 796, Jame Jamshed Road,

303, MATRIX, Behind Divya Bhaskar Press,
Off. S. G. Highway, Makarba, Ahmedabad- 380 051, Gujarat, India