GREEN AUDIT REPORT

2021-22

Submitted to

Smt. Chandibai Himathmal Mansukhani college

Ulhasnagar, Mumbai - 421003

Prepared by

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ARCHITECTURE . INTERIORS . ENERGY . ENVIRONMENT

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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.

Acknowledgement

We extend our sincere thanks to Hyderabad (Sind) National Collegiate Board, the Management of Smt. Chandibai Himathmal Mansukhani College for taking up the initiative to conduct Green Audit.

We are grateful to the Principal of the College, Dr Manju Lalwani Pathak for her support and enthusiasm in taking up this venture. We acknowledge the initiative of the college Internal Quality Assurance Cell (IQAC) for providing us with detailed information needed to conduct the audit and their presence during the audit visits.

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 –** a unit of Illuminance
- **m -** Meter
- **mm -** Millimetre
- **W -** Watt
- **W/m² -** Watts per square meter
- **Wh -** Watthour

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Executive Summary 2021-22

The Smt. Chandibai Himathmal Mansukhani college premises has an energy consumption of **95,498 kWh** for the academic year 2021-22 as per metered electricity bill. This may not be the total consumption during full occupancy as the college functioned offline for only 3 months in 2021-22 due to the Covid-19 Pandemic. The main areas of electricity consumption are Lighting, Fans, Air Conditioning and Equipment. Of this, **Equipment** load is the **highest at 29% (31,599 kWh)** followed by **Lighting load at 27% (29,380 kWh), AC at 22% (23,826 kWh),** and **Fans at 22% (24,067 kWh)**. **Seven percent** of the College space is **air-conditioned** which includes IT labs, an auditorium and a few administrative spaces, having only split ACs. The college functions in two buildings, the Main building(G+4) and the Extension building(G+3).

The Energy Performance Index (EPI) of the building is **7.86 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 currently achieved by the college. The college has scope for adding solar panels on its roof top.

86 % of spaces within the college comply with the maximum allowable Lighting Power Density (LPD) as per the **Space Function method of ECBC 2017**. Also, the lighting levels meet the National Building Code (NBC) standard in most of the spaces.

According to municipal water bills, the average monthly consumption is around **427 KL** which comes to about **20 KL** per day which is around **9.4%** of the standards prescribed by the NBC for domestic usage. The flushing requirement of the college is fulfilled by the bore well present on site. There is scope for reducing water consumption to around 50% by using aerators for taps, and drip irrigation for watering trees.

The college generates Paper, Glass, Cardboard, Electrical and Electronic waste which constitutes of **50% of recyclable solid waste**, while **50% of organic** waste is generated by food waste from the canteen and leaf litter is composted on site. The electronic waste generated of 350 kg was collected by the Eco Friend industries, for the audited period.

The college has good ambient air quality due to the vegetation on campus. The main building is renovated recently, and all windows have white PVC frames. Classrooms, corridors and staircases are large and spacious with good light, ventilation and signages.

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

Recommended Measure	Potential Savings per year (kWh/ Litres)	Potential Financial Savings Per year (Rs)	Estimated Investment (Rs)	Simple Pay Back Period (year)
Energy				
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)	**3,105**	**57,374**	**45,540**	1
Replacement of regular fans with BEE star rated fans and Brushless Direct Current (BLDC) fans	**9,536**	**1,76,226**	**20,79,000**	11.8
Installation of APFC panel	**0**	**96,000**	**1,50,000**	1.5
Renewable Energy				
Installation of solar PV and Net metering to be arranged with Utility - Mahadiscom	**57,450**	**10,61,676**	**14,64,439**	1.4
Total	**70,091**	**13,91,276**	**37,38,979**	3
Water				
Wash basin faucet to water saving aerators	50%	NA		NA
Water meter to measure borewell water usage	Mandatory		500	NA

Table 1: Key Recommendations for improving the environment at Smt. Chandibai Himathmal Mansukhani college

BEE-Bureau of Energy Efficiency
kWh- Kilowatt hour

1. Introduction

Smt. Chandibai Himathmal Mansukhani college was established in 1965 and managed by Hyderabad (Sind) National Collegiate Board (HSNC board). Smt. Chandibai Himathmal Mansukhani College is one of the largest Colleges at the University of Mumbai located in an area of 16 acres (65,000 m2) of lush green land. The campus is rich in scenic and greenery around. The college has taken extra measures to protect and conserve its natural environment and the greenery.

The College was established with about 250 students and four departments and has transformed into one of the largest Colleges affiliated with the University of Mumbai. The college has more than 10,000 students and 400+ teaching and non-teaching staff. There are 27 Undergraduate and 11 Postgraduate Departments, 06 Research Centres, 08 Professional and 11 Certificate Courses and 02 prestigious UGC sponsored community outreach centres.

The College won second prize at the Intercollegiate "Green and Clean Environment Campus" organized by the Indian Merchants Chamber in 2011-2012. The college has one of the largest NSS Units of the University of Mumbai with an enrolment of 300 Volunteers per year taking major initiatives in organizing the Social and Community based programmes in the City of Ulhasnagar and Districts of Mumbai and Thane.

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 devise 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 rainwater 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 systems 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.
- 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 the 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 on 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 **1,30,825 sq. ft. (12,154 sq. m)**, is considered for the audit and was evaluated based on existing drawings, information as well as on-site measurements as it forms the basis of assessment of the energy, water and waste consumption to existing benchmarks. The college campus has an area of **64,749 sq m,** which has other colleges like law, engineering, pharmacy.

The college functions mainly in 2 main buildings namely the Main building and Extension building. Main building has Ground to fourth floors while extension building has ground to 3rd floor.

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

The analysis shows that **14%** of the total built-up area of the college is used as a common passage. The college building has classrooms for Junior and Senior Degree college, computer labs, administrative 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	Library in both buildings, Canteen, Auditorium, Toilets, Chemistry lab, Professor's common room, NSS and NCC rooms, Gymkhana, Examination Cell.
2	First Floor	Administrative office, Principal's cabin, HoD cabins, Girls common room, Classrooms, Laboratories, Water

		room, Toilets
3	Second Floor	HoD cabins, Classrooms, Water room, Laboratories
4	Third Floor	Classroom, HoD cabins, Water room, Toilets
5	Fourth Floor	Store rooms, Class rooms

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: Classroom in extension building

Plate 2: Classroom 315 in the main building

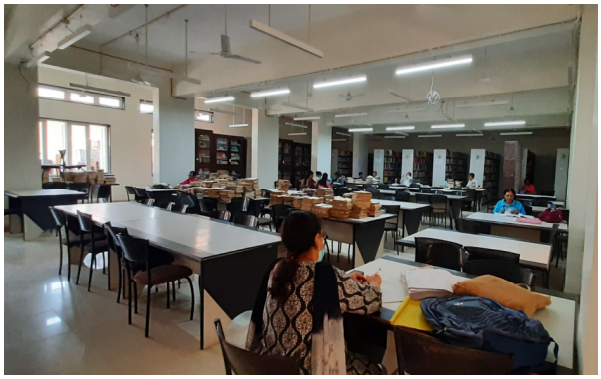



Plate 3: Library on the ground floor of Main Building


Plate 4: Third floor and First-floor corridor- Main Building

Plate 5: Chemistry lab

Plate 6: Butterfly Garden

Plate 7:Borewell no 2

Plate 8 : Ramp for universal access

Plate 9: Solar panel for lighting of Pump room

Plate 10 : Passage of Extension Building

Plate 11: Terrace above the third floor(main building)

Plate 12: Main entrance (East Side)

2. Audit Methodology

Five steps involved in the audit process are as follows:

Step	Objective	Activities
Step 1	Audit of historical data	• Online data collection • Building drawings, utility bills
Step 2	Screening survey or walk-through audit	• A random verification 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 power system 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

Table 3: Steps in the Green Audit

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

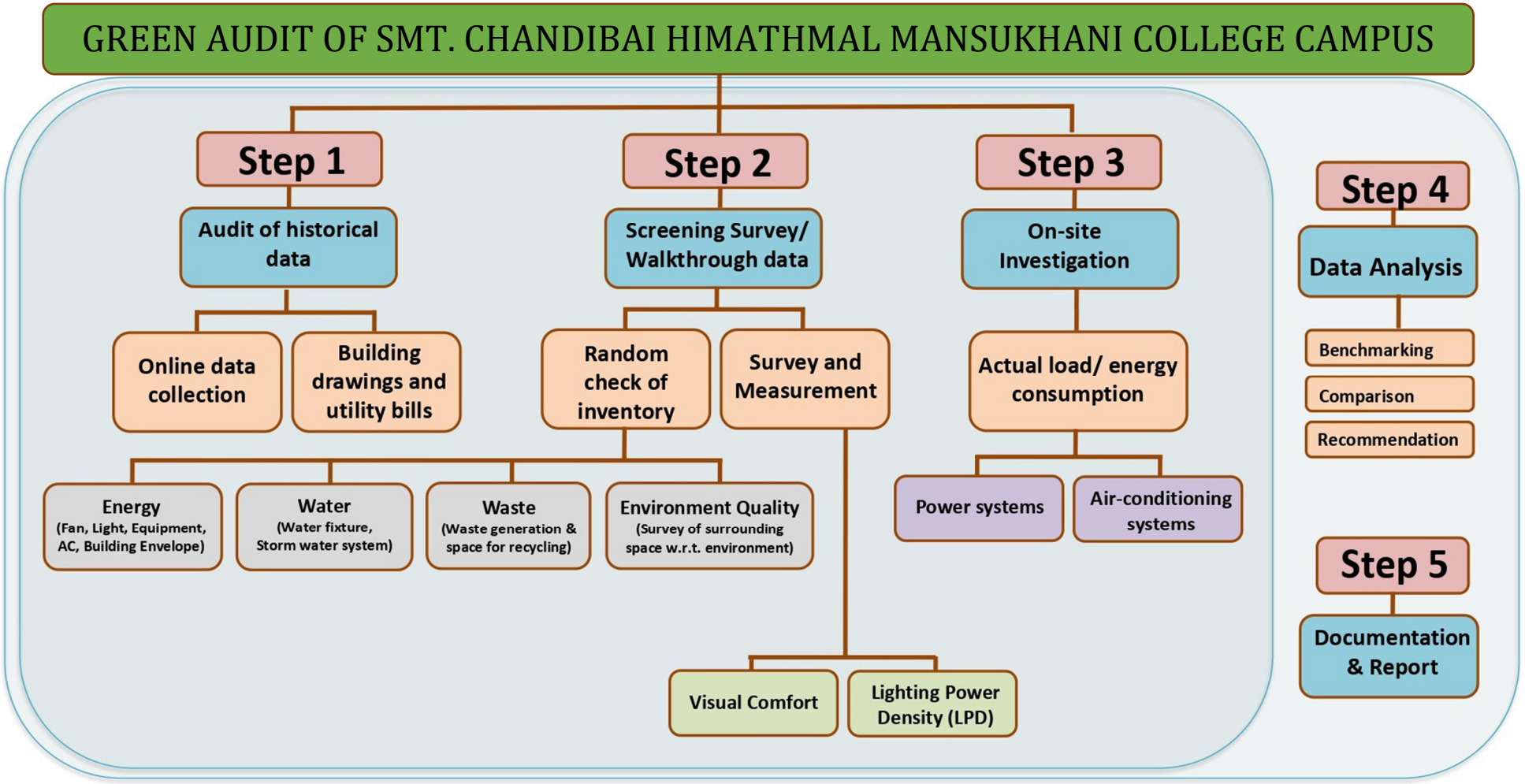


Figure 1: Methodology of the Green Audit at Smt. Chandibai Himathmal Mansukhani college

2.1 Data Collection

General Data collection such as the 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 (June 2021to May 2022).

Walk-through Audit

A walk-through audit was conducted by the Team which was followed by a few more visits to review the accuracy of the data. Special guided visits of the campus were conducted along with Dr. Rashmi Deshpande.

Detailed Audit and Measurements

A detailed audit of the air conditioning system (window and spit units), as well as the electrical system, was conducted by our BEE-certified energy auditor team. The indoor and outdoor units of the Air Conditioners 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.

The energy audit study was carried out for the year, during the lockdown period, and hence the building had limited occupancy and load on the systems, as only administrative staff was present in the college. For the audit purpose, some of the air-conditioning systems were switched ON to generate load on the system. Below are some pictures of the detailed audit in process.

The observation Checklist was used during the walk-through audits to gather information about the location of windows, Window Wall Ratio (WWR), number and type of lights, fans, air conditioners and Equipment

BEE: Bureau of Energy Efficiency

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 the 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 40 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	College and Green Audit Team	Date
1.	Preliminary visit and walk-through audit	Dr. Roshni Yehuda, Director, Roshni Udyavar & Associates Dr. Rashmi Deshpande, Assistant Professor, CHM College	04.04.2022
2.	Online data form link provided to college	Dr. Manju Lalwani Pathak, Principal, CHM College	05.04.2022
3.	Online data submission	Dr. Rashmi Deshpande, Assistant Professor, CHM College	17.06.2022
4.	Walk through and detailed audit	Ar. Trupti Kamat, Project Coordinator, Roshni Udyavar & Associates Dr. Rashmi Deshpande, Assistant Professor, CHM College	25.06.2022
5.	Detailed audit of air conditioning, meters and power systems	Mr. Navneet Kale and Mr. Mahesh Harad, Energy Audit Assistants, Roshni Udyavar & Associates	07.07.2022 and 08.07.2022

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, and 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 Energy Conservation Building Code (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

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

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

Information on the 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, the total built-up area provided in an online questionnaire and building drawings were utilized. As per online data submitted, the approximate total population of the college is **11326 people.** This will be used for SEC calculation. The total built-up area of the college considered for EPI is **1,30,825 sq. ft. (12,154 sq. m).**

Sr no.	Category	No. of Person
1	Students	10975
2	Teachers	171
3	Non-Teaching Staff	173
4	Administrative Staff	7
	Total	**11326**

Table 6: Break- up of the total population of college

3. Analysis and Benchmarking

3.1 Energy

3.1.1 Overall Energy Consumption

The overall electricity load at CHM college can be divided into four major sections viz. Lights, Fans, Air conditioners and Equipment. The total **conditioned area in the college is 7%** while the overall AC load corresponding to this conditioned area is 22%. The college has a few office areas, a conference room, a principal room, and computer labs which are fully air-conditioned and have a significant number of computers and lights. The break-up of energy consumption among the four major contributors end-use-wise, connected load and as per floor-wise is shown in Figure 2, Figure 3, and Figure 4 respectively. .

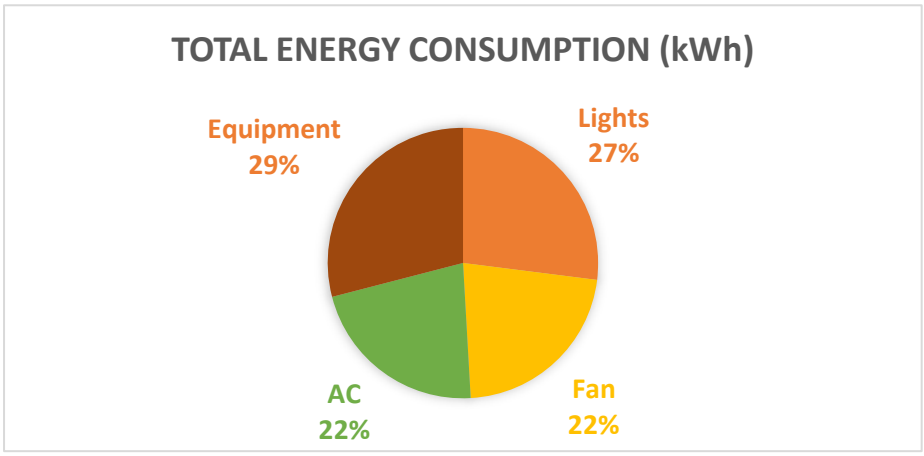


Figure 2: Distribution of Annual Energy Consumption based on end use

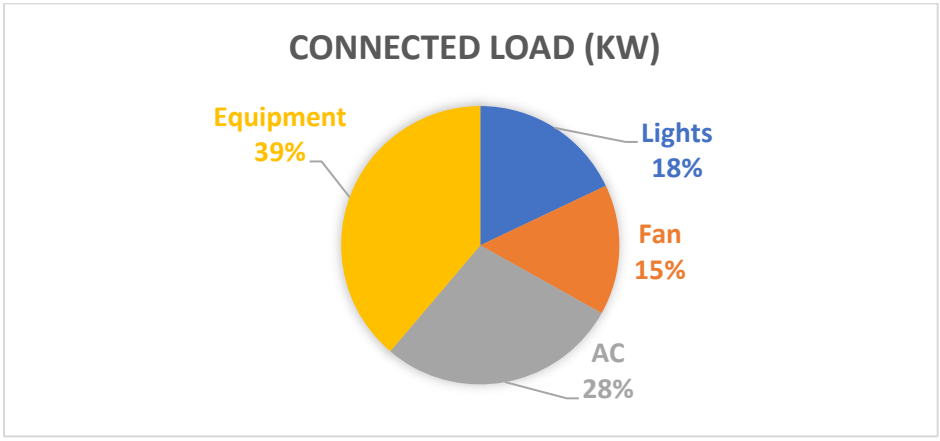


Figure 3: Distribution of Annual Energy Consumption as per Connected Load

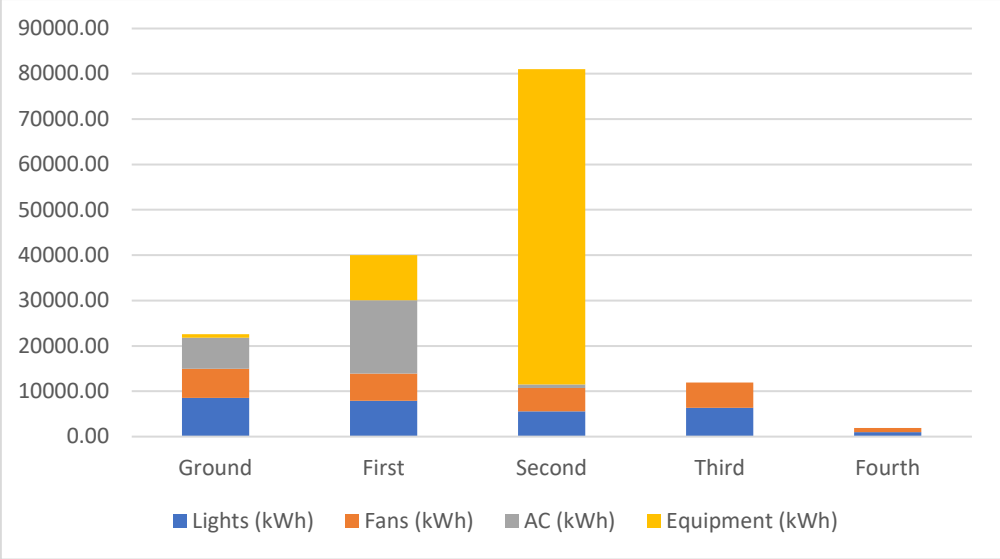


Figure 4 : Distribution of Annual Energy Consumption Floor-wise

Summary of observations – overall energy consumption:

1. The total calculated annual energy consumption of the campus is **1,08,872 kWh**.
2. The total billed electricity for the college for June 2021 to May 2022 is **95,498 kWh**.
3. The diversity factor is **1.14.** This may be due to occupancy information provided by the college considering full occupancy**.**
4. The contribution of **Equipment is 31,599 kWh (29%), AC is 23,826 kWh (22%), Lights is 29,380 kWh (27%), and Fans is 24,067 kWh (22%)**
5. As per the total connected load, the contribution of **Equipment is 39%, AC is 28%, Lights is 18% and Fan is 15%.**
6. **The total air-conditioned area in the college is 7%** while the overall **AC load corresponding to this conditioned area is 22%**
7. **The floor-wise consumption shows that the second, first and ground floors have the majority consumption as compared to all other floors.** This is mainly due to the energy consumption of equipment used in labs and administrative spaces mainly located on the first and second floor while the Ground floor houses spaces like library and chemistry labs in main building, while an auditorium in an extension building
8. The College has an office area, conference room, principal room, and computer labs which are fully air-conditioned and have a significant number of computers and lights.

9. **Circulation spaces** i.e. corridors and staircases, attribute to around **14% of the built area while consuming minimal energy**. Circulation spaces are also naturally lit and ventilated with a parapet wall.

3.1.2 Lighting Energy Consumption

3.1.2.1 Artificial lighting

Artificial lighting contributes to **27% (29,380kWh) of the total consumption** in CHM college. Classrooms and other habitable spaces have overall good day litght while some areas have indirect day lighting through corridors. College has installed Philips PureLine Slim 50mm luminaries (efficacy of 100 lm/W) which provide good diffuse light (reducing shadow) for library. As college is going through major renovation, majority of the lamps are replaced with LED Tubelights and LED ceiling recessed lights. Hence campus has 90% LED lights as shown in Fig. 5. 84% of the lighting energy consumption is from LED. The types and wattage of lamps used are shown in figure 5 and Table 7.

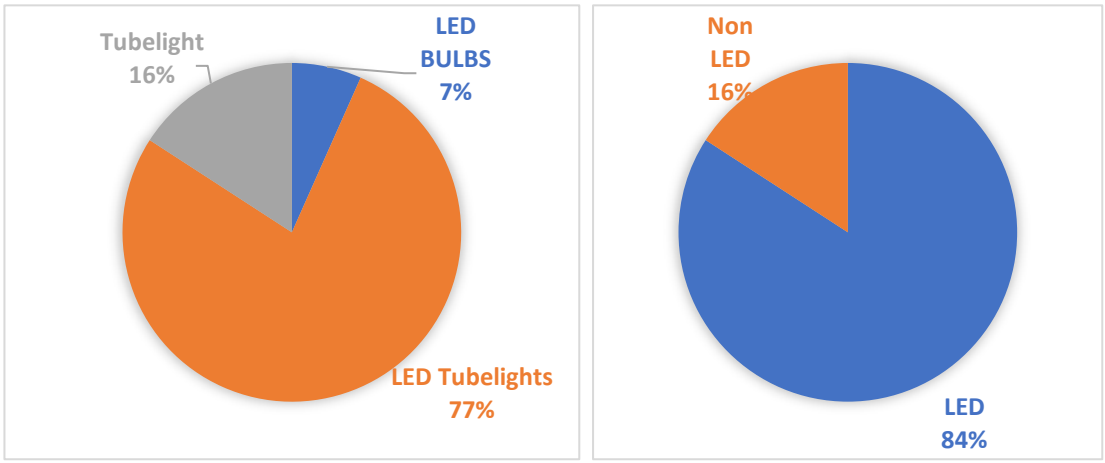


Figure 5: Types of lights and their consumption in percentage

S. No.	Lamp Type	Approximate wattage per lamp (W)	Numbers	Total Consumption (kWh)
1.	LED Bulb	15	175	1963.6
2.	LED Tube Lights	36	1010	22759.86
3	Tubelight	54	132	4656.96
Grand total			1317	29380.42

Table 7: Number and kWh distribution of all Lights

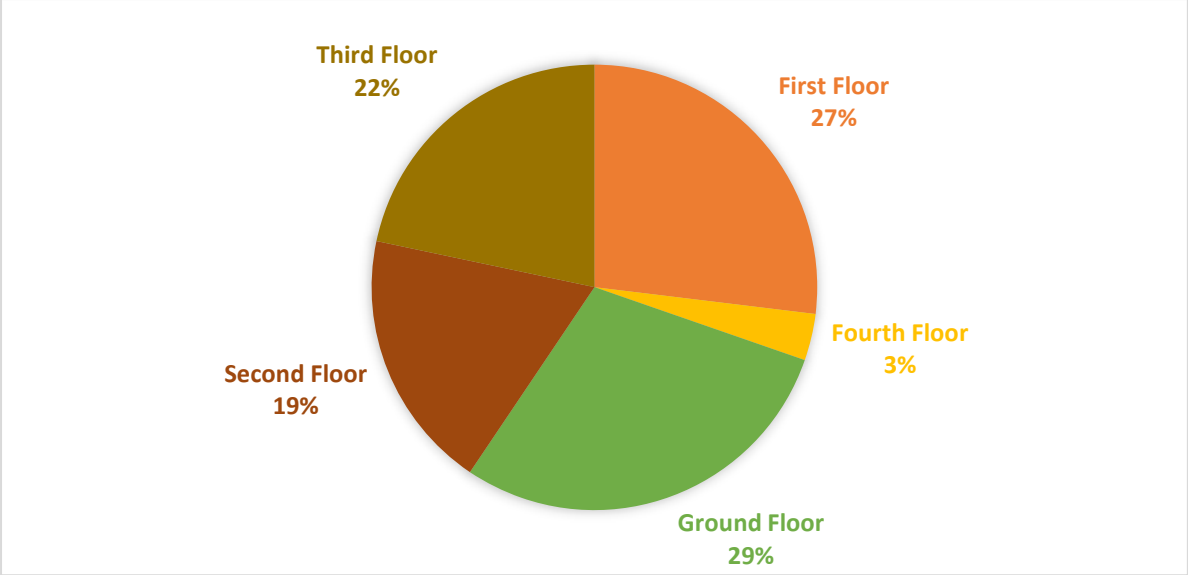


Figure 6: Percentage breakup of Floor-wise Annual Energy Consumption of Lights

Sr no	Floor	Sum of Total usage kWh/year
1	Ground floor	8554.83
2	1st Floor	7909.6
3	2nd Floor	5554.72
4	3rd Floor	6366
5	4th Floor	995.52
	Grand Total	29380.43

Table 8: Total floor-wise annual Lighting 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 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. It is observed that **86% of the spaces** in the college **comply with LPD norms** provided in ECBC.

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	30	No
2.	Classroom	13.8	4.27	Yes
3.	Lab- Physics, Chemistry	15.1	18.62	No
4.	Computer lab	15.1	6.52	Yes

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

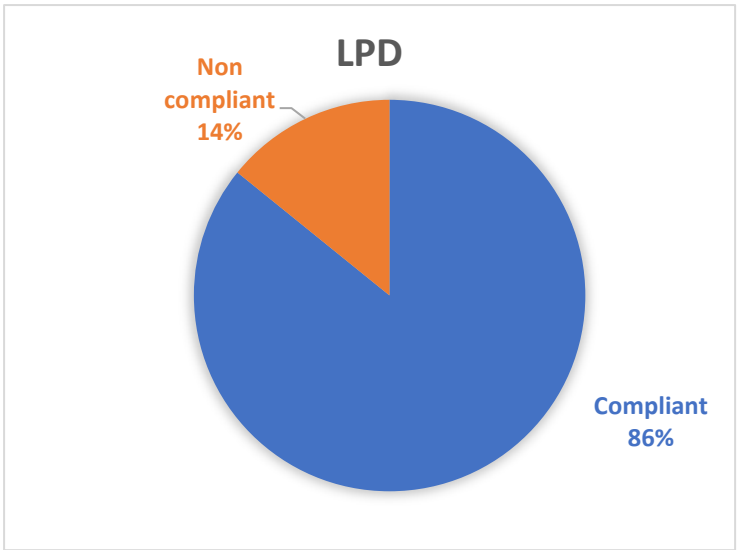


Figure 7: Percentage of areas complying with LPD norms as per ECBC using Space Function Method

3.1.2.3 Efficacy of Lamps

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

The comparative efficacies and environmental impacts of the lamps are provided in the table 10 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	Up to 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 lighting level

The overall **Wall to window ratio (WWR) is observed to be 21%.** During a detailed energy audit, lighting level was measured in some rooms randomly, to verify whether they are in accordance with NBC standards. In the random survey of lux levels at different places, it was found that **74%** of **the lux level** measurements are matching with the NBC norms, 15% were over-lit (mostly on the 3rd and fourth floor of main building), and 9% were underlit (these are spaces from extension building, as classroom have windows opening in corridors).

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

Sr. No	Space	Avg Lux level	Lux level as per NBC	Remark
1	Room No. 01	350	200 – 300 - 500	Within Limit
2	Room No. 02	340	200 – 300 - 500	Within Limit
3	Room No. 03	350	200 – 300 - 500	Within Limit
4	Room No. 04	330	200 – 300 - 500	Within Limit
5	Room No. 05	310	200 – 300 - 500	Within Limit
6	Room No. 08	340	200 – 300 - 500	Within Limit
7	Room No. 12	480	200 – 300 - 500	Within Limit
8	Room No. 17	430	200 – 300 - 500	Within Limit
9	Room No. 21	580	200 – 300 - 500	Exceeds Limit
10	Room No. 101	330	200 – 300 - 500	Within Limit
11	Room No. 103	470	200 – 300 - 500	Within Limit
12	Room No. 104	480	200 – 300 - 500	Within Limit
13	Room No. 105	490	200 – 300 - 500	Within Limit
14	Room No. 107	360	200 – 300 - 500	Within Limit
15	Room No. 108	670	200 – 300 - 500	Exceeds Limit
16	Room No. 110	340	200 – 300 - 500	Within Limit
17	Room No. 113	530	200 – 300 - 500	Exceeds Limit
18	Room No. 114	430	200 – 300 - 500	Within Limit
19	Room No. 115	370	200 – 300 - 500	Within Limit
20	Room No. 116	330	200 – 300 - 500	Within Limit

21	Room No. 118	360	200 – 300 - 500	Within Limit
22	Room No. 119	360	200 – 300 - 500	Within Limit
23	Room No. 120	595	200 – 300 - 500	Exceeds Limit
24	Room No. 121	530	200 – 300 - 500	Exceeds Limit
25	Room No. 204	427	200 – 300 - 500	Within Limit
26	Room No. 205	532	200 – 300 - 500	Exceeds Limit
27	Room No. 206	360	200 – 300 - 500	Within Limit
28	Room No. 207	330	200 – 300 - 500	Within Limit
29	Room No. 208	340	200 – 300 - 500	Within Limit
30	Room No. 209	402	200 – 300 - 500	Within Limit
31	Room No. 211	330	200 – 300 - 500	Within Limit
32	Room No. 213	492	200 – 300 - 500	Within Limit
33	Room No. 214	350	200 – 300 - 500	Within Limit
34	Room No. 217	340	200 – 300 - 500	Within Limit
35	Room No. 218	330	200 – 300 - 500	Within Limit
36	Room No. 219	430	200 – 300 - 500	Within Limit
37	Room No. 301	670	200 – 300 - 500	Exceeds Limit
38	Room No. 302	550	200 – 300 - 500	Exceeds Limit
39	Room No. 303	660	200 – 300 - 500	Exceeds Limit
40	Room No. 304	430	200 – 300 - 500	Within Limit
41	Room No. 305	360	200 – 300 - 500	Within Limit
42	Room No. 306	756	200 – 300 - 500	Exceeds Limit
43	Room No. 307	640	200 – 300 - 500	Exceeds Limit
44	Room No. 308	540	200 – 300 - 500	Within Limit
45	Room No. 309	690	200 – 300 - 500	Exceeds Limit
46	Room No. 310	630	200 – 300 - 500	Exceeds Limit
47	Room No. 311	330	200 – 300 - 500	Within Limit
48	Room No. 312	680	200 – 300 - 500	Exceeds Limit
49	Room No. 313	542	200 – 300 - 500	Exceeds Limit
50	Room No. 314	480	200 – 300 - 500	Within Limit
51	Room No. 315	590	200 – 300 - 500	Exceeds Limit

52	Room No. 316	330	200 – 300 - 500	Within Limit
53	Room No. 317	510	200 – 300 - 500	Exceeds Limit
54	Room No. 318	530	200 – 300 - 500	Exceeds Limit
55	Room No. 319	340	200 – 300 - 500	Within Limit
56	Room No. 320	330	200 – 300 - 500	Within Limit
57	Room No. 321	410	200 – 300 - 500	Within Limit
58	Room No. 402	570	200 – 300 - 500	Exceeds Limit
59	Room No. 403	850	200 – 300 - 500	Exceeds Limit
60	Room No. 404	966	200 – 300 - 500	Exceeds Limit
61	Room No. 405	612	200 – 300 - 500	Exceeds Limit
62	Room No. 407	720	200 – 300 - 500	Exceeds Limit
63	Room No. G-24	270	200 – 300 - 500	Within Limit
64	Room No. G-25	250	200 – 300 - 500	Within Limit
65	Room No. G-27	540	200 – 300 - 500	Exceeds Limit
66	Room No. G-28	542	200 – 300 - 500	Exceeds Limit
67	Room No. G-29	520	200 – 300 - 500	Exceeds Limit
68	Room No. G-30	530	200 – 300 - 500	Exceeds Limit
69	Room No. E-101	230	200 – 300 - 500	Within Limit
70	Room No. E-102	160	200 – 300 - 500	Below Limit
71	Room No. E-103	180	200 – 300 - 500	Below Limit
72	Room No. E-108	160	200 – 300 - 500	Below Limit
73	Room No. E-109	140	200 – 300 - 500	Below Limit
74	Room No. E-110	130	200 – 300 - 500	Below Limit
75	Room No. E-201	160	200 – 300 - 500	Below Limit
76	Room No. E-202	140	200 – 300 - 500	Below Limit
77	Room No. E-203	160	200 – 300 - 500	Below Limit
78	Room No. E-204	140	200 – 300 - 500	Below Limit
79	Room No. E-205	196	200 – 300 - 500	Below Limit
80	Room No. E-206	242	200 – 300 - 500	Within Limit
81	Room No. E-207	210	200 – 300 - 500	Within Limit
82	Room No. E-208	132	200 – 300 - 500	Below Limit

83	Room No. E-209	212	200 – 300 - 500	Within Limit
84	Room No. E-301	130	200 – 300 - 500	Below Limit
85	Room No. E-302	140	200 – 300 - 500	Below Limit
86	Room No. E-303	153	200 – 300 - 500	Below Limit
87	Room No. E-304	116	200 – 300 - 500	Below Limit
88	Room No. E-305	136	200 – 300 - 500	Below Limit
89	Room No. E-306	240	200 – 300 - 500	Within Limit
90	Room No. E-307	168	200 – 300 - 500	Below Limit
91	Room No. E-308	170	200 – 300 - 500	Below Limit
92	Room No. E-309	180	200 – 300 - 500	Below Limit
93	Room No. E-310	230	200 – 300 - 500	Within Limit

Table 11: Summary of lux levels comparison with NBC

Summary of Observations: Lighting

1. There are in total **1317** lamps (artificial light sources) in the college buildings amounting to an annual energy consumption of **29,380kWh** constituting **27% of total energy consumption**.
2. **90% of lighting fixtures are LED.**
3. The building envelope has a **Window Wall Ratio (WWR) of 21%,** which is within ECBC's allowable norms of up to 40%.
4. **84%** 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.
5. In the random survey of lux levels at different places, it was found that **74%** of **the lux level** measurements are matching with the NBC norms.
6. The highest lighting consumption is on the **Ground floor (29%), First floor (27%), and third floor (22%)** followed by **the Second floor (19%)** and the fourth floor 3%.
7. Currently, all the lights have to be manually switched off and switched on.

3.1.3 Energy Consumption for Thermal Comfort

Fans and Air Conditioning together consume **44%** of the energy consumption of the campus. Both these are required for the thermal comfort of occupants. Only **7%** of the college space is conditioned.

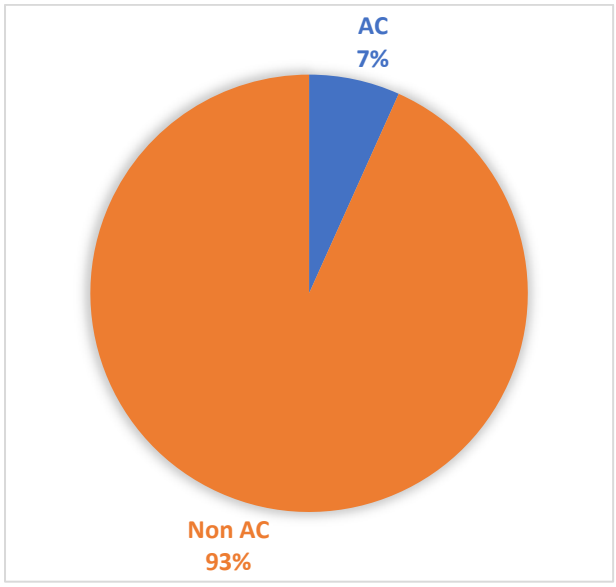


Figure 8: Conditioned and un-conditioned areas in Smt. Chandibai Himathmal Mansukhani college

There are in total 693 ceiling fans fitted in the audited area of the college.

1. Fans contribute **22**% (**24,067 kWh)** of the energy consumption. The ground floor has a maximum load of 27%. As 93% of the college spaces are naturally ventilated, all the floors have a similar load, except the fourth floor which has only 4 classrooms and 3 store rooms. The floor-wise break-up of fan consumption is provided in Figure 9 and Table 12.

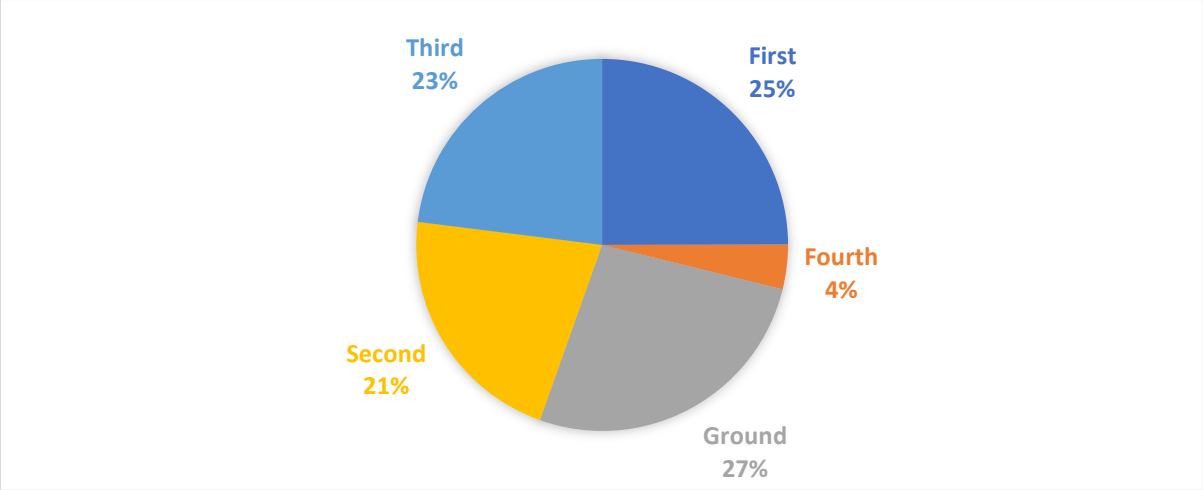


Figure 9: Percentage breakup of Floor-wise Annual Energy Consumption of Fans

Sr. No.	Floor	Total Consumption (kWh/year)
1	Ground floor	6394
2	First floor	6009
3	Second floor	5189
4	Third floor	5540
5	Fourth floor	935
Grand Total		**24,067**

Table 12: Total floor-wise annual energy consumption by Fans (kWh/year)

2. Air conditioning has the overall consumption amounting to **22%** of the college total energy consumption, **20 TON** of refrigeration and **23,826 units** of electricity annually (2021-2022) as per calculated consumption. The comfort air-conditioning system at college mainly comprises split units. The ground floor has an auditorium, mini-conference and exam department room respectively while the first floor has air-conditioned administrative spaces and labs contributing to a major air conditioning load. The breakup of different indoor units and the floor-wise consumption of AC is shown in Fig 10 and Table 13. Detailed parameters of the AC are shown in Table 14.

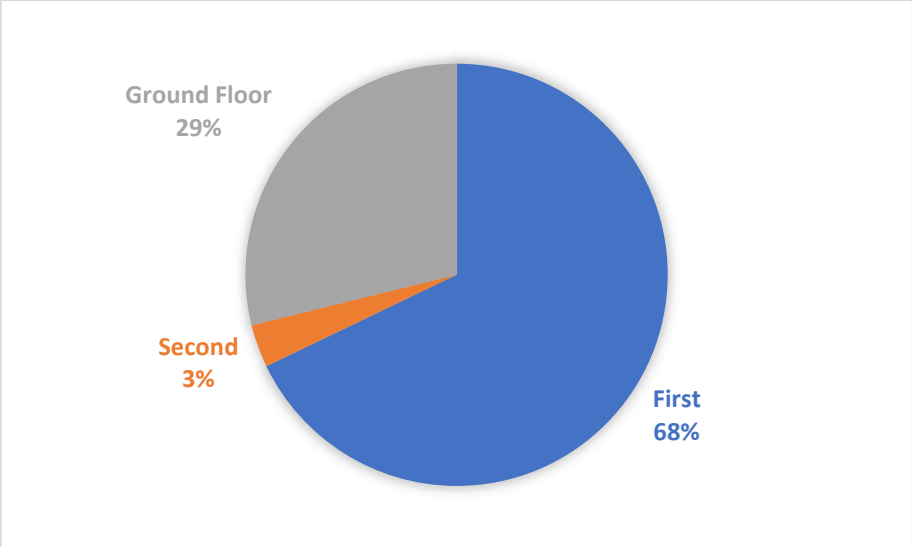


Figure 10: Percentage breakup of Floor-wise Annual Energy Consumption of AC

Sr. No.	Building	Total Consumption (kWh/year)
1	Ground floor	6872
2	First floor	16170
3	Second floor	784
Grand Total		**23,826**

Table 13: Total floor-wise AC consumption (kWh/year)

Sr. No.	Parameters	Auditorium (Extension building)				
		AC unit-1	AC unit-2	AC unit-3	AC unit-4	AC -5
1	Make	Voltas	Voltas	Voltas	Voltas	Voltas
2	Capacity (TR)	2.12	2.12	2.12	2.08	2.12
3	Cooling Effect Delivered (TR)	0.54	0.35	0.78	0.32	1.08
4	Power Consumption (kW)	1.58	1.43	1.72	1.90	3.10
5	Specific energy consumption (kW/TR)	2.9060	4.0551	2.2172	5.9774	2.8650
6	Energy Efficiency Ratio	1.21	0.87	1.58	0.59	1.23

Sr. No	Parameters	Server Room		107-IT Lab	
		AC unit-1	AC unit-2	AC unit-1	AC unit-2
1	Make	Daikin	Daikin	Voltas	Voltas
2	Capacity (TR)	1.16	1.16	1.62	1.74
3	Cooling Effect Delivered (TR)	0.41	0.44	0.80	0.36
4	Power Consumption (kW)	0.85	0.90	2.50	1.76
5	Specific energy consumption(kW/TR)	2.0782	2.0595	3.1116	4.9244
6	Energy Efficiency Ratio	1.69	1.70	1.13	0.71

Sr. No	Parameters	Exam Room	108-Vice Principal Office		
		AC unit-1	AC unit-1	AC unit-2	AC unit-3
1	Make	Voltas	Voltas	LG	Onida
2	Capacity (TR)	1.74	2.12	1.05	1.14
3	Cooling Effect Delivered (TR)	1.11	0.41	0.22	0.22
4	Power Consumption (kW)	1.38	1.50	1.09	0.99
5	Specific energy consumption(kW/TR)	1.2408	3.6987	4.8550	4.4756
6	Energy Efficiency Ratio	2.83	0.95	0.72	0.78

Sr. No	Parameters	Mini-Conference room		Principal Office	
		AC unit-1	AC unit-2	AC unit-1	AC unit-2
1	Make	Voltas	Voltas	Voltas	Voltas
2	Capacity (TR)	1.69	1.69	1.67	1.67
3	Cooling Effect Delivered (TR)	0.89	0.79	0.49	0.35
5	Power Consumption (kW)	1.32	1.25	1.10	1.18
6	Specific energy consumption(kW/TR)	1.4861	1.5862	2.2488	3.3244
7	Energy Efficiency Ratio	2.36	2.21	1.56	1.06

Table 14: Details of audited AC units with their Performance parameters

The college uses 20 Tonnage of ACs in total which includes AC for Auditorium, Principal's cabin, computer lab, Vice principal cabin etc. The overall performance of AC compared to the (Bureau of Energy Efficiency) Energy Efficiency Ratio(EER), as shown in table 15 is critical, as they are performing well below the standards, contributing to energy losses. The efficiency of some units is very poor and needs complete overhauling of the unit

(From 1st January, 2018 to 31st December, 2020)

Indian Seasonal Energy Efficiency Ratio (kWh/kWh)		
Star level	Minimum	Maximum
1 Star	3.1	3.29
2 Star	3.3	3.49
3 Star	3.5	3.99
4 Star	4.0	4.49
5 Star	4.5	

Table 15: Energy efficiency ratio as specified by BEE for split AC

Summary of Observations:

1. The college has Ceiling fans whose energy consumption account for only **22 %** of the total annual consumption.
2. The overall fan consumption shows that the **ground floor has a maximum load of 27%. As 93%** of the college spaces are naturally ventilated, all the floors have a similar load, except the fourth floor which has only 4 classrooms
3. Although only **7% of the built area, it contributes to 22% of the total energy consumption.**
4. The overall air conditioning consumption shows that maximum usage is by the **First floor– 68%,** followed by **ground floor -29%** and second floor at 3%. This is because, first floor has air-conditioned administrative spaces and labs. Ground floor has an auditorium, exam section and mini-conference room.
5. The performance of ACs is poor, can be improved with proper maintenance and chemical cleaning.

3.1.4 Equipment Energy Consumption

Equipment contributes **29%** of the total energy consumption. Major equipment includes Fridge, computers, microwave, projector, water pump, desktops etc. The detailed break-up of energy consumed by equipment is shown below.

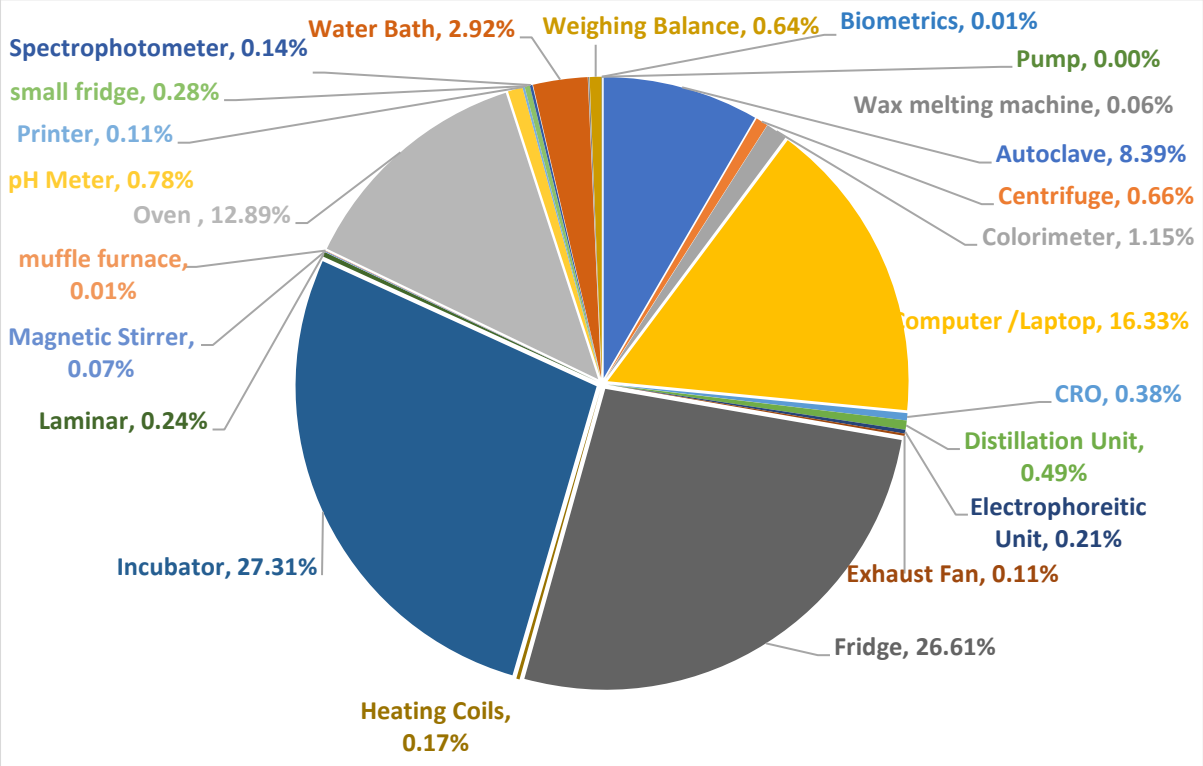


Figure 11: Types of equipment

Name of Equipment	Sum of Total usage kWh/year	No. of Equipment
Autoclave	2650	5
Centrifuge	210	6
Colourimeter	365	10
Computer /Laptop	5159	146
CRO	121	7
Distillation Unit	153	2
Electrophoretic Unit	65	2
Exhaust Fan	36	2
Flame Photometer	0	1
Fridge	8410	12
Heating Coils	55	5
Incubator	8629	11

Laminar	77	2
Magnetic Stirrer	23	3
Microscope	0	1
Muffle furnace	4	1
Oven	4075	15
pH Meter	248	10
Printer	36	5
Small fridge	90	1
Spectrophotometer	43	2
Water Bath	923	8
Wax melting machine	20	1
Weighing Balance	203	10
Pumps	1	2
Biometrics	4	3
Grand Total	**31599**	**271**

Table 16: Type of Equipment and their annual usage

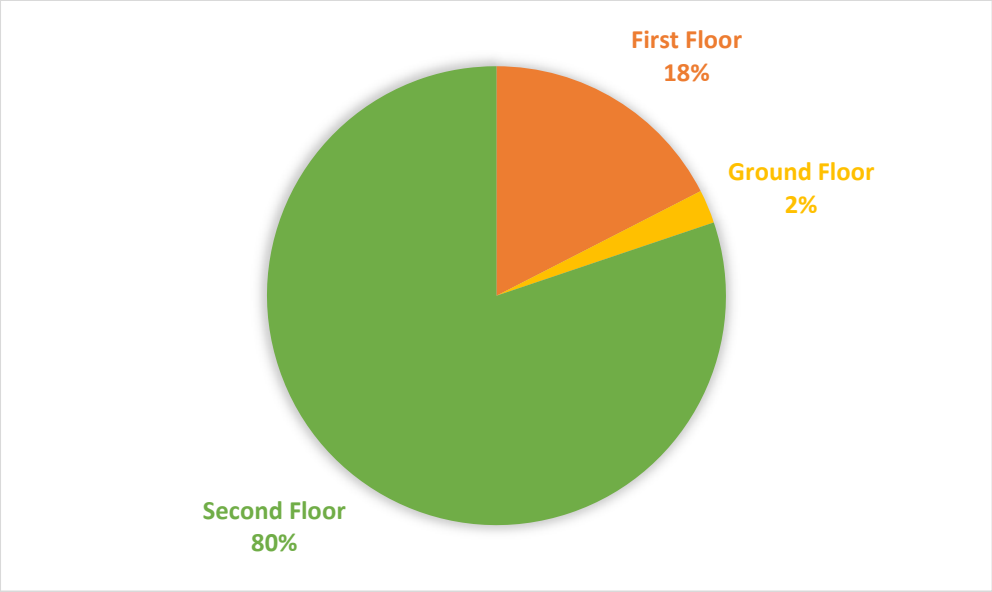


Figure 12: Percentage breakup of Floor-wise Annual Energy Consumption of Equipment

S. No.	Floor	Total Consumption (kWh).
1	Ground	748.00
2	First	5518.34
3	Second	25332.52
Total		**31,599**

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

3.1.4.1. Pumps and Motors

There are 4 pumps, of which 2 were non-functional during the audit. One pump is use to pump municipal water supply for all the domestic requirements except flushing from the underground tank to overhead tank. For the flushing requirement, 1 pump is fitted over the borewell.

S. No.	Item Description	Capacity	Usage	Power (kW)
1	Water Pump	7.5 HP	0.5 hours/day	6.21
2	Water Pump	5 HP	2 hours/day	3.47
3	Water Pump	1 HP	Non functional	
4	Water Pump	1 HP	Non functional	

Table 18: Detail of the pumps

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

Plate 13: Biology lab- Incubators

Plate 14: Computer lab

Plate 15:Auditorium having projectors

Summary of Observations: Equipment

1. Total energy consumption by equipment is **29%.**
2. The energy consumption by equipment is primarily through **incubator and Fridge** is 27% each, **Computers** is 1**6%, oven** is **12%. Autoclave** is **8%.**
3. The largest consumption of energy concerning equipment is on the **Second floor** is **80%**, the **first floor** is **18%**, followed by the **ground floor- 2%**. This was mainly due to various labs are on the second floor.

3.1.5 Electrical system study and leakage currents

The main supply wires were studied for their capacity and size, they were found to be adequate to serve the purpose as seen in table 19.

Sr. No	Description	Cable Size	Current per Phase			Remark
			R	Y	B	
1	Source-1(Main Building)	3.5C x 240 sq. mm Al. Cable	35.1Amp	45.8mp	49.7Amp	Adequate
2	Source-2(Main Building)	3.5C x 240 sq. mm Al. Cable	55.3Amp	44.55Amp	71.4Amp	Adequate
3	Extension Building	3.5C x 120 sq. mm Al. Cable	23.6Amp	23.59Amp	37.42Amp	Adequate

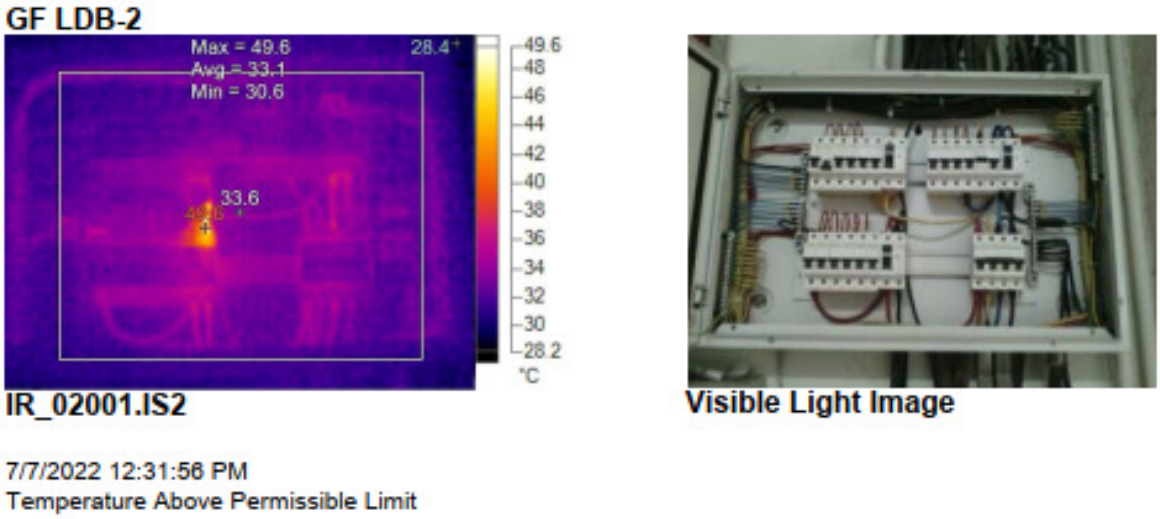
Table 19: Study of main supply cables

Thermal imaging of the electrical power distribution was done to detect hot spots – likely to cause failures. Temperature readings above 60°C, are of concern (highlighted in Yellow) and repairs to those spots are necessary.

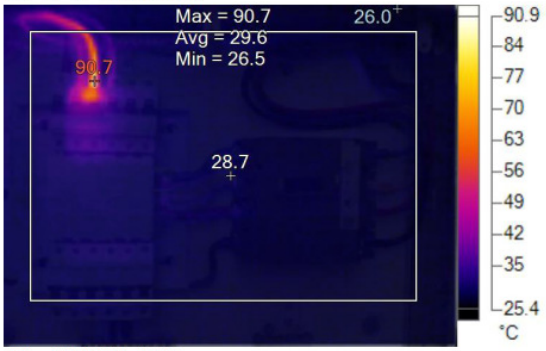
Sr No	Description	Temperature in °C	Remark
Main Building			
Changeover Panel-2			
1	250Amp Input	32.2	Temperature Within Permissible Limit
2	200Amp Floor panel	32.3	Temperature Within Permissible Limit
Changeover Panel-1			
3	250Amp Input	29.2	Temperature Within Permissible Limit
4	200Amp Floor panel	36.7	Temperature Within Permissible Limit
5	3rd floor main-125Amp	30.8	Temperature Within Permissible Limit
Main Building			
6	1F1-200Amp Panel-1	31.2	Temperature Within Permissible Limit
7	1F2-100Amp VTPN DB	30.8	Temperature Within Permissible Limit
8	1F3-100Amp VTPN DB F1	30.9	Temperature Within Permissible Limit
9	1F4-100Amp VTPN DB S1	30.2	Temperature Within Permissible Limit
10	1F5-100Amp VTPN DB T1	30.5	Temperature Within Permissible Limit
11	1F6-100Amp MCCB	36.5	Temperature Within Permissible Limit
12	1F1-200 C/O Panel-2	32.5	Temperature Within Permissible Limit
13	1F2-100Amp VTPN G2	33.1	Temperature Within Permissible Limit
14	1F3-100Amp VTPN F2	33.9	Temperature Within Permissible Limit
15	1F4-100Amp VTPN S2	31.5	Temperature Within Permissible Limit
16	1F5-100Amp VTPN T2	31	Temperature Within Permissible Limit
17	GF Mini Conference room	29.7	Temperature Within Permissible Limit
18	GF VTPN DB-1	29.8	Temperature Within Permissible Limit
19	GF LDB-1	28.8	Temperature Within Permissible Limit

20	GF VTPN-2	33.3	Temperature Within Permissible Limit
21	GF LDB-2	49.6	Temperature Above Permissible Limit
22	1st Floor DB-2	38	Temperature Within Permissible Limit
23	1st Floor LDB-40Amp Main	30.4	Temperature Within Permissible Limit
24	1F VTPN -1	30.5	Temperature Within Permissible Limit
25	1F LDB	30.8	Temperature Within Permissible Limit
26	2F VTPN DB-1	34.3	Temperature Within Permissible Limit
27	2F LDB-1	30	Temperature Within Permissible Limit
28	2F VTPN DB-2	31.8	Temperature Within Permissible Limit
29	2F LDB	30.8	Temperature Within Permissible Limit
30	3F VTPN-1	30.1	Temperature Within Permissible Limit
31	3F LDB-1	30.2	Temperature Within Permissible Limit
32	3F VTPN DB-2	90.7	Temperature Above Permissible Limit
33	3F LDB-2	31.2	Temperature Within Permissible Limit
34	4F Terrace DB	27.8	Temperature Within Permissible Limit
Extension Building			
35	VTPN DB	28.5	Temperature Within Permissible Limit
36	LDB	32.5	Temperature Within Permissible Limit
37	Emergency DB	29.2	Temperature Within Permissible Limit
38	DG Fuse-200Amp	35.8	Temperature Within Permissible Limit
39	Main Fuse-200Amp	63	Temperature Above Permissible Limit
40	Main Changeover switch	106.3	Temperature Above Permissible Limit
41	GF Office	30.7	Temperature Within Permissible Limit
42	THM Hall DB	38.3	Temperature Within Permissible Limit
Main Building			
43	GF ELDB	28.4	Temperature Within Permissible Limit
44	ELDB-1	30.2	Temperature Within Permissible Limit
45	ELDB-2	28.1	Temperature Within Permissible Limit
46	ELDB-3	28.6	Temperature Within Permissible Limit

Table 20: Results of thermal imaging of distribution panels



3F VTPN DB-2

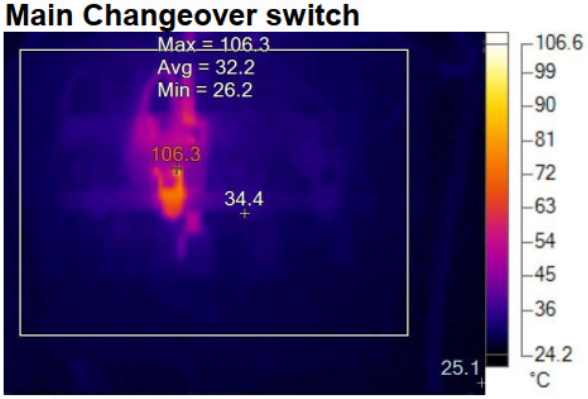


IR_02012.IS2

Visible Light Image

7/7/2022 1:31:22 PM
Temperature Above Permissible Limit

Main Changeover switch

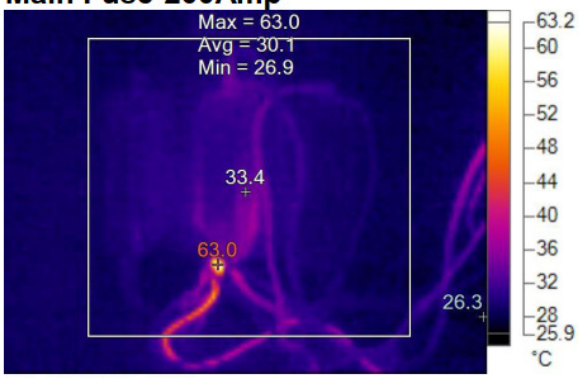


IR_02020.IS2

Visible Light Image

7/7/2022 3:14:53 PM
Temperature Above Permissible Limit

Main Fuse-200Amp



IR_02019.IS2

Visible Light Image

7/7/2022 3:14:27 PM
Temperature Above Permissible Limit

Sr. No.	Description	Earthing		Remark
		Resistance in Ω	Current in Amp	
Main Building				
1	Main Building DG Neutral	22.1	0	Earth resistance found above permissible limit.
2	Extension Building DG Body	5.7	0.59	Earth resistance found above permissible limit.
3	Extension Building DG Neutral	3.8	5.8	Earth resistance found above permissible limit.
4	Main Building Main Panel	0.01	24.1	Within permissible limit.
5	GF Mini conference room DB	0.1	32.4	Leakage current found above permissible limit
6	GF LDB-1	830	0	Earth resistance found above permissible limit.
7	GF VTPN DB-2	1.1	0.3	Within permissible limit.
8	GF LDB-2	1.2	7.4	Within permissible limit.
9	1st Floor DB-2	0.79	10.4	Within permissible limit.
10	1st Floor LDB-40Amp Main	0.91	12.3	Within permissible limit.
11	1F VTPN -1	0.023	5.2	Within permissible limit.
12	1F LDB	0.022	5.6	Within permissible limit.
13	2F VTPN DB-1	0.017	1.7	Within permissible limit.
14	2F LDB-1	0.018	1.8	Within permissible limit.
15	2F VTPN DB-2	0.016	20.1	Within permissible limit.
16	2F LDB	0.017	18.1	Within permissible limit.
17	3F VTPN-1	0.015	29.4	Within permissible limit.
18	3F LDB-1	0.018	30.1	Within permissible limit.
19	3F VTPN DB-2	0.017	0.7	Within permissible limit.
20	3F LDB-2	0.016	0.59	Within permissible limit.
21	4F Terrace DB	0.015	29.1	Within permissible limit.
22	Earth pit No-1	0.023	5.2	Within permissible limit.

Table 21:Earth Resistance measurement

Sr. No	Images	Description
1		Neutral to earth voltage for main building and extension building incomers is found very high i.e. (44.7V) than the standard limits.
2		Cable joint found in between MSEB meter to Main Outgoing MCCB of all the three sources.
3		DG set installed for extension building, has it's canopy rusted, need to be attended.
4		MSEDCL transformer installed in CHM college premises, LV Side cable bushings found in open condition.

5		Insulated rubber mat is not provided in front of main panel of Main Building and extension building.
6		MSEB main panel installed inside transformer compartment cable terminations found in open condition would suggest providing shrouding for the same.
7		Loose and hanging cables found near extension building main electrical installation. Unwanted/ Combustible material near electrical installation.
8		During socket testing, phase and neutral were found reversed for few sockets, and wiring corrections suggested.
9		During socket testing, Earthing found faulty for both the building all floor sockets installed.

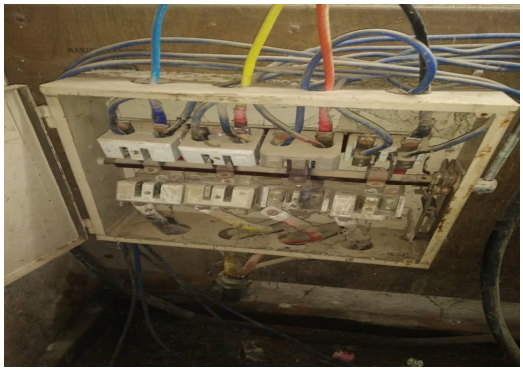
10		Sparking observed inside the extension building main changeover switch, need to be attend the same.
11		Gland plate opening holes found in Main panel and distribution board, need to be sealed the same by using rubber grommets.

Table 22: Observations with actual images

3.1.6 Benchmarking - Energy Performance Index (EPI)

The **Energy Performance Index (EPI)** of Smt. Chandibai Himathmal Mansukhani college **is 7.86 kWh/sq. m/year** in 2021-2022 as the billing data. As per the **Bureau of Energy Efficiency (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, as the college was fully functional for around 3 months, due to the Covid pandemic.

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

Table 23: EPI benchmark 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 considering students, faculty and staff members was calculated to form a benchmark of **8.43 kWh/ person/ year** and **Rs. 156 per person per annum (considering 2021 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 **Maharashtra State Electricity Distribution Co. Ltd**
2. The College has three connections billed under the category **LT II B commercial.**
3. The Tariff Structure of the Utility company along with the additional Time of Day (TOD) tariff is summarized in the table 24 below:

Tariff Category	Meter No	Contract Demand kVA	Fixed Demand charge ₹/Month	Energy charge ₹/Unit	Wheeling charge ₹/Unit	Overall Cost per Unit
LT II B (Commercial)	055-X1152120	45	Rs. 427 per kVA	6.00	1.46	18.48
	055-X1152119	45				
	055-X1130747	47				

Table 24: Tariff Structure as per the Mahadiscom for Year 2022

4. The fixed charges of the commercial meters are quite high.
5. The overall per unit charge is Rs**. 18.48 per unit.**
6. It is observed that the annual energy consumption of the college as per electricity bills is **95,498kWh** for the Year **Jun 2021 – May 2022.** The average monthly consumption is approximately **7,958 units.**

It can be seen that March, April and May 2022 have the highest consumption. This could be attributed to excessive discomfort and use of fans and ACs due to higher insolation and relative humidity. The college was fully functional only for around 3 months, due to the Covid pandemic. Although May month has vacations, building repair and renovation works were in progress.

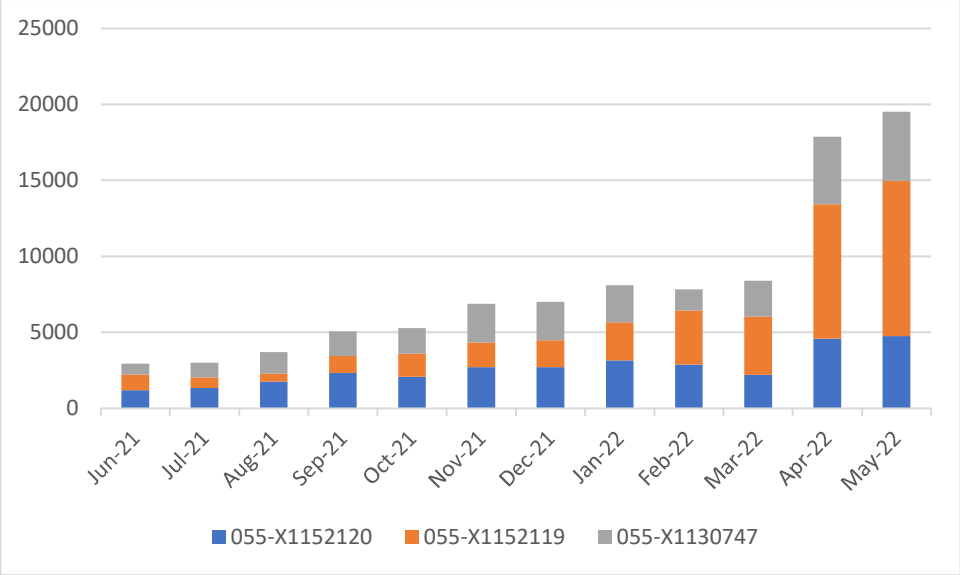


Figure 13: Monthly billed units by meter

3.2 Water

The College has 2 OHT of a capacity of in total of **40,000** and a UGT of capacity **36,000 litres**. There are 17 wash basins (located in washrooms), and 22 WC have single flush type flushing tanks of which 4 are Indian water closets with ablution taps and a total of 3 drinking water coolers.

Considering 11,326 people at a rate of 45 litres per person per day (as per NBC), the maximum total **daily** requirement of the college is **509.67** kilo litres (227 kLD domestic and 283kLD flushing) This is shown in table no. 25. Monthly requirement should be **11,722 kilo litres** considering **23 days** of operation per month.

Category	Number of Occupants	Water requirement per person (LPCD)			Total water requirement (LPCD)		
		Domestic	Flushing	Total	Domestic	Flushing	Total
Students	10975	20	25	45	219500	274375	493875
Teachers	171	20	25	45	3420	4275	7695
Non-teaching staff	173	20	25	45	3460	4325	7785
Administrative staff	7	20	25	45	140	175	315
Total	11326				226520	283150	509670
Total in KLD					**226.52**	**283.15**	**509.67**

Table 25: Total water usage of the Campus

However, as per water bills submitted by the college, the average monthly water consumption is **457 kilo litres**, which means daily consumption is around **20 kilo litres.** This amounts to only **9%** of the calculated domestic daily water consumption. The exact daily consumption can be observed in figure 14.

The college has the municipal water connection whose meter is not working for the entire last year, as per bills. They also have three private connections of water supply in addition to active borewells, which are not metered.

The College campus water bill shows that the **average monthly water charges are Rs. 1715.08/-,** accordingly the **per kilolitre of water cost is around Rs. 22/-.**

Table no. 26 gives details of the faucets, flushing devices and water coolers in the College.

S. No	Building	Floor	Type of toilet block	Total no. Of toilet blocks	Drinking water/ cooler	Water closet (wc)	Urinals	Wash basin taps	Flushing tank	Type of flushing tank (dual flush/ single flush)	Remark
1	**Building 1 (main building)**	Ground	Ladies washroom	1	1	2	Nil	1	2	Single	One of Indian and one western type
2		Ground	Mini conference	1	Nil	1	Nil	1	1	Single	Western
3		Ground	Gents washroom	2	Nil	1+1 (Universal access toilet)	1+4	1+2	2	Single	Both are western type
4		First	Gents washroom	1	1	2	3	1	2	Single	
5		First	Principal office	1	Nil	1	Nil	1	1	Single	Western

6		Third	Ladies washroom	1	1	2	Nil	1	2	Single	One is Indian and one is western type
7		Third	Gents washroom	1	Nil	1	1	1	1	Single	
8	Building 2 (extension building)	Ground	Ladies washroom	1	Nil	2	Nil	1	2	Single	Both are western type
9		Ground	Gents washroom	1	Nil	3	1	1	3	Single	
10		First	Ladies washroom	1	Nil	4	Nil	2	4	Single	Two western, two Indian
11		First	Gents washroom	1	Nil	1	Nil	1	1	Single	Western
12		Second	Ladies' washroom	1	Nil	2	Nil	1	1	Single	One western, one Indian
13		Second	Gents' washroom	1	Nil	2		1	1	Single	Both western
14		Third	Gents' washroom	1		1		1	1	Single	Western

Table 26: Details of faucets, flushing devices and water coolers in the College.

3.2.1. Rain Water Harvesting

As per the data submitted by the college, it had a rainwater harvesting system wherein down take pipes collecting water from the rooftop catchment, was connected to a drain in the borewell., to facilitate groundwater recharge. At the time of audit, some of the down take pipes were disconnected from the drains, and in a few places the drains were clogged due to renovation work at college. The college is planning to restore the system.

3.3 Solid Waste

The college generates Paper, Glass, Cardboard, Cloth, Electrical and Electronic waste is collected in different bins i.e waste is segregated at source. This mainly constitutes to **50% of recyclable solid waste**, while **50% of organic** waste is generated by food waste from the canteen and leaf litter which can be composted on site.

The college had developed an E-waste collection system in collaboration with Eco friend industries, (a government approved E waste disposal facility) to facilitate periodically collection of E-waste. The college also facilitated recycling of paper waste generated in the academic year, by selling it to the waste to manager. (Certificate is provided in annexure F)

An incinerator for disposal of sanitary napkins, is available in one of the toilets on the 1st floor. Awareness regarding the instrument is needed to use it effectively.

The college also had vermicomposting pits which were later changed to organic composting. During the lockdown, it was not maintained.

Plate 16: Incinerator located in ladies toilet

Plate 17: Bins for segregation of waste at source

3.4 Environment Quality

The college has created a Botanical and Butterfly Garden which was partially destroyed during the lockdown, it has a wide variety of trees which shade the south façade, some trees are as high as the second floor. Some trees are older than the establishment itself, while others were planted by faculty who have since moved on. The college has generated QR code for the campus trees, scanning which a detail information regarding the tree can be obtained by the user.

Plate 18 :QR coding of the trees on campus

The department of Botany of Smt. CHM college has always been keen on maintaining a record of the greenery of the campus. A green census is a yearly practice of the department where the students of botany are educated and updated about the various tree species, their identification, method of propagation and use. The study has recorded a total of 308 trees and shrub species on the campus. The green census report is added as Annexure E. The college is located next to the river, facilitating various birds, insects etc, an overall good biodiversity, for example, 24 different birds are seen on the campus, as listed below.

Plate 19 :Butterfly Garden

Plate 20 : Vegetation in front of main building

Plate 21: Botanical garden

The list of birds observed on the campus, submitted by the college is given below:

S. No	Observed on campus - Birds
1	Asian Koel
2	Black Kite
3	Coppersmith Barbet
4	Crow
5	Cuckoo
6	White throated Kingfisher
7	Lesser Egret
8	Pond Heron
9	Pigeon
10	Rose Ringed Parakeet
11	Sparrow
12	Scaly Breasted Munia

S. No	Observed on campus - Birds
13	Red Vented Bulbul
14	Asian Pied Starling
15	Common Myna
16	Indian Golden Oriole [Migratory]
17	Little Cormorant
18	Cattle Egret
19	Green Bee-eater
20	White throated fantail
21	Black Drongo [Migratory]
22	Common Raven
23	Oreintal Magpie-Robin
24	Purple-rumped Sunbird

Plate 22: Oreintal Magpie-Robin

Plate 23: White throated Kingfisher

Plate 24: Coppersmith Barbet

Plate 25: Rose Ringed Parakeet

4. Recommendations for Green Campus and Feasibility for Smt. Chandibai Himathmal Mansukhani college

4.1 Visual Comfort and Energy Efficiency

The Light power density values in educational spaces such as classrooms are found to be meeting the maximum norms as prescribed by ECBC 2017. However, all spaces correspond to satisfactory 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 energy efficiency of the illumination levels following measures can be implemented

4.1.1 Replacement of T8 (36W) Fluorescent Tube Lights (FTLs) along with electromagnetic ballast with 18W LED Tube Lights having a lumen output of 1800 (efficacy = 100 Lumens per Watt)

Since 36W 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 a long life of 40,000 hours, diffused uniform light output, better colour rendering (CRI>83) suitable for learning spaces and built-in protection circuit.

Plate 26: Existing 36W Fluorescent Tube Lights

Plate 27: Proposed 18W LED Tube Lights of 1800 Lumens output (efficacy = 100 L/W)

Areas applicable: All classrooms, staffroom, conference, computer lab, cabins										
Existing Type of Light	**Existing Quantity**	**Existing Wattage (kWh)**	**Proposed type of Light**	**Proposed Quantity**	**Estimated Wattage (kWh)**	**Rate per unit (Rs)**	**Total Cost (Rs)**	**Annual Savings (kWh)**	**Annual Savings* (Rs)**	**Pay back in year**
36 W Fluorescent tube light	**132**	**4656.96**	**18W LED (t8) of 1800 Lumens**	**132**	**1552.32**	**345**	**45,540**	**3105**	**₹57,374**	**1**

Table 27: Table for calculation of Replacement of tube lights and LED lights

4.1.2 Optimization of outdoor lights operation based on Astronomical timer

Energy efficiency improvement measures	Investment Rs. In Lakh
Optimization of street light operation based on Astronomical timer	**0.10**

Table 28: Energy efficiency improvement measures

Most of the switching points are manually operated to switch ON and OFF the lighting system. The operating schedule is as per the 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 concerning 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 the desired time of the day/night thereby giving the advantage of convenience and reduction in power wastage or substantial energy savings. The need for automation in the street light system is for accurate switching of lights at sunset or twilight sunset and switch OFF at sunrise or twilight sunrise, avoiding the human error to operate the switch, thereby providing 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										
Areas applicable: Classrooms, office, computer lab, staff room, cabins										
Existing Type of Fan	**Existing Quantity**	**Existing Wattage (kWh)**	**Proposed type of Fan**	**Proposed Quantity**	**Estimated Wattage (kWh)**	**Rate per unit based on exchange policy of Utility (Rs)**	**Total Cost (Rs)**	**Annual Savings (kWh)**	**Annual Savings* (Rs)**	**Pay-back**
Ceiling Fans 53 W	**693**	**24067**	**Atomberg Gorilla 32W**	**693**	**14531**	**3,000**	**20,79,000**	**9,536**	**1,76,225.83**	**11.8**

Table 29: Replacement of Regular fans with BEE star rated/ Brushless Direct Current (BLDC) fans.

The cost and payback period for fans is according to market value, i.e. purchased from the vendor. The vendor list is provided in Annexure H.

Plate 28: Existing Ceiling Fan of 60 W

Plate 29: Proposed Ceiling Fan of Atomberg Gorilla 32W

4.2.2 AC maintenance

Currently, the ACs are performing in good condition as per the audit. However, 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.

4.3 Recommendations for Solar PV system

College should install Solar PV system to harness renewable solar energy. Then college has has to collaborate with Utility (Mahadiscom) to introduce a net metering system so that there is the scope of wheeling the power back to the Grid by way and accounting for it in the College electricity bills. **This can provide a reduction in electricity bills by 15-20% to the College.**

Plate 30: Picture showing the proposed Solar PV panels

Calculations of the solar photovoltaic installation are done using SPIN (An online portal for solar photovoltaic Installation) developed by the Ministry of New & Renewable energy. The Solar rooftop calculator shows the following statistics;

• Average solar irradiation in MAHARASHTRA state is 1266.52 W / sq.m

• 1kWp solar rooftop plant will generate on an average over the year 5.0 kWh of electricity per day (considering 5.5 sunshine hours)

1. Size of Power Plant	
Feasible Plant size as per your Roof Top Area :	38.3kW
2. Cost of the Plant :	
MNRE current Benchmark Cost (without GST) :	Rs. 38236 Rs. / kW
Without subsidy (Based on the current MNRE benchmark) :	Rs. 14,64,439
3. Total Electricity Generation from Solar Plant :	
Annual :	57,450kWh
Life-Time (25 years):	14,36,250kWh
4) Financial Savings :	
Tariff @ Rs.18.48/ kWh (for top slab of usage) - No increase assumed for 25 years	
Monthly :	Rs. 88,473
Annually :	Rs. 10,61,676
Life-Time (25 years) :	Rs. 2,65,41,900

Table 30: Solar Rooftop plant calculation

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, a 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 a real-time basis. Vendor details are shared in Annexure H
- **Clean the AC filter** at least once a fortnight. A choked filter means a 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 are 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 the clause on **'Performance Guarantee'** with a 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

It is recommended, to install hour meter as a check on the usage time of each pump to calculate the energy consumption of the pump. It is used to track and record the elapsed running time of the motor during service.

Sr. No.	Observations	Recommendations	Risk category
1	04 Nos of Hotspot found in changeover switch and distribution boards. (upto 106.3 degree).	Need to be attended on priority by taking following actions: - 1. Tightening of connections. 2. Re-lugging of cable ends 3. Replacing the wire leads if required.	High
2	Earthing resistance value for DG sets body, DG neutral earth, Changeover panel earth is found very high i.e up to 84 ohm.	Earthing resistance value should be less than 1.0ohm, As Standard limits of earth pit resistance specified in Indian electricity Act 2003 is up to 1 ohm.	High
3	Leakage current through earthing for main building DG body found high i.e. 117mA.	Earth Leakage current should be less than 30.0mA. This may increase the chances of electrical shock. Suggest attending the same on priority.	Medium
4	Neutral to earth voltage for main building and extension building incomers, distribution boards, Switchboards is found very high i.e. (44.7V) than the standard limits.	Need to attend the same (it should be less than 2.0V as per standard engineering practices)	High
5	A lightning arrestor is not provided for CHM College Main Building and Extension Building.	It is suggested to install Early streamer emission (ESE) type lightning arrestor for the premises which is required as per IS IEC 62305.	Medium
6	A single line diagram for the Electrical distribution system is not available with CHM College.	SLD of power distribution needs to be prepared and displayed at prominent locations.	Medium
7	Gland plate opening holes are found in distribution panels.	Gland plate opening holes need to be sealed by using a rubber grommet to avoid the reptile's entry inside the panel.	Medium

8	Cable joint found in between MSEB meter to Main Outgoing MCCB of all the three sources.	Suggest replacing the cable to avoid cable joints.	Medium
9	The insulated rubber mat is not provided in front of the main panel of the Main Building and extension building.	Insulated Rubber mat complying with IS 15652 should be provided in front of Electrical panels and distribution boards.	Low
10	Load found unbalanced for all three incoming sources.	Load need to be balanced.	Medium.
11	During socket testing, Earthing was found faulty for both the building and all floor sockets installed.	Wiring corrections of phase, neutral and earth need to be properly done.	Medium
12	Loose and hanging wires were found near floor distribution boards.	Earthing cables need to be terminated inside distribution boards.	Medium
13	A shock treatment chart is not provided near electrical panels which are required as per I.E. rules and are checked during a regular electrical inspection by electrical inspectors.	A shock treatment chart needs to be provided in the electrical panel areas. Suitable training needs to be provided to all the electrical working personnel on regular basis.	Low
14	A 52-week Preventive Maintenance schedule is not available for site equipment and electrical & fire system.	A preventive maintenance plan needs to be prepared to cover all the equipment covering AC, Electrical and fire systems installed at the site.	Medium
15	Lux level for Extension Building classrooms is found very low.	Suggested to replace Tubelights/ PL by LED Lights	Medium

Table 31: Issues in electrical system w.r.t to their risk category and recommendation

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4.6. Energy Bills

4.6.1. Change of Tariff

All the meters of the college are currently billed under LT II B i.e. commercial tariff is applicable. As college comes under the non-government institutional category, can apply and change their tariff to LT VII B. This tariff has fixed charges, costs that do not change with electricity usage. This amount is fixed in a customer's monthly bill. Whereas current demand charges are the costs that vary according to electricity usage. The more the electricity usage, the higher this portion of the bill. These are the costs other than, wheeling charge, per unit electricity charges etc. as shown in the table below.

Tariff Category	Contract Demand / Load	Fixed Demand charge /Month	Energy charge ₹/Unit	Wheeling charge ₹/Unit	Overall Cost per Unit
LT II B (Commercial)	>20 - ≤ 50 kW	Rs. 427 per kW	10.79	1.35	18.48
LT VII B (Educational Institutional)	>20 - ≤ 50 kW	Rs.384.00 per kW	7.23	1.35	Around 14

As per the current annual consumption of 95,498 units, the bill amount paid is Rs. 17,59,577/-. Assuming Rs 14/unit, this could have been reduced to 13,36,972/- making a saving of **Rs. 4,22,605/-**

4.6.2. Installation of APFC panel

Currently out of 3 metered connections, 2 bills have a provision of power factor incentive. As per the electricity bill shared the power factor is 0.97 and 0.99.

It is recommended to install Automatic power factor correction panel of 40KVAR capacity each and maintain the power factor up to 0.995 (unity) to get a maximum incentive of 3.5% of the monthly bill.

Additional incentive expected per annum will be **Rs.96,000/-** which will be recovered in approx. **1.5 years** considering the investment of around **1.5 Lacs**.

4.7 Retrofit of Water Efficient Equipment

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

Plate 31: Existing Single Flush

Plate 32: Proposed Dual Flush

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

Plate 33: 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 (litres)	Projected Water savings with efficient equipment (litres) - Annual	Unit rate (Rs)	Total Cost (Rs)	Payback period (Year/ Months)
1	Single Flush	Dual Flush	24	120	72	3840	92160	NA
2	Regular Washbasin faucet	Water-saving aerator faucet	17	17	9	8.5	144.5	NA

Table 32: Retrofit for Water Efficient Equipment

A water meter should be installed to measure the water usage from the well. The water meter costs around Rs 500.

Use of Drip irrigation instead of manual using pipe to water trees and use of sprinkle for lawns can further help reduce water consumption for landscaping.

4.8 Waste Segregation and Composting

As college already has waste segregation in place, organic composting and maintenance and collection of recyclable waste can be undertaken by contract with NGO such as Stree Mukti Sanghatana, i.e resuming the service, which was suspended due to the pandemic. Incentive based collection campaigns should be organized under NSS/NCC program for collecting Multilayer plastic and tetra packs. This would create awareness amongst the faculty and students of the college, in the process reducing pollution and facilitating recycling of those.

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 and improve air quality can be provided in the administrative areas on all floors.

Plate 34: 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. As the college has a lot of green space around, planting trees to the existing botanical and butterfly garden is recommended.

Plate 35 : Plant species attracting birds and butterflies

Considering the universal access, the building should have a lift in the passage of Main building. This could facilitate the movement of special abled students and faculties on all the spaces of floors above ground.

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 33: Green Building Rating Systems

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.

6. References

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7. Annexure

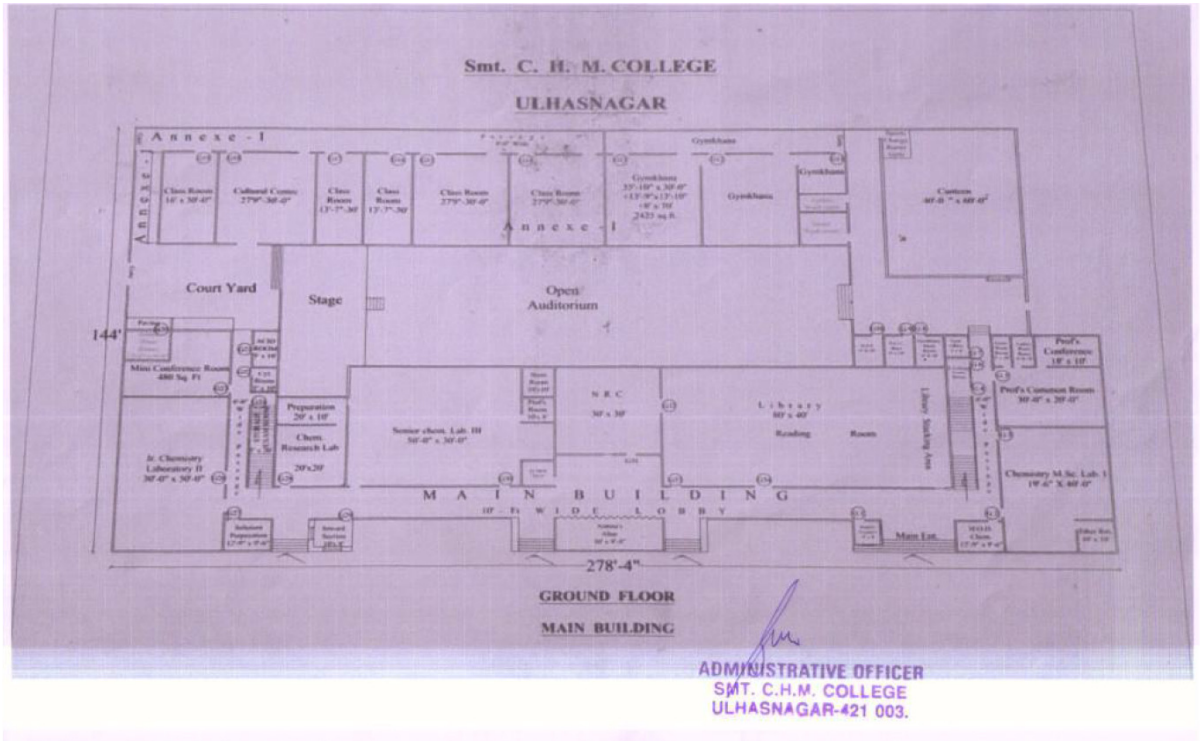
A. Usage data collection template

Sr No	Name of the room	Name of the Space	Area	Floor	Maximum No. Of Persons at a time	Type of Light (LED/ Halogen/ Tubelight/	LED/NON LED	Total no.	Approximate Wattage	Usage hours/ day	Total no. of days used	Total usage Wh/year	Total usage KWh/year	Connected Load	LPD calculation	LPD	AC/ NON AC
1	NSS Room	G-01	11.62	Ground Floor	8	LED Tubelights	LED	2	36	8	300	172800	57.6	72	6.20	Compliant	Non AC
2	NCC-Boys	G-02	11.62	Ground Floor	8	LED Tubelights	LED	2	36	8	300	172800	57.6	72	6.20	Compliant	Non AC
3	NCC-Girls	G-03	11.62	Ground Floor	8	LED Tubelights	LED	3	36	8	300	259200	86.4	108	9.30	Compliant	Non AC
4	First Aid	G-04	9.29	Ground Floor	2	LED Tubelights	LED	2	36	8	365	210240	70.08	72	7.75	Compliant	Non AC
5	Examination Room-1	G-05	12	Ground Floor	4	LED Tubelights	LED	3	36	8	60	51840	17.28	108	9.00	Compliant	Non AC
6	Teachers common Room	G-06	55.2	Ground Floor	50	LED Tubelights	LED	14	36	8	245	987840	329.28	504	9.13	Compliant	AC
7	Meeting room	G-07	16.56	Ground Floor		LED Tubelights	LED	6	36	8	245	423360	141.12	216	13.04	Non Compliant	Non AC
8	Chemistry Lab-1 PG	G-08	55.2	Ground Floor	25	LED Tubelights	LED	14	36	8	245	987840	329.28	504	9.13	Compliant	Non AC
9	Enquiry	G-09	5.81	Ground Floor	4	LED Tubelights	LED	2	36	8	245	141120	47.04	72	12.40	Non Compliant	Non AC
10	Library	G-10	82.8	Ground Floor	100	LED Tubelights	LED	69	36	8	300	5961600	1987.2	2484	30.00	Non Compliant	Non AC
11	Online public access catalogue	G-11	82.8	Ground Floor	4	LED Tubelights	LED	2	36	8	300	172800	57.6	72	0.87	Compliant	Non AC
12	Book Bank	G-12	82.8	Ground Floor	4	LED BULBS	LED	6	15	8	300	216000	72	90	1.09	Compliant	Non AC
13	Chemistry Lab	G-13	36.8	Ground Floor	4	LED BULBS	LED	2	15	8	245	58800	19.6	30	0.72	Compliant	Non AC
14	Chemistry Lab	G-14	55.2	Ground Floor	50	LED BULBS	LED	52	15	8	245	1528800	509.6	780	14.13	Non Compliant	Non AC
15	Chemistry Lab	G-15	41.4	Ground Floor	20	LED Tubelights	LED	13	36	8	245	917280	305.76	468	11.30	Non Compliant	Non AC
16	Chemistry Lab	G-16	36.8	Ground Floor	4	LED Tubelights	LED	2	36	8	245	141120	47.04	72	1.96	Compliant	Non AC
17	Chemistry Lab	G-17	55.2	Ground Floor	50	LED Tubelights	LED	18	36	8	245	1270080	423.36	648	11.74	Non Compliant	Non AC
18	Store Room	G-18	18.4	Ground Floor	2	LED Tubelights	LED	3	36	8	300	259200	86.4	108	5.87	Compliant	Non AC
19	Gas Room	G-19	18.4	Ground Floor	2	LED Tubelights	LED	2	36	8	300	172800	57.6	72	3.91	Compliant	Non AC
20	Store Room	G-20	18.4	Ground Floor	2	LED Tubelights	LED	2	36	5	50	18000	6	72	3.91	Compliant	AC
21	Board Room	G-21	55.2	Ground Floor	25	LED Tubelights	LED	33	15	8	300	1188000	396	495	8.97	Compliant	Non AC
21	Girls common Room	101	55.74	First Floor	30	LED Tubelights	LED	10	36	8	245	705600	235.2	360	6.46	Compliant	Non AC
22	Lecture Room 1	102	83.61	First Floor	100	LED Tubelights	LED	13	36	8	245	917280	305.76	468	5.60	Compliant	Non AC
23	Lecture Room 2	103	55	First Floor	50	LED Tubelights	LED	9	36	8	245	635040	211.68	324	5.89	Compliant	Non AC
24	Facilitation Room	104	11.8	First Floor	5	LED Tubelights	LED	3	36	8	245	211680	70.56	108	9.15	Compliant	Non AC
25	Admin Office	105	111.5	First Floor	30	LED BULBS	LED	60	15	8	300	2160000	720	900	8.07	Compliant	Non AC
26	Registrar Office	106	12	First Floor	6	LED tubelights	LED	6	36	8	300	518400	172.8	216	18.00	Non Compliant	Non AC
27	IT Lab 1	107	55.2	First Floor	50	LED tubelights	LED	10	36	8	245	705600	235.2	360	6.52	Compliant	AC
28	Principal's office	108	16.56	First Floor	10	LED tubelights	LED	14	36	8	300	1209600	403.2	504	30.43	Non Compliant	AC
29	Vice Principal's office	109	36.8	First Floor	10	LED BULBS	LED	47	15	8	300	1692000	564	705	19.16	Non Compliant	AC
30	HOD Marathi	110	8.9	First Floor	6	LED tubelights	LED	1	36	8	245	70560	23.52	36	4.04	Compliant	Non AC
31	HOD Economics	111	8.9	First Floor	4	LED tubelights	LED	2	36	8	245	141120	47.04	72	8.09	Compliant	Non AC
32	Water Room	112	8.9	First Floor	2	LED tubelights	LED	1	36	8	365	105120	35.04	36	4.04	Compliant	Non AC
33	Exam Room	113	83.6	First Floor	10	LED tubelights	LED	8	36	8	300	691200	230.4	288	3.44	Compliant	Non AC
34	Exam Control Room	114	2.78	First Floor	6	LED tubelights	LED	4	36	8	120	138240	46.08	144	51.80	Non Compliant	Non AC
35	Physics Lab	115	139.35	First Floor	50	LED tubelights	LED	31	36	8	245	2187360	729.12	1116	8.01	Compliant	Non AC
36	IQAC Room	116	27.9	First Floor	20	LED tubelights	LED	4	36	8	300	345600	115.2	144	5.16	Compliant	AC
37	Chenistry Lab	117	83.6	First Floor	50	LED tubelights	LED	11	36	8	245	776160	258.72	396	4.74	Compliant	Non AC
38	Video Recording Room	118	55.74	First Floor	4	LED tubelights	LED	2	36	8	245	141120	47.04	72	1.29	Compliant	Non AC
39	Physics Lab	119	34.8	First Floor	50	LED tubelights	LED	18	36	8	245	1270080	423.36	648	18.62	Non Compliant	Non AC
40	IT Lab 2	120	27.9	First Floor	50	LED tubelights	LED	10	36	8	245	705600	235.2	360	12.90	Non Compliant	AC
41	HOD Sindhi	121	8.9	First Floor	4	LED tubelights	LED	2	36	8	245	141120	47.04	72	8.09	Compliant	Non AC
42	Micro Biology Lab	201, 202,	205.5	Second Floor	60	LED tubelights	LED	24	36	8	245	1693440	564.48	864	4.20	Compliant	Non AC
43	HOD Microbiology	204	11.8	Second Floor	6	LED tubelights	LED	2	36	8	245	141120	47.04	72	6.10	Compliant	Non AC
44	Zoology Lab	205	83.6	Second Floor	6	LED tubelights	LED	12	36	8	245	846720	282.24	432	5.17	Compliant	Non AC
45	Preparation Room	206	2.78	Second Floor	10	LED tubelights	LED	2	36	8	245	141120	47.04	72	25.90	Non Compliant	Non AC

S. No	Name of the Space	Floor	Maximum No. Of Persons at a time	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	Connected Load
1	G-01	Ground	8	Ceiling Fans	1	53	8	300	127200	42.40	53
2	G-02	Ground	8	Ceiling Fans	1	53	8	300	127200	42.40	53
3	G-03	Ground	8	Ceiling Fans	1	53	8	300	127200	42.40	53
4	G-04	Ground	2	Ceiling Fans	1	53	8	365	154760	51.59	53
5	G-05	Ground	4	Ceiling Fans	1	53	8	60	25440	8.48	53
6	G-06	Ground	50	Ceiling Fans	6	53	8	245	623280	207.76	318
7	G-07	Ground		Ceiling Fans	2	53	8	245	207760	69.25	106
8	G-08	Ground	25	Ceiling Fans	12	53	8	245	1246560	415.52	636
9	G-09	Ground	4	Ceiling Fans	1	53	8	245	103880	34.63	53
10	G-10	Ground	40	Ceiling Fans	37	53	8	300	4706400	1568.80	1961
11	G-11	Ground	4	Ceiling Fans	1	53	8	300	127200	42.40	53
12	G-12	Ground	4	Ceiling Fans	4	53	8	300	508800	169.60	212
13	G-13	Ground	4	Ceiling Fans	1	53	8	245	103880	34.63	53
14	G-14	Ground	50	Ceiling Fans	9	53	8	245	934920	311.64	477
15	G-15	Ground	20	Ceiling Fans	6	53	8	245	623280	207.76	318
16	G-16	Ground	4	Ceiling Fans	1	53	8	245	103880	34.63	53
17	G-17	Ground	50	Ceiling Fans	7	53	8	245	727160	242.39	371
18	G-18	Ground	2	Ceiling Fans	2	53	8	300	254400	84.80	106
19	G-19	Ground	2	Ceiling Fans	5	53	8	300	636000	212.00	265
20	G-20	Ground	25	Ceiling Fans	5	53	8	245	519400	173.13	265
21	G-22	Ground	60	Ceiling Fans	8	53	8	245	831040	277.01	424
22	G-23	Ground	30	Ceiling Fans	3	53	8	245	311640	103.88	159
23	G-24	Ground	30	Ceiling Fans	3	53	8	245	311640	103.88	159
24	G-25	Ground	30	Ceiling Fans	3	53	8	245	311640	103.88	159
25	G-26	Ground	30	Ceiling Fans	5	53	8	245	519400	173.13	265
26	G-27	Ground	30	Ceiling Fans	5	53	8	245	519400	173.13	265
27	G-28	Ground	30	Ceiling Fans	5	53	8	245	519400	173.13	265
28	G-29	Ground	30	Ceiling Fans	5	53	8	245	519400	173.13	265
29	G-30	Ground	30	Ceiling Fans	4	53	8	245	415520	138.51	212
30	101	First	30	Ceiling Fans	6	53	8	245	623280	207.76	318
31	102	First	100	Ceiling Fans	9	53	8	245	934920	311.64	477
32	103	First	50	Ceiling Fans	6	53	8	245	623280	207.76	318
33	104	First	5	Ceiling Fans	1	53	8	245	103880	34.63	53
34	105	First	30	Ceiling Fans	17	53	8	300	2162400	720.80	901
35	106	First	6	Ceiling Fans	2	53	8	300	254400	84.80	106
36	107	First	50	Ceiling Fans	4	53	8	245	415520	138.51	212
37	108	First	10	Ceiling Fans	5	53	8	300	636000	212.00	265
38	109	First	10	Ceiling Fans	5	53	8	300	636000	212.00	265
39	110	First	6	Ceiling Fans	1	53	8	245	103880	34.62666667	53
40	111	First	4	Ceiling Fans	1	53	8	245	103880	34.62666667	53

S. No	Name of the Space	Floor	Name of the Equipment	Total no. of Equipment	Approximate Wattage (W)	Usage hours/ day	Total no. of days used	Total usage Wh/year	Total usage KWh/year	Connected Load
1	G-15 (Chemistry Analytical Lab.)	Ground Floor	spectrophotometer	2	500	0	0	0	0	1000
2	G-15 (Chemistry Analytical Lab.)	Ground Floor	Magnetic Stirrer	1	300	1	90	27000	9.00	300
3	G-15 (Chemistry Analytical Lab.)	Ground Floor	Colorimeter	5	200	5	180	900000	300.00	1000
4	G-15 (Chemistry Analytical Lab.)	Ground Floor	pH Meter	6	100	5	180	540000	180.00	600
5	G-17 (Chemistry Junior Lab.)	Ground Floor	Weighing Balance	1	100	6	180	108000	36.00	100
6	G-14 (Chemistry Senior Lab.)	Ground Floor	Oven	1	1500	5	60	450000	150.00	1500
7	G-14 (Chemistry Senior Lab.)	Ground Floor	Weighing Balance	2	100	6	180	216000	72.00	200
8	Office administration area	First Floor	Biometrics	3	2	8	245	11760	3.92	6
9	107 (I.T. Lab. 1)	First Floor	Computer /Laptop	26	100	6	180	2808000	936.00	2600
10	120 (I.T. Lab. 2)	First Floor	Computer /Laptop	24	100	6	180	2592000	864.00	2400
11	115 (Physics Sr. Lab.)	First Floor	Computer /Laptop	5	100	3	180	270000	90.00	500
12	115 (Physics Sr. Lab.)	First Floor	Printer	1	30	1	180	5400	1.80	30
13	115 (Physics Sr. Lab.)	First Floor	Heating Coils	2	1000	1	60	120000	40.00	2000
14	115 (Physics Sr. Lab.)	First Floor	CRO	6	40	6	245	352800	117.60	240
15	115 (Physics Sr. Lab.)	First Floor	Weighing Balance	1	100	1	60	6000	2.00	100
16	117 (Physical Chem. Lab.)	First Floor	Computer /Laptop	1	100	1	245	24500	8.17	100
17	117 (Physical Chem. Lab.)	First Floor	Printer	1	30	1	245	7350	2.45	30
18	117 (Physical Chem. Lab.)	First Floor	Water Bath	3	1000	2	180	1080000	360.00	3000
19	119 (Physics Junior Lab.)	First Floor	Heating Coils	3	1000	0.5	30	45000	15.00	3000
20	119 (Physics Junior Lab.)	First Floor	CRO	1	40	3	90	10800	3.60	40
21	119 (Physics Junior Lab.)	First Floor	Weighing Balance	1	100	3	30	9000	3.00	100
22	201, 202, 203 (Microbiology Laboratory	Second Floor	Fridge	6	240	24	365	12614400	4204.80	1440
23	201, 202, 203 (Microbiology Laboratory	Second Floor	Oven	4	1500	3	270	4860000	1620.00	6000
24	201, 202, 203 (Microbiology Laboratory	Second Floor	Computer /Laptop	1	100	4	250	100000	33.33	100
25	201, 202, 203 (Microbiology Laboratory	Second Floor	Printer	1	30	0.5	180	2700	0.90	30
26	201, 202, 203 (Microbiology Laboratory	Second Floor	Water Bath	1	1500	0.5	30	22500	7.50	1500
27	201, 202, 203 (Microbiology Laboratory	Second Floor	Weighing Balance	2	100	3	280	168000	56.00	200
28	201, 202, 203 (Microbiology Laboratory	Second Floor	Distillation Unit	1	2000	0.5	280	280000	93.33	2000
29	201, 202, 203 (Microbiology Laboratory	Second Floor	Laminar	1	450	0.5	50	11250	3.75	450
30	201, 202, 203 (Microbiology Laboratory	Second Floor	Spectrophotometer	1	500	0.5	30	7500	2.50	500

B.Sample Floor Layouts



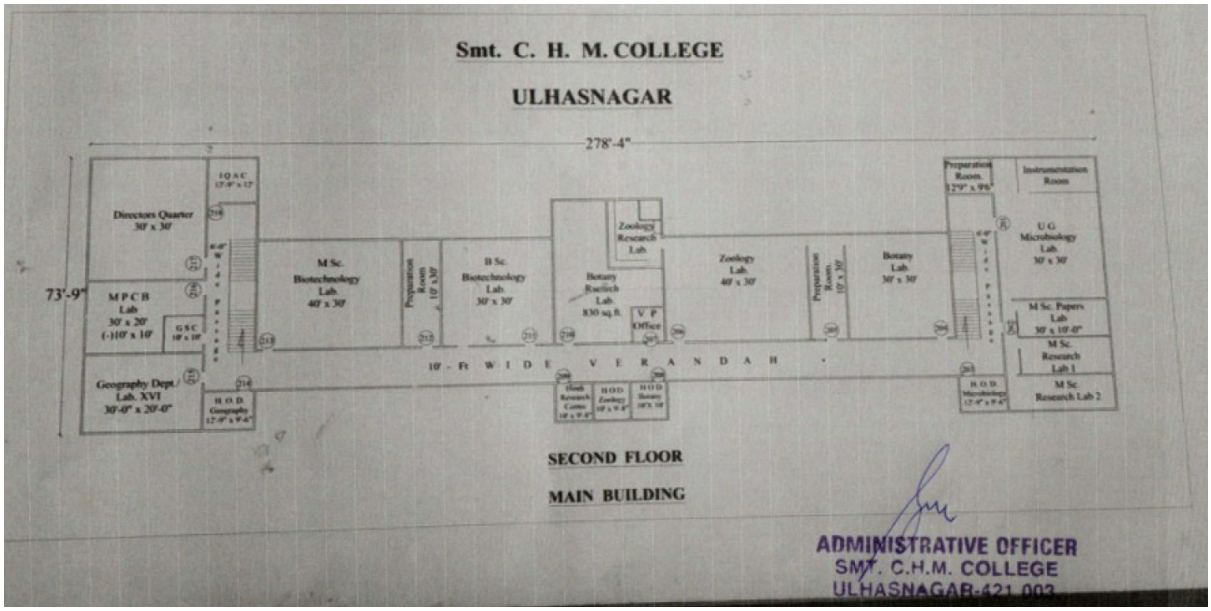
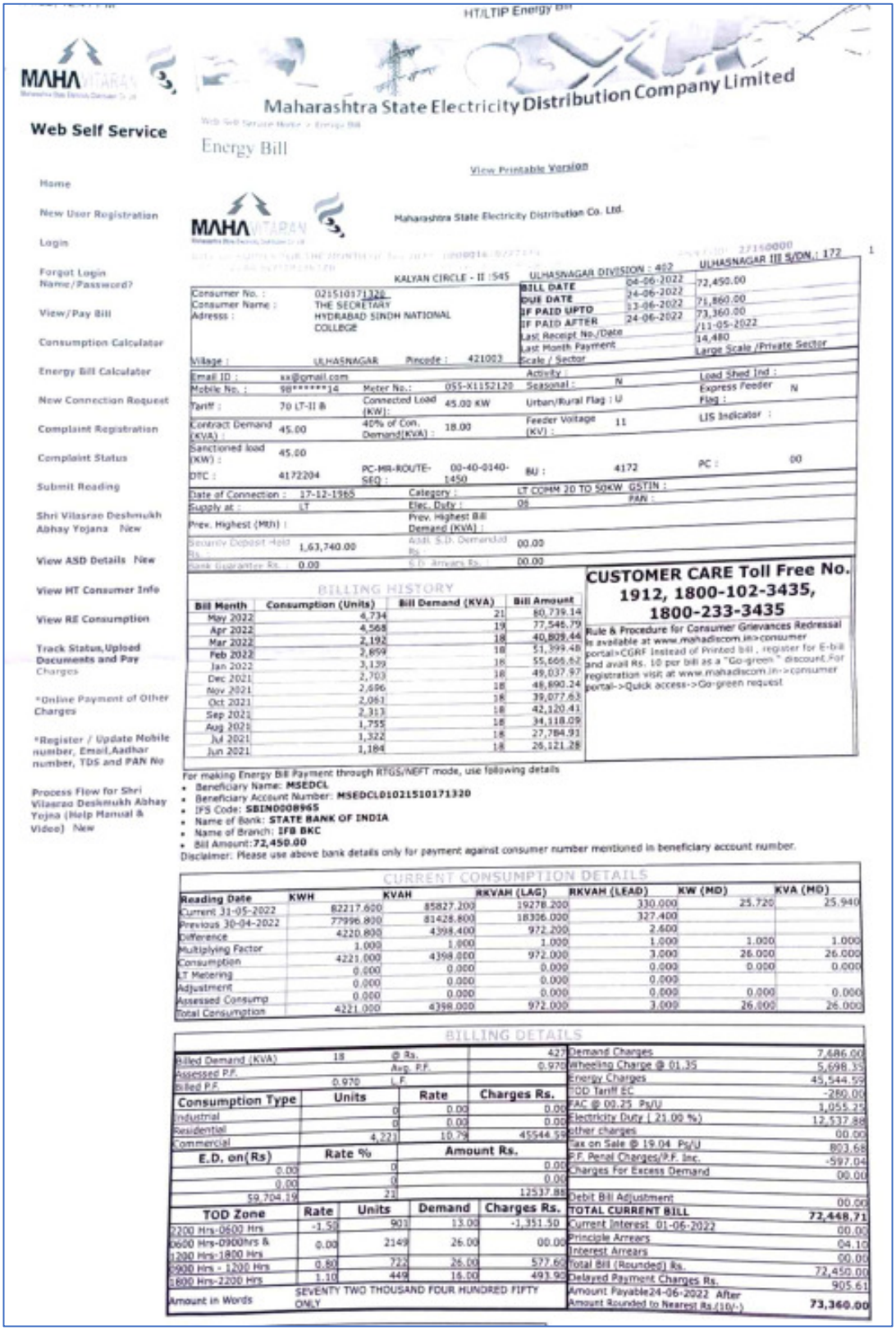


Figure 15: Campus Layout

C.Sample Electricity bill of Smt. Chandibai Himathmal Mansukhani college



HT/LTIP Energy Bill

MAHAVITARAN

Maharashtra State Electricity Distribution Company Limited

Web Self Service

Energy Bill

View Printable Version

Home
New User Registration
Login
Forgot Login Name/Password?
View/Pay Bill
Consumption Calculator
Energy Bill Calculator
New Connection Request
Complaint Registration
Complaint Status
Submit Reading
Shri Vilasrao Deshmukh Abhay Yojana New
View ASD Details New
View HT Consumer Info
View RE Consumption
Track Status,Upload Documents and Pay Charges
*Online Payment of Other Charges
*Register / Update Mobile number, Email,Aadhar number, TDS and PAN No
Process Flow for Shri Vilasrao Deshmukh Abhay Yojna (Help Manual & Video) New

Maharashtra State Electricity Distribution Co. Ltd.

KALYAN CIRCLE - II :545 ULHASNAGAR DIVISION : 462 ULHASNAGAR III S/DN. : 172

Consumer No. :	021510171320	BILL DATE	04-06-2022 72,450.00
Consumer Name :	THE SECRETARY	DUE DATE	24-06-2022 71,860.00
Adress :	HYDRABAD SINDH NATIONAL COLLEGE	IF PAID UPTO	13-06-2022 73,360.00
		IF PAID AFTER	24-06-2022 /11-05-2022
		Last Receipt No./Date	14,480
		Last Month Payment	Large Scale /Private Sector
Village :	ULHASNAGAR Pincode : 421003	Scale / Sector	
Email ID :	xx@gmail.com	Activity :	Load Shed Ind :
Mobile No. :	98******14 Meter No.: 055-X1152120	Seasonal : N	Express Feeder Flag : N
Tariff :	70 LT-II B Connected Load (KW): 45.00 KW	Urban/Rural Flag : U	LIS Indicator :
Contract Demand (KVA) :	45.00 40% of Con. Demand(KVA) : 18.00	Feeder Voltage (KV) : 11	
Sanctioned load (KW) :	45.00		
DTC :	4172204 PC-MR-ROUTE-SEQ : 00-40-0140-1450	BU : 4172	PC : 00
Date of Connection :	17-12-1985 Category :	LT COMM 20 TO 50KW GSTIN :	
Supply at :	LT Elec. Duty :	06 PAN :	
Prev. Highest (MtH) :	Prev. Highest Bill Demand (KVA) :		
Security Deposit Held Rs.	1,63,740.00 Addl. S.D. Demanded Rs.	00.00	
Bank Guarantee Rs.	0.00 S.D. Arrears Rs. :	00.00	

BILLING HISTORY

Bill Month	Consumption (Units)	Bill Demand (KVA)	Bill Amount
May 2022	4,734	21	80,739.14
Apr 2022	4,568	19	77,546.79
Mar 2022	2,192	18	40,809.44
Feb 2022	2,859	18	51,399.48
Jan 2022	3,139	18	55,665.62
Dec 2021	2,703	18	49,037.97
Nov 2021	2,696	18	48,890.24
Oct 2021	2,061	18	39,077.63
Sep 2021	2,313	18	42,120.41
Aug 2021	1,755	18	34,118.09
Jul 2021	1,322	18	27,784.91
Jun 2021	1,184	18	26,121.28

CUSTOMER CARE Toll Free No. 1912, 1800-102-3435, 1800-233-3435

Rule & Procedure for Consumer Grievances Redressal is available at www.mahadiscom.in>consumer portal>CGRF Instead of Printed bill , register for E-bill and avail Rs. 10 per bill as a "Go-green " discount.For registration visit at www.mahadiscom.in->consumer portal->Quick access->Go-green request

For making Energy Bill Payment through RTGS/NEFT mode, use following details

- Beneficiary Name: **MSEDCL**
- Beneficiary Account Number: **MSEDCL0102151017132O**
- IFS Code: **SBIN0000965**
- Name of Bank: **STATE BANK OF INDIA**
- Name of Branch: **IFB BKC**
- Bill Amount:**72,450.00**

Disclaimer: Please use above bank details only for payment against consumer number mentioned in beneficiary account number.

CURRENT CONSUMPTION DETAILS

Reading Date	KWH	KVAH	RKVAH (LAG)	RKVAH (LEAD)	KW (MD)	KVA (MD)
Current 31-05-2022	82217.600	85827.200	19278.200	330.000	25.720	25.940
Previous 30-04-2022	77996.800	81428.800	18306.000	327.400		
Difference	4220.800	4398.400	972.200	2.600		
Multiplying Factor	1.000	1.000	1.000	1.000	1.000	1.000
Consumption	4221.000	4398.000	972.000	3.000	26.000	26.000
LT Metering	0.000	0.000	0.000	0.000	0.000	0.000
Adjustment	0.000	0.000	0.000	0.000		
Assessed Consump	0.000	0.000	0.000	0.000	0.000	0.000
Total Consumption	4221.000	4398.000	972.000	3.000	26.000	26.000

BILLING DETAILS

Billed Demand (KVA)	18	@ Rs.	427
Assessed P.F.		Avg. P.F.	0.970
Billed P.F.	0.970	L.F.	

Consumption Type	Units	Rate	Charges Rs.
Industrial	0	0.00	0.00
Residential	0	0.00	0.00
Commercial	4,221	10.79	45544.59

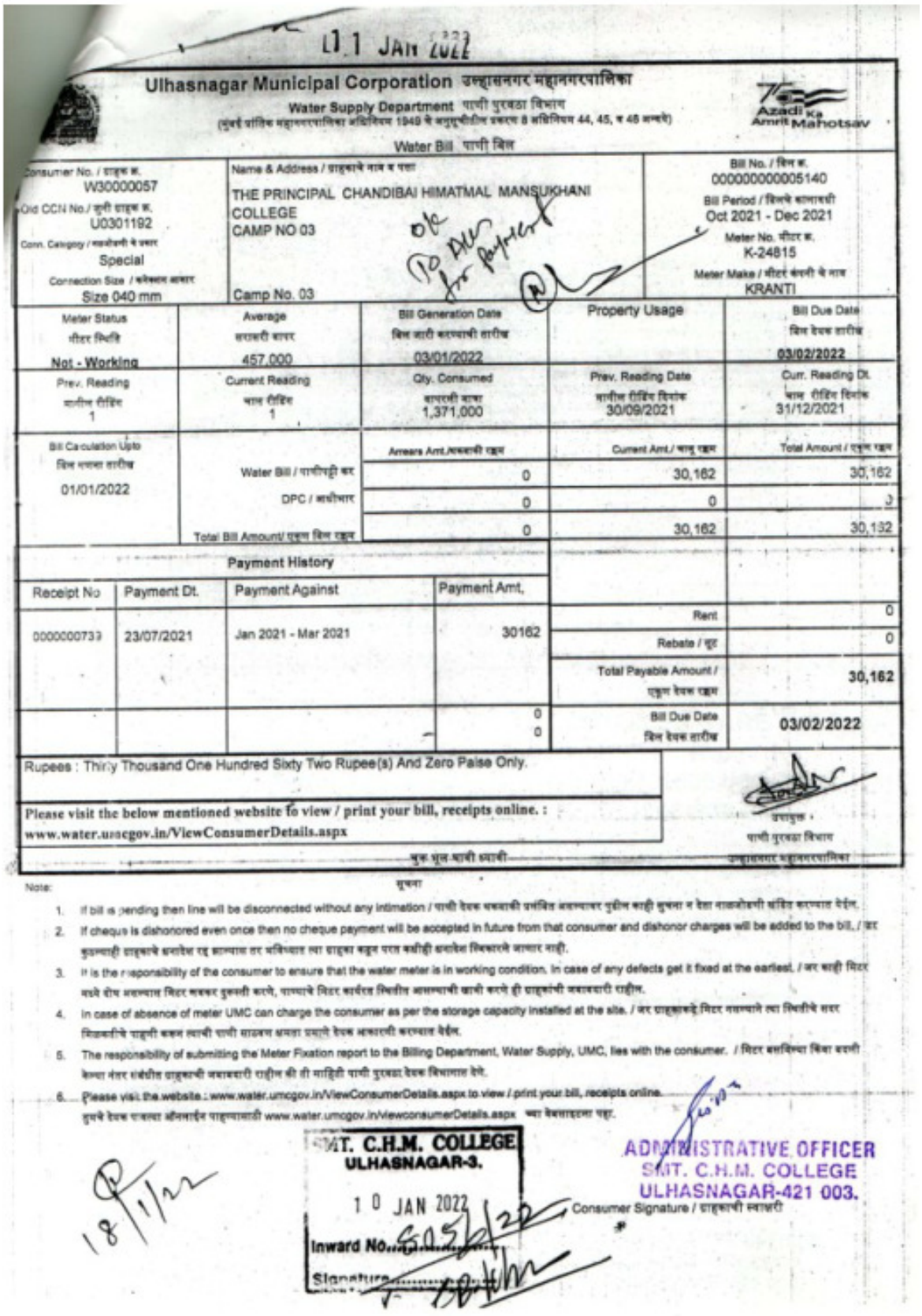
E.D. on(Rs)	Rate %	Amount Rs.
0.00	0	0.00
0.00	0	0.00
59,704.19	21	12537.88

TOD Zone	Rate	Units	Demand	Charges Rs.
2200 Hrs-0600 Hrs	-1.50	903	13.00	-1,351.50
0600 Hrs-0900hrs & 1200 Hrs-1800 Hrs	0.00	2149	26.00	00.00
0900 Hrs - 1200 Hrs	0.80	722	26.00	577.60
1800 Hrs-2200 Hrs	1.10	449	16.00	493.90

Amount in Words: SEVENTY TWO THOUSAND FOUR HUNDRED FIFTY ONLY

Demand Charges	7,686.00
Wheeling Charge @ 01.35	5,698.35
Energy Charges	45,544.59
FOD Tariff EC	-280.00
FAC @ 00.25 Ps/U	1,055.25
Electricity Duty [21.00 %]	12,537.88
Other charges	00.00
Tax on Sale @ 19.04 Ps/U	803.68
P.F. Penal Charges/P.F. Inc.	-597.04
Charges For Excess Demand	00.00
Debit Bill Adjustment	00.00
TOTAL CURRENT BILL	72,448.71
Current Interest 01-06-2022	00.00
Principle Arrears	04.10
Interest Arrears	00.00
Total Bill (Rounded) Rs.	72,450.00
Delayed Payment Charges Rs.	905.61
Amount Payable24-06-2022 After Amount Rounded to Nearest Rs.(10/-)	73,360.00

D.Sample Water bill



11 JAN 2022

Ulhasnagar Municipal Corporation उल्हासनगर महानगरपालिका

Water Supply Department पाणी पुरवठा विभाग

(मुंबई प्रांतिक महानगरपालिका अधिनियम 1949 चे अनुसूचीतील प्रकरण 8 अधिनियम 44, 45, व 46 लागू)

Azadi Ka Amrit Mahotsav

Water Bill पाणी बिल

Consumer No. / ग्राहक क्र. W30000057 Old CCN No./ जुनी ग्राहक क्र. U0301192 Conn. Category / जोडणीची से प्रकार Special Connection Size / जोडणाचा आकार Size 040 mm	Name & Address / ग्राहकाचे नाव व पत्ता THE PRINCIPAL CHANDIBAI HIMATMAL MANSUKHANI COLLEGE CAMP NO 03 Camp No. 03	Bill No. / बिल क्र. 000000000005140 Bill Period / बिलचे कालावधी Oct 2021 - Dec 2021 Meter No. मीटर क्र. K-24815 Meter Make / मीटर बनवणारी से नाव KRANTI

Meter Status मीटर स्थिति	Average सरासरी वापर	Bill Generation Date बिल जारी करण्याची तारीख	Property Usage	Bill Due Date बिल देयक तारीख
Not - Working	457.000	03/01/2022		03/02/2022
Prev. Reading मागील रिडिंग 1	**Current Reading** चालू रिडिंग 1	**Qty. Consumed** वापरली वाचा 1,371,000	**Prev. Reading Date** मागील रिडिंग दिनांक 30/09/2021	**Curr. Reading Dt.** चालू रिडिंग दिनांक 31/12/2021

Bill Calculation Upto बिल गणना तारीख		Arrears Amt./थकबाकी रक्कम	Current Amt./ चालू रक्कम	Total Amount / एकूण रक्कम
01/01/2022	Water Bill / पाणीपट्टी कर	0	30,162	30,162
	DPC / आकारभार	0	0	0
	Total Bill Amount/ एकूण बिल रक्कम	0	30,162	30,162

Payment History

Receipt No	Payment Dt.	Payment Against	Payment Amt.
0000000733	23/07/2021	Jan 2021 - Mar 2021	30162
			0 0

Rent	0
Rebate / सूट	0
Total Payable Amount / एकूण देयक रक्कम	30,162
Bill Due Date बिल देयक तारीख	03/02/2022

Rupees : Thirty Thousand One Hundred Sixty Two Rupee(s) And Zero Paise Only.

Please visit the below mentioned website to view / print your bill, receipts online. :
www.water.umcgov.in/ViewConsumerDetails.aspx

उपायुक्त ,
पाणी पुरवठा विभाग
उल्हासनगर महानगरपालिका

मुक्त मूल थाबी स्थायी

Note: सूचना

1. If bill is pending then line will be disconnected without any intimation / पाणी देयक थकबाकी प्रलंबित असल्यास पुढील काही सूचना न देता नळजोडणी खंडित करण्यात येईल.
2. If cheque is dishonored even once then no cheque payment will be accepted in future from that consumer and dishonor charges will be added to the bill. / जर कुठल्याही ग्राहकाचे धनादेश एक वेळेस तर अनेकवार त्या ग्राहका कडून परत कधीही धनादेश स्विकारले जाणार नाही.
3. It is the responsibility of the consumer to ensure that the water meter is in working condition. In case of any defects get it fixed at the earliest. / जर काही मिटर मध्ये दोष असल्यास मिटर बदलून दुरुस्ती करणे, पाण्याचे मिटर कार्यरत स्थितीत असल्याची खात्री करणे ही ग्राहकांची जबाबदारी राहील.
4. In case of absence of meter UMC can charge the consumer as per the storage capacity installed at the site. / जर ग्राहकाकडे मिटर नसल्याने त्या स्थितीचे सदर मिळकतीचे साठवणी क्षमता प्रमाणे देयक आकारणी करण्यात येईल.
5. The responsibility of submitting the Meter Fixation report to the Billing Department, Water Supply, UMC, lies with the consumer. / मिटर बसविल्या किंवा बदली केल्या नंतर संबंधीत ग्राहकाची जबाबदारी राहील की ती माहिती पाणी पुरवठा देयक विभागात देणे.
6. Please visit the website : www.water.umcgov.in/ViewConsumerDetails.aspx to view / print your bill, receipts online.
तुमचे देयक पाहण्या साठी वेबसाईट पाहण्यासाठी www.water.umcgov.in/ViewconsumerDetails.aspx भेट देवूशकता पहा.

SMT. C.H.M. COLLEGE
ULHASNAGAR-3.
10 JAN 2022
Inward No. 605/22
Signature

ADMINISTRATIVE OFFICER
SMT. C.H.M. COLLEGE
ULHASNAGAR-421 003.

18/1/22

Consumer Signature / ग्राहकाची स्वाक्षरी

E. Green census report

The objective of the green census is 1. To evaluate the present status of individual trees, and shrubs and to quantify the greenery found on campus 2. To label the trees and shrubs of the campus which will provide information about the scientific name, common name and vernacular name, and importance. 3. to educate the students and staff about the different tree species that they encounter in their daily lives. 4. To maintain an inventory of tree and shrub diversity, health status, frequency, and distribution to create a more reliable database of tree species.

Methodology - The project was be carried out in two phases by the staff and students of the Botany department. **Mr. Prashant Patil, Dr. Lakshmi Girish, Dr. Neelam Parab** led the project. The TY students were involved in the project. In the first phase, the students were divided into groups and they were taught about the identification and numbering system of the trees and shrubs. Each group was guided by project leaders of Botany Department. All the trees and shrubs having a height of 6 mts were considered for the census. Inside the garden, all trees, shrubs and herbs were recorded. The groups were allotted different locations on the campus to carry out the census. Finally, the individual data was compiled and the final report was prepared. During the census, the students recorded the health status of the trees. In the second phase of the project, with the prepared census data name plates were prepared using metal sheets. The trees were numbered and the nameplates were attached to them. The nameplate reveals the details about the tree such as botanical name, common name and family.

The campus was divided into five locations for the convenience of the project study. The following are the area covered during the census

1. From the college gate till the building entrance
2. Near the Pharmacy college building
3. Nearby and back of the canteen
4. Inside and surrounding the garden
5. The area behind the junior chemistry lab to the main entrance of the annexure building

The study recorded a total of 308 trees and shrubs species on the campus which count the number of trees and shrubs. There are 75 trees belonging to 26 different plant species recorded from the main gate to the entrance of the college.

List of plants from the college gate till the building entrance

Sr. No.	Botanical name	Common Name	Family	No. of Plants
1	*Terminalia catappa L.*	Indian Almond	Combretaceae	04
2	*Terminalia tomentosa* Wight & Arn	Crocodile Bark tree	Combretaceae	01
3	*Samanea saman Merr.*	The Rain Tree	Mimosae	03
4	*Peltophorum pterocarpum Backer.*	Copper Pod Tree	Caesalpinaceae	04
5	*Cassia siamea Lamk.*	Kassod	Caesalpinaceae	02
6	*Pithocolobium dulce Benth.*	Manila Tamarind	Mimosae	04
7	*Spathodea campanulate P.Beauv.*	African Tulip Tree	Bignoniaceae	06
8	*Quisqualis indica* L	Rangoon creeper	Combrtaceae	02
9	*Ficus religiosa L.*	Pipal	Moraceae	01
10	*Ficus glomerata Roxb.*	Umber	Moraceae	01
11	*Caesalpinea pulcherrima Linn.*	Peacock Flower	Caesalpinaceae	10
12	*Azardirachta indica A. juss.*	Margosa Tree	Meliaceae	01
13	*Antigonon leptopus* Hook. & Arn	Icecream creeper	Polygonaceae	01
14	*Vernonia elaeagnifolia DC*	Curtain plant	Asteraceae	01
15	*Chrysalidocarpous lutescens H. Wendl.*	Madagascar Palm.	Palmae	04
16	*Annona squamosa L.*	Custard Apple	Annonaceae.	01
17	*Tecoma stans* (L.) Juss. ex Kunth	Yellow bells	Bignoniaceae	01
18	*Alstonia scholaris R. Br..*	Devil's tree, saptaparni	Apocynaceae	01
19	*Morinda citrifolia L.*	Indian Mulberry, Noni	Rubiaceae	01

20	*Pongamia pinnata Pierre.*	Pongam Tree, Karanj	Papilionaceae	01
21	*Trema orientalis* (L.) Bl.	pigeon wood	Ulmaceae	01
22	*Ficus benjamina L.*	Weeping fig	Moraceae	01
23	*Pedilanthus thithimaloides*	Ladies slipper plant	Euphorbiaceae	05
24	*Casuarina equisitifolia*		Amentiferae	01
25	Prosopis cineraria; (L.) Druce	Khejri Tree	Mimosae	01
26	*Bamboosa arundinaceae*	Bamboo		15
Total				**75**

The area in front of the pharmacy college consist of total 18 trees and shrubs belonging to 11 different plant species.

List of plants near the Pharmacy college building

Sr. No.	Botanical name	Common Name	Family	No. of Plants
1	*Polyalthia longifolia* (Sonn.) Thwaites	False Ashoka	Annonaceae	03
2	*Butea monosperma* (Lam.)Taub.	Flame of the Forest,	Papilionaceae	01
3	*Spathodea campanulate P.Beauv.*	African Tulip Tree.	Bignoniaceae	02
4	*Roystonea regia (Kunth) O.F. Cook*	Royal palm	Palmae	04
5	*Ficus religiosa L.*	Pipal	Moraceae	01
6	*Ficus glomerata Roxb.*	Umber	Moraceae	02
7	*Pongamia pinnata Pierre.*	Karanj	Papilionaceae	01
8	*Ficus benjamina L.*	Weeping fig	Moraceae	01
9	*Peltophorum pterocarpum Backer.*	Copper Pod Tree	Caesalpinaceae	01
10	*Grevillea robusta; A.Cunn. ex R.Br.*	Silver Oak		01
11	*Cassia fistula L.*	Golden shower	Caesalpinaceae	01
			Total	**18**

The area Nearby and back of the canteen consist of total 13 huge trees and shrubs belonging to 8 different plant species.

Nearby and back of the canteen

Sr. No.	Botanical name	Common Name	Family	No. of Plants
1	*Samanea saman* Merr.	The Rain Tree	Mimosae	04
2	*Psidium guajava L.*	Guava	Myrtaceae	01
3	*Ficus religiosa L.*	Pipal	Moraceae	01
4	*Ficus benghalensis L.*	Banyan tree	Moraceae	01
5	*Acacia auriculiformis Benth.*		Mimosae	01
6	*Pongamia pinnata* Pierre.	Karanj	Papilionaceae	03
7	*Peltophorum pterocarpum* Backer.	Copper Pod Tree	Caesalpinaceae	01
8	*Trema orientalis* (L.) Bl.	pigeon wood	Ulmaceae	01
			Total	**13**

The botanical garden (K. M. Kundnani Botanical Garden) was recorded to be the most rich and diverse location in the campus. The interiors and surrounding the garden consist of in total 158 trees and shrubs belonging to 54 different plant species.

Inside and surrounding the garden

Sr.No.	Botanical name	Common Name	Family	No. of Plants
1	*Anacardium occidentale L.*	Cashew nut	Anacardiaceae	02
2	*Psidium guajava L.*	Guava	Myrtaceae	01
3	*Ficus religiosa L.*	Pipal	Moraceae	01
4	*Cycas circinalis*	The queen sago	Cycadaceae	02
5	*Ecbolium viride* (Forssk.) Alston	Blue fox tail	Acanthaceae	10
6	*Pongamia pinnata Pierre.*	Karanj	Papilionaceae	03
7	*Peltophorum pterocarpum Backer.*	Copper Pod Tree	Caesalpinaceae	01
8	*Ficus benjamina*	Weeping fig	Moraceae	01
9	*Chrysalidocarpous lutescens H. Wendl.*	Madagascar Palm.	Palmae	10

10	*Polyalthia longifolia* (Sonn.) Thwaites	False Ashoka	Annonaceae	15
11	*Cocos nucifera L.*	Coconut palm	Palmae	20
12	*Auracaria auracana*	monkey puzzle tree	Auracariaceae	01
13	*Azadirachta indica* A. Juss	Margosa Tree	Meliaceae	02
14	*Agalonema commutatum Schott.*	Chinese evergreen	Araceae	02
15	*Kopsia fruticosa (Roxb.) A. DC.*	Pink kopsia	Apocynaceae	01
16	*Cassia fistula L.*	Indian laburnum	Caesalpinaceae	03
17	*Carissa carandus*	Karanda	Apocynaceae	02
18	*Livistona chinensis* · (Jacq.) R.Br. ex Mart.	Chinese Fan palm	Palmae	01
19	*Roystonea regia (Kunth) O.F. Cook*	Royal palm	Palmae	01
20	*Madhuca indica*	honey tree	Sapotaceae	01
21	*Plumbago zeylanica L.*	Ceylon leadwort	Plumbaginacae	10
22	*Aegle marmelos* (L.) Correa	Wood apple	Rutaceae	07
23	*Murraya koenigii (L.) Spreng*	Curry leaf tree	Rutaceae	08
24	*Phyllanthus reticulatus* Poir	Black-berried Featherfoil	Euphorbiaceae	01
25	*Nephrolepis exapltata*	sword fern	Polypodiaceae	03
26	*Fargesia rufa*	*Bamboo grass*	Graminae	01
27	*Achras sapota L.*	Sapota	Sapotaceae	01
28	*Murraya paniculata* · (L.) Jack	China-box	Rutaceae	01
29	*Syzygium jambolanum (Lam.) DC.*	Java plum	Myrtaceae	04
30	*Dieffenbachia seguine (Jacq.) Schott*	Dumbane	Araceae	09
31	*Gliricidia sepium (Jacq.) Steud.*	Mexican Lilac	Papilionaceae	01
32	*Schefflera arboricola (Hayata) Merr*	Umbrella plant	Araliaceae	02
33	*Baliospermum montanum* (Willd.) Müll.Arg.	Red Physic Nut,	Euphorbiaceae	01
34	*Curcuma longa L.*	Turmeric	Zingiberaceae	03
35	*Clerodendrum inerme (L.) Gaertn.*	the glory bower	Papilionaceae	01
36	*Butea monosperma* (Lam.)Taub.	Flame of the Forest,	Papilionaceae	01
37	*Mangifera indica L.*	Mango tree	Anacardiaceae	03
38	*Morus alba L.*	White Mulberry	Moraceae	01
39	*Annona squamosa L.*	Custard apple	Annonaceae	01

40	*Polyscias scutellaria*	Sheild Aralia	Araliaceae	01
41	*Areca catechu L.*	Betel nut Palm	Palmae	01
42	*Thespesia populnea* (L.) Soland. ex Correa	Portia Tree	Malvaceae	01
43	*Delonix regia* (Hook.) Raf	May flower	Caesalpinaceae	01
44	*Asparagus racemosus* Willd	Shatavari	Liliaceae	01
45	*Pavetta indica L.*	Bride's bush	Rubiaceae	01
46	*Pandanus odoratissimus L.f.*	Screw pine	Pandanaceae	01
47	*Citrus limon* (L.) Burm.f.	Lemon	Rutaceae	01
48	*Pimenta Dioica* [(L) Merr.	All spice or Jamaica pepper	Myrtaceae	01
49	*Ficus glomerata Roxb.*	Cluster fig	Moraceae	01
50	*Adhatoda vasica* (L.) Nees	Malabar nut	Acanthaceae	01
51	*Terminalia catappa L.*	Indian almond	Combretaceae	01
52	*Monstera deliciosa* Liebm.	Split leaf philodendron	Araceae	01
53	*Canna indica L.*	Edible canna	Cannaceae	01
54	*Bauhinia purpurea* L	Purple bauhinia	Caesalpinaceae	05
		Total		**158**

The area behind the junior chemistry lab to the main entrance of the annexure building consists of a total of 44 trees and shrubs belonging to 17 different plant species.

Area behind the junior chemistry lab till the main entrance of annexure building

Sr. No.	Botanical name	Common Name	Family	No. of Plants
1	*Terminalia catappa L.*	Indian almond	Combretaceae	04
2	*Cocos nucifera L.*	Coconut palm	Palmae	05
3	*Ficus religiosa L.*	Pipal	Moraceae	04
4	*Roystonea regia (Kunth) O.F. Cook*	Royal palm	Palmae	01
5	*Achras sapota L.*	Sapota	Sapotaceae	01
6	*Ficus benjamina*	Weeping fig	Moraceae	04
7	*Mangifera indica L.*	Mango tree	Anacardiaceae	04
8	*Psidium guajava L.*	Guava	Myrtaceae	01
9	*Tamarindus indica L.*	Tamarind	Caesalpinaceae	01

10	*Luecana leucocephala*	Babool	Mimosae	01
11	*Alstonia scholaris R. Br..*	Devil's tree, saptaparni	Apocynaceae	01
12	*Hibiscus rosa-sinensis L.*	Shoe flower	Malvaceae	01
13	*Acalypha wilkesiana* Muell. Arg	Copperleaf	Euphorbiaceae	01
14	*Gardenia jasminoides J. Ellis.*	Cape Jasmine	Rubiaceae	02
15	*Dieffenbachia seguine (Jacq.) Schott*	Dumbane	Araceae	07
16	*Lagerstroemia flos-reginae* Retz.	Pride of India,	Lythraceae	01
17	*Ixora coccinea* L.	Scarlet jungle flame	Rubiaceae	05
			Total	**44**

The green census revealed the fact that the campus is very rich in its vegetation especially the biodiversity of tree species. The prominent trees which were recorded were *Polyalthia, Peltophorum, Samanea, Spathodea and Terminalia* etc. while among the shrubs *Chrysalidocarpus, Ixora, Diffenbeckia etc* were recorded. *Samanea and Peltophorum* trees were of over 70 years old trees of the campus which reflects the history and glory of the college.

The campus has proud of having many medicinal and ornamental plants. The small herbaceous plants were not taken into consideration because of their annual nature of growth. There are several trees with edible fruits, including Jamun, Guava, cashew nut, mulberry, anjeer, chikoo and mango. The large canopy with spreading branched trees support a rich avian diversity also. Most of the trees recorded on the campus were of indigenous origin which gives stability to the ecosystem. The large trees with huge canopy and branches make the atmosphere pure and oxygen-rich. The presence of large open spaces and the deep root system of the trees helps the campus to recharge a huge amount of rainwater which will help to support the neighbouring population. During the study, some of the trees were found to be infected and dead which were removed then after so that other tree species could be well protected.

Dr. Lakshmi Girish (Incharge of green Census)

Mr. Prashant Patil, (HOD, Botany)

Dr. Neelam Parab (Senior Staff, Junior college)

F. Certificates and bills of waste disposal.

a. Green certificate

ECO FRIEND INDUSTRIES
10 Maya, 5 College St., Dadar (W),
Mumbai 400028, Maharashtra, INDIA

MPCB / CPCB Authorized E-Waste Disposal Facility
MPSB Consent No. BO/MPCB/RO(HQ)/R/B - 1703000632 Date 14/03/2017

Green Certificate
for E-Waste Disposal

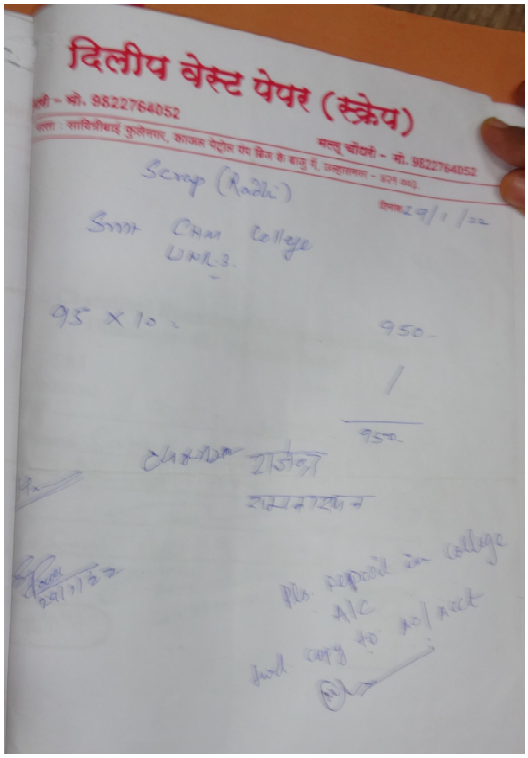
Certificate Sr. No.: 46 /

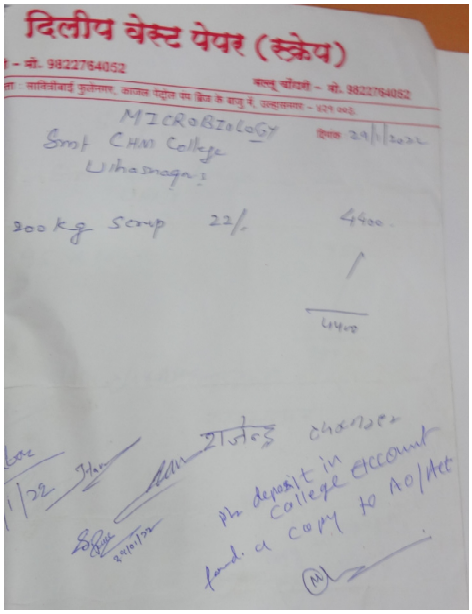
This is to certify that
M/s. SMT. Chandibai Hiroothamal Mansukhani College
Address: Ulhasnagar
Road name: Opp. Ulhasnagar Railway Station, CHM Road
City: Kalyan State: Maharashtra
Pin Code: Country: INDIA has disposed 350 Kg (in figures)
Three hundred fifty Kg (in Words)
of Electronic/Electrical Waste with Eco Friend Industries on dt. 30th / Nov / 2021

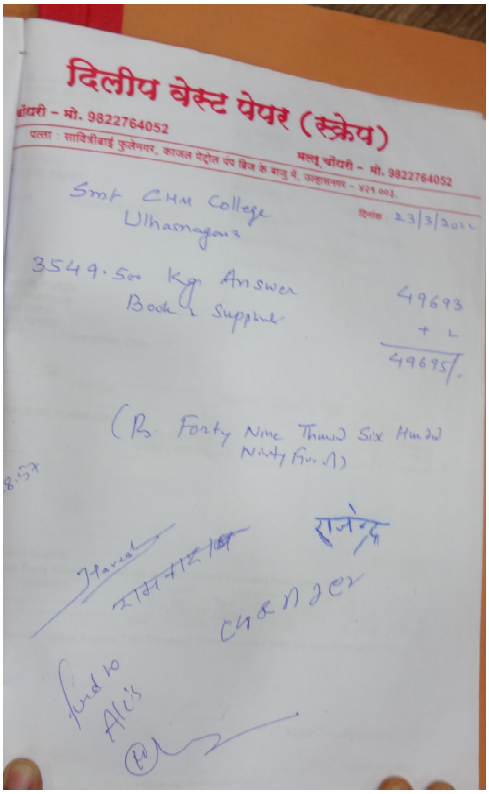
Authorized Signatory

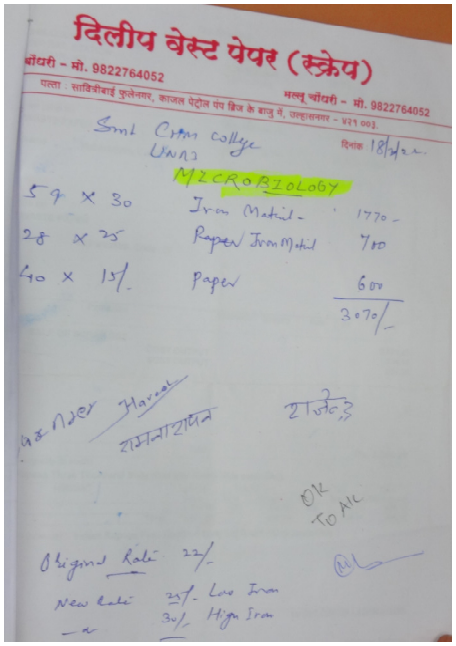
For and on behalf of
ECO FRIEND INDUSTRIES

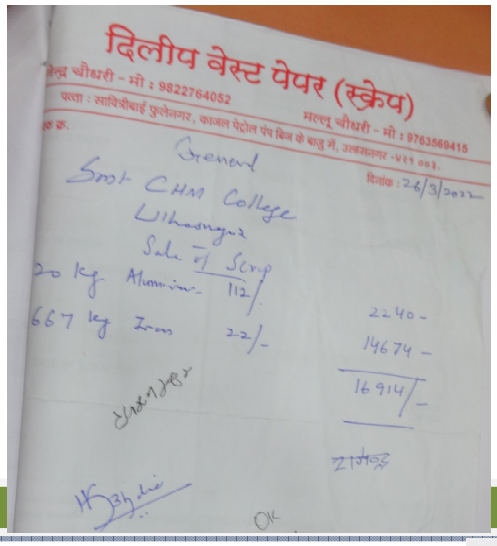
b. Bills of paper trash.



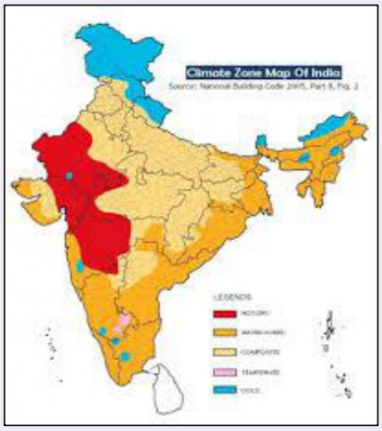








G. Energy benchmarks for Commercial Buildings



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

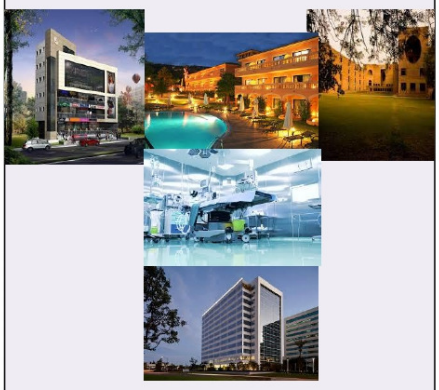
Climate Zone	EPI (kWh/m²/yr)
Warm & Humid	150
Composite	117
Hot & Dry	106
Moderate	129

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

H.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

IOT based monitoring

Ecolibrium Energy

IOT powered Asset Intelligence Software
Contact: Bhavesh Bhatt
Mobile: 9833821814
Email: bhavesh.bhatt@ecolibrium energy.com

I. Unitary AC Operation, Inspection and Maintenance Guidelines

INSTALLATION

1. Outdoor Unit of Split Unit should be located such that it has free flow of air for heat rejection
2. Safety protocol to be followed as per the OEM guidelines
3. Earthing to be properly provided to the Unit
4. Checking the Voltage Supply levels (Phase to Neutral 230 Volts, Phase to Earth 230 Volts, Neutral to Earth ≤ 0.5 -1 Volts
5. Electrical Compartment should be properly closed to avoid water ingress at the Electrical connections at the Outdoor Unit
6. Indoor Unit to be located to ensure free flow of air and proper circulation for effective cooling
7. Condensate Water Drain from Indoor Unit to be properly provided with adequate slope for water to drain off by gravity
8. Water drain to have proper Water Seal to avoid foul smell entering the conditioned space
9. Proper Insulation of Refregerant Lines (To & From Indoor & Out door Unit) to be provided.
10. Insulation material's protection by Tape or Aluminium thin foil is highly desirable for longevity of Insulation
11. Window AC's Condenser should be installed such that it has free flow of air for heat rejection
12. Ensure Proper Sealing of Conditioned spaces @ Window Sills, Glass Panes etc.
13. Double Glazed Units (DGU) are highly desirable for Windows. If not posssible to changeover, Install Heat resistant Films on the Existing Glass panes.
14. Roofing material should exhibit Good Thermal Resistance proprerties. (Insulation to be provided at the Roof)
15. Heat Gain through Glazing and Roof can have significant contribution towards

Energy Consumption of the AC.

OPERATIONS

1. Every 1° C lowering of Room Temperature set point, results in 3-5% increase in Energy Consumption
2. Ideal Room Temperature Set point @ 25° C
3. Energy savings can be achieved by Increasing Set point to 26° C and operate Ceiling Fan at lower Speed.
4. Ceiling Fans to be of BLDC (Brushless Direct Current) technology with offers @ 50% energy saving as compared to Conventional Fans.
5. Install 'Energy Saver' having features viz. 'High Accuracy Thermostat' (± 1° C) control and Artificial Intelligent Microprocessor Controller.
6. Incase of multiple Units (Split/Window) in the premise, there are New Technological innovations on Demand Side controls resulting in Energy Savings.
7. Filters: Clean Filters has potential of Energy Savings @ 5%
8. Covid situation warrants great care on Filter cleanliness management.
9. Filters offering microscopic filteration properties are also available, proper evaluation to be done for a retrofit job.

INSPECTIONS

1. Condenser Coil (Outdoor Unit of Split AC / Window AC external facing portion)

a. Check the condition of Coils at regular intervals. It should be clear of 'fouling materials' eg. Dust, dirt, leaves etc.

b. Ideal Frequency of Checking should be Monthly. It may be decided upon depending on the Location and weather conditions

2. Evaporator Coils (Indoor Unit of Split AC / Window AC internal facing portion)

a. Check the condition of Coils at regular intervals. It should be clear of 'fouling materials' eg. Dust, dirt, leaves etc.

b. Ideal Frequency of Checking should be Quarterly. It may be decided upon depending on the Location and weather conditions

3. Filters @ Evarporator Coils

a. Frequency of Check: Monthly or depending on the Usage and location

b. Dry / Wet cleaning has to be determined as per the site condition requirement

c. Replace the Filters as per OEM's guidelines

d. Never operate the AC without Filter

4. Fan Motor

a. Frequency of Check : Quaterly / Six monthly depending on the Usage.

b. Check for Freeness of the Fan

c. Clean the Dust accumulated on the Fan Blades

d. Check for Vibration & Noise level

e. Fan Mounting bracket's condition

f. Wiring and Termination at the Motor

5. Compressor

a. Frequency of Check : Quaterly / Six monthly depending on the Usage.

b. Check for Vibration and Noise level

c. Check for Wires & its Terminal point

d. Check for Capacitor Condition. (If found bulging on sides or Top, replace it immedeately. Capacitors have been source of fire in ACs)

e. Check for cleaninliness @ surrounding area

6. Refrigerant & Refrigerant Piping

a. Frequency of Check : Annual

b. Check for Refrigerant Piping Condition

c. Harnessing of the Piping

d. Insulation over the Piping Condition

7. Drain Pan

a. Frequency of Check : Monthly / Quaterly depending on the Usage.

b. Drain Pan should be clear of Water accumulation

c. Check the outflow water point @ drain pan for clogging.

d. Outflow Pipe from the Drain to be properly in place.

8. Performance Check

a. After Regular Checks / Servicing monitor the following

i. Grill Temperature

ii. Time required to attain the Temperature Set point

iii. Start / Stop of Compressor w.r.t the Set Point

iv. Current / Power drawn by the Fan Motor

v. Current / Power drawn during starting of the Compressor and steady state operation

MAINTENANCE

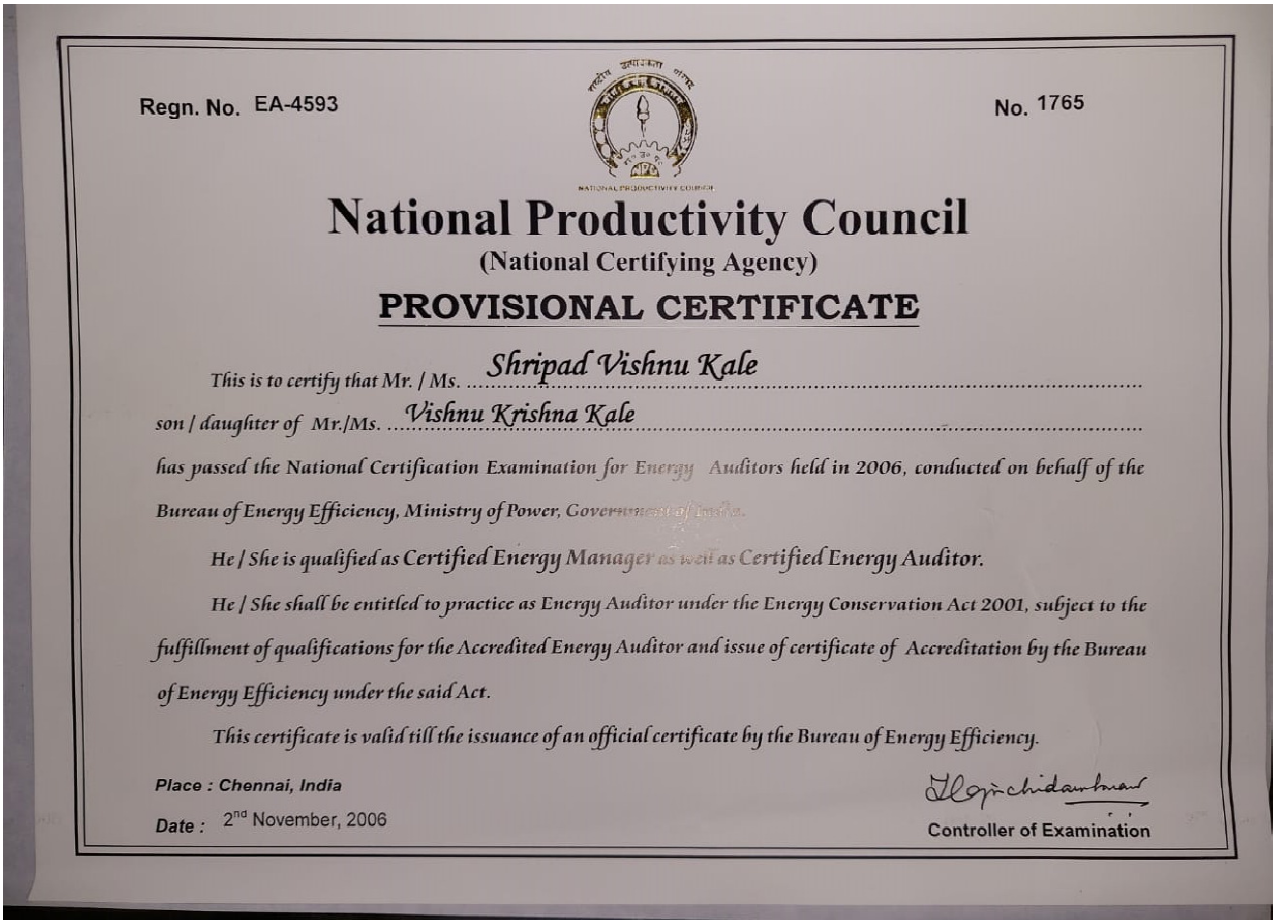
1. SAFETY FIRST: SWITCH OFF THE POWER to the Unit, Lock Out & Tag Out (LOTO) the Supply Point to the Unit

2. Servicing to be done by Authorised Personnel

3. Post Maintenance the Unit needs to be Operated for One cooling cycle to demonstrate its performance

4. Proper Records with Historical Information on Faults attended, Parts replaced, Checks Performed etc.

J. 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.

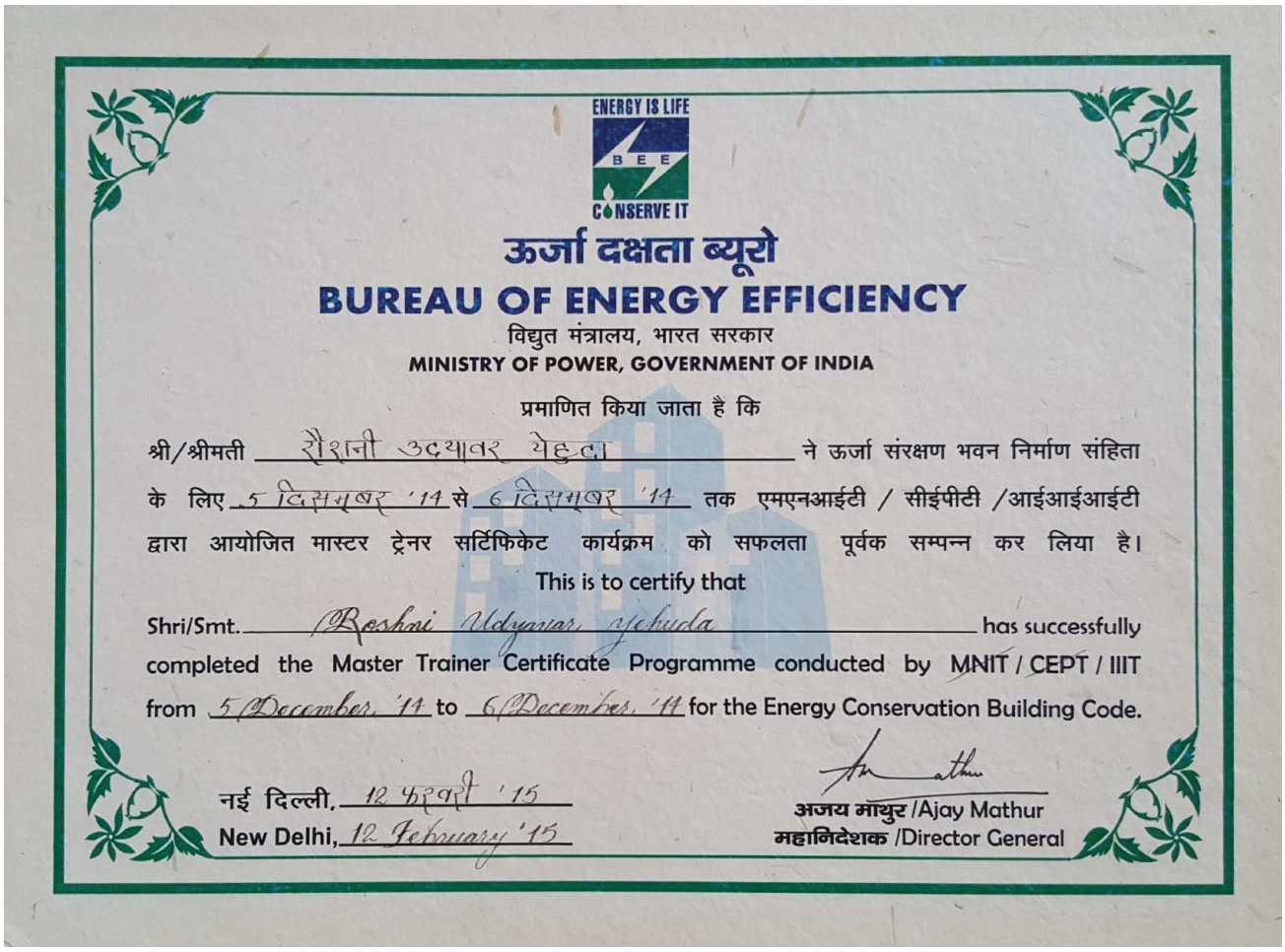
This certificate is valid till the issuance of an official certificate by the Bureau of Energy Efficiency.

Place : Chennai, India

Date : 2nd November, 2006

Controller of Examination

K. BEE Master Trainer Certificate



ENERGY IS LIFE
BEE
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 '14 से 6 दिसम्बर '14 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 '14 to 6 December '14 for the Energy Conservation Building Code.

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

अजय माथुर /Ajay Mathur
महानिदेशक /Director General

L. BEE Empaneled Expert professional

ENERGY IS LIFE
CONSERVE IT

ऊर्जा दक्षता ब्यूरो
(भारत सरकार, विद्युत मंत्रालय)

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

SPEED POST

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

M. Renewable Energy Mashav Course Certificate