GREEN, ENERGY AND ENVIRONMENT AUDIT REPORT OF

CITY ENGINEERING COLLEGE

Bangalore, Karnataka

EXECUTED BY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
&
DEPARTMENT OF MECHANICAL ENGINEERING

INDUSTRY- INSTITUTE PARTNERSHIP CELL

CENTRE OF EXCELLENCE IN ENERGY STUDIES

KONGU ENGINEERING COLLEGE

PERUNDURAI
ERODE – 638 060
TAMILNADU

May 2024

Acknowledgement

The Industry Institute Partnership Cell (IIPC) of Kongu Engineering College (KEC) expresses the gratitude to the Management of **City Engineering College, Doddakallasandra, Off Kanakapura Road, Next to Gokulam Apartment, Bangalore - 560 062** for providing an opportunity to conduct Environment, Green and Energy audit inside their college premises. The KEC Energy Audit team wishes to thank **City Engineering College,** Bangalore, Karnataka for giving them the opportunity to carry out the energy audit in their institution and for providing all support to the team during the audit. We extend our thanks to **City Engineering College,** Principal, HODs, IQAC team, NAAC coordinators, other Faculty members from various department and the Electrical Maintenance team for their support and for providing various information enabling the successful completion of the audit , which has facilitated the submission of this report.

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S.NO

1.	EXECUTIVE SUMMARY

City Engineering College had agreed to provide access to Kongu Engineering College to undertake Environmental/Green and Energy Audit related measurements at their campus. This Audit has been conducted by a team of faculty members from Mechanical and Electrical Engineering Department of Kongu Engineering College. As there is no standard model for such an audit, the committee brainstormed and evolved a questionnaire. The data was collected, compiled and was finally analyzed by the audit team members. The remaining data which involved measurement using sophisticated instruments were done by the audit team members. By and large, the audit reveals a healthy environment in the campus. The committee has made short term and long-term suggestions to protect environment at higher levels and it is hoped that this will receive due attention of authorities and all stakeholders of the College.

1.1 ABOUT THE INSTITUTION

City Engineering College (CEC), established under Jayanagar Education Society by Dr K.R Paramahamsa, Chairman in the year 2001. CEC is one of the most sought colleges by students from across the country for Engineering and Management Education. The college believe in providing a high-quality education to the prospective professionals of the country for which necessary quality bench marks have been put in place, in the areas of faculty recruitment, training and development, teaching and learning process, student's grooming, external academic audits and feedback system for academic enhancement.

College offers 9 UG courses, 03 PG courses and PhD programmes across various disciplines. In addition to its academic offerings, CEC actively promotes research and innovation through dedicated research centers and initiatives that encourage students and faculty to engage in cutting-edge projects. The college also boasts a strong placement and training cell, providing students with extensive career counseling, industry interactions, internships and job placement opportunities.

2.	OBJECTIVES OF THE AUDIT STUDY

The goals of the present environmental/green and energy audits typically include:

- To recognize, diagnose and resolve the environmental problems.
- To recognize the effects of an organization on the environment and vice versa.
- To suggest the best protocols for sustainable development of organization and environment.
- To assess environmental performance and the effectiveness of the measures to achieve the defined objectives and targets.
- To identify the various pressures and influences on organizations that drive them to improve their environmental performance.
- To ensure that the natural resources are utilized properly as per national policy of environment.
- To establish the parameters for maintaining health and welfare of the community of the organization.
- To set the procedure for disposal of all types of harmful wastes.
- To reduce energy consumption.
- To give preference to the most energy efficient and environmentally sound appliances.
- To minimize the consumption of water and monitor its quality.
- To identify the risks of hazards and implement the policies for safety of stakeholders.
- To facilitate the stakeholders with different aspects of disaster management.
- To train all stakeholders of the organization and empower them to contribute and participate in the environmental protection.

To achieve the mentioned objectives, following stages are implemented. It includes three stages viz. pre-audit stage, audit stage and post-audit stage. Each of these stages comprises a number of clearly defined objectives, with each objective to be achieved through specific actions and these actions yielding results in the form of outputs at the end of each stage.

3.	INTRODUCTION TO ENVIRONMENTAL/GREEN AUDIT

The various activities carried out in the academic institutions affects the environment in which it is situated. To address the issues, the institutions can successfully use auditing strategies to monitor their environmental-energy related activities. An "environmental audit" is a "systematic, documented, periodic and objective review to meet environmental requirements". Although environmental audits may be performed in many ways for different purposes, the reasons for performing an audit and the goals to be achieved will determine the type of environmental audit to be performed. Green audit is the tool of management system used methodologically for protection and conservation of the environment. It is also used for the sustenance of the environment. The audit suggests different standard parameters, methods and projects for environmental protection. The green audit is useful to detect and monitor sources of environment pollution and it emphasizes on management of all types of wastes, monitoring of energy consumption, monitoring of quality and quantity of water, monitoring of hazards, safety of stakeholders and even the management of disasters.

Figure 1. Green Campus

3.1 WATER MANAGEMENT

The college has adequate provisions for water storage. Bore-wells is used as the source of water. Recharging of ground water and rainwater harvesting are implemented by the college thereby conserving the water from its inception. This recharging and harvesting has been very

helpful to augment the ground water. RO is installed in the campus with the capacity of 250 LPH for satisfying the drinking needs. Grey water from the RO plant is used for irrigating the garden. The administration takes much efforts to save water. This can be seen from the slogans placed at most of the places.

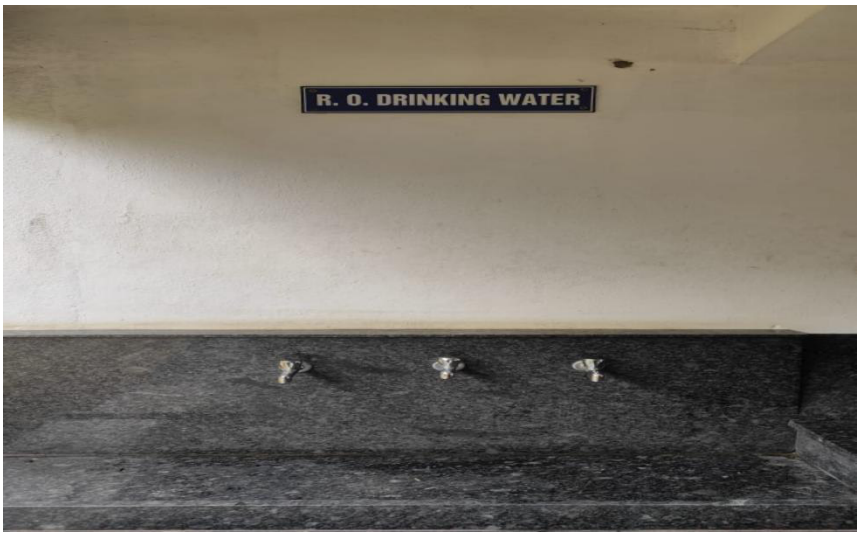

Figure 2. RO Drinking Water

(a) **(b)**

Figure 3. Rainwater Harvesting System

3.2 SOLID WASTE MANAGEMENT

The campus is cleaned on daily basis. Waste bins are placed in corridors, office and staff rooms. The waste generated in the campus includes wrappers, glass, metals, paper, etc. Old newspapers, used papers, files, etc. are given for recycling to external agencies. Glass, metals and other non-biodegradable wastes are given to external agencies where they are segregated and disposed/ recycled according to the nature of the waste. Non-biodegradable and plastic wastes are disposed by Municipal collection centre. Slogans placed at appropriate places help students understand the importance of food and impact of plastics. Bio degradable wastes are decomposed using composite pit and used as manures.

(a) **(b)**

Figure 4. Bio degradable waste collection

3.3 LIQUID WASTE MANAGEMENT

Sewage, Laboratory and canteen effluent waste are the major liquid waste. Effective drainage system is found in all buildings for managing sewages. The laboratory waste water does not contain hazardous chemicals and periodical monitoring is done by the maintenance team. The college will be strict on the source reduction of chemical waste. Laboratories purchase only the chemicals they need, ensuring minimal waste and efficient use of resources.

3.4 E WASTE MANAGEMENT

Electronic goods are put to optimum use; the minor repairs are set right by the Laboratory assistants and teaching staff; and the major repairs are handled by the Technical Assistant and are reused. UPS Batteries are recharged / repaired / exchanged by the suppliers. E-waste like non-functional computers, equipment's and the other metal and wood waste are periodically collected by third party vendor for recycling.

3.5 GREEN COVER

The college is occupied with nearly 128 trees. Apart from that, the college's botanical garden also cultivates a variety of rare and medicinal plants, along with organic vegetation. This green cover helps in reducing CO2 levels in and around the vicinity of the campus.

Figure 5. Green Cover in the campus

3.6 TRANSPORTATION

The college provides four buses for transportation. Most students use public local transportation, such as buses, the metro, auto-rickshaws and cabs, for their commute. Faculty members also use a mix of personal vehicles and public transportation. The widespread use of shared transportation options helps reduce CO_2 emissions associated with fuel usage from individual vehicles.

Figure 6. Shaded Parking

3.7 BASIC AMENITIES

The campus is equipped with essential amenities, including a cafeteria, pedestrian pathways, a bank ATM and sport facilities for students and staff. Additionally, to create a barrier-free environment, the buildings are accessible with ramps, lifts, and PWD toilets, catering to the needs of physically challenged students, the elderly individuals and those with disabilities.

Figure 7. Basic Facilities

3.8 GREEN EDUCATION

Events related to green practices are organized frequently through students and staff associations. National Service Scheme (NSS) unit is actively functioning in the institution and contributes towards inculcating green practices among the students and staff.

4.	INDOOR AIRQUALITY

Indoor air quality (IAQ) refers to the quality of the air inside buildings as represented by concentrations of pollutants and thermal (temperature and relative humidity) conditions that affect the health and performance of occupants. It has become one of the most important issues of environment and health worldwide considering the principle of human rights to health that everyone has the right to breathe healthy indoor air. With the help of Indoor Air Quality meter (Extech EA80), CO_2 level, relative humidity and dry bulb temperatures can be measured. The measurements are carried out based on the protocol given by Central Pollution Control Board, Ministry of Environment and Forests, Govt. of India and the norms are discussed briefly in the subsequent sections. Indoor air quality test was carried out at different locations of the institution. Carbon dioxide levels are within the ASHRAE 55-1992 limit in the outdoor and indoor. The instrument used in the present audit was Extech Make EA80 Model of Indoor air quality meter. The range of the instrument is given below

CO_2 range : 0 to 6,000ppm
Temperature range : -4 to 140°F (-20 to 60°C)
Humidity range : 10 to 95%RH

Figure 8. Indoor air quality meter

4.1 AIR QUALITY MEASUREMENTS

Table 1. Air Quality Measurements

			ASHRAE and OSHA standards: 1000 ppm		
Standard Level of Relative Humidity			**30 – 60 % (ASHRAE)**		
Standard Level of Temperature			**26 - 30°C ±3°C (ASHRAE)**		
S.No.	**Location**	**CO_2 Level (ppm)**	**Relative Humidity (%)**	**Temperature (°C)**	**Comments & Recommendation**
Admin Block					
1.	Chemistry lab	320	83.1	24.1	Within the limits
2.	Sports Room	324	82.9	24.2	Within the limits
3.	1st Floor- Class room	331	82.7	24.6	Within the limits
4.	2nd Floor-ECE Lab	329	83.2	24.1	Within the limits
5.	2nd Floor – Class room	327	82.6	24.2	Within the limits
6.	3rd Floor- Class room	330	83.5	24.5	Within the limits
7.	4th floor- Class Room	329	82.5	24.7	Within the limits
8.	5th Floor -Auditorium	325	82.4	24.5	Within the limits
9.	5th Floor -Library	341	82.7	24.1	Within the limits
C Block					
10.	Staff Room	324	83.4	23.8	Within the limits
11.	Laboratory C008	326	83.2	23.5	Within the limits
12.	1st Floor DAA Lab	325	82.9	23.9	Within the limits
13.	1st Floor Python lab	331	82.8	24.1	Within the limits
14.	1st Floor Faculty room	328	82.7	24.2	Within the limits
15.	2nd Floor Faculty room	327	82.8	24.3	Within the limits
16.	2nd Floor Seminar hall	328	82.6	24.1	Within the limits
17.	4th Floor Class room	326	82.5	24.2	Within the limits
18.	5th Floor Computer science laboratory	325	81.9	24.3	Within the limits

4.2 COMFORT LEVEL

Discomfort can be caused to the occupants due to

- Inadequate ventilation
- High temperature and humidity levels
- High levels of CO_2

Ventilation should be distributed effectively in spaces, and stagnant air zones should be avoided. ASHRAE recommends relative humidity levels between 30 and 60 percent for optimum comfort. Higher humidity may result in microbial growth. A consistently implemented good-housekeeping plan is essential to eliminate or reduce the microbial growth in the building.

Damp indoor environments have been associated with many serious health effects, including asthma, hypersensitivity, and sinusitis. Moisture incursion leading to dampness can result from water leaks and/or by condensation due to high humidity. Common sources of moisture in buildings include: plumbing; roof and window leaks; flooding; condensation on cold surfaces, e.g., pipe sweating; poorly-maintained drain pans; and wet foundations due to landscaping or gutters that direct water into or under the building. Well-designed, well-constructed and well–maintained building envelopes are critical to the prevention and control of excess moisture and microbial growth by avoiding thermal bridges and preventing intrusion by liquid or vapor-phase water. Management of moisture requires proper control of temperatures and ventilation to avoid high humidity, condensation on surfaces, and excess moisture in materials.

CO_2 is a colourless, odourless, and tasteless gas. It is a product of completed carbon combustion and the by-product of biological respiration. ASHRAE states that CO_2 concentrations in acceptable outdoor air typically range from 300-500 ppm. Adverse health effects from CO_2 may occur since it is an asphyxiate gas. The CO_2 levels can be used as a rough indicator of the effectiveness of ventilation, and excessive population density in a structure. CO_2 increases in buildings with higher occupant densities, and is diluted and removed from buildings based on outdoor air ventilation rates. Therefore, examining levels of CO_2 in indoor air can reveal information regarding occupant densities and outdoor air ventilation rates. High CO_2 levels may indicate a problem with overcrowding or inadequate

outdoor air ventilation rates.CO_2, a by-product of normal cell function, is removed from the body via the lungs in the exhaled air. Exposure to high levels of CO_2 can increase the amount of this gas in the blood, which is referred to as *Hypercapnia* or *Hypercarbia*. As the severity of hypercapnia increases, more symptoms ranging from headache to unconsciousness appear, and it can also lead to death.

The traditional means of dealing with IAQ is through ventilation with outdoor air, but this approach assumes that the outdoor air is cleaner than the indoor air. In many locations and for many contaminants, this is not the case, and insufficiently treated ventilation air can actually make IAQ worse. Poor outdoor air quality includes regionally elevated outdoor contaminant levels, as well as local sources such as motor vehicle exhaust from nearby roadways and contaminants generated by activities in adjacent buildings. Some green building programs recommend across-the-board increases in ventilation rates, but such recommendations may be counterproductive in areas with poor outdoor air quality unless accompanied by appropriate and effective increases in filtration and air cleaning.

4.3 INFERENCES

- Carbon-di-oxide levels are within the ASHRAE 55-1992 limit in the outdoor and indoor. For indoor condition, CO_2 level should be less than 1000 ppm. CO_2 levels are well within the limits in all places.
- ASHRAE recommends relative humidity levels between 30 and 60 percent for optimum comfort. The humidity is within the limit in most of the places. The buildings are well planned and natural circulation of air is felt in all places.
- The average ambient temperature in the campus is found to be 32°C.
- Tree plantation is highly promoted and it is evidenced through the presence of trees in many areas where buildings have not been constructed.
- Awareness programmes on environmental consciousness are organized and it is evidenced through the student participation in the respective activities.

5.	LIQUID AND GASEOUS FUEL CONSUMPTION

The "City Engineering College" in Bangalore minimizes liquid and gaseous fuel consumption by operating only four college buses and not having a hostel. This results in significantly lower usage of diesel and LPG, reducing carbon emissions and fostering a more eco-friendly environment. The limited reliance on fuel-driven transportation and cooking aligns with sustainable practices, promoting the use of public transport and local amenities. This approach reflects the college's dedication to environmental responsibility and operational efficiency.

The table 2 displays Diesel Consumption and expenditure on diesel for transport during the academic year 2023-2024.

Table 2. Diesel Consumption details for generator

S.NO	Month	Total Diesel Consumption by Generator in Litres	Total Expenditure on Diesel for Generator in Rupees
1	June 2023	74	6,502.38
2	July 2023	12	1,054.44
3	August 2023	32.5	2,855.775
4	September 2023	41.5	3,646.605
5	October 2023	134.5	11,818.515
6	November 2023	-	-
7	December 2023	45	3,954.15
8	January 2024	2.5	219.725
9	February 2024	5.3	465.817
10	March 2024	24.5	2,154.285
11	April 2024	6.5	571.545
12	May 2024	4.5	386.685

Diesel Consumption by generator for the academic year 2023-2024 is depicted in the figure 9.

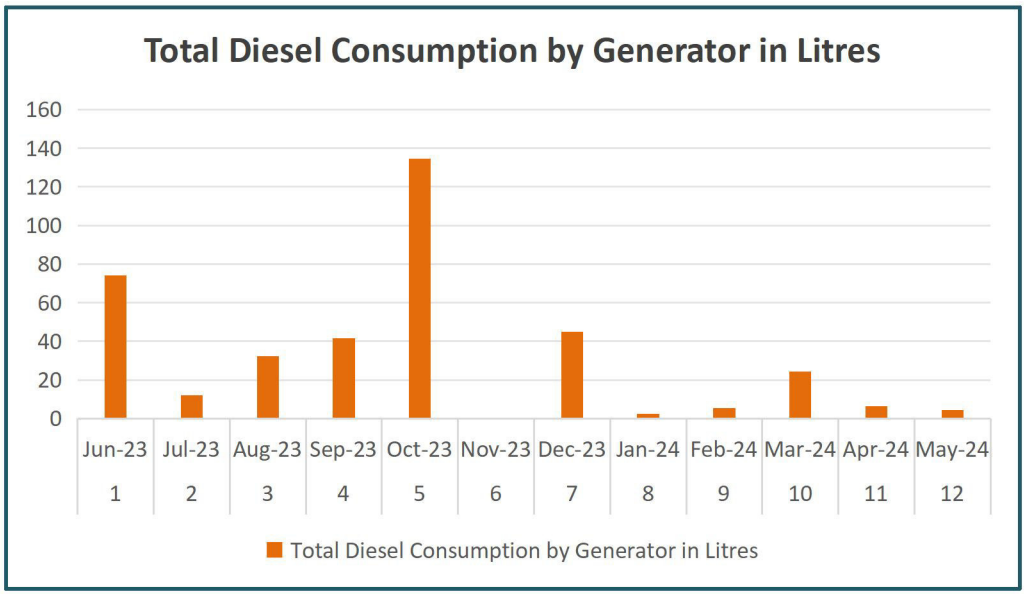

Figure 9. Total Diesel Consumption by Generator in Litres

Figure 10 illustrates the expenditure on Diesel Consumption by the generator for the academic year 2022-2023

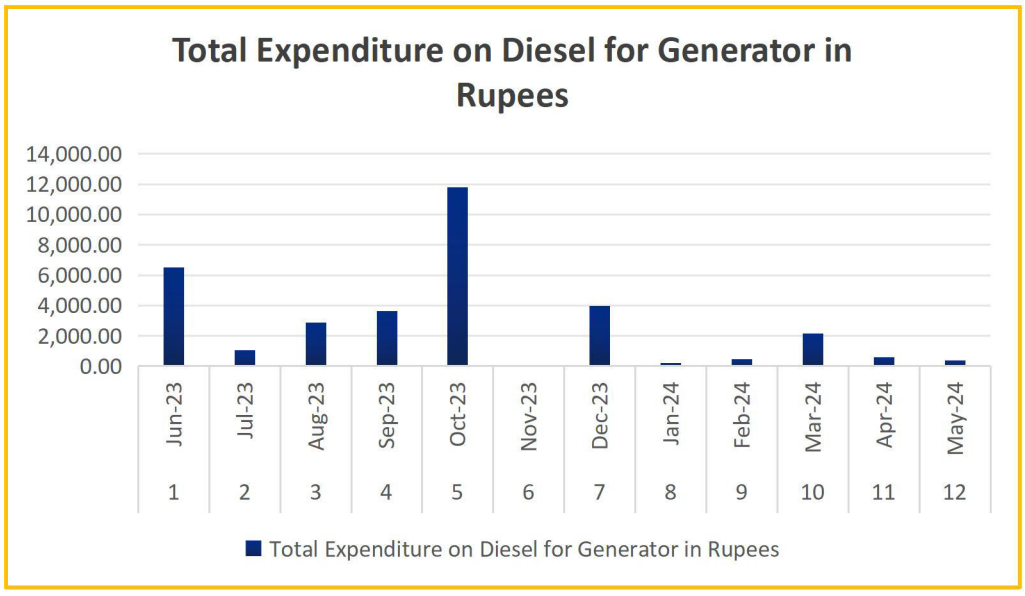

Figure 10. Amount Spent in Rupees on Diesel for Generator

The table 3 provides data on Diesel Consumption and expenditure for transport during the academic year 2023-2024

Table 3. Total Diesel Consumption details for Transportation

S.NO	Month	Total Diesel Usage for Transportation (in Litres)	Total Cost of Diesel for Transportation in rupees
1	June 2023	307.24	27,000
2	July 2023	448.78	39,439
3	August 2023	338.50	29,747
4	September 2023	385.30	33,860
5	October 2023	299.40	26,311
6	November 2023	182.07	16,000
7	December 2023	266.49	23,419
8	January 2024	206.76	18,170.38
9	February 2024	233.46	20,516.09
10	March 2024	289.13	25,066.70
11	April 2024	54.71	4,701.23
12	May 2024	157.66	13,547.64

Diesel Consumption for transport for the academic year 2023-2024 is depicted in the figure11.

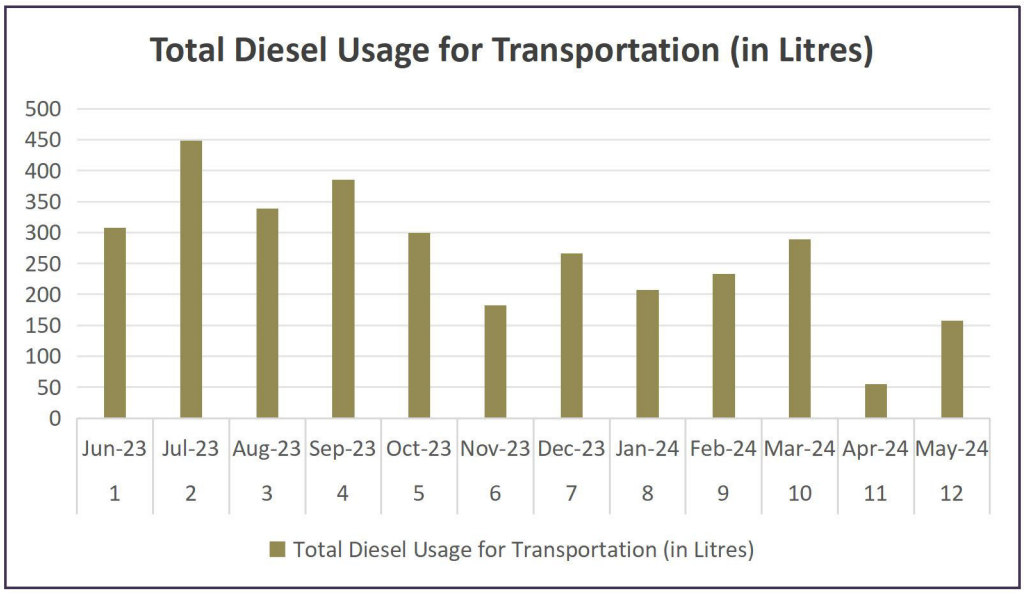

Figure 11. Total Diesel Usage for Transportation

Amount spent on Diesel Consumption for transport for the academic year 2023-2024 is depicted in the figure 12.

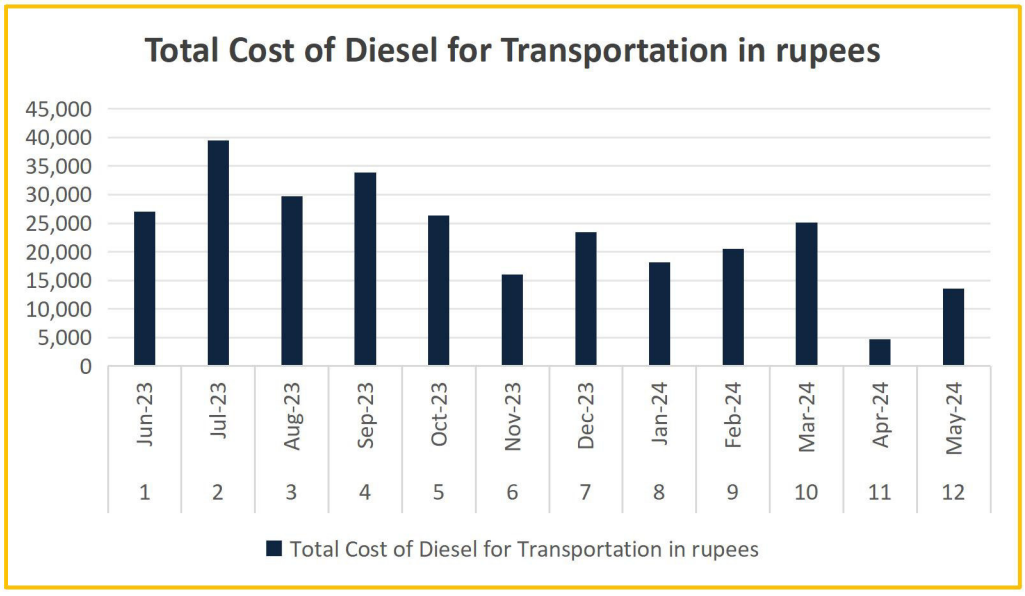

Figure 12. Total Cost of Diesel for Transportation in Rupees

6.	ENERGY AUDIT

6.1 INTRODUCTION

An energy audit is an examination of the total energy used in a particular building or industry. The analysis is designed to provide a relatively quick and simple method of determining not only how much energy is being consumed but where and when. The energy audit will identify deficiencies in operating procedures and in physical facilities. Once these deficiencies have been identified, it will be apparent where to concentrate efforts in order to save energy. The energy audit is the beginning of and the basis for an effective energy-management programme. Human settlements encompass a variety of buildings. Regardless of the building involved, the audit procedure is basically the same. No two buildings are identical regarding energy usage. This is due to the possible variables affecting the buildings, e.g., occupancy rates, the building's size and orientation, its geographic location, the type of heating and cooling systems, the amount and types of equipment in use, the type of construction, the level of insulation and so on. Because each building is unique, it is difficult to generalize about energy-consumption patterns, and so it is necessary to conduct an energy audit for each building. This energy audit is aimed at obtaining a detailed idea about the various end use energy consumption activities and identification, enumerating and evaluating the possible energy saving opportunities.

6.2 ELECTRICITY CONSUMPTION

The energy audit is aimed at obtaining a detailed idea about the various end use energy consumption activities and identification, enumerating and evaluating the possible energy saving opportunities. It is a customary practice to conduct Energy audit every year in the Institute in order to estimate the energy consumption pattern. The present level of energy consumption of the institution has been analyzed, averaged by collecting utility bills from june 2023 to May 2024. The same is detailed in this report.

Table 4 presents a comprehensive breakdown of electric energy consumption over the period from June 2023 to May 2024. The table details the monthly usage in kilowatt-hours (kWh), highlighting any fluctuations or trends that occurred throughout the academic year. This data serves as a vital reference for understanding the consumption patterns and guiding future energy management strategies. By analyzing this information, stakeholders can identify areas for potential efficiency improvements and implement measures to optimize electric energy usage in the future.*

Table 4: Electric Energy Consumption details from June 2023 to May 2024

Academic Blocks			
S.NO	**Month**	**Total Electrical Units Consumed (kWh)**	**Amount Spent on Electricity in Rupees**
1	June 2023	11,124	1,38,785.00
2	July 2023	10,976.5	1,34,472.00
3	August 2023	10,691.5	1,22,031.00
4	September 2023	9,783.98	1,12,031.00
5	October 2023	10,660.9	1,13,104.00
6	November 2023	11,091.5	1,15,140.00
7	December 2023	11,257.03	1,08,261.00
8	January 2024	10,791.99	1,11,118.00
9	February 2024	10,956.54	1,11,663.00
10	March 2024	22,920.44	2,20,988.00
11	April 2024	11,634.00	2,34,925.00 *
12	May 2024	12,629.00	1,10,749.00
* Include arrears			

The Figure 13 illustrates the overall electric energy consumption, measured in kilowatt-hours (kWh), over a specified period. By depicting the total units consumed, this graph provides a clear visual representation of the energy usage trends and patterns.

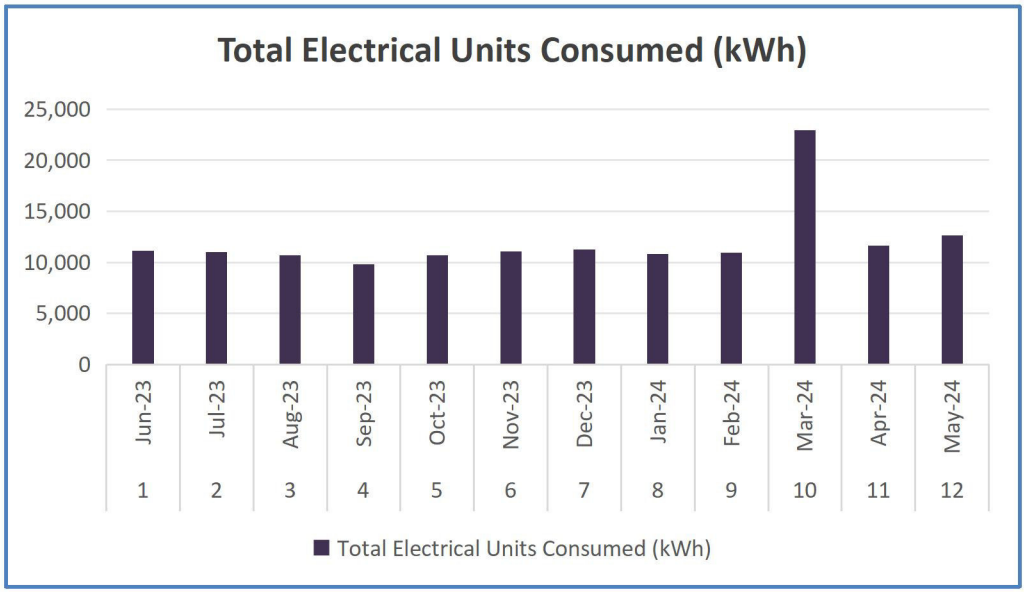

Figure 13. Total Electrical Units Consumed (kWh)

The figure 14 provides a visual representation of the expenditure on electricity, denoted in Indian Rupees (Rs.), over a specific period.

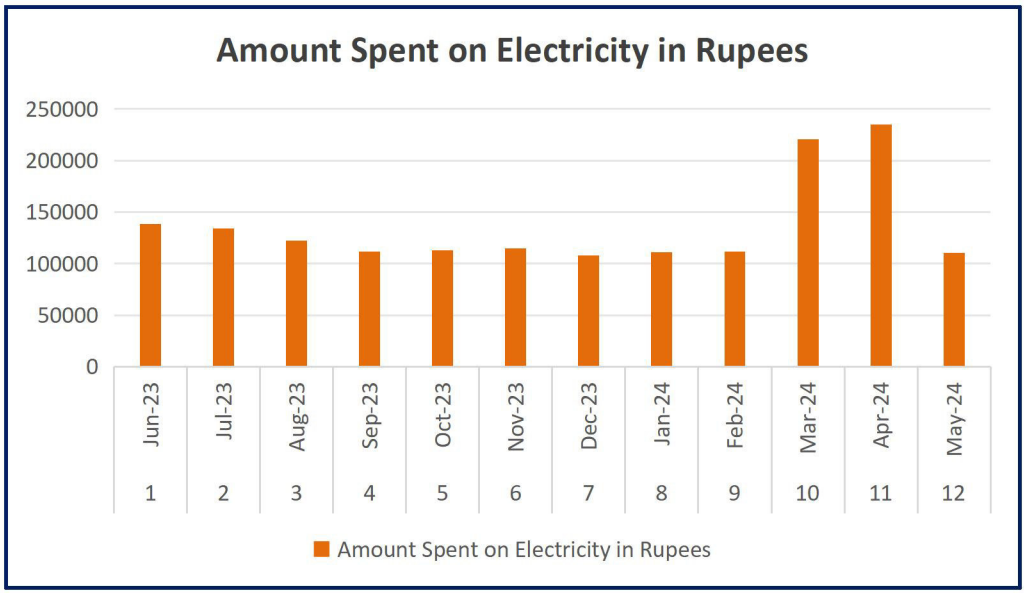

Figure 14. Amount Spent on Electricity in Rupees

7.	CARBON FOOTPRINT AND TOTAL ENERGY CONSUMPTION

Carbon footprint Carbon foot print is the total amount of Green House Gases (GHGs) emitted in terms of carbon dioxide by a person, institute, company, state or country. Carbon footprint is typically given in tons of CO_2 equivalent per year. For calculation of carbon foot print the basic data regarding direct and indirect sources of emission of Green House Gases is needed. How we get around and commute to and from college each day has an impact on the environment through the emission of greenhouse gases into the atmosphere by the burning of fossil fuels (such as petrol). The most common greenhouse gases are carbon dioxide, water vapour, methane, nitrous oxide and ozone. Of all the greenhouse gases, carbon dioxide is the most prominent greenhouse gas. The release of carbon dioxide gas into the Earth's atmosphere through human activities is commonly known as carbon emissions. A matured tree absorbs about 22 to 40 kg of CO_2 per year.

Table 5: CO_2 Emissions and Total Energy Consumption

S.No.	Description	Type of fuel and their conversion process	
		Electrical energy consumed	**Diesel**
1	Annual Energy Consumption	144517.38 kWh	3552.3 lit
2	CO_2 Emission standards	0.95 kg/kWh	2.68 kg/lit
3	Total CO_2 emission(tonne/Annum)	146.812 tonnes	
4	Total No. of students and staff	1334	
5	Per capita CO_2 emission per year	0.11 tonne (+)	
6	No. of Matured Trees	116	
7	CO_2 neutralised due to matured trees (tonne/Annum)	2.55 tonnes	
8	CO_2 to be neutralised per capita per	0.108 tonnes(-)	

8.	ENERGY SAVING OPPORTUNITIES

8.1 Lighting:

Table 6: Sample calculation for energy saving

DESCRIPTION	FTL FITTINGS	LED FITTINGS
	40W	**18W**
No. OF FITTINGS	100	**100**
WATTS	40	**18**
TOTAL WATTS	4000	1800
CONSUMPTION UNITS PER DAY	40.000	**18.000**
RUNNING COST PER DAY	272.00	**122.40**
SAVINGS LED INSTEAD OF FTL IN WATTS	2200	
UNITS SAVINGS PER DAY	22.000	
UNITS SAVINGS PER MONTH	**550.000**	
RUNNING HOURS PER DAY	10	
PRESENT KSEB UNITS COST Rs.	6.80	
COST SAVINGS PER DAY Rs.	149.60	
COST SAVINGS PER MONTH Rs.	**3740.00**	
LED LIGHT FITTING TOTAL EXPENSES Rs. (100*Rs.650)	**65000.00**	
COST RETURN PERIOD IN DAYS	434	
COST RETURN PERIOD IN MONTHS	14.48	
COST RETURN PERIOD IN YEARS	**1.19**	

8.2 Fan:

Table 7.Sample calculation for energy saving

DESCRIPTION	NORMAL FAN	**BLDC FAN**
	80W	**30W**
No. OF FITTINGS	100	**100**
TOTAL WATTS	8000	**3000**
CONSUMPTION UNITS PER DAY	80.000	**30.000**
RUNNING COST PER DAY	544.00	**204.00**
SAVINGS BLDC INSTEAD OF NORMAL FAN IN WATTS	5000	
UNITS SAVINGS PER DAY	50.000	
UNITS SAVINGS PER MONTH	**1250.000**	
RUNNING HOURS PER DAY	10	
PRESENT KSEB UNITS COST Rs.	6.80	
COST SAVINGS PER DAY Rs.	340.00	
COST SAVINGS PER MONTH Rs.	**8500.00**	
BLDC FAN TOTAL EXPENSES Rs. (100*Rs.3250)	**325000.00**	
COST RETURN PERIOD IN DAYS	956	
COST RETURN PERIOD IN MONTHS	31.86	
COST RETURN PERIOD IN YEARS	**2.62**	

8.3 Air Conditioner:

Table 8. Sample calculation for energy saving

Model	Star Rating	EER	Cooling Capacity	Power Consumption (Watts/Hr)	No. of Watts saved / Hr to 0 Star Level	No. of Units saved / 8 Hr.	**Savings (Rs / Yr) (300Days)
Split AC	5 Star	3.59	6212	1732	1268	10.1	19240
Split AC	3 Star	3.12	6044	1938	1062	8.5	16192
Split AC	2 Star	3	6610	2210	791	6.3	12001

(Actual may vary)

- **Raising AC setting by 1° can save 6% power**
- **Typically the temperature is set at 20-21 degree Celsius, whereas, the comfort number is 24-28 degree Celsius.**
- **A change from 20 degree Celsius to 24 degree Celsius, has the potential to save about 24 per cent of power.**

9.	BEST PRACTICES

- Energy is conserved by using natural light in the classrooms.
- LED bulbs and CFLs are used in all possible locations as an energy conservation measure.
- A training program on Energy Conservation, Environmental Impacts and Fuel Savings is conducted for students, staff and faculty members by external agencies.
- Solar street lights are installed throughout the campus to reduce energy consumption and promote sustainability.
- A 70 kW solar panel system is installed to generate renewable energy and further reduce the campus's reliance on conventional energy sources.

10	OBSERVATIONS, RECOMMENDATIONS AND GENERAL SUGGESTIONS

10.1 OBSERVATIONS

(i) Water saving plumbing fixtures may be provided in common utility areas

(ii) Energy saving air-conditioners may be purchased for new building expansion.

(iii) Programmes are being regularly conducted for planting saplings and creating awareness about efficient energy usage.

(iv) Water metering facility may be provided for monitoring the water consumption and planning for future.

(v) Natural ventilation and day lighting is used in many places.

(vi) An Internal Audit Team may be formed and an audit may be carried out six months once.

(vii) Grey water is used for gardening purposes. It can be used, but soil testing has to be done where the grey water is used. The grey water from RO plant has high alkalinity and it can reduce the percolation capacity of the soil. This can cause water logging problems in case of rain.

(viii) Diesel consumption in generator need to be recorded for every operation.

(ix) It is good practice of testing the Earth Electrode and maintaining the minimum Earth Electrode resistance at college campus area.

10.2 GENERAL SUGGESTIONS

1. Class rooms and laboratory's to display messages regarding optimum use of electrical appliances like lights, fans, computers in the room
2. All computers to have power saving settings to turn off monitors and hard discs, say after 10 minutes / 30 minutes.
3. The comfort air conditioning temperature to be set between 24˚C to 28˚C.
4. It is recommended to replace fluorescent light by LED whenever they get fused.
5. Vehicle pass may be issued as a sticker and that can be pasted in the vehicles belonging to Faculty, Staff and Students. This is to track the number of vehicles commuting inside the campus and to prevent the entry of unauthorized vehicles. This will help to find the percentage of institute population using own vehicles.
6. Safety precautions/ Warning signs need to be displayed near to the chemical storage points such as Chemistry Laboratories.
7. All Faculty and non-teaching staff should be made aware of common safety procedures and location of centralized facility like RO Plant, Rain water harvesting tanks, etc.
8. Responsibility chart (Name and In-charge) may be made available at RO, Gardening and Transport Offices/rooms as like in laboratories. This will be a first level of motivation and bring better attachment to towards institution.
9. Green, Environment and Energy Audits (internal) to be conducted every year, and progress can be analyzed by creating action taken report on the recommendations.
10. Switching to digital forms, electronic means of communication helps in avoiding paper wastage.
11. Eliminate or reduce paper processes by scanning paperwork that you produce or receive from others.
12. Instead of using several paper documents or records, compile important information into a shared, accessible folder in a Google Drive and keep it updated.

11	ANNEXURE

This section will include all the necessary documentation, such as:

1. **Energy Auditor Certificate**
2. **Green Auditor Certificate**
3. **Environmental Auditor Certificate**
4. **Accreditation Bodies Support Document**

Regn. No. EA-13164

Certificate No. 6461

National Productivity Council

(National Certifying Agency)

PROVISIONAL CERTIFICATE

This is to certify that Mr. / Ms. Logeswaran T

son / daughter of Mr. Thangamuthu

has passed the National Certification Examination for Energy Auditors held in October - 2011, 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 : 1st February, 2012

Controller of Examination

IGBC

Confederation of Indian Industry

The Indian Green Building Council

hereby certifies that

Logeswaran T

has successfully demonstrated knowledge on the Green Building Design & Construction, Building Standards & Codes, IGBC Resources & Processes and Green Design Strategies & their Impacts, required to be awarded the title of

IGBC Accredited Professional

K S Venkatagiri
Executive Director
CII-Godrej GBC

V Suresh
Chairman
Indian Green Building Council

Gurmit Singh Arora
Vice-Chairman
Indian Green Building Council

10115

18 December 2021

Certificate 73531799 / 159674238

LOGESWARAN T

has been awarded a Certificate of Achievement for

ISO 14001:2015 - Environmental Management Systems Auditor/Lead Auditor Training Course

by passing the written examination and continuous assessment this learner has successfully passed all the course assessment requirements

Held at SGS India Private Limited
Completed on 28 April 2022 - 2 May 2022
Exam taken on 2 May 2022

This course meets the formal training requirements for individuals seeking certification under the CQI and IRCA Auditor Certification Scheme and for this purpose is valid for five years from the date of completion of the exam.

Course Number 17972 - PR 315
Certificated by the Chartered Quality Institute (CQI) and International Register of Certified Auditors (IRCA)

Authorised by

H Crick
UK Business Manager

A Mangan
Global Training Manager

Issued by SGS United Kingdom Ltd. Registered in England No 1193985
Registered Office SGS United Kingdom Ltd. Rossmore Business Park
Ellesmere Port, Cheshire, CH65 3EN
SGS United Kingdom Ltd. Knowledge
SGS House, 217-221 London Road, Camberley, Surrey, GU15 3EY
t +44(0) 1276 697 777 f +44(0) 1276 697 696 www.sgs.com

CQI IRCA APPROVED TRAINING PARTNER

CQI IRCA CERTIFIED COURSE

SOLAR ENERGY SOCIETY OF INDIA (SESI)

CBIP Building, Malcha Marg, Chanakyapuri, New Delhi – 110 021

Indian Section of the International Solar Energy Society (ISES)

THIS IS TO CERTIFY THAT

Selvakumar P

Is hereby authorised to use the style and title of

Solar Chartered Engineer

President

Certificate No. : 893388-N
Date of Issue : 24/01/2023

MEMORANDUM OF UNDERSTANDING

BETWEEN

BUREAU OF ENERGY EFFICIENCY

AND

NATIONAL ACCREDITATION BOARD FOR CERTIFICATION BODIES

FOR

IMPLEMENTATION OF REGULATORY AND VOLUNTARY FRAMEWORKS BASED ON ACCREDITATION

MEMORANDUM OF UNDERSTANDING

This Memorandum of Understanding (MoU) entered into on the 28th day of May in the year 2018.

BETWEEN

The **Bureau of Energy Efficiency**, a statutory body under the Ministry of Power, Government of India, formed under Energy Conservation Act, 2001 (52 0f 2001), having its office at 4th Floor, Sewa Bhawan, R K Puram, New Delhi-110066 (hereinafter referred to as "BEE" which expression shall include its successors, administrators, executors and assignees)

AND

The **National Accreditation Board for Certification Bodies** (hereinafter referred to as NABCB), the national accreditation body of India for certification/inspection bodies, with its headquarters in the 2nd Floor, Institution of Engineers Building, 2, Bahadur Shah Zafar Marg, New Delhi 110002. NABCB is a constituent Board of the **Quality Council of India** which has been set up by the Central Government in partnership with CII, FICCI and ASSOCHAM and is an autonomous body with the **Department of Industrial Policy and Promotion**. NABCB, which expression shall, where the context so admits, be deemed to include its successors executors and administrators of the OTHER PART

henceforth be referred to as the 'Parties'.

Accordingly, the Parties have decided to enter into this MoU for the aforesaid objectives on the terms & conditions as mentioned hereunder.

ARTICLE 1

OBJECTIVE

The principal objective of this Memorandum is to establish a mechanism for cooperation between BEE and NABCB wherein NABCB will provide accreditation services to support BEE including accredited certification services through NABCB accredited product certification bodies who will carry out activities as IAME (Independent Agency for Monitoring and Evaluation) to support implementation of BEE's Standards & Labelling (S&L) Program.

ARTICLE 2

SCOPE

2.1 The MOU covers all activities needed to create and implement regulatory and voluntary frameworks based on accreditation with the aim of securing international acceptability, wherever possible.

2.2 Both parties recognize specifically the need for the following activities for the purpose which would be covered under this MoU:

- Implementation of BEE's S&L Programme by using NABCB accredited product Certification Bodies
- Any other activity necessary for the smooth operation of BEE's regulatory regimes and voluntary initiatives

ARTICLE 3

RESPONSIBILITIES

3.1 Responsibilities of BEE

- BEE own the systems for supporting implementation of its regulations and voluntary initiatives.
- BEE will provide inputs with respect to its requirements to NABCB for developing the accreditation frameworks.
- BEE will aim to make available its experts, as and when required by NABCB, to support its accreditation activities.
- BEE, as the regulator, will keep NABCB informed of any changes in the regulations which may affect the accreditation activities.

3.2 Responsibilities of NABCB

- NABCB shall accredit product certification bodies to be empaneled under the BEE's S&L Program for scopes covering the products enlisted in BEE's S&L Program.

- NABCB shall support BEE in development of accreditation framework for international acceptance.

- NABCB shall support BEE in the development of systems for approval of NABCB accredited product certification bodies.

- NABCB shall offer services consistent with the international norms of accreditation activities for BEE's activities.

- NABCB shall give due recognition to international systems of equivalences in its services which support BEE's activities.

- NABCB shall take into account any specific requirements laid down by BEE in its accreditation services in support of BEE's activities.

- NABCB shall undertake any other activity necessary for the development and/or operation of BEE's initiatives consistent with its charter.

- NABCB shall update any changes in accreditation status of Product Certification Bodies (addition/deletion of scopes/suspension/withdrawal) to BEE.

ARTICLE 4

ADMINISTRATION OF MOU

4.1 To achieve the objective of the MOU, BEE and NABCB shall set up a Joint Coordination Committee (JCC) with the following composition:

DG, BEE (Chairman)
CEO, NABCB
One other member each from BEE and NABCB

4.2 The JCC may invite any expert to assist its work, if needed.

ARTICLE 5

CONFIDENTIALITY

Both parties agree that information obtained in carrying out the objectives shall be kept confidential, unless decided otherwise with mutual agreement

ARTICLE 6

DISPUTES

In case any disputes arise in implementing the MoU, these shall be resolved amicably by mutual consultation

ARTICLE 7

VALIDITY

This MoU shall be valid as long as both Parties desire and are meeting their responsibilities mentioned in this MoU.

ARTICLE 8

MISCELLANEOUS

Neither Party shall use or publicize the MoU in such a manner as to cause any disrepute to the other party and shall not make any statement relevant to this MoU which may reasonably be considered to be misleading.

This MOU signed as hereunder shall be effective from the date of signing

For **BEE**

Signature: .....
Name: ..... PANKAJ KUMAR
Address: 4th Floor, Sewa Bhawan
R.K.Puram
New Delhi 110066
Seal:

Witness
Signature: .....
Name: ..... SAMEER PANDITA
Address:..... BEE .....

For **NABCB**

Signature: .....
Name:..... ANIL JAUHRI
Address: 2nd Floor, Institution of Engineers Building, 2, Bahadur Shah Zafar Marg,
New Delhi 110002
Seal: N.A.B.C.B. C/o Quality Council of India 2nd Floor, Institution of Engineers Bldg. Bahadur Shah Zafar Marg New Delhi-110002 (INDIA)

Witness
Signature: .....
Name:..... Ajay Kumar Sharma.
Address:..... NABCB .....

Dated: 28.05.18

Place: New Delhi

End of the Report

Thank You

CHIEF CO-ORDINATOR

INDUSTRY - INSTITUTE PARTNERSHIP CELL

KONGU ENGINEERING COLLEGE

PERUNDURAI, ERODE - 638 060

PHONE : 04294-226642

CELL : 98941 - 57003 (IIPC)

E-MAIL : keciipc@kongu.ac.in

QUALITY AUDIT REPORT

ON

WATER AUDIT, ENERGY AUDIT,

WASTE MANAGEMENT AUDIT,

GREEN CAMPUS MANAGEMENT AUDIT,

AND ENVIRONMENT AUDIT

OF

CITY ENGINEERING COLLEGE

DODDAKALLASANDRA,

NEAR GOKULAM APARTMENT,

OFF – KANAKAPURA MAIN ROAD,

BENGALURU – 560 061

2022 – 2023

ECO ENERGIME ENGINEERS LLP

ENHANCING RESOURCE EFFICIENCY

QUALITY AUDIT REPORT

OF

CITY ENGINEERING COLLEGE

Surveillance Audit

OFF – KANAKAPURA MAIN ROAD,

BENGALURU – 560 061

KARNATAKA

2022 – 2023

For More Information

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Project Team

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- Mr. R Arasakumar, M. E

Project Advisor

- Mr. Prabu Das, M. Tech
- Ms. Aparna Reddy, B.Arch., MBA

Acknowledgements

We are thankful to the management of **City Engineering College, Bengaluru,** for the support, guidance and, giving us the opportunity to be involved in this very interesting and challenging assignment.

We would be happy to provide any further clarifications, if required, to facilitate the implementation of the recommendations.

We received full co-operation and support from the concerned personnel/ staff members of the college. They took key interest and gave valuable inputs during the course of study. We would like to thank:

Chairman – City Engineering College, Bengaluru

And other Staff in personnel who have given full co-operation and support. They took a keen interest and gave valuable inputs during the course of study.

Smart Solutions for Sustainable Tomorrow

Eco Energime Engineers LLP

Certificate

This is to certify that M/s. Eco Energime Engineers LLP, Bengaluru has conducted **Surveillance Green Audit** and **Quality Audit** of **"City Engineering College, Doddakallasandra, Off – Kanakapura main road, Bengaluru"**, during December 2022 to January 2023. The Audit includes water audit, energy audit, waste management audit, green campus management audit and aspects of environment audit.

The audit involves field visit, measurements and observations, verification of bills, log books, data base, maintenance registers and interview with staffs, and this gives an overview of the existing system. In an opinion and to the best of our information and according to the information given to us, said Quality Audit gives a true and fair view in conformity with auditing principles.

For Eco Energime Engineers LLP

Authorized Signatory

No.14, S-1, 3rd Main, 14th Cross, AECS Layout, B-Block, Singasandra, Bangalore - 560 068, Karnataka
80503 87500 www.eeellp.com info@eeellp.com

EEELLP ACKNOWLEDGEMENT

EEELLP team thanks the management of **City Engineering College, Bengaluru,** for assigning this interesting work to us. We appreciate the cooperation extended to our team during the entire process.

Our special thanks are due to Principal & Team of colleagues for giving us necessary inputs to carry out this very vital exercise. We would like to thank all the head of the departments and staff members who were actively involved while collecting the data and conducting field measurements.

For Eco Energime Engineers LLP

Authorized Signatory

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DISCLAIMER

The Audit Team has prepared this report for City Engineering College, Bengaluru, based on the input data submitted by the representatives of college complemented with the best judgment capacity of the expert team.

While all reasonable care has been taken in its preparation, details contained in this report have been compiled in good faith based on information gathered.

It is further informed that the recommendations are arrived following best judgments and no representation, warranty or undertaking, express or implied is made and no responsibility is accepted by Audit Team in this report or for any direct or consequential loss arising from any use of the information, statements or forecasts in the report

For Eco Energime Engineers LLP

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ABBREVIATION AND ACRONYMS

1.	A	:	Amperes
2.	AC	:	Air Conditioner
3.	APFC	:	Automatic Power Factor Controller
4.	BBMP	:	Bruhat Bengaluru Mahanagara Palike
5.	BESCOM	:	Bangalore Electricity Supply Company
6.	BWSSB	:	Bangalore Water Supply and Sewerage Board
7.	CC Camera	:	Closed Circuit Camera
8.	DG	:	Diesel Generators
9.	EE	:	Energy Efficient
10.	E-Waste	:	Electronic Waste
11.	etc.	:	Etcetera
12.	FTL	:	Fluorescent Tube Light
13.	GHG	:	Green House Gas
14.	Hz	:	Hertz
15.	HP	:	Horse Power
16.	HT	:	High Tension
17.	I	:	Current
18.	ICT	:	Information and Communications Technology
19.	IQAC	:	Internal Quality Assurance Cell
20.	ISO	:	International Organization for Standardization
21.	kgs	:	Kilograms
22.	kL	:	Kilo Liters
23.	kV	:	kilo volt
24.	kVA	:	kilo volt ampere
25.	kVAr	:	Reactive kilo volt ampere
26.	kW	:	Kilo Watt
27.	kWh	:	kilo Watt hour
28.	kWp	:	kilo Watt peak
29.	Lab	:	Laboratory
30.	LCD	:	Liquid Crystal Display
31.	LDPE	:	Low density polyethylene
32.	LED	:	Light Emitting Diode
33.	LT	:	Low Tension
34.	mA	:	Milli Amperes
35.	MoU	:	Memorandum of Understanding
36.	NA	:	Not Applicable
37.	NAAC	:	National Assessment and Accreditation Council
38.	No.	:	Numbers
39.	NSS	:	National Service Scheme

40.	Prim/Sec	:	Primary/Secondary
41.	PF	:	Power factor
42.	PG	:	Post Graduate
43.	Ph.D.	:	Doctor of Philosophy
44.	PV	:	Photo Voltaic
45.	Rs.	:	Rupees
46.	RO	:	Reverse Osmosis
47.	RR. No.	:	Revenue Register Number.
48.	S. No.	:	Serial Number
49.	Sq. Ft.	:	Square Feet
50.	Sq. m.	:	Square Meter
51.	SRTPV	:	Solar Roof Top Photo Voltaic
52.	TL	:	Tube Light
53.	TR	:	Ton of Refrigeration
54.	TV	:	Television
55.	UG	:	Under Graduate
56.	V	:	Volts
57.	W	:	Watts
58.	Wi-Fi	:	Wireless Fidelity
59.	Wp	:	Watt peak
60.	#	:	Number

1. INTRODUCTION

City Engineering College, Bangalore affiliated to Visvesvaraya Technological University (VTU) is centrally located in Bangalore. The College has expanded over the last 20 years with sophisticated infrastructure as a part of the Institution's commitment to provide higher quality education in the area of Engineering. The highly facilitated landmark building – provides a perfect ambience for creativity and learning. City Engineering College is known for its academic excellence, friendly welcoming atmosphere and community spirit. Over large number of full-time students study here in a wide range of programs. It is a center of talented, experienced teachers who inspire and energize the students to achieve the best.

The City Engineering College (CEC) was started in the year 2001 by Jayanagar Education Society, Bengaluru, Karnataka, India. Dr. K. R. Paramahamsa – A Distinguished Academician, Educationist & Philanthropist is the Chairman of Jayanagar Education Society. Dr. K.R. Paramahamsa is an Outstanding Personality with a vision to develop standard educational institutions and to deliver Quality Education in an excellent academic environment from primary to research level. The special focus areas of his efforts are extended to disciplines of Engineering & Technology, Business Management and Administration, Science, Computer Applications and Hospitality Management. The City Engineering College is administered by the Governing Body and Governing Council duly constituted as per norms.

The City Engineering College is Recognized by Government of Karnataka and Approved by AICTE, New Delhi. The college is situated in a sprawling campus spread around 11 acres area located next to Gokulam Apartments, Doddakallasandra off Kanakapura Road, Bengaluru, Karnataka, India. Currently we have 6 UG programmes with a total approved intake of 600; one PG programme with an approved intake of 24 and two Ph.D programmes.

The Institution provides an Excellent Learning echo-system to students through sustained efforts by providing Teaching, Lab, Library and Building Infrastructure facilities and fulfilling Quality expectations. IQAC has been formed to monitor quality aspects. ERP software is employed to monitor Teaching-Learning. The Model Curriculum as per the AICTE guidelines has been implemented from the fresh batch of 2018-19. Study material and Assignment questions for students are hosted on Pupil pod-ERP platform on a regular basis.

Online Grievance-redressal mechanism has been implemented. E-SHIKSHANA, a e-learning platform for Interactive Seminars, Webinars and Conferences has been instituted. The Institution is inching towards out-come based education from being a mere an in-put based.

VISION

Making Remarkable Contribution by Disseminating Knowledge on Emerging Trends in Engineering and Technology through various Programmes, Innovation and Research so as to Excel in Quality both at National and International level and to provide Career Guidance & Training for Employment.

MISSION

- To encourage Knowledge Acquisition and Foster Innovation & Research.
- To Prepare Students for Immediate Employment, leading to Technological and Socio-economic growth.
- To Provide Guidance for a Productive Career under various programmes.

QUALITY POLICY

The Institution believes in providing High Quality Education to the Students using necessary quality benchmarks in the area of Faculty Recruitment, Development and Student Learning processes through sustained efforts.

Committee and Cells

Internal Quality Assurance Cell (IQAC)

The establishment of Internal Quality Assurance Cell (IQAC) by accredited institutions (after the first cycle) is a major step in pushing long-term quality standards. IQAC in any institution is a significant administrative body that is responsible for all quality matters. It is the prime responsibility of IQAC to initiate, plan and supervise various activities that are necessary to increase the quality of the education imparted in an institution or college. The role of IQAC in maintaining quality standards in teaching, learning and evaluation becomes crucial.

The Indian higher education system is on the brink of great transformations to cope with global competence. The overall quality of higher education is the main concern in policy framing and for that it has been made mandatory to obtain accreditation of higher education institutions (HEIs) by the National Assessment and Accreditation Council (NAAC) to improve quality. Maintaining quality is a matter of long-term initiative; to reach this long-term goal, NAAC has established detailed guidelines from time to time. The establishment of Internal Quality Assurance Cell (IQAC) by accredited institutions (after the first cycle) is a major step in pushing long-term quality standards. IQAC in any institution is a significant administrative body responsible for all quality matters. It is the prime responsibility of IQAC to initiate, plan and supervise various activities which are necessary to increase the quality of the education imparted in institutions and colleges. It can promote and determine quality related activities and issues through various

programmes and activities such as seminars, workshops, symposia, conferences, panel discussions, role playing exercises, (model) demonstrations, case studies, academic meetings and any such kind of event or programme for all the stakeholders of the institution. The role of IQAC in maintaining quality standards in teaching, learning and evaluation becomes crucial.

Various committees and cells are listed below:

- Anti-ragging Committee
- Discipline Committee
- Anti-Sexual Harassment Committee
- Industry Institution Interaction Cell
- SC/ST Cell
- Women Empowerment Cell
- Grievance Redressal Committee
- Research & Development Cell

Campus Area and Built-up area

The area of the campus (built up and total) is given in table 1-1.

S. No.	Description	Units	Details
1	Engineering Campus total area	Acres	11

Table 1-1: College area

The details of infrastructure area are given in table 1-2.

PARTICULAR		EXISTING AREA (Sq.m)
CLASS ROOMS	UG	2033 (19 x 107) 1580 (20 x 079)
	PG	0100 (02 x 050)
TUTORIAL ROOMS		0711 (09 x 079)
DRAWING HALL		0158 (02 x 079)
COMPUTER CENTRE		0158 ----
WORKSHOP		0245 ----
PHYSICS LAB		0100 ----
CHEMISTRY LAB		0100 ----
CAED LAB		0158 ----
CCP LAB		0158 ----
CSE LABS 10		1000 ----
ECE LABS 08		1009 ----
MECH LABS 11		1388 ----
CIVIL LABS 08		1000 ----
SEMINAR HALLS **Class Rooms for NEW COURSES**		0940 ---- (3 *160 + 1 * 180 + 1 * 280) 0432 (108x4) + 5210 (AVAILABLE)
TOTAL INSTRUCTIONAL AREA		16480

Table 1-2: Infrastructure area

The details of administrative area are given in table 1-3.

Sl. No.	Particulars	Existing Area in Sq.m.
1.	PRINCIPAL ROOM	052
2.	VICE –PRINCIPAL ROOM	030
3.	ADMISSION ROOM	060
4.	HEAD OF DEPARTMENT ROOM/OFFICE	140 (20x07)
5.	FACULTY ROOM	900
6.	DEPARTMENTAL LIBRARY	Available
7.	STORE ROOM	040
8.	CONFERENCE ROOM	120
9.	MAINTENANCE/ESTATE OFFICE	040
10.	RECEPTION OFFICE	030
11.	COLLEGE OFFICE	350
12.	BOARD ROOM	082
13.	SECURITY	020
14.	HOUSE KEEPING	030
15.	EXAMINATION OFFICE	107
16.	PLACEMENT	182

Table 1-3: Administrative area

The details of campus amenities area are given in table 1-4.

Sl. No.	Particulars	Existing Area in Sq.m.
1.	SPORTS FIELD	20234.3
2.	SPORTS FACILITY	250
3.	GIRL'S COMMON ROOM	108
4.	CAFETERIA	250
5.	TOILETS	625
6.	FIRST AID & MEDICAL ROOM	020
7.	STATIONARY STORE AND REPROGRAPHY	040
8.	AUDITORIUM	8500
9	LIFT FACILITY	FIVE FLOORS
10	RO DRINKING WATER PLANT	1000 Ltrs
11	RAMP FACILITY	FOR SPECIALLY ABLED
12	FREE PARKING/TRANSPORTATION	TR. FOR NEAR BY AREAS

Table 1-4: Details of Campus amenities area

The details of lab area are given in table 1-5.

DEPT	NO.OF LABS	LAB AREA
Computer Science Engineering	16	1600 Sq. m
Electronics & Communication Engineering	09	1109 Sq. m
Mechanical Engineering	11	1388 Sq. m
Civil Engineering	08	1000 Sq. m
Basic Science	06	1019 Sq. m
Library	03	1100 Sq. m

Table 1-5: Details of Lab area

The details of facilities in college are given in table 1-6.

Sl. No.	Particulars	Details
1	LIBRARY	800 Sq.m
2	BANK WITH ATM (BANK OF INDIA)	606 Sq.m
3	DIESEL GENERATOR SET (Koel Kirloskar Green)	250 KVA
4	UPS	160 KVA
5	KEB POWER SUPPLY	250 KVA
6	TRANSPORTATION	03 Buses
7	CCTV CAMERA	23
8	FIRE EXTINGUISHER	15
9	RO PLANT FOR PURE DRINKING WATER	01 (with 1000 Ltrs. Capacity)
10	LIFT FACILITY FOR FIVE FLOORS	SCHINDLER (8 Person capacity)

Table 1-6: Details of Facilities in college

The details of departments in college with approved intake are given in table 1-7.

Course	Sl. No.	Programme/Course	Year of Establishment	Present Intake 2021-2022	Applied Intake for 2022-23
UG	1	Computer Science & Engineering	2001-02	180	180
	2	Electronics & Communication Engineering	2001-02	60	60
	3	Mechanical Engineering	2004-05	60	60
	4	Civil Engineering	2011-12	60	30
	5	Artificial Intelligence & Machine Learning	2020-21	60	60
	6	Information Science & Engineering	2020-21	30	60
			Total Intake	**450**	**450**
PG	1	Computer Science & Engineering.	2014-15	12	12
PhD	1	ME - Research Centre	2019-20	--	Continuation
	2	CSE – Research Centre.	2020-21	--	Continuation

Table 1-7: Details of Departments in college with approved intake

Internal Quality Auditing Team – 2022 – 2023

The college management constitutes the internal Quality Auditing team including students, staff, stakeholders, employees, and alumina's every year. Table 1-6 gives the list of internal Quality Auditing team for the year 2022 – 2023.

S. No.	Name	Designation	Role
1	Dr.H.N.Thippeswamy	Principal	Chairman
2	Dr.P.Jyothi	Vice-principal & HOD, Dept. of Mathematics	Vice-chairman
3	Dr.K.Sujatha	HOD, Dept. of Physics	Member
4	Dr.P.Rajasekhar	HOD, Dept. of Chemistry	Member
5	Mr.Vivekavardhana Reddy	HOD, Dept. of CSE	Member
6	Mr.Mallikarjun	HOD, Dept. of ECE	Member
7	Dr.S.Karunakara	HOD, Dept. of Mechanical Engg.	Member
8	Dr.P.Sowmiya Naik	Executive officer & Professor, Dept. of CSE	Member
9	Dr.Rajasekhar Reddy	HOD, Dept. of Information Science	Member
10	Dr. Vagdevi	HOD, Dept. of AI & ML	Member
11	Mr.Satish Hande	Administrative officer	Member

Table 1-8: Internal Quality Audit Team

Overview of Green Audit:

Green Audit helps college / facility to:

- Understand the usage of electricity, water and other natural resources
- Identify opportunities to conserve various natural resources
- Identify various technological improvements
- Evaluate the techno-commercial of identified conservative measures
- Create awareness among the students and staff
- Disseminate the commitment of management towards saving nature
- Develop a culture among students, staff and management to be socially responsible

2. PRE – AUDIT PHASE

A pre-audit meeting is a prerequisite for the Audit; it helps to meet and discuss about the schedule and documents required during the audit. The pre-audit meeting was conducted at City Engineering College, Off Kanakapura, Bengaluru in the end of February 2022. During the meeting, introduction of team members, scope and objectives of the audit were discussed.

Management Commitment

The Management of the college has shown significant commitment towards Quality Auditing during the pre-audit meeting. They were ready to encourage all green activities. It is decided to promote all activities that are environment friendly such as awareness programmes on the environment, campus farming, planting more trees on the campus etc., after the Quality Auditing.

College administration is vital to the process of realizing campus sustainability, and college policy is an essential instrument for any substantial change in the campus environment.

Scope and goals of Quality Auditing

A clean and healthy environment aids effective learning and provides a conducive learning environment. There are various efforts around the world to address environmental education issues. Quality Auditing is one among them for educational institutions.

Once a baseline is established, the data can serve as a point of departure for further action in campus greening. Existing data will allow the college to compare its programs and operations with those of peer institutions, identify areas in need of improvement, and prioritize the implementation of future projects.

This data will also provide a basis for calculating the economic benefits of resource conservation projects by establishing the current rates of resource use and their associated costs. This audit initiative focused initially on educating colleges and universities through workshops, guidebooks, fact sheets and ensuring compliance through inspections and self-audits.

2.1. Audit Schedule

Quality Audit schedule includes the pre-audit phase, on-site / audit phase and post audit phase. Table 2-1 details the complete Quality Audit schedule.

S. No	Description	Timeline
1.	Pre-audit Phase	01 Dec 22 to 03 Dec 22
2.	Onsite-audit Phase	12 Dec 22 to 16 Dec 22
3.	Post-audit Phase	04 Jan 23 to 06 Jan 23
4.	Presentation	20 Jan 23

Table 2-1: Audit Schedule

3. ON-SITE AUDIT PHASE

3.1. Scope / Target Areas of Quality Auditing

3.1.1. Water Audit

Water Audit addresses water consumption, water sources, appliances and fixtures. Aquifer depletion and water contamination are taking place at unprecedented rates. It is therefore essential that any environmentally responsible institution should examine its water use practices.

3.1.2. Energy Audit

Energy Audit addresses energy consumption, energy sources, energy monitoring, lighting, appliances, and vehicles. Energy use is clearly an important aspect of campus sustainability.

3.1.3. Waste Management Audit

Waste Audit addresses waste production and disposal, plastic waste, paper waste, food waste, and recycling. Municipal solid waste has a number of adverse environmental impacts, most of which are well known and not in need of elaboration.

3.1.4. Green Campus Management Audit

Green campus initiatives are becoming an integral part of modern day's university systems. Green campus Audit helps in maintaining the air and water clean. It regulates the climatic conditions and provides a healthy and comfortable environment for living.

3.1.5. Environment Audit

Environment Audit addresses the usage of fossil fuels (coal, diesel, petrol and gas). The mode of commute to and from college each day has an impact on the environment through the emission of greenhouse gases into the atmosphere by the burning of fossil fuels.

3.2. Audit Methodology and Approach

The methodology and approach adopted for the study involve various steps that include:

- Review of Document and records
- Review of Policies
- Review of MoU
- Review of various measures implemented
- Site Walkthrough
- Data Collection
- Interviews

3.2.1. Review of Document and Records

Electricity bills, Water bills, equipment register, list of appliances, office registers, internal Quality Audit document, purchase document, were reviewed and relevant data and inputs required for analysis have been collected.

3.2.2. Review of Policies

College has various policies that include safety policy, environment policy, and Anti-ragging policy.

A. Safety Policy:

An organization's safety policy is a recognized, written statement of its commitment to protect the health and safety of the students and employees, as well as the surrounding community. All the students, teaching and non-teaching staff, maintenance and house-keeping staff have been given training to use fire extinguishers in emergency situations of fire and explosion. Fire extinguishing cylinders have been installed in each floor, UPS rooms and in laboratory areas.

Sample photos of fire extinguisher is as shown in figure 3-1.

Figure 3-1: Fire extinguisher

The refilling certificate for the fire extinguishers at college premises is shown in figure 3-2.

Aim Fire Services

FIRE PROTECTION ENGINEERS

REFILLING CERTIFICATE

REFIAIM/140/2020

M/R.City Engineering Collage
Doddakallasandra,Near Gokulam
Apartments, off kanakapura Road,
Bangalore-560061.

Dear Sir,

This is to Certify that the existing Fire Extinguisher at your premises has been Refilling on 4/11/2020-4/11/2021

Sl. N	Type of F/E	Qty	Refilling date	N. Refilling Date
1	Recharging of ABC 1 kg cap. F/E.	2.00	4/11/2020.	3/11/2021.
2	Recharging of ABC 2 kg cap. F/E.	6.00	4/11/2020.	3/11/2021.
3	Recharging of ABC 4 kg cap. F/E.	6.00	4/11/2020.	3/11/2021.
4	Recharging of ABC 5 & 6 kg cap. F/E.	2.00	4/11/2020.	3/11/2021.
5	Recharging of CO2 4.5 kg cap. F/E.	1.00	4/11/2020.	3/11/2021.
6	Recharging of DCP 10 kg cap. F/E.	1.00	4/11/2020.	3/11/2021.

All the above mentioned Fire Extinguisher are ready to use for any emergency and are guaranted against manufacturing defects for a period of One year. (Subject to any tampering or misuse)

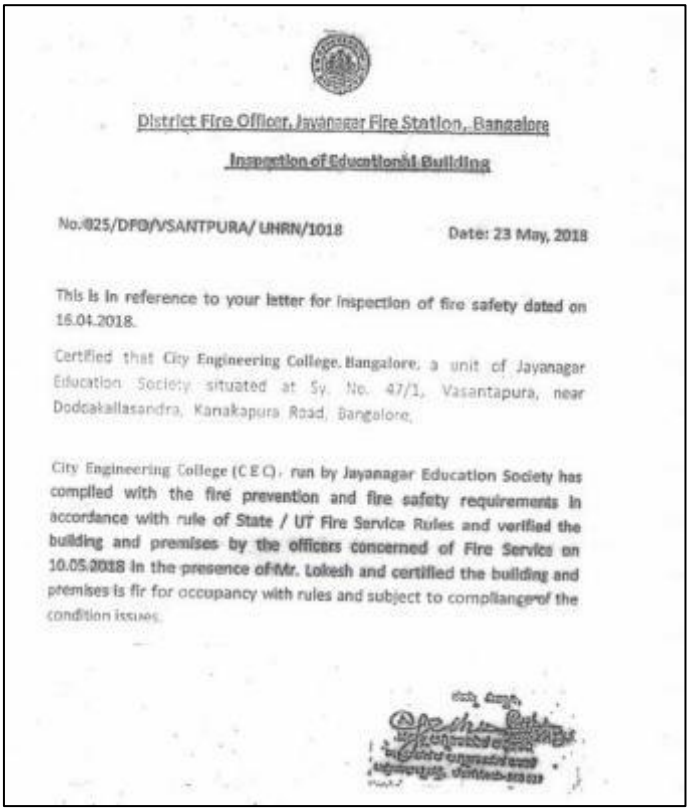
Thanking You
Yours faithfully,

DR. V S RAMAMU RTHY

ISO 9001 / 2015 Certified Company

Figure 3-2: Refilling certificate for fire extinguishers

The certificate for inspection of fire safety issued by district fire officer, Jayanagar fire station is shown in figure 3-3.



District Fire Officer, Jayanagar Fire Station, Bangalore

Inspection of Educational Building

No.025/DFO/VSANTPURA/ UHRN/1018 Date: 23 May, 2018

This is in reference to your letter for inspection of fire safety dated on 16.04.2018.

Certified that City Engineering College, Bangalore, a unit of Jayanagar Education Society situated at Sy. No. 47/1, Vasantapura, near Dodcakallasandra, Kanakapura Road, Bangalore.

City Engineering College (C E C), run by Jayanagar Education Society has complied with the fire prevention and fire safety requirements in accordance with rule of State / UT Fire Service Rules and verified the building and premises by the officers concerned of Fire Service on 10.05.2018 in the presence of Mr. Lokesh and certified the building and premises is fir for occupancy with rules and subject to compliangeof the condition issues.

Figure 3-3: Letter of Inspection of fire safety

B. Anti-Ragging policy:

Ragging in all its forms shall be totally banned in the entire institution, including its departments, constituent units, all its premises (academic, hostel, sports, canteen, etc.) whether located within the campus or outside and in all means of transportation of students whether public or private. Sample photos of anti-ragging posters displayed within the college premises are shown in the figure 3-4.

Figure 3-4: Anti-ragging posters

3.2.3. Review of various measures implemented

During the Green Audit study, it was observed the college has taken various initiatives in conserving natural resources that include:

- Internal Quality Auditing team is available. It is comprised of chairman, vice-chairman and members.
- Usage low flow water taps like pressmatic taps, push type taps and taps with aerators is used to minimize water usage.
- Cleaning activity using bucket & mop is followed instead of using a water hose.
- Regular testing water quality parameters.
- Regular maintenance of RO plant is done.
- Installation of waste segregation bins at all the rooms to separate the dry and wet waste
- Installation of LCD/LED monitors for all the desktops to conserve electricity
- Switching OFF lights and fans whenever not in use to save electricity
- Sensor based solar LED street lights are used.
- De-composter pit is available for decomposing the leaves.

3.2.4. Site Walk through

Site walk through was conducted with staff members, students and audit team members. Staff and students have shown very keen interest in the data collection process and methods to be followed in field data collection. The staff and students have given inputs and suggestions for resource conservation as well.

College Infrastructure

CITY Engineering College campus has two blocks with departments. Each floor has state of the art class rooms, staff rooms, laboratories, libraries and many more. Details of infrastructure are as follows:

Figure 3-5: Infrastructure Details

All the classrooms and staff rooms are well ventilated and the integration of day-light is well utilized. This has helped in optimized usage of electricity for lights and fans during day time.

3.2.5. Inventory Collection

To understand the types of appliances used, inventory collection was carried out by the audit team members. The various types of appliances used are lights, fans, RO water plants etc. The consolidated list of inventories is given in table 3-1.

S. No.	Inventory Type	Wattage	Quantity
1.	FTL	1 x 36 W	537
2.	LED Tube light	1 x 18 W	19
3.	LED	9 W	30
4.	LED solar light	40 W	9
5.	LED Façade light	100 W	3
6.	CFL bulb	1 x 14 W	72
7.	Décor LED lamp	5 w	3
8.	Incandescent bulb	40 W	15
9.	LCD Projector		14
10.	Computer		414
11.	Printer		26
12.	Ceiling Fan	65 W	233
13.	Stand / Wall mount fan		4
14.	Exhaust fan		7
15.	Xerox machine		2
16.	LED TV screen		1
17.	Cassette AC		1
18.	RO Plant (250 lph)		1

Table 3-1: Consolidated list of Inventories

3.2.6. Interviews

To collect the various data, information and operating patterns, interviews were conducted with college staff (Principal, teaching staff, non-teaching staff) and students. The consolidated information from the interviews is given in the following sub-sections.

3.2.6.1. List of Holidays

The lists of holidays were collected during the study and the same is given in figure 3-6, figure 3-7 and figure 3-8.

Date	Day	General Holidays 2021
14-01-2021	Thursday	Uttarayana Punyaa kaala, Makara Sankranti Festival
26-01-2021	Tuesday	Republic Day
11-03-2021	Thursday	Maha Shivaratri
02-04-2021	Friday	Good Friday
13-04-2021	Tuesday	Ugadi Festival
14-04-2021	Wednesday	Dr. B R Ambedkar Jayanthi
01-05-2021	Saturday	May Day/ Labour Day
14-05-2021	Friday	Basava Jayanthi/ Akshaya Tritiya, Khutub-E-Ramzan
21-07-2021	Wednesday	Bakrid
20-08-2021	Friday	Last Day of Moharam
10-09-2021	Friday	Varasiddhi Vinayaka Vrata
02-10-2021	Saturday	Gandhi Jayanthi
06-10-2021	Wednesday	Mahalaya Amavasya
14-10-2021	Thursday	Mahanavami, Ayudhapooja
15-10-2021	Friday	Vijayadashami
20-10-2021	Wednesday	Maharishi Valmiki Jayanti, Eid-Milad
01-11-2021	Monday	Kannada Rajyothsava
03-11-2021	Wednesday	Naraka Chaturdashi
05-11-2021	Friday	Balipadyami Deepavalli
22-11-2021	Monday	kanakadasa Jayanti

Figure 3-6: List of Holidays for 2021

VTU Holidays 2022 (General)

Date	Day	General Holidays 2022
15-01-2022	Saturday	Uttarayana Punyaa kaala, Makara Sankranti Festival
26-01-2022	Wednesday	Republic Day
1-03-2022	Tuesday	Maha Shivaratri
02-04-2022	Saturday	Ugadi Festival
14-04-2022	Thursday	Dr. B R Ambedkar Jayanthi, Mahaveera Jayanthi
15-04-2022	Friday	Good Friday
03-05-2022	Tuesday	Basava Jayanthi/ Akshaya Tritiya, Khutub-E-Ramzan
09-08-2022	Tuesday	Last Day of Moharam
15-08-2022	Monday	Independence Day
31-08-2022	Wednesday	Varasiddhi Vinayaka Vrata
04-10-2022	Tuesday	Mahanavami, Ayudhapooja
05-10-2022	Wednesday	Vijayadashami
24-10-2022	Monday	Naraka Chaturdashi
26-10-2022	Wednesday	Balipadyami Deepavalli
01-11-2022	Tuesday	Kannada Rajyothsava
11-11-2022	Friday	kanakadasa Jayanti

Figure 3-7: List of Holidays for 2022

ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ

(ಎ ಟಿ ಯು ಅಧಿನಿಯಮ ೧೯೯೪ ರ ಅಡಿಯಲ್ಲಿ ಕರ್ನಾಟಕ ಸರ್ಕಾರದಿಂದ ಸ್ಥಾಪಿತವಾದ ರಾಜ್ಯ ವಿಶ್ವವಿದ್ಯಾಲಯ) "ಜ್ಞಾನ ಸಂಗಮ", ಬೆಳಗಾವಿ-೫೯೦೦೧೮, ಕರ್ನಾಟಕ, ಭಾರತ

Visvesvaraya Technological University

(State University of Government of Karnataka Established as per the VTU Act, 1994)
"Jnana Sangama" Belagavi-590018, Karnataka, India

ಡಾ. ಕೆ. ಎ. ರಂಗಸ್ವಾಮಿ
ಕುಲಸಚಿವರು (ಪ್ರಭಾರಿ)

Phone : (0831) 2498100
Fax:(0831) 2405467, Website: vtu.ac.in

ಉಲ್ಲೇಖ ಸಂ. ವಿಶಾವಿ/ಪಬಮಂ/"ಇಎಸ್"ಟಿ/MISC(4)/2022-23/ 2156 ದಿನಾಂಕ : 06 DEC 2022

ಅಧಿಸೂಚನೆ

ವಿಷಯ : 2023 ನೇ ಸಾಲಿನ ಸಾರ್ವತ್ರಿಕ ಮತ್ತು ಪರಿಮಿತ ರಜೆಗಳು.

ಉಲ್ಲೇಖ : 1. ಕರ್ನಾಟಕ ಸರ್ಕಾರದ ಅಧಿಸೂಚನೆ ಸಂಖ್ಯೆ ಸಿಆಸುಇ 16 ಹೆಚ್‌ಹೆಚ್‌ಎಸ್ 2022 ದಿನಾಂಕ : 21-11-2022.
2. ಮಾನ್ಯ ಕುಲಪತಿಗಳ ಅನುಮೋದನೆ ದಿನಾಂಕ : 02-12-2022

ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯವು ತನ್ನ ಅಧೀನದಲ್ಲಿರುವ ಎಲ್ಲ ಕಛೇರಿಗಳು, ಘಟಕ ಕಾಲೇಜು, ಸ್ನಾತಕೋತ್ತರ / ಪ್ರಾದೇಶಿಕ ಕೇಂದ್ರಗಳು, ಇತ್ಯಾದಿ ವಿಭಾಗಗಳಿಗೆ 2023 ನೇ ವರ್ಷದಲ್ಲಿ ಬರುವ ಸಾರ್ವತ್ರಿಕ ಮತ್ತು ಅನುಬಂಧದಲ್ಲಿ ಸೂಚಿಸಿರುವಂತೆ ಪರಿಮಿತ ರಜೆಗಳನ್ನು ಈ ಕೆಳಗಿನಂತೆ ಘೋಷಿಸಿದೆ.

ಸಾರ್ವತ್ರಿಕ ರಜೆ

ಎಲ್ಲಾ ಎರಡನೇ ಶನಿವಾರ, ಉಳಿದೆ ಶನಿವಾರ ಮತ್ತು ಭಾನುವಾರಗಳು ಹಾಗೂ ಈ ಕೆಳಕಂಡ ದಿನಗಳು.

ಕ್ರ.ಸಂ.	ದಿನಾಂಕ	ವಾರಗಳು	ಸಾರ್ವತ್ರಿಕ ರಜಾ ದಿನಗಳು
01	26-01-2023	ಗುರುವಾರ	ಗಣರಾಜ್ಯೋತ್ಸವ
02	18-02-2023	ಶನಿವಾರ	ಮಹಾ ಶಿವರಾತ್ರಿ
03	22-03-2023	ಬುಧವಾರ	ಯುಗಾದಿ ಹಬ್ಬ
04	03-04-2023	ಸೋಮವಾರ	ಮಹಾವೀರ ಜಯಂತಿ
05	07-04-2023	ಶುಕ್ರವಾರ	ಗುಡ್ ಫ್ರೈಡೆ
06	14-04-2023	ಶುಕ್ರವಾರ	ಡಾ॥ ಬಿ.ಆರ್.ಅಂಬೇಡ್ಕರ್ ಜಯಂತಿ
07	01-05-2023	ಸೋಮವಾರ	ಕಾರ್ಮಿಕ ದಿನಾಚರಣೆ
08	29-06-2023	ಗುರುವಾರ	ಬಕ್ರೀದ್
09	29-07-2023	ಶನಿವಾರ	ಮೊಹರಂ ಕಡೇ ದಿನ
10	15-08-2023	ಮಂಗಳವಾರ	ಸ್ವಾತಂತ್ರ್ಯ ದಿನಾಚರಣೆ
11	18-09-2023	ಸೋಮವಾರ	ವರಸಿದ್ಧಿ ವಿನಾಯಕ ವ್ರತ
12	28-09-2023	ಗುರುವಾರ	ಈದ್ ಮಿಲಾದ್
13	02-10-2023	ಸೋಮವಾರ	ಗಾಂಧಿ ಜಯಂತಿ
14	23-10-2023	ಸೋಮವಾರ	ಮಹಾನವಮಿ, ಆಯುಧಪೂಜೆ
15	24-10-2023	ಮಂಗಳವಾರ	ವಿಜಯದಶಮಿ
16	01-11-2023	ಬುಧವಾರ	ಕನ್ನಡ ರಾಜ್ಯೋತ್ಸವ
17	14-11-2023	ಮಂಗಳವಾರ	ಬಲಿಪಾಡ್ಯಮಿ, ದೀಪಾವಳಿ
18	30-11-2023	ಗುರುವಾರ	ಕನಕದಾಸ ಜಯಂತಿ
19	25-12-2023	ಸೋಮವಾರ	ಕ್ರಿಸ್ ಮಸ್

ಮೇಲಿನ ಸಾರ್ವತ್ರಿಕ ರಜೆ ಪಟ್ಟಿಯಲ್ಲಿ ಎರಡನೇಯ ಶನಿವಾರವು ಬರುವ ಮಹಾಲಯ ಅಮವಾಸ್ಯೆ (14-10-2023) ಹಾಗೂ ಉಳಿದೆ ಶನಿವಾರದಂದು ಬರುವ ಖುರ್ಬಾನ್-ಏ ರಂಜಾನ್ (22-04-2023) ಮತ್ತು ಮಹರ್ ವಾಲ್ಮೀಕಿ ಜಯಂತಿ (28-10-2023) ಈ ರಜೆ ಪಟ್ಟಿಯಲ್ಲಿ ಸಮೂಹಿಸಿರುವುದಿಲ್ಲವಾದ್ದರಿಂದ, ಎರಡನೇಯ ಶನಿವಾರದಂದು ಹಾಗೂ ಉಳಿದೆ ಶನಿವಾರದಂದು ಬರುವ ಉಲ್ಲೇಖಿತ ಸಾರ್ವತ್ರಿಕ ರಜೆದಿನಗಳಂದು ವಿ.ತಾ.ವಿ.ಯ ಸ್ನಾತಕೋತ್ತರ ಕೇಂದ್ರಗಳಿಗೆ ಹಾಗೂ ಘಟಕ ಮಹಾವಿದ್ಯಾಲಯಗಳಿಗೆ ಯಥಾಪ್ರಕಾರ ಕಾರ್ಯನಿರ್ವಹಣೆಯ ರಜೆಯನ್ನು ಘೋಷಿಸಿದೆ.

1/3

Figure 3-8: List of Holidays for 2023

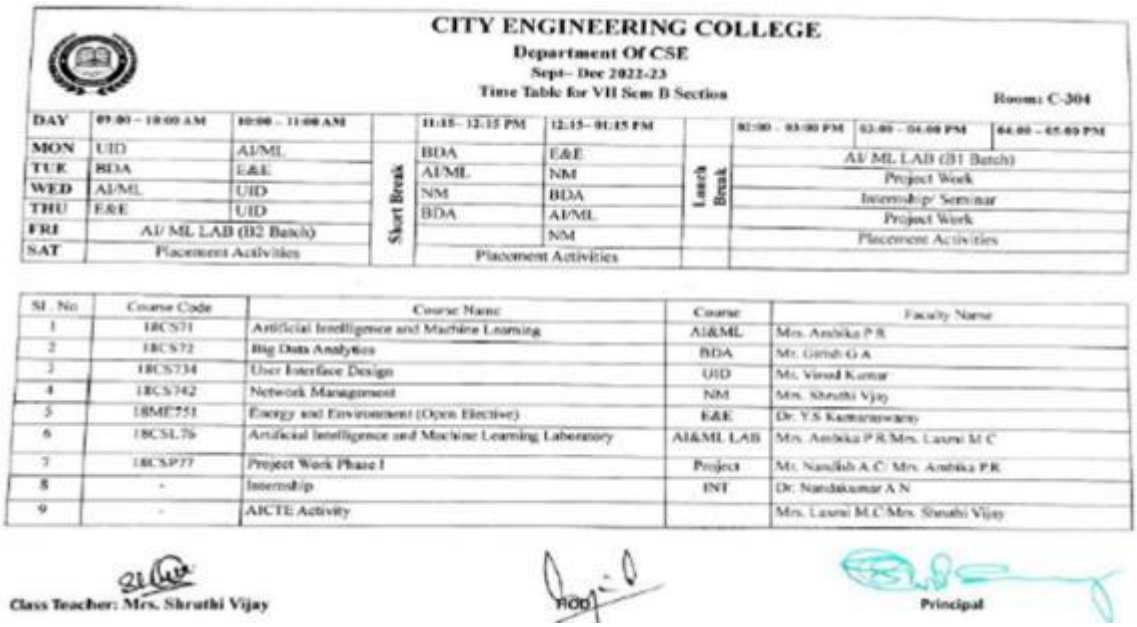
3.2.6.2. Tentative Schedule of College:

The tentative schedule of the college is 09.00 AM to 5:00 PM. The details of the sessions are given in table 3.2.

S. No.	Description	Timings
1	Session – I	09.00 AM to 10.00 AM
2	Session – II	10.00 AM to 11.00 AM
3	Break	11.00 AM to 11.15 AM
4	Session – III	11.15 AM to 12.15 PM
5	Session – IV	12.15 PM to 01.15 PM
6	Lunch	01.15 PM to 02.00 PM
7	Session – V	02.00 PM to 03.00 PM
8	Session – VI	03.00 PM to 04.00 PM
9	Session – VII	04.00 PM to 05.00 PM

Table 3-2: Tentative College Schedule

The image of sample time table is shown in figure 3-9.



CITY ENGINEERING COLLEGE

Department Of CSE

Sept– Dec 2022-23

Time Table for VII Sem B Section

Room: C-304

DAY	09.00 – 10.00 AM	10.00 – 11.00 AM		11.15– 12.15 PM	12.15– 01.15 PM		02.00 – 03.00 PM	03.00 – 04.00 PM	04.00 – 05.00 PM
MON	UID	AI/ML		BDA	E&E		AI/ML LAB (B1 Batch)		
TUE	BDA	E&E		AI/ML	NM		Project Work		
WED	AI/ML	UID	Short Break	NM	BDA	Lunch Break	Internship/ Seminar		
THU	E&E	UID		BDA	AI/ML		Project Work		
FRI	AI/ML LAB (B2 Batch)				NM		Placement Activities		
SAT	Placement Activities			Placement Activities					

Sl. No	Course Code	Course Name	Course	Faculty Name
1	18CS71	Artificial Intelligence and Machine Learning	AI&ML	Mrs. Ambika P R
2	18CS72	Big Data Analytics	BDA	Mr. Girish G A
3	18CS734	User Interface Design	UID	Ms. Vinod Kumar
4	18CS742	Network Management	NM	Mrs. Shruthi Vijay
5	18ME751	Energy and Environment (Open Elective)	E&E	Dr. Y.S Kumaraswamy
6	18CSL76	Artificial Intelligence and Machine Learning Laboratory	AI&ML LAB	Mrs. Ambika P R/Mrs. Laxmi M C
7	18CSP77	Project Work Phase I	Project	Mr. Nandish A.C/ Mrs. Ambika P.R
8	-	Internship	INT	Dr. Nandakumar A N
9	-	AICTE Activity		Mrs. Laxmi M.C/Mrs. Shruthi Vijay

Class Teacher: Mrs. Shruthi Vijay

HOD

Principal

Figure 3-9: Sample image of Time table

3.2.6.3. Staff and Students of College:

The number of staff includes teaching and non-teaching is given in the table 3-3. The number of students includes both boys and girls.

S. No.	Academic year	Staff	Students
1	2021- 2022	109	689
2	2022 – 2023	146	848

Table 3-3: Number of staff and students

4. WATER AUDIT

4.1. Facility description

The water audit study involved carrying out various observations and analysis, to realistically assess usage of water and potential for water conservation.

Borewell is the main source of water, for facilitating the water supply requirement of the entire campus. No water is purchased from BWSSB and through tankers.

Two borewells are available in campus. From borewells, the water is pumped and filled in sump near Dr. A.P.J. Abdul Kalam block. Then, from sump the water is pumped to overhead tanks using submersible type pumps. The location of borewells and pump capacity are given in table 4.1

S. No.	Location	Name	Pump type / Rating, HP
1	Near School block	Borewell 1	Submersible / 7.5 HP
2	Near Admin block	Borewell 2	Submersible / 7.5 HP

Table 4-1: Details of borewells

From borewell 1, the water is supplied to school block, sump (near Dr. A.P.J. Abdul Kalam block) and garden. For this purpose, valve mechanism is provided at borewell point. The borewell 1 is shown in figure 4-1.

Figure 4-1: Borewell 1 & Control panel (near school block)

From borewell 2, the water is supplied to sump and overhead tanks of admin block. The borewell 2 is shown in figure 4-2.

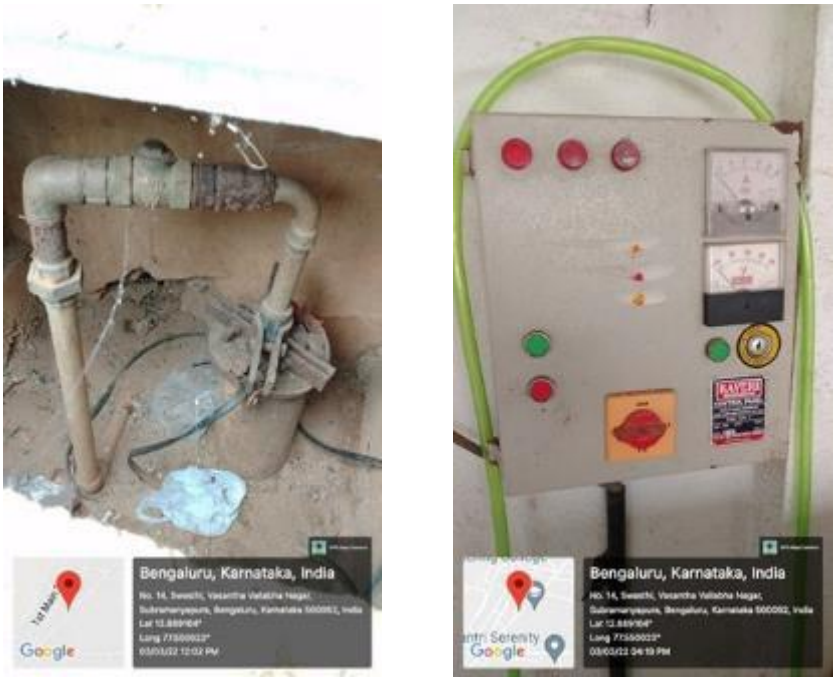


Figure 4-2: Borewell 2 & Control panel (near admin block)

One underground sump is available. The sump is located near Dr. A.P.J. Abdul Kalam block. The capacity of sump is 35 kL. The sump and valve mechanism is shown in figure 4-3 and figure 4-4.

Figure 4-3: Underground sump (near CS/IS block)

Figure 4-4: Valve mechanism for sump

For sump, input water supply is provided using borewell 1 and borewell 2. Primary water supply is done from borewell 1(near school block). In case of maintenance, the water is supplied from borewell 2 (near admin block).

From sump, the water is pumped to overhead tanks of Dr. A.P.J. Abdul kalam block (CS/IS block). In case of maintenance work at borewell 2, the water from sump is pumped to overhead tanks of Dr. Sir. M. Visveswaraya block (Admin block). For pumping, 3 HP submersible type pump is used.

In case of maintenance work at sump, the water from borewells is directly pumped to overhead tanks.

Based on the source, usage and type, water is classified as following types in the college campus that include:

- Raw Water
- Drinking Water
- Hot Water
- Rain Water
- Sewage Water

Details of the various types of water usages are discussed in detail, in the following sections.

4.1.1. Raw Water System

The raw water is consumed in the following areas:

- RO plant Input
- Student's toilets
- Staff toilets
- Laboratories
- Canteen
- Garden

The schematic of overall raw water distribution system of the campus is given in figure 4-5.

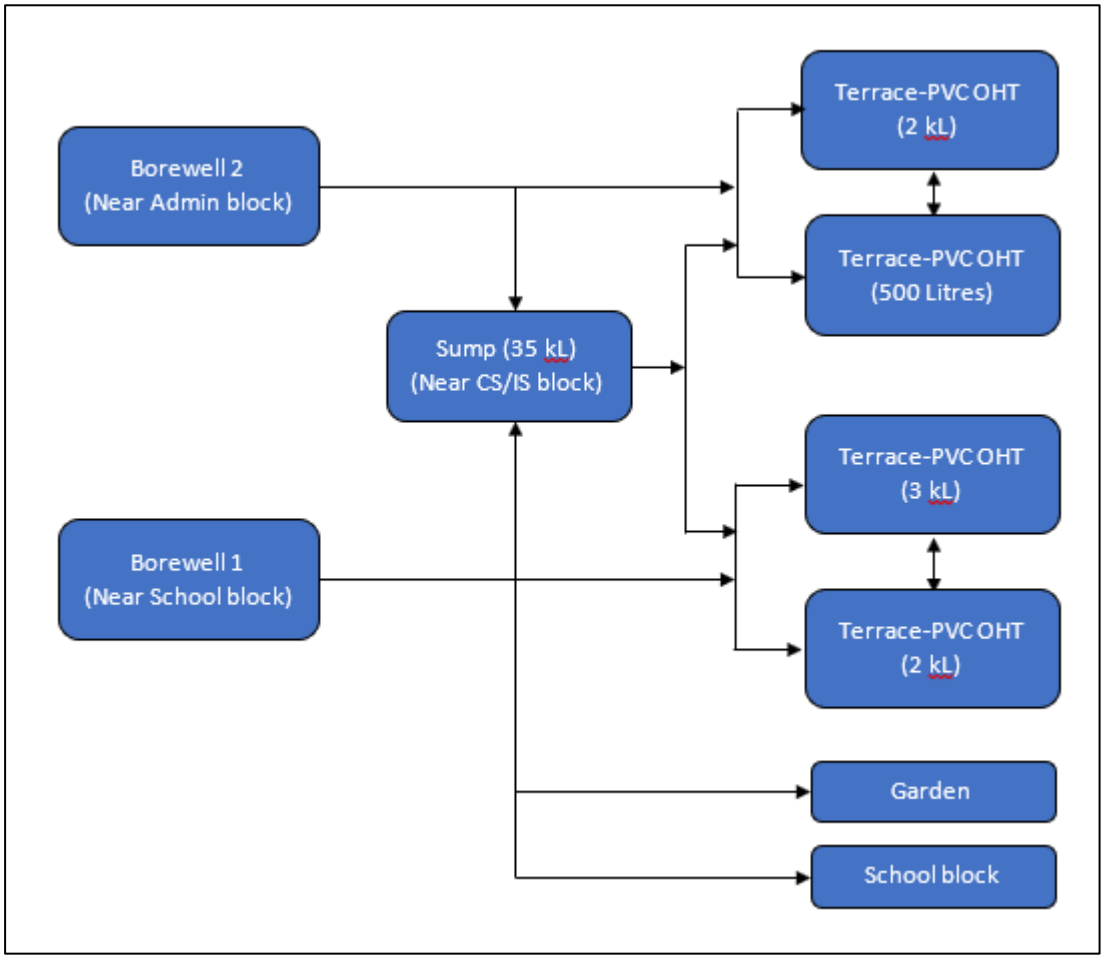


Figure 4-5: Overall schematic of raw water system

Dr. Sir. M. Visveswaraya Block (Admin block):

Borewell 2 is the primary source of water supply for Dr. Sir. M. Visveswaraya block (Admin block). From borewell 2, water is pumped to the two PVC overhead tanks located at the terrace. The capacity of tanks are 2000 litres and 500 litres.

The water from 2000 litres PVC overhead tank is distributed to RO plant input, student's toilets, staff toilets, laboratories, canteen and garden. Dedicated pipeline is provided for RO plant input. The 2000 litres PVC overhead tank is shown in figure 4-6.

Figure 4-6: 2000 litres PVC overhead tank

The water from 500 litres PVC overhead tank is distributed to chairman room, principal chamber, mechanical staff room and civil lab. The 500 litres PVC overhead tank is shown in figure 4-7.

Figure 4-7: 500 litres PVC overhead tank

In case of maintenance at borewell 2, the water is supplied to PVC overhead tanks from sump (near Dr. A.P.J. Abdul Kalam block).

If borewell 1 is under maintenance, then borewell 2 is used to fill the sump.

Dr. A.P.J. Abdul Kalam Block (CS & IS block):

Borewell 1 (near school block) is the primary source of water supply for Dr. A.P.J. Abdul Kalam block (CS & IS block). From borewell 1, water is pumped directly to the two PVC overhead tanks located at the terrace. The capacity of tanks are 3000 litres and 2000 litres. Both tanks are interconnected and provided with valve mechanism. In case of maintenance at borewell 1, water from sump is pumped to the terrace PVC overhead tanks.

The water from PVC overhead tanks is distributed to student's toilets, staff toilets, laboratories, and garden. The PVC overhead tanks are shown in figure 4-8.

Figure 4-8: PVC overhead tanks (3 kL & 2 kL)

The interconnection between tanks with valve control is shown in figure 4-9.

Figure 4-9: Interconnection between tanks with valve control

4.1.2. Drinking water system

To provide drinking water, RO plant is installed at ground floor of Dr. Sir. M. Visveswaraya block (Admin block). The input water for RO plant is supplied from 2000 litres terrace PVC overhead tank. The permeate rate of RO plant is 250 litres per hour. The RO drinking water is stored in 500 litres RO tank. From RO tank, the RO water is filled in 25 litres can and kept at each floor for consumption.

The schematic block diagram RO drinking water system is shown in figure 4-10.

Figure 4-10: Schematic of RO drinking water system

The RO plant and RO tank is shown in figure 4-11.

Figure 4-11: RO plant & RO tank

The 25 litres water cans kept at each department is shown bin figure 4-12.

Figure 4-12: 25 litres water can in each department

The RO reject water is used for watering the garden. The hose is connected at RO reject tap and it is used for watering the garden. The image is shown below in figure 4-13.

Figure 4-13: RO Reject tap with hose

4.1.3. Rain water system

Rain water harvesting system is not available in the campus. Provisions for rain water to drain from terrace is provided in both blocks. The rain water from terrace of buildings directly falls on ground and it is absorbed.

Provisions for draining rain water from terrace to ground in shown in figure 4-14.

Figure 4-14: Rain water pipes at terrace

4.1.4. Waste Water System:

The sources of waste water in the college campus are as follows

- Washrooms
- Toilets
- Labs
- Canteen

The schematic of waste water system is shown in figure 4-15.

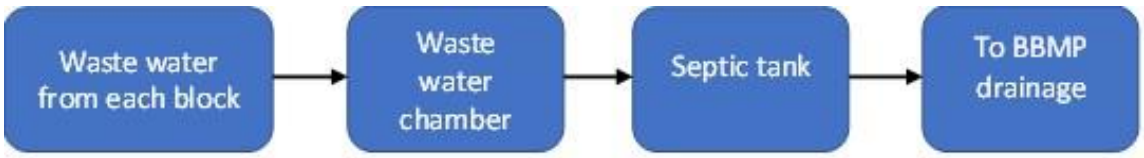


Figure 4-15: Schematic of waste water system

Three waste water tanks are available. First tank is near the Dr. A.P.J. Abdul kalam block, second tank is near transformer yard, and third one near the compound wall of canteen.

Waste water from the wash rooms, toilets and labs are connected to the waste water chambers in each block. Then, from chambers the waste water is collected in a sewage tank. From sewage tank, the overflowing sewage water is made to reach a chamber. Then, from this chamber the sewage reaches the BWSSB drainage system through underground pipes. At present, the underground connection is provided but BWSSB drainage system is yet to be finished.

Whenever the sewage water tank is filled, it is disposed using sewage water disposal tanker lorries. The images of waste water pipeline from rest rooms, waste water chamber and waste water septic tank are shown in figure 4-16 to figure 4-18.

Figure 4-16: Waste water pipeline from rest rooms

Figure 4-17: Waste water chamber

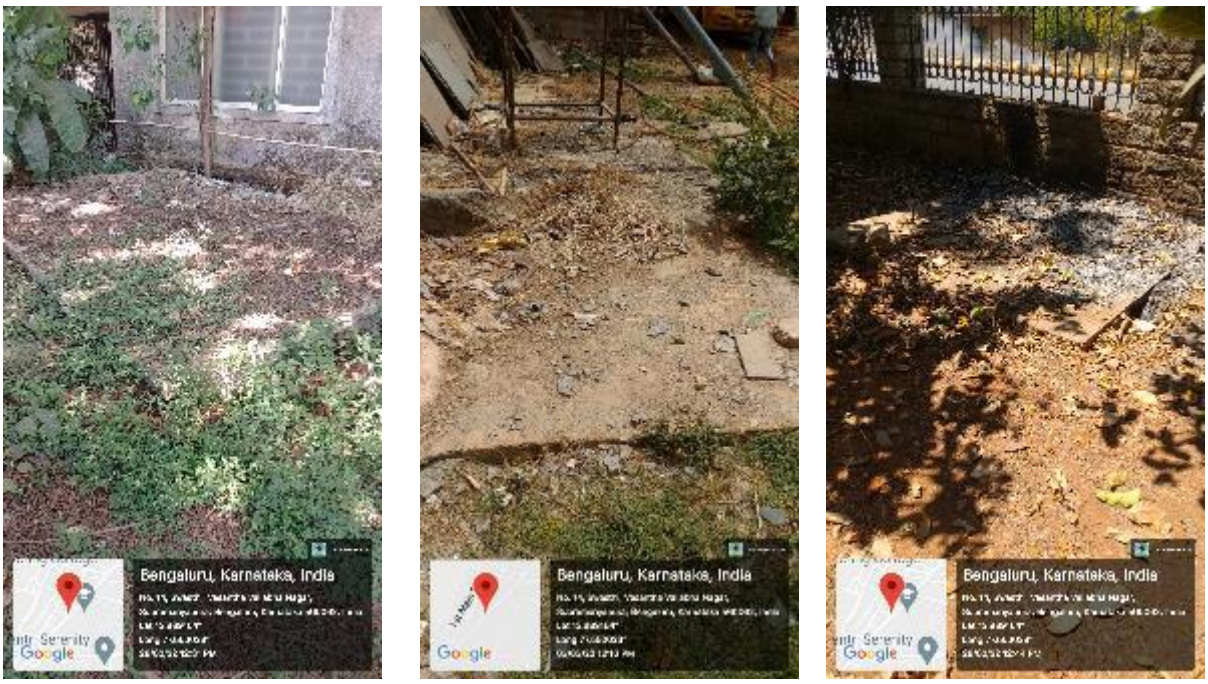


Figure 4-18: Waste water tanks of admin block, CS/IS block & canteen

4.2. Best Practices Implemented for Water Conservation

4.2.1. Aerator for taps

Aerator for taps is installed at labs and in handwash sinks to save water. The image of tap with aerator is shown in figure 4-19.

Figure 4-19: Tap with aerator

The aerator is a small attachment that either fits onto the end of the tap or can be inserted inside of the existing spout. These water saving devices will control the amount of water that flows through the tap without affecting the water pressure as they mix the water with air which will save water and money.

The aerators will separate a single flow of water into many tiny streams which introduces the air in to the water flow. Also, as there is less space for the water to flow through, the water flow is reduced, resulting in water savings. As the water pressure is maintained, most people don't notice a difference in the amount of water coming out of an aerated faucet yet benefit from the water efficiency.

Tap aerators are of most use to those with older taps which run on average around 15 litres of water per minute. Adding an aerator to an older tap can reduce this to as little as 6 litres of water per minute.

The biggest water saving benefit is achieved in the hand wash sinks where you are often turning the taps on and off to wash your hands and for other uses.

4.2.2. Use of Push taps

Push type taps are installed for urinals. This helps to save water.

A push tap is a type of faucet that can be operated by just pushing a button in order to activate the water flow. It's a self-closing faucet which if once pressed, emits water until the pressing is held and automatically shuts off if pressing is released.

The image of push taps installed in boy's toilet is shown in figure 4-20.

Figure 4-20: Push type tap for urinals

Push type taps are designed to control wastage of water caused due to human laxity. Also, it eliminates the risk of the tap being left on by a user.

Push type taps are more water-saving when compared to the other taps because they have a controlled water stream which limits the water use.

4.2.3. Use of Pressmatic taps

Pressmatic taps are installed for handwash basins and for urinals to save water. The pressmatic tap installed is shown in figure 4-21.

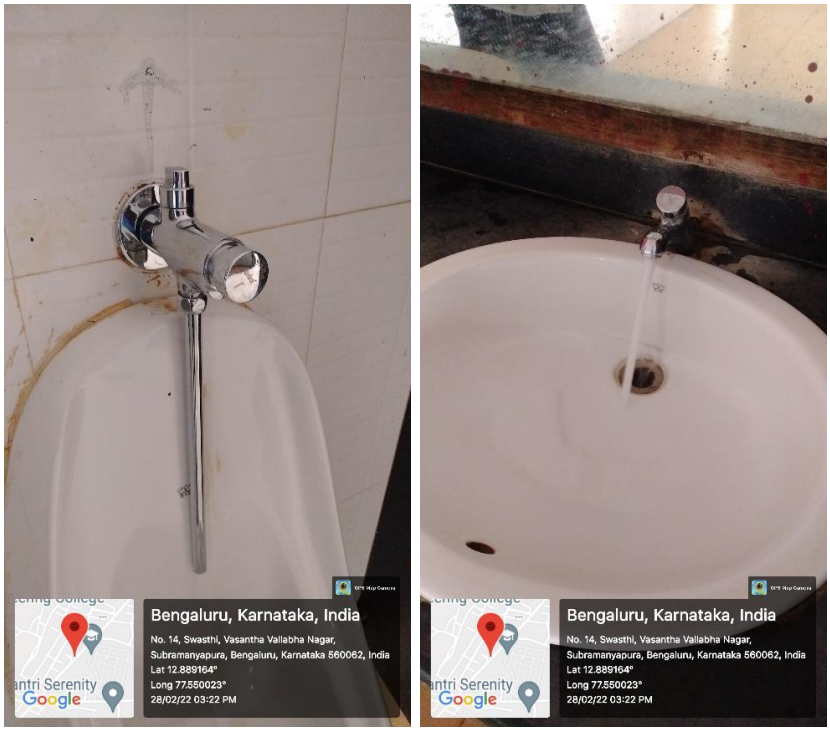


Figure 4-21: Pressmatic tap for urinals & handwash basins

Pressmatic taps helps in saving water using auto closing valve mechanism after 8 to 10 seconds.

Pressmatic taps generally include an aerator in the spout which disperses the water and means that much less is needed for washing than is the case with traditional taps. This means that Pressmatic taps generally have a much lower flow rate than traditional hand-operated basin taps.

4.2.4. Usage of bucket and mop cleaning instead of hose:

For cleaning purpose, using a hose will result in lot of water wastage. In order to avoid wastage of water, cleaning activities are done using a bucket and mop. The sample image of bucket and mop for cleaning is shown in figure 4-22.

Figure 4-22: Bucket and mop

College buses are also cleaned using a wet towel instead of using hose from tap for cleaning. The sample image bus cleaning activity is shown in figure 4-23.

Figure 4-23: Bus cleaning using cloth and bucket water

4.2.5. Regular water testing

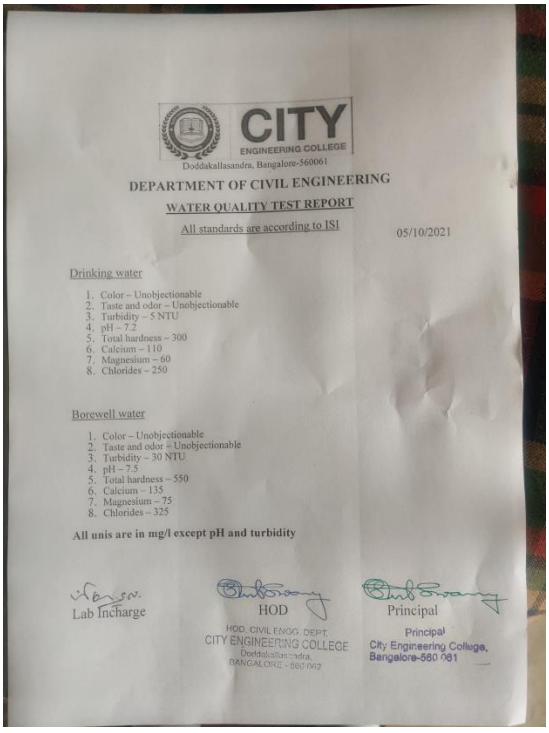
Testing water quality on a regular basis is an important part of maintaining a safe and reliable source. The test result allows to properly addressing the specific problems of a water supply. This will help ensure that the water source is being properly protected from potential contamination, and that appropriate treatment is selected and operating properly.

It is important to test the suitability of water quality for its intended use, whether it be livestock watering, chemical spraying, or drinking water. This will assist in making informed decisions about your water and how you use it.

Regular testing is important to:

- Identify existing problems
- Ensure water is suitable for the intended use, especially if used for drinking by humans and animals
- Track changes over time
- Determine the effectiveness of a treatment system

Water testing is carried out for RO purified water and borewell water. The sample water test report for borewell water and RO purified is shown in figure 4-24



CITY
ENGINEERING COLLEGE
Doddakallasandra, Bangalore-560061

DEPARTMENT OF CIVIL ENGINEERING

WATER QUALITY TEST REPORT

All standards are according to ISI

05/10/2021

Drinking water

1. Color – Unobjectionable
2. Taste and odor – Unobjectionable
3. Turbidity – 5 NTU
4. pH – 7.2
5. Total hardness – 300
6. Calcium – 110
7. Magnesium – 60
8. Chlorides – 250

Borewell water

1. Color – Unobjectionable
2. Taste and odor – Unobjectionable
3. Turbidity – 30 NTU
4. pH – 7.5
5. Total hardness – 550
6. Calcium – 135
7. Magnesium – 75
8. Chlorides – 325

All unis are in mg/l except pH and turbidity

Lab Incharge

HOD

HOD, CIVIL ENGG. DEPT.
CITY ENGINEERING COLLEGE
Doddakallasandra,
BANGALORE - 560 061

Principal

Principal
City Engineering College,
Bangalore-560 061

Figure 4-24: Water test report

4.2.6. Regular maintenance of RO plant

The RO plant is checked regularly. If any maintenance required then it is done at the earliest. The sample image of expense bill for RO maintenance is shown in figure 4-25.

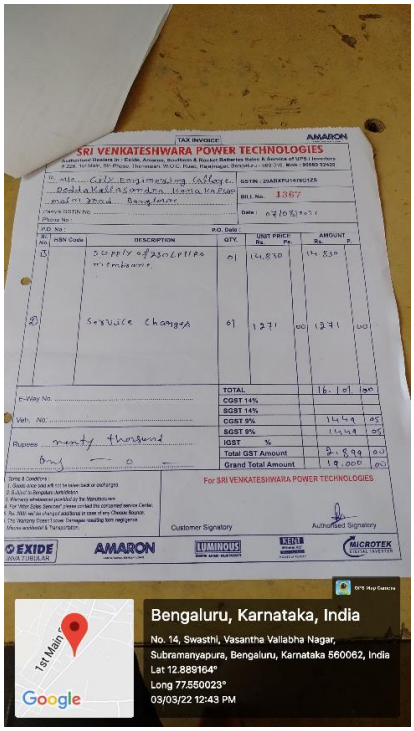


Figure 4-25: RO plant - Maintenance expenses bill

4.2.7. Purchase of plumbing materials

If any maintenance required for plumbing system, then it is done at the earliest. The sample image of purchase bill for plumbing materials is shown in figure 4-26.

Figure 4-26: Purchase bill – Plumbing materials

4.2.8. Maintenance Team

The maintenance team consist of five members. The team carry out maintenance activities in concern sections i.e., electrical, water and gardening. The maintenance team list shared by the institution is given in table 4-2.

S. No	Name	Designation
1.	Mr. Lokesh M K	Electrician
2.	Mr. Rangaswamy	Electrician
3.	Mr. Vikas	Plumber
4.	Mr. Chikkanna	Gardener
5.	Mr. Venkateshappa	Gardener

Table 4-2: Details of Maintenance team

4.2.9. Program on "Jal Shakthi Abhiyan"

The NSS unit of City Engineering College, organized "Jal Shakthi Abhiyan" program on 4th Apr 2022 to 13th April 2022 to create awareness on water conservation and recharge of water. The sample image of the report is shown in figure 4-27.

CITY ENGINEERING COLLEGE

BENGALURU

NATIONAL SERVICE SCHEME

Date: 05/05/2022

Report on Jal Shakti Abhiyan: Catch the Rain – 2022

NSSof City Engineering College, Bengalura, organised Jal Shakti Abhiyan fromApril 04thto April 13thnear Thittahalli & Chinnakurchi village to create awareness and bring together all stakeholders in a mass movement to conserve and recharge water. Water conservation and recharge is of utmost importance to ensure water security for our country to protect lives and livelihoods. Ministry of Jal Shakti has proposed implementation of "Jal Shakti Abiyan: Catch The Rain-2022". The campaign is to be implemented with the theme "Catch the Rain, where it falls, when it falls".

Sixth semester students of Civil Engineering Department were actively participated in the programme. Gopikishan J, Programme Coordinator, NSS, CEC welcomed the gathering.Vinaykumar S N, Manjunath K E, Jayanth K S, Assistant professors, CEC, initiated the activity among volunteers. The volunteers created Public Awareness about Rain Water Harvesting, Water conservation, Reuse&borewell recharge. Refreshments were distributed to public gathered. We heartily express our thanks towards the K.Gollahalli Grama Panchayath, Thittahalli & Chinnakurchi villagers &head of the institute for their kind and cooperative support all the time for the success of the event.

Figure 4-27: Program on "Jal Shakthi Abhiyan"

4.3. Recommendations

4.3.1. Rain water harvesting

The rain water from terrace of each of blocks is made to drain on ground level through pipes and it is absorbed by earth surface. At present no rain water harvesting system is installed in the campus.

The rain water can be used for recharging the ground water level by constructing an rain water harvesting system or an open borewell recharge pond. This will enhance the ground water level.

Rain water harvesting will help in collection of rain falling on earth surfaces for beneficial uses before it drains away as run-off. Harvested rain water can be utilized immediately or after storage.

However, initiatives have been taken for rain water harvesting system implementation. Implementing rain water harvesting system will help in maintaining ground water level.

4.3.2. Borewell/Ground water recharge System:

Two borewells are available within the college campus. Borewells is the only source of water used in campus. Hence, it is necessary to consider a borewell recharge system so that the ground water level can be well maintained.

Water resource is being categorized as a renewable energy source, which means, natural water resources can be easily replenished back to nature.

Borewell recharging technically focuses on the use of harvested surface water (obtained via rainfall or nearby water bodies) where runoff water begins to pass through a natural filter made up of large and small stones. Then, there is another layer of sand through which water passes and finally, it perforates in the borewell pipe via a fine mesh which is wrapped around the drilled casing pipe. The fine mesh ensures the removal of big and tiny impurities before the water enters the borewell.

Benefits :

- Assured supply of water for irrigation and potable water, in rural and urban areas
- Increased water table reduces pumping costs.
- Recharge of Groundwater, replenishes the deeper layers of the earth's crust which in turn insulates the earth from rise in temperature, reducing global warming
- Groundwater Recharge will bridge the gap between acute shortage & available water during the peak summer months.
- Provides hygienic and safe drinking water(Death and disease, especially in children under the age of five due to unsafe drinking water)
- Reduces hardness , salinity and TDS contents in the bore well
- Reduces significant carbon foot prints
- Prevents water logging in low lying areas.

4.3.3. RO Plant Reject water:

- If RO plant is Single stage, then TDS level of RO reject water will be low. For example: When 100 L of raw water is treated in RO plant, it produces 40 L of drinking water (permeate) and 60 L of reject water (reject).

  This type of system will have low TDS in reject water

- If RO plant is Multi stage, then TDS level of RO reject water will be high. For example: When 100 L of raw water is treated in RO plant, it produces 80 L of drinking water (permeate) and 20 L of reject water (reject).

Hence, it is recommended to check the reject water quality parameters from NABL Accredited Lab. Based on the results the usage of water shall be planned accordingly

Uses of RO plant reject water:

1. **Cleaning and Toilet flushing**

   Every single flush sends approximately 5 to 7 litres of potable water down the drain.RO waste water can be used effectively to reduce this wastage of clean water by using it to flush your toilets. With a periodical clean-up using common toilet cleaners, the chances of discoloration and salt deposits can be avoided.

2. **Floor mopping and cleaning**

   Using the RO waste water for mopping the floor is easy and will definitely save tens of litres of clean water every day. It can be used for all the floor mopping, cleaning windows, work places, etc., If TDS is higher than 2000 PPM then dilute with raw water or use alternate days.

3. **Washing utensils**

   Another useful application for Reverse Osmosis waste water is to wash utensils. Simply store the waste water in bucket or tank, make sure to place the bucket for collecting RO waste water near your washing area so it can be used easily when you clean your utensils.

4. **Cleaning vehicles**

   A single car wash could consume anywhere between 14 litres (for car wash using a bucket) to 75 litres (for car wash using a hosepipe) of water. Simply store the waste water in some tank or bucket and reuse it for washing your car. Water with a TDS level of

1200 – 1500 PPM can be safely used for car washing. If the TDS level of waste water is high you can mix tap water to dilute it.

5. Watering garden or plants

The wastewater can be used for watering your plants to keep your indoor or terrace garden green. For gardening/irrigation use, a TDS level of up to 2100 PPM is permissible. You should also check out the percentage of Sodium, it should be less than 60 % (i.e., Na / Na + Ca + Mg). High Sodium content causes loss of soil porosity and therefore harmful to soil fertility in the long run.

4.3.4. Sewage Treatment Plant

The waste water sources are washrooms, toilets and labs. The waste water from both blocks is sent to septic tank and then to BBMP drainage through underground pipe.

Cost effective and advanced water purification technologies are available to recycle and reuse the waste (sewage) water. Integration of recycled water use in the existing system will result in reduced raw water usage. An STP plant will treat the waste water to make it fit for safe disposal.

At present, raw water is used for watering the garden. If STP is established, the treated water can be used for watering the garden. Also, it can be used in dual piping system for toilet flushing.

Hence, it is advised to establish a Sewage Treatment Plant.

4.3.5. Water flow meters

In college campus, two borewells are used as sources of water. Water is pumped daily from the borewells and distributed to overhead tanks available in each block for usage.

However, data regarding the quantity of water used per day is not accounted. With the presence of flow meters, it is possible to measure quantity of water used per day. Installing water flow meters at each block will quantify the water used in individual blocks. Whereas, installing flow meters in borewells will help in quantifying overall water consumption.

Measurement is the first step towards conservation of water. Hence, water usage has to be measured by installing proper metering and monitoring systems.

4.3.6. Waterless urinals

Traditional water-based urinals are one of the major waters consuming area in any facility. Apart from the normal water usage, the cost for handling raw water to the urinals is an added expenditure. Also, maintaining the water taps and flushes for urinals will add to maintenance cost as well.

To overcome these challenges and as part of water conservation measure, implementation of waterless urinals can be incorporated in the campus.

Waterless urinals may look similar to regular flush urinals, but they use no water and have no flush valves. The sample image of waterless urinals is shown in figure 4-28.

Figure 4-28: Waterless urinals

Schematic of Water less urinals functioning:

Figure 4-29 shows the functioning of waterless urinals.

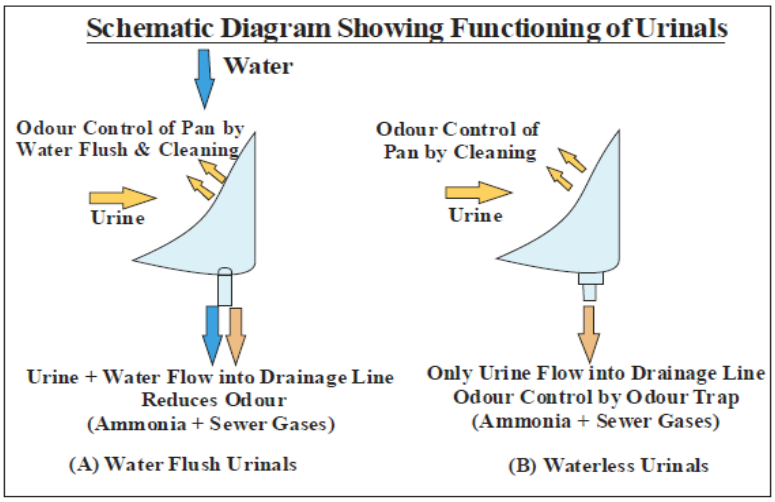


Figure 4-29: Schematic of function of Waterless urinals

The advantages of water less urinals are as follows:

- Reduces water bill
- Reduces usage of chemicals
- Improves overall bathroom hygiene
- Save enormous quantities of freshwater
- Enhance efficiencies of sewer lines and wastewater treatment plants
- Optimize cost of plumbing accessories at supply & consumption ends
- Conserve electricity used for pumping water & treating wastewater

Types of Waterless urinals and Pricing:

1. Sealant Liquid Traps
    a. Sealant liquids have lower specific gravity than urine, these allow passage of urine but prevent odour emitted by drainage lines.
    b. The sealant liquid needs refilling as they evaporate and also get washed away owing to the urine flow.
    c. The cost of one waterless urinal pans with sealant liquid trap ranges from Rs 7000/- to Rs 18,000/-.
2. Membrane based Traps
    a. Membrane based traps use rubber, silicone or LDPE (low density polyethylene) in the shape of tubes is used for controlling odour.
    b. The cleaning frequency depends directly on the number of uses per day.
    c. Membranes need to be replaced between three months to six months depending on quantum of usage
    d. The approximate trap costing is around Rs.250/-. The current trap design fits only to low-cost basins from the bottom

Checklist for water less urinals:

- Regular cleaning
- Do not use brushes, towels or abrasive cleaners
- Never put water down a waterless urinal
- Use the correct cleaning products

4.3.7. Awareness posters and campaigns

In order to create awareness regarding water conservation, sign boards / posters indicating not to waste water can be made available at appropriate locations like handwash area, drinking water tap points.

Similarly, posters indicating the importance of water can be made available throughout the campus.

To create awareness about the water conservation among new students and staff, awareness programs/campaigns need to be conducted inside the campus on a periodic basis.

5. ENERGY AUDIT

5.1. Facility Description

City Engineering College – Bannerghatta Road, receives power supply from the state electricity board (BESCOM – Bangalore Electricity Supply Company Limited) ISRO Layout substation at HT 11 kV. CEC has availed power supply, with connection – RR. No 0413062796 (S5HT37) with 1HT2C1tariff.

Incoming power supply from BESCOM is received at the transformer yard inside the college premises. The 11 kV rated HT power supply is stepped down to LT 433V, by one number of 250 kVA rated transformer. Transformer unit installed inside college premises is as shown in the figure 5-1.

Figure 5-1: Transformer unit Installed in the campus

The name plate details of transformer are given in table 5-1.

S. No.	Description	Units	Details
1	Rated Capacity	kVA	250
2	Rated Voltage Prim/Sec	kV	11/0.433
3	Rated Current Prim/Sec	A	13.12 / 333.4
4	Type of Cooling	-	ONAN
5	Frequency	Hz	50
6	Impedance volts%	-	2.5%
7	Phase	-	3
8	Make	-	Vivekanand Electrical Industries Pvt. Ltd.

Table 5-1: Name plate details of transformer

The LT supply from the transformer is taken to the main distribution panel inside the DG room located near transformer yard. Electrical panel room is as shown in the figure 5-2.

Figure 5-2: Main panel in DG room

Power supply cables from the electrical panel room is distributed to the various distribuition panels placed inside the campus. From main panel room, power supply is catered to sub

distribution panels of admin block and CS/IS block.The sub distribution panels at admin block is shown in figure 5-3

Figure 5-3: Sub-distribution panels for admin block

The sub distribution panels at CS/IS block is shown in figure 5-4.

Figure 5-4: Sub -distribution panels for CS/IS block

In each floor, MCBs are provided for load distribution. The load distribution box MCBs are shown in figure 5-5.

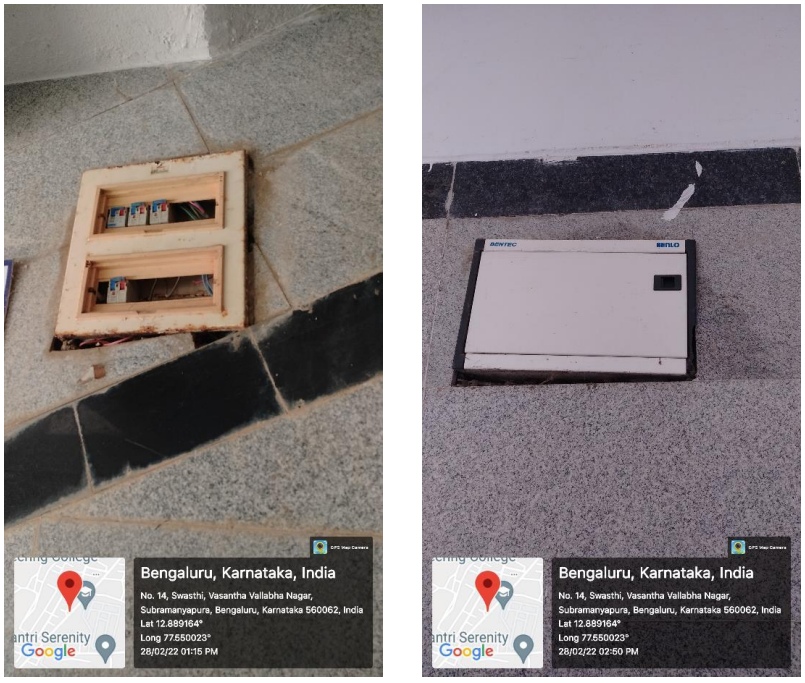


Figure 5-5: Load distribution box MCBs at each floor

One number of DG (Diesel Generator) sets are used for backup power supply, during power failure from BESCOM. DG set installed at the college premises is shown in the figure 5-6. The name plate specification rating of the DG set is shown in the table 5-6.

Figure 5-6: Diesel Generator (DG) sets

S. No.	Description	Unit	Details
1	Rated Capacity	kVA	125
2	Rated voltage	Volts	415
3	Rated current	Ampere	173.9
4	Frequency	Hz	50
5	Power factor	-	0.80
6	Rated Demand	kVA	125
7	Rated Power	kW	100
8	Make	-	Kirloskar

Table 5-2: DG set specifications

UPS is available in the campus to give the backup power supply for all the critical loads like computer labs, server rooms etc. Sample picture of the UPS room at admin block is shown in the figure 5-7.

Figure 5-7: UPS in computer Lab - Admin block

Sample picture of the UPS room at CS/IS block is shown in the figure 5-8.

Figure 5-8: UPS room in Dr. A.P.J. Abdul Kalam block

List of UPS system with its rated capacity are shown in figure 5-9.

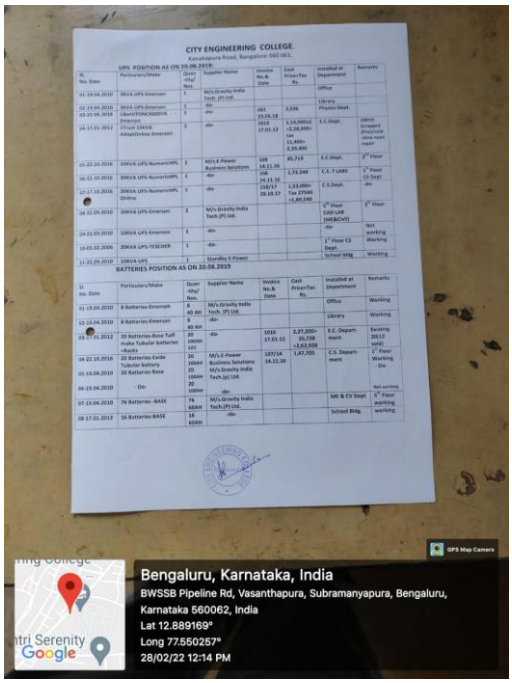


Figure 5-9: List of UPS details

Note: ***As part of regular practice the inverters and batteries are always kept in a separate room and electrical panel rooms are separate.***

5.1.1. Tariff Structure

The sanctioned contract demand of the campus is 80 kVA at specified voltage of 11 kV. Electricity supply from BESCOM is billed under HT2(c)(ii) schedule of tariffs. The tariff includes demand charges of Rs. 240 per kVA (Earlier Rs. 220 per kVA), and energy charges of Rs.7.20 per kWh for the submeter 3236222806 and Rs.9.25 per kWh for the submeter 0668407874.

The kVA demand charges @ Rs. 240/kVA of maximum demand recorded during the month or 85% of the contract demand, whichever is higher

5.1.2. Electricity Consumption Data

Details of electricity consumption for the last one year have been collected and Salient features of electrical energy details are given in table 5-3.

S. No.	Description	Unit	Details
1	Contract Demand	kVA	80
2	Demand Charges	Rs./kVA	240
3	Maximum Demand Recorded during last one year	kVA	38
4	Average Monthly Energy Consumption during last one year	kWh	9013.8
5	Average System Power Factor		0.945
6	Average Energy Charges considered for savings calculations	Rs./ kWh	8.39

Table 5-3: Electricity Bill Parameters

Figure 5-10 indicates the month wise recorded maximum demand and month wise energy consumption of the college campus for the last one year (Jan 2021 to Jan 2022) and ((Jan 2022 to Nov 2022)

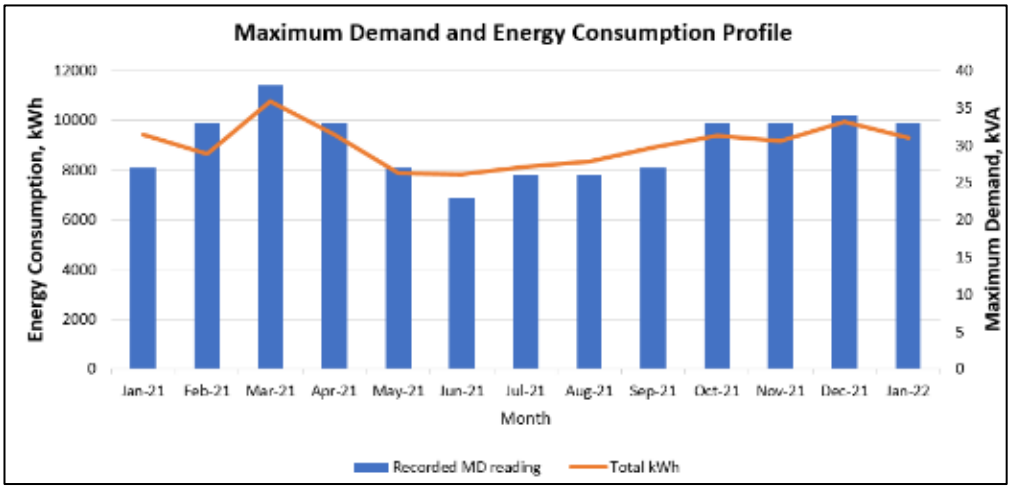


Figure 5-10: Month wise Recorded Maximum Demand and Energy Consumption

From the month-wise maximum demand curve, it was observed that maximum demand registered during the month of March 2021 was found to be **38 kVA** and is the peak demand during the last one year of billing period. Average of registered maximum demand during January-2021 to January 2022 is **30.23 kVA.**

From the month-wise energy consumption profile, it was observed maximum energy consumption was registered during March 2021. Average monthly energy consumption is **9013.8 kWh**.

5.2. Best Practices Implemented for Energy Conservation

During the study, observations were carried out on the usage of the inventories in the college building premises. In the intension of saving the electricity, various measures have been adopted in the college. Computers and AC units are used only during the working hours, after completion of class hours – fans, lights, computers and AC units are found to be turned OFF. This practice is followed across the college premises (class rooms, labs, staff rooms, office rooms, library and seminar halls).

5.2.1. Day-light Integration:

During the audit phase classrooms, staff-rooms, laboratories, seminar hall, UPS & batteries room and library areas were surveyed for illumination levels and fresh air-circulation. It was observed most of the rooms are well ventilated and day-light integrated; sample photos are shown in figure 5-11 to figure 5-15.

Figure 5-11: Day-light integrated Class room

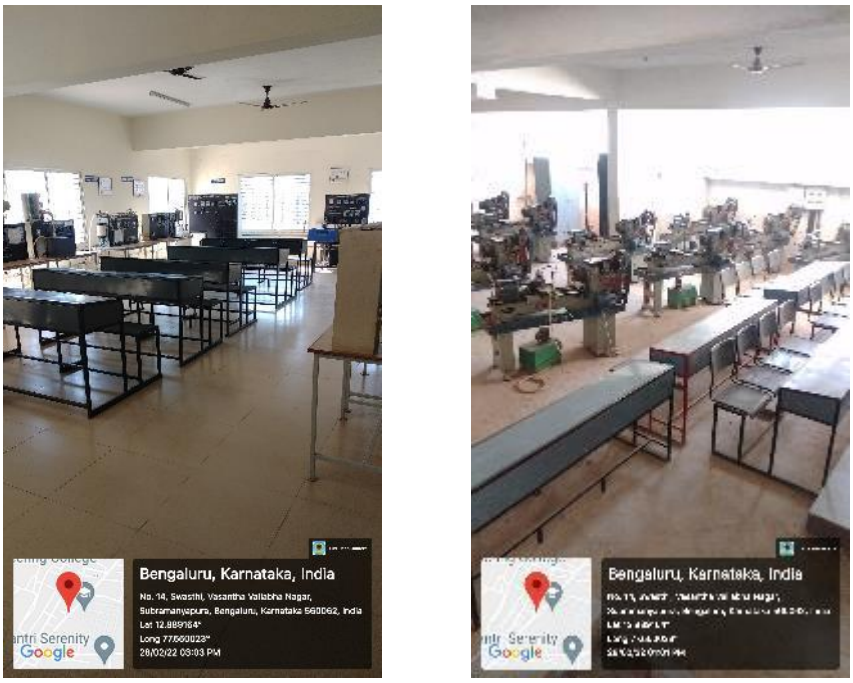


Figure 5-12: Well-ventilated and day-light integrated labs

Figure 5-13: Well-ventilated and day-light integrated Seminar Hall

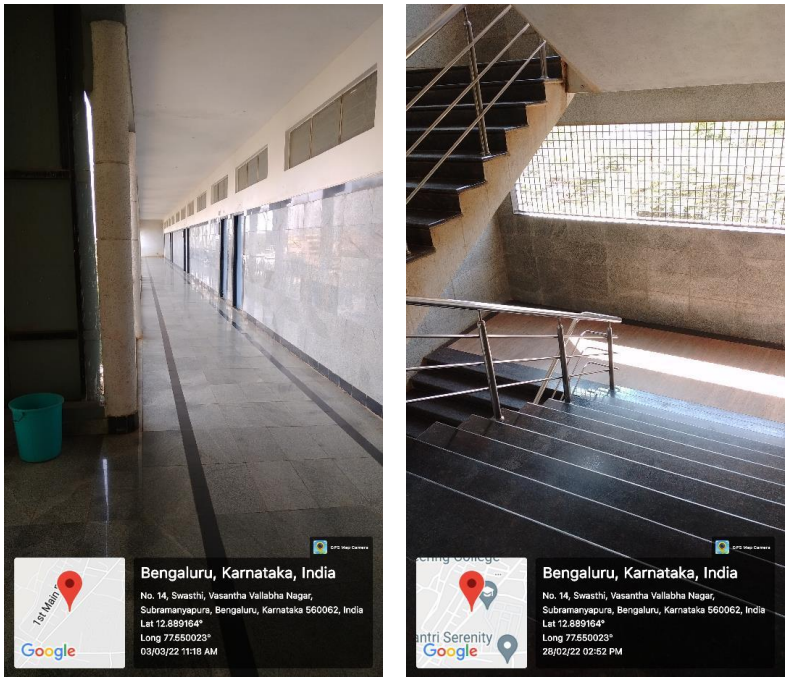


Figure 5-14: Well-ventilated and day-light integrated campus

Figure 5-15: Well-ventilated and day-light integrated campus

5.2.2. Installation of LED lights

LED tube lights and bulbs are used in the office rooms, staff-rooms, rest rooms areas. Building façade lightings are LED type. Sample photo of façade LED light used in the college area is shown in figure 5-16.

Figure 5-16: Use of facade LED lights

The sample image of LED fixture purchase bill is shown in figure 5-17.

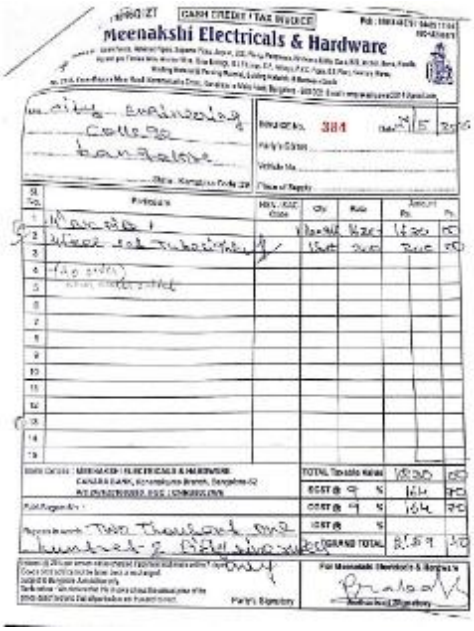


Figure 5-17: Purchase bill – LED fixture

The cost savings by existing 20W LED tube lights are given in table 5-4.

S. No.	Description	Unit	Values
1	Rated Wattage of LED lamps installed	W	20
2	Quantity of LED lamps installed	Nos	19
3	Rated wattage of lamps used earlier	W	40
4	Savings per lamp by installation of LED lamps	W	20
5	Total savings	kW	0.38
6	Working hours per day	hours	9
7	No. of working days per year	days	250
8	Annual electricity savings	kWh	855
9	Average electricity cost	Rs. /kWh	8.39
10	Annual cost savings achieved per year	Rs. lakh/year	0.07
11	CO2 mitigations per year	Tons/year	0.73

Table 5-4: Annual cost savings by existing LED tube lights

The cost savings by existing 9W LED bulbs are given in table 5-5.

S. No.	Description	Unit	Values
1	Rated Wattage of LED lamps installed	W	9
2	Quantity of LED lamps installed	Nos.	30
3	Rated wattage of CFL lamps used earlier	W	14
4	Savings per lamp by installation of LED lamps	W	5
5	Total savings	kW	0.15
6	Working hours per day	hours	9
7	No. of working days per year	days	250
8	Annual electricity savings	kWh	337.5
9	Average electricity cost	Rs. /kWh	8.39
10	Annual cost savings achieved per year	Rs. lakh/year	0.03
11	CO2 mitigations per year	Tons/year	0.29

Table 5-5: Annual cost savings by existing LED bulbs

5.2.3. Installation of LED/LCD monitors

LED/LCD monitors are used for all the desktop computers in staff rooms and in computer labs. Sample photos of the computer labs are as shown in the figure 5-18.

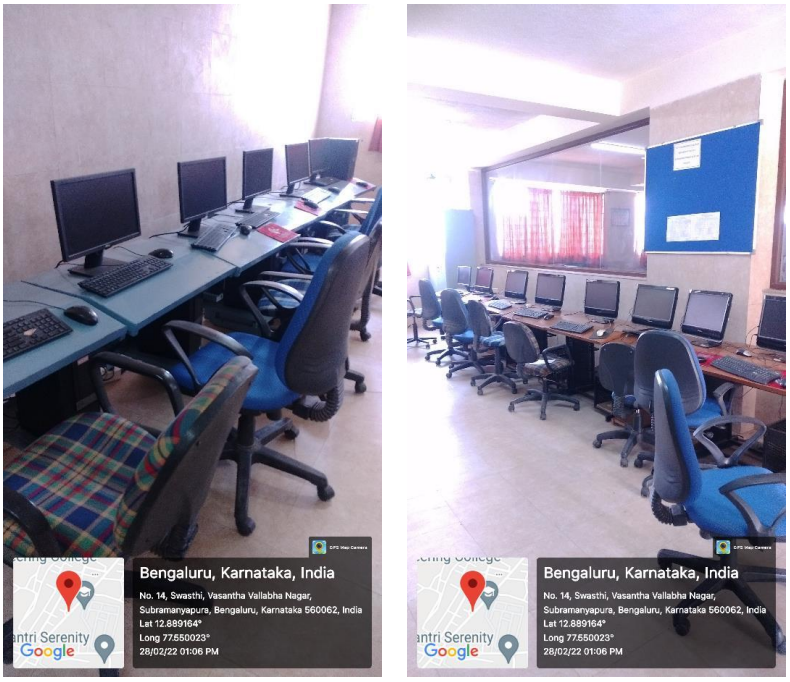


Figure 5-18: Use of LED/LCD monitors in the computer labs

5.2.4. LED Street Lights

Solar street lights with sensors have been installed inside the campus. Each LED Street light consists of sensor and LED light. In college campus, nine solar LED lights are available. Sample photos of the street lights are shown in figure 5-19.

Figure 5-19: Solar LED Street lights with sensors

Savings achieved due to installation of LED street lights is given in table 5-6.

S. No.	Description	Unit	Values
1	Rated Wattage of LED street light installed	W	40
2	Quantity of LED lamps installed	Nos	9
3	Rated wattage of lamps used earlier	W	150
4	Savings per lamp by installation of LED lamps	W	110
5	Total savings	kW	0.99
6	Working hours per day (6pm to 6am)	hours	12
7	No. of working days per year	days	365
8	Annual electricity savings	kWh	4336.2
9	Average electricity cost	Rs./kWh	8.39
10	Annual cost savings achieved per year	Rs. lakh/year	0.36
11	CO2 mitigations per year	Tons/year	3.69

Table 5-6: Annual cost savings by LED street lights

5.2.5. Maintenance of Earth pits

Separate earth pits are available for HT pole, transformer, HT metering cubicle, DG set, main power control panel and lift. The earth pits are well maintained and covered properly with lids. The sample images of earth pits are shown in figure 5-20 and figure 5-21.

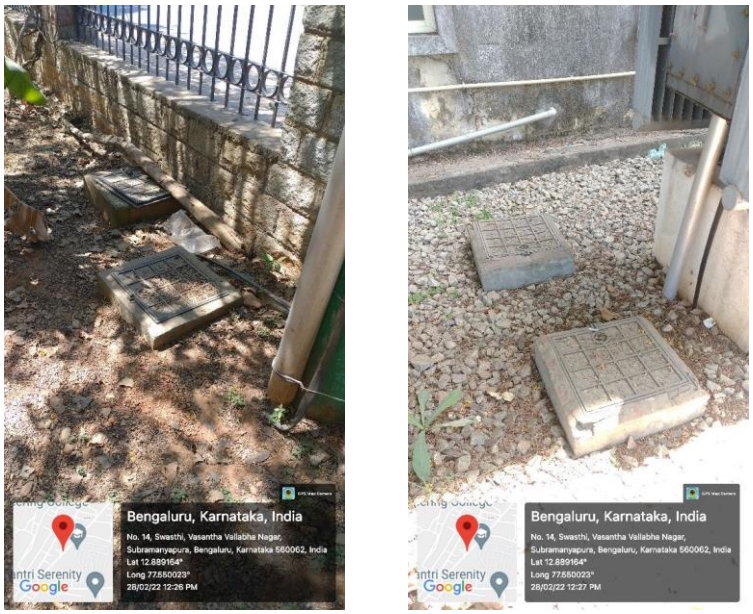


Figure 5-20: Earth pits for HT pole and transformer yard

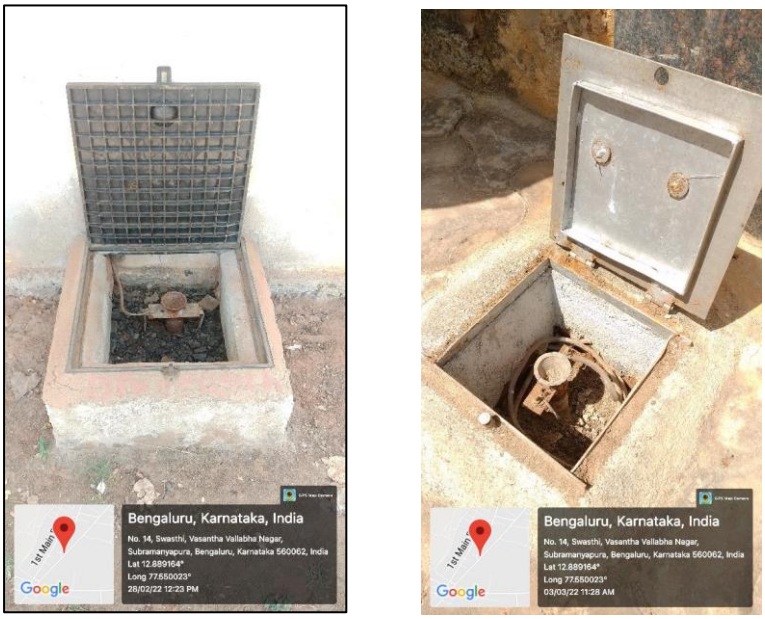


Figure 5-21: Earth pits for DG set and Lift

5.2.6. DG set log register

The hours of operation of DG set are logged on register regularly. Any problems on DG set are rectified immediately. The DG operating hours register is shown in figure 5-22.

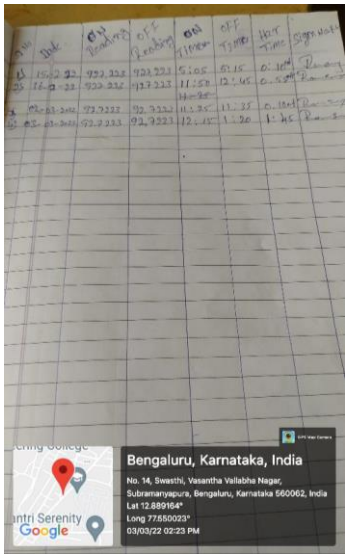


Figure 5-22: DG operating hours Register

The sample image of DG set field service report is shown in figure 5-23.

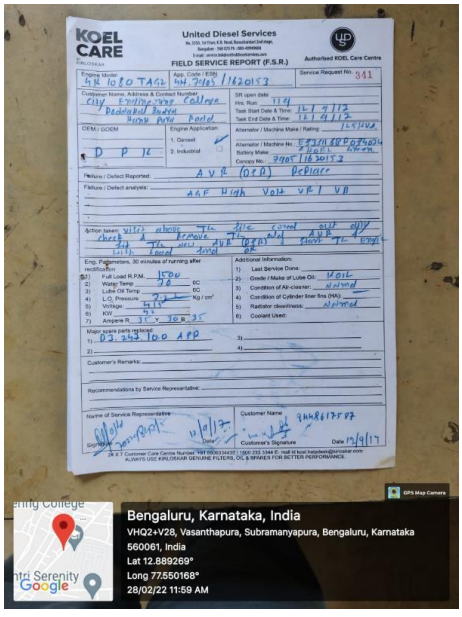


Figure 5-23: DG set - Field service report

The sample image of purchase bill for DG set service work is shown in figure 5-24.

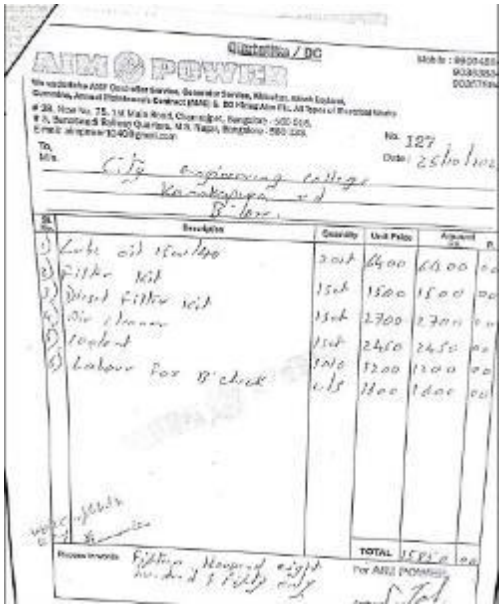


Figure 5-24: Purchase bill – DG set service work

5.2.7. Preventive maintenance for Lift

Lift facility available at the Dr. Sir. M. Visveswaraya block (admin block). The preventive maintenance is done regularly. The lift invoice copy and preventive maintenance report is shown in figure 5-25 and figure 5-26.

Figure 5-25: Lift - Invoice copy

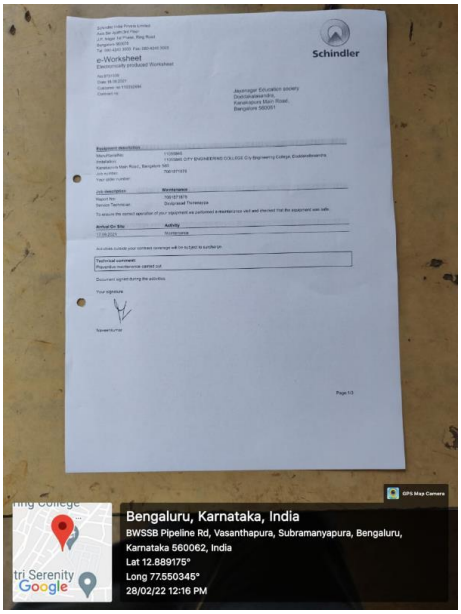


Figure 5-26: Lift- Preventive maintenance report

The AMC contract for lift is shown in figure 5-27.

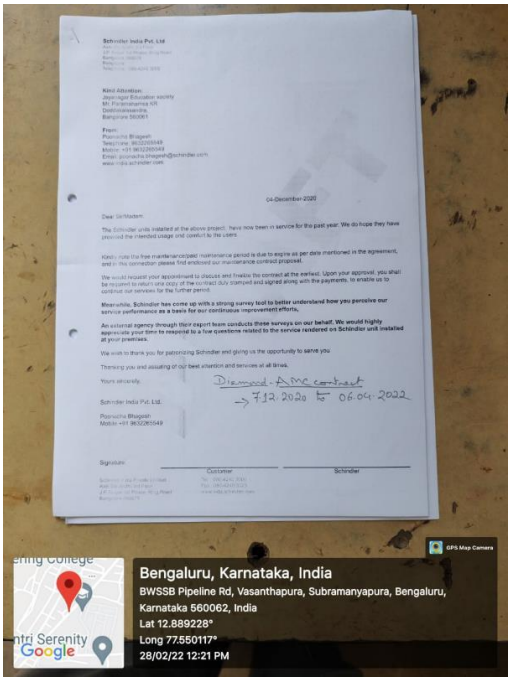


Figure 5-27: Lift- AMC Contract 2020 -2022

The AMC contract for lift (2022-2023) is shown in figure 5-28.

SELCOM ELEVATORS

Quotation / Agreement

MAINTENANCE CONTRACT FOR ELEVATORS

Name & Address of site	M/s. CITY ENGINEERING COLLAGE
Job No	SLE-140
Lift No	140
Lift Make	Schindler Lift
Contract Type	Comprehensive
Contract Period	One Year (01-11-2022 TO 31-10-2023)
Payment Terms	50% in Advance and 50% after 6-months in advance only.
Contact Person	Mr./Deepak

Yours faithfully,

for SELCOM ELEVATORS

Authorised Signature

Customer authorised signature with Seal

Name

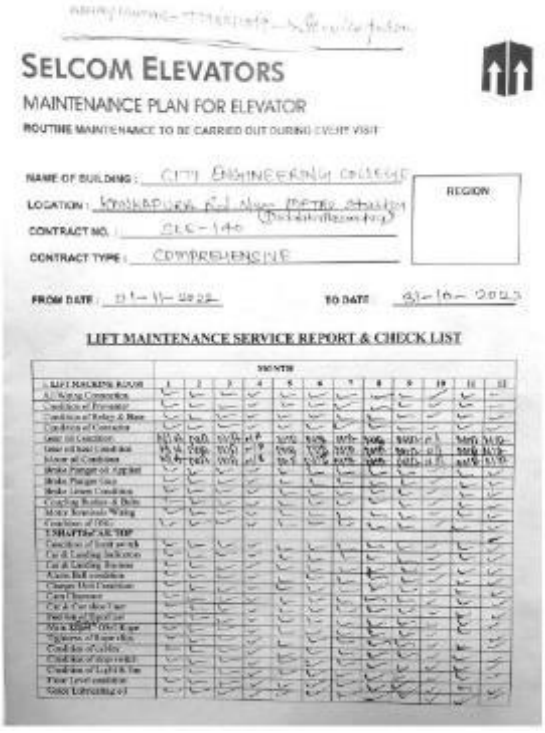
Designation

COMPREHENSIVE

1 of 4

Figure 5-28: Lift- AMC Contract 2022 -2023

The sample image lift service report is shown in figure 5-29.



SELCOM ELEVATORS

MAINTENANCE PLAN FOR ELEVATOR

ROUTINE MAINTENANCE TO BE CARRIED OUT DURING EVERY VISIT

NAME OF BUILDING : CITY ENGINEERING COLLEGE

LOCATION : KONAPPANA Rd, Near METRO STATION

CONTRACT NO. : SLE-140

CONTRACT TYPE : COMPREHENSIVE

REGION

FROM DATE : 01-11-2022 TO DATE 31-10-2023

LIFT MAINTENANCE SERVICE REPORT & CHECK LIST

Figure 5-29: Service report of Lift

5.3. Recommendations for Energy Audit

5.3.1. Replacement of conventional FTL with EE LED lamps

Background

From the inventory data; collected during study it is observed conventional FTL lighting fixtures are used in the campus. The total number of 1x40W FTL fixtures is 537. The power consumed by FTL in comparison with LED fixtures is 50% higher. Replacing the existing FTL with LED will result in energy savings.

Recommendation

It is recommended to replace the existing 1x40W FTL lamps with 1x20W LED tube lights.

Energy Savings

The energy savings and investment cost for replacement of FTL with LED fixtures and its payback period are given in table 5-7.

S. No.	Description	Unit	Details
1	Total no. of 1x40W FTL	No.	537
2	Power consumption by 1x40W FTL	kW	21.48
3	% of savings if all FTL replaced by LED fixtures	%	50
4	% of savings in kW if replaced by LED fixtures (Considering all fixtures)	kW	10.74
5	% of Lights found to be ON during working hours	%	50
6	Energy savings for fixtures in ON condition (4 x 5%)	kW	5.37
7	Total working hours per day	hours	9.0
8	Annual savings (6 x 7 x 250 days)	kWh/Annum	12082.5
9	Average energy cost per kWh	Rs. / kWh	8.39
10	Annual cost savings	Rs. lakh	1.0
11	Cost of LED per fixture	Rs.	350.0
12	Total Investment cost for 537 LED fixtures	Rs. lakh	1.9
13	Simple payback period (12 / 10)	Years	1.85

Table 5-7: LED replacement cost and payback period calculations

5.3.2. Replacement of conventional fans with energy efficient fans

Background

1x65W conventional fans have been used in almost all the rooms of the college. Total number of 1x65W fans used accounts to around 233 numbers. Hence, replacing the 1x65W conventional fans with 1x35W energy efficient fans will result in energy savings.

Recommendation

It is recommended to replace 65 W fans with 35 W EE fans, as procurement practice. Whenever the existing fans fails, while procuring 35W EE fans shall be procured.

Energy Savings

The energy savings and investment cost for replacement of 65 W fans with 35 W EE fans and its payback period are given in table 5-8.

S. No.	Description	Unit	Details
1	Total no. of 1x65W Fans	No	233
2	Power consumption by 1x65W Fan	W	65
3	Total power consumed by all the fans (1x2/1000)	kW	15.145
4	% of savings achieved by EE fans	%	45
5	% of savings in kW if replaced by EE fans (Considering all fans) (3 x 45%)	kW	6.815
6	% of fans found to be ON during working hours	%	50
7	Energy savings for fans in ON condition (5 x 6)	kW	3.4
8	Total working hours per day	hours	9
9	Annual savings (7 x 8 x 250 days)	kWh/Annum	**7650**
10	Average energy cost per kWh	Rs./kWh	8.39
11	Annual cost savings	Rs. lakh	**0.64**
12	Cost of one EE fan	Rs.	2500
13	Total Investment cost for 233 EE fans	Rs. lakh	5.82
14	**Simple payback period (13 / 11)**	**Years**	**9.06**

Table 5-8: EE Fans replacement and payback period calculations

5.3.3. Solar Roof Top PV (SRTPV) system

At present grid power supply and stand-by DG set power supply are the sources of electricity for the college. Installation of SRTPV (Solar Roof Top Photo Voltaic) system will result in renewable energy generation inside the campus and also reduces the electricity bill.

Estimation of SRTPV installation for the campus is given in table 5-9.

S. No.	Description	Unit	Values
1	Rated Capacity of SRTPV system	kWp	200
2	Average units generated per day	kWh/day/kWp	3
3	No. of working days per annum	days	365
4	Annual energy generation from SRTPV	kWh/ annum	2,19,000
5	Average energy cost	Rs./kWh	8.39
6	Annual cost savings due to installation of SRTPV	Rs. Lakh / annum	18.37
7	Investment cost for 200 kWp SRTPV system	Rs. Lakh	180
8	Simple payback period (7 / 6)	Years	9.80

Table 5-9: Estimation of SRTPV system

5.3.4. Other Recommendations for Energy Conservation

- Conduct training and awareness programs on energy conservation
- Posters stating 'Switch off lights, Fans & appliances when not in use' or 'Use electricity wisely' or 'Once the Electricity is used -It cannot be regained' etc., needs to be sticked to the walls at all the appropriate places.
- Conduct Seminars and workshops on a regular basis among all the staffs and students to create awareness about Energy conservation and proper usage.

6. WASTE MANAGEMENT AUDIT

6.1.Facility Description

The study involved carrying out various analyses to realistically assess waste generation. There are different types of waste generated in the college and is tabulated in table 6-1.

S. No.	Description	Yes / No	Details
1	E-Waste	Yes	Vendors
2	Hazardous / Chemical Waste	No	NA
3	Solid Waste	Yes	BBMP
4	Dry Leaves	Yes	Compost Unit
5	Food Waste	Yes	Compost Unit
6	Waste Water	Yes	Drainage
7	Glass Waste	No	NA
8	Unused Materials	No	-
10	Plastic Waste	Yes	BBMP

Table 6-1: Types of waste generated in the college

6.1.1. Dry Waste Management

Separate bins are used across the campus for Dry and Wet wastes. Each room (Staff, class rooms, office, restrooms, library and corridors) is provided with the dustbin to segregate waste. The housekeeping staffs cleans and collect the wastes generated inside the campus and dumps them into the larger waste bins in segregated manner at disposal point. From, there the wastes are taken by the BBMP vehicles.

Old newspapers, exam papers, academic records etc., are disposed yearly or two years once. The dry wastes are disposed through local vendor. This activity is managed by the admin office. The revenue generated is used for campus maintenance.

6.1.2. Wet Waste Management

To manage the wet waste produced in the college, which is produced from the canteen in campus, from the remains of the tiffin boxes brought by the students, teachers, & staff of the college, the college management has thought of a very novel way to make a difference, create cleaner healthier campus, and provide an opportunity to see a fresh campus.

The house keeping Staff collects all the wet waste produced in the college and dumps in larger bins. Then it is disposed to the BBMP vehicles.

6.1.3. E- Waste Management

E-Waste produced in the campus is stored at separate place in both Admin block and CS/IS block. All e-waste generated is dumped into e-waste storage place. Based on the quantity of e-waste, it is disposed to the local vendor yearly or two years once. This activity is managed by the admin office. The revenue generated is used for campus maintenance.

E-waste at admin block in shown in figure 6-1.

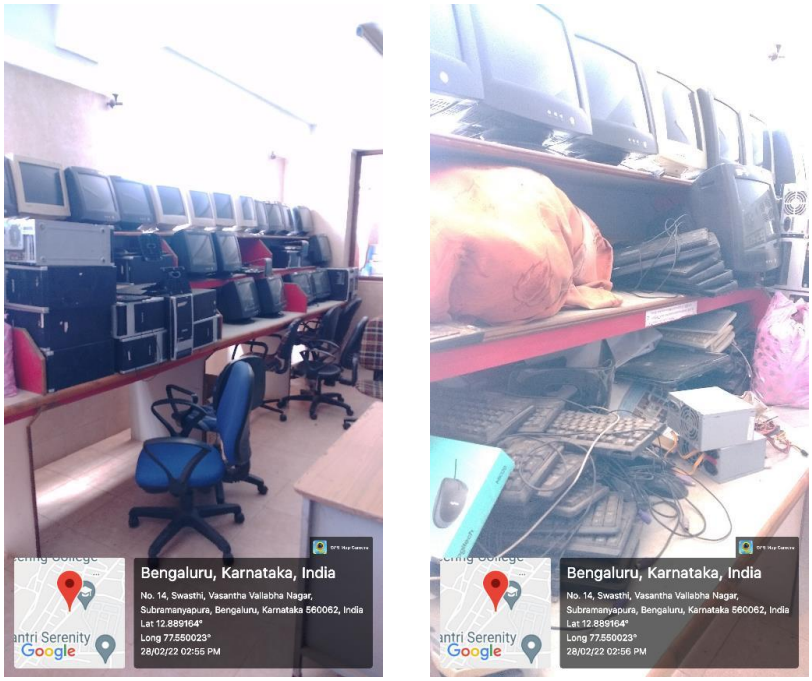


Figure 6-1: E-waste at admin block

E-waste at CS and IS block is shown in figure 6-2.

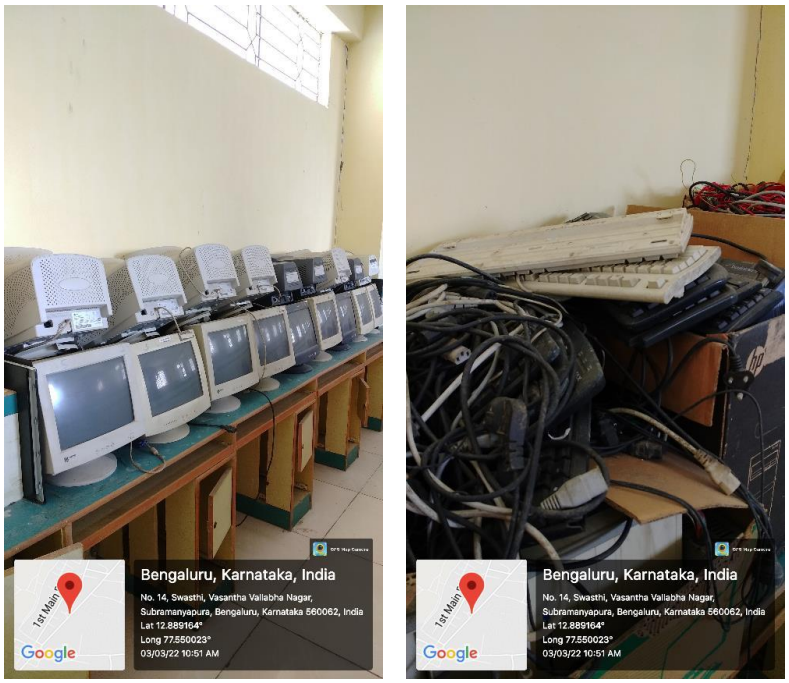


Figure 6-2: E-waste at CS/IS block

The sample bills for e-waste disposal to vendor is shown in figure 6-3.

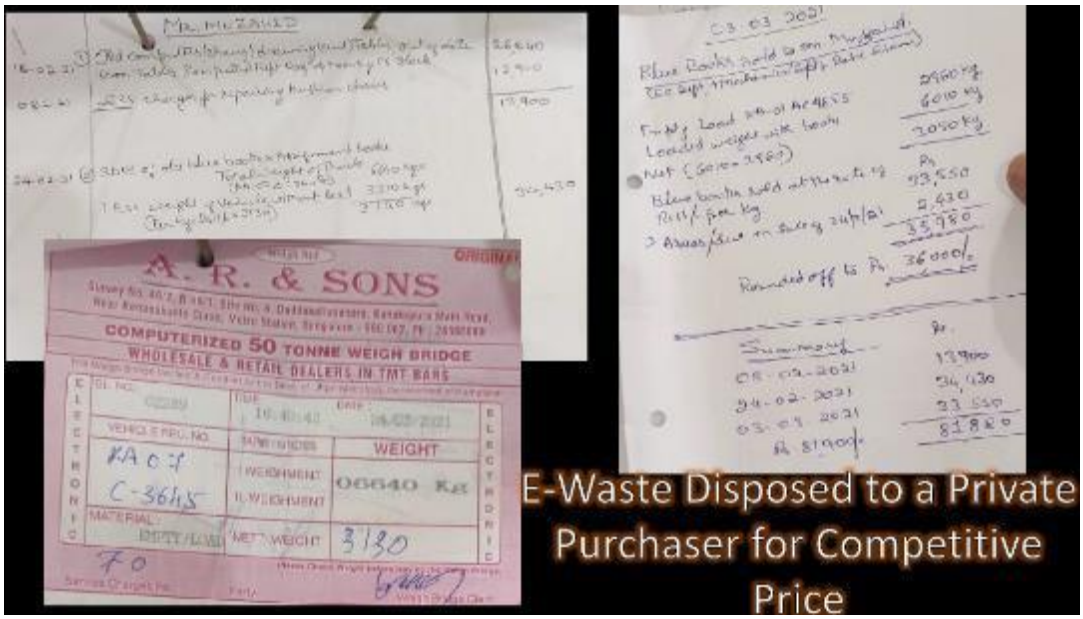


Figure 6-3: Sample bill for e-waste disposal to vendors

6.1.4. Bio- Waste Management:

As part of maintaining hygienic environment for the girl's, the management has provided the sanitary napkin vending machine and sanitary napkin incinerator in ladies lounge room at Dr. A.P.J. Abdul Kalam block. The napkin vending machine is shown in figure 6-4.

Figure 6-4: Bio – waste management - Napkin vending machine

The napkin incinerator is shown in figure 6-5.

Figure 6-5: Bio – waste management - Napkin incinerator

Usage of napkin incinerator machine gives the following advantages,

- Complete disposal of used napkin by burning
- Self-disposal by user by directly putting into the incinerator.
- Gets rid of the embarrassment of finding out ways to dispose used napkins.
- Eco-friendly disposal
- Less than 1gm of ash per cycle.

6.2. Best Practices Implemented for Waste management

6.2.1. Waste Collection Bins

The waste segregation is done at source level itself. Separate waste bins for dry waste, wet waste, and plastic waste are kept at appropriate locations of the campus. This helps to maintain the college premises clean & hygiene. Figure 6-6 shows the waste segregation bins and figure 6-7 shows the waste collection bins at different locations of college campus.

Figure 6-6: Sample photo of dustbin in classroom

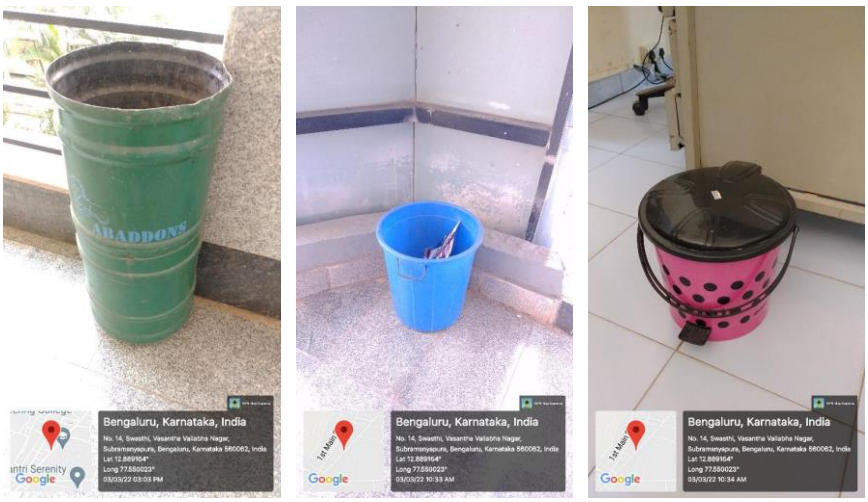


Figure 6-7: waste collection bins at different places

6.2.2. De-composter pit for dry leaves

The fallen leaves from trees and plants within the campus is cleaned daily. The dry leaves are collected and dumped into a de-composter pit located near playground. The depth of de-composter pit is around 8 feet. The stems and leaves collected during the maintenance activity is also dumped into this pit. After dumping it covered with soil and left natural de-composting. The de-composted waste is used as manure for trees and plants. The de-composer pit is shown in figure 6-8.

Figure 6-8: De-composter unit

6.2.3. Sign boards to use dustbin

Sign boards indicating to use dustbin is kept all around the campus. The sample image of sign board is shown in figure 6-9.

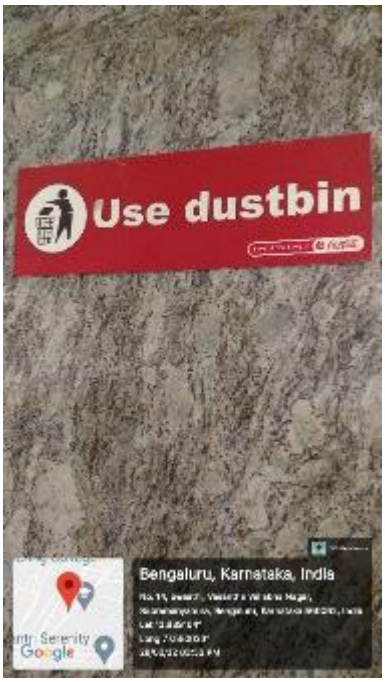


Figure 6-9: Sign boards - Use dustbin

6.2.4. Usage of blowers and suction cleaner

To maintain dust free library and laboratories, machineries like suction cleaner and blowers are used. This helps to keep the campus atmosphere at finest clean. The blower machine is shown in figure 6-10.

Figure 6-10: Blower machine

The suction cleaner machine is shown in figure 6-11.

Figure 6-11: Suction cleaner machine

6.2.5. Regular cleaning of campus

Regular cleaning of campus is done to maintain overall hygiene. Cleaning activities are carried out using chemicals wherever necessary. Purchase of brooms, chemicals, phenyls, mop etc., are done based on requirement. The sample image of cleaning activity is shown in figure 6-12.

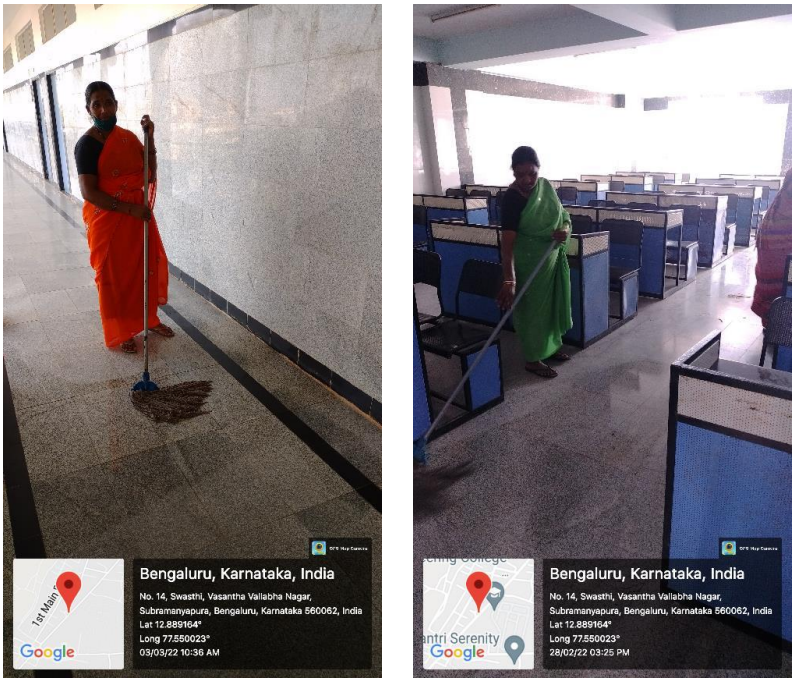


Figure 6-12: Cleaning activity in campus

The sample bills for purchase of chemicals and other cleaning items are shown in figure 6-13.

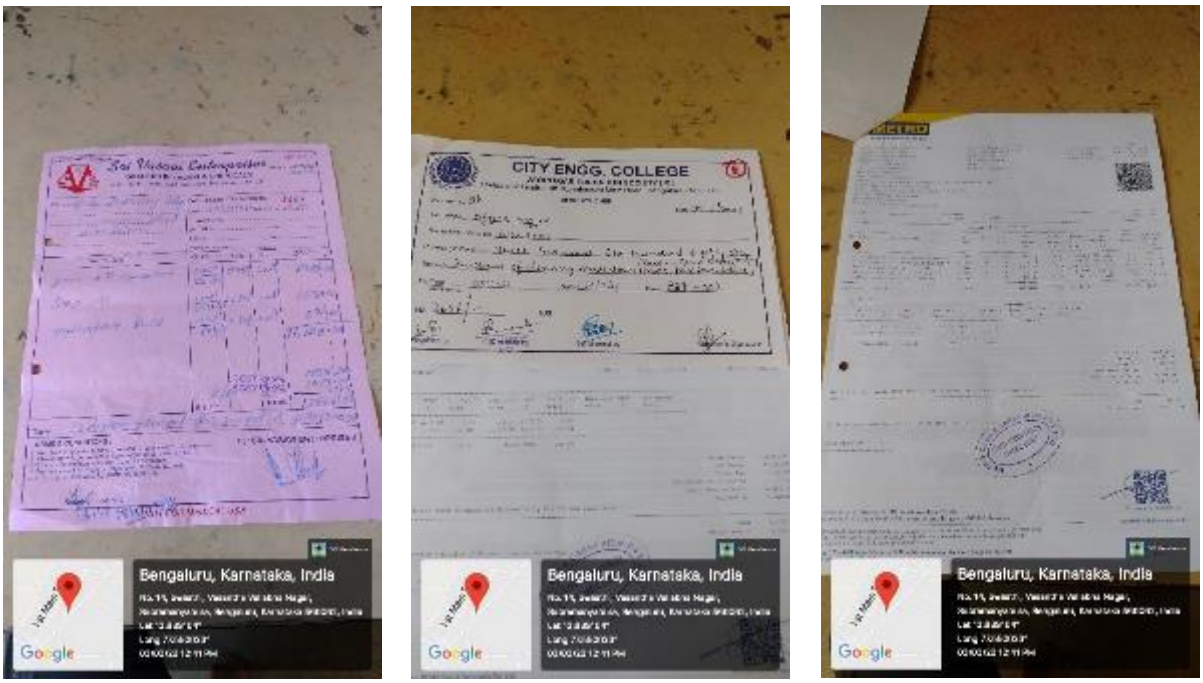


Figure 6-13: Sample bills for purchase of cleaning materials

6.2.6. Awareness Program - Clean India Activity

NSS of City Engineering College, Bengaluru, organized Clean India activity on October 25th at 2.00 p.m. at College Campus.

A total of 22 NSS volunteers participated in the programme. Vinaykumar S N, Programme Coordinator, NSS, CEC welcomed the gathering. Dr Thippeswamy H N, Principal, CEC, initiated cleaning activities among volunteers. He motivated students towards 'Clean India' by his inspirational talk.

The volunteers along with some of the faculties and non-teaching staff cleaned the entire campus and collected almost one bucket of plastic for safe disposal. The volunteers were instructed to clean their hands with soap at the end of programme.

The images of Clean India activity are shown in figure 6-14.

Figure 6-14: Clean India Activity - 2021

6.3. Recommendations on Waste Management Audit

6.3.1. Color Code Bins

Different color code bins for the waste segregation (Dry, Wet, Bio-medical/Sanitary) at the source itself will make the segregation easy and hence it is recommended to place standard color code bins at all waste collection points of the campus.

6.3.2. Posters on Plastic Ban

Different posters on 'Plastic Ban' can be placed in and around the blocks of the campus. So that the students, staff and trespassers are aware of the college is Plastic Free zone.

6.3.3. Replacement of plastic with Steel Cutlery

To give a logical behavioral solution to substitute or recycle that had to be accepted and practiced by the institution; management has to take a step ahead and inform all the vendors not to use the single use plastic and replace it with reusable utensils in the canteen and inside the campus.

6.3.4. Conducting waste management (collection) drives & awareness programs

Keeping the environment clean is not a one-man job, it is the responsibility of every person inside the society/campus. Hence, it is necessary to create awareness programs and waste management drives often and often for the institutions to keep the environment clean, green and hygiene.

Use of posters stating 'Proper usage of dustbins' to create awareness among students and staff regarding waste management.

6.3.5. Usage of awareness signboards

Use of more sign boards to create awareness for better waste management like 'Plastic ban', 'Do not litter', 'Think clean and use dustbin' etc., shall be placed at appropriate locations.

7. GREEN CAMPUS MANAGEMENT AUDIT

7.1. Facility Description

The students and faculty are encouraged to adopt cleanliness, making the campus garbage and plastic free zone. Tree plantation programs help in encouraging eco-friendly environment, which provides pure oxygen within the institute.

The maintenance team takes care of the up-keeping of the environment and ensures to keep the surroundings clean. They maintain all the plantations by employing the cleanliness and watering regularly.

7.1.1. Landscaping with Trees and Plants

Entire campus of the college has been made green by planting trees and plants. By this, the green campus concept offers the City Engineering College to take the lead in redefining its environmental culture and developing new paradigms by creating sustainable solutions to environmental, social and economic needs of the mankind.

Tree Plantation is done every year through NSS. The college has nurtured number of trees of different variety.

Figure 7-1: Sample photos of Trees around the campus

Figure 7-2: Sample photos of plantations around different blocks

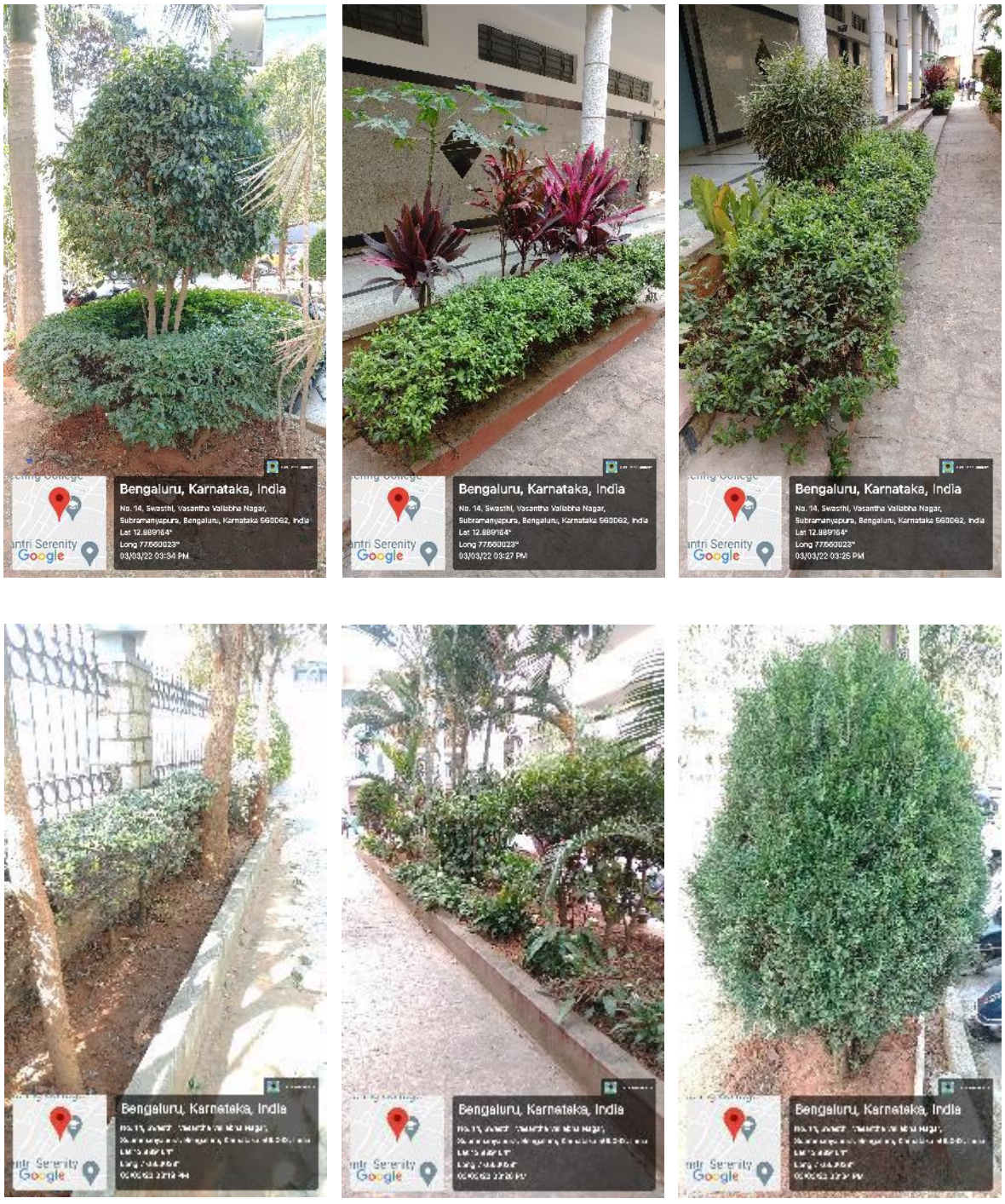


Figure 7-3:Sample photos of Lawn and plantations

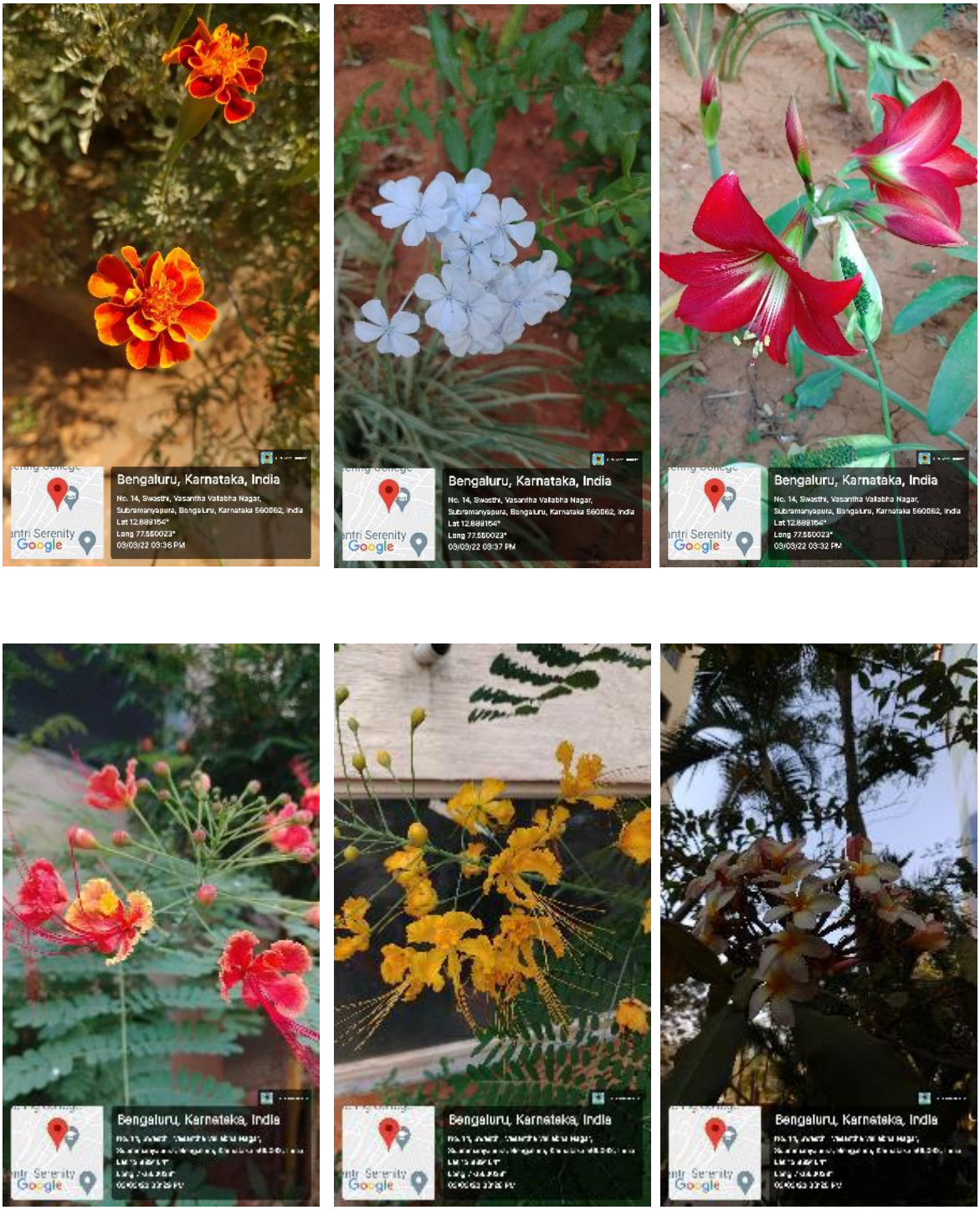


Figure 7-4: Sample Flower plantations

Table 7-1 indicates the details of type and quantities of trees inside the campus as per the data shared by the institution.

S. No.	Name of Tree / Plant	No.
1.	Jack fruit tree	5
2.	Almond tree	4
3.	Coconut tree	3
4.	Jamaican cherry tree	10
5.	Silver oak tree	10
6.	Baniyan tree	2
7.	Sacred fig tree	1
8.	Nerium Oleander flower plants	25
9.	Show tree	13
10.	Neem tree	12
11.	Blue berry tree	12
12.	Indian beech tree	10
13.	Papaya tree	10
14.	Banana plants	20
15.	Palm tree	8
16.	Guava tree	8
17.	Lemon tree	4
18.	Sweet like tree	3
19.	Ceylon Ironwood / Champak tree	6
20.	Avocado tree	1
21.	Mango tree	4
22.	Bambo tree	6
23.	Night blooming Cereus	2
24.	Regina cherry tree	13
25.	Pomegranate tree	1
26.	Malabar neem wood tree	5
27.	Indian gooseberry	2
28.	Amla tree	2

Table 7-1 : Details of type and quantity of trees

7.2. Best Practices Implemented for Green Campus Management

7.2.1. Regular maintenance of greeneries

The greeneries within the campus are maintained properly with dedicated garden maintenance staff. They proper maintenance like weeding, lawn care and watering etc., The sample image of garden maintenance is shown in figure 7-5.

Figure 7-5: Sample image of garden maintenance

The tap and water can used for watering the garden is shown in 7-6.

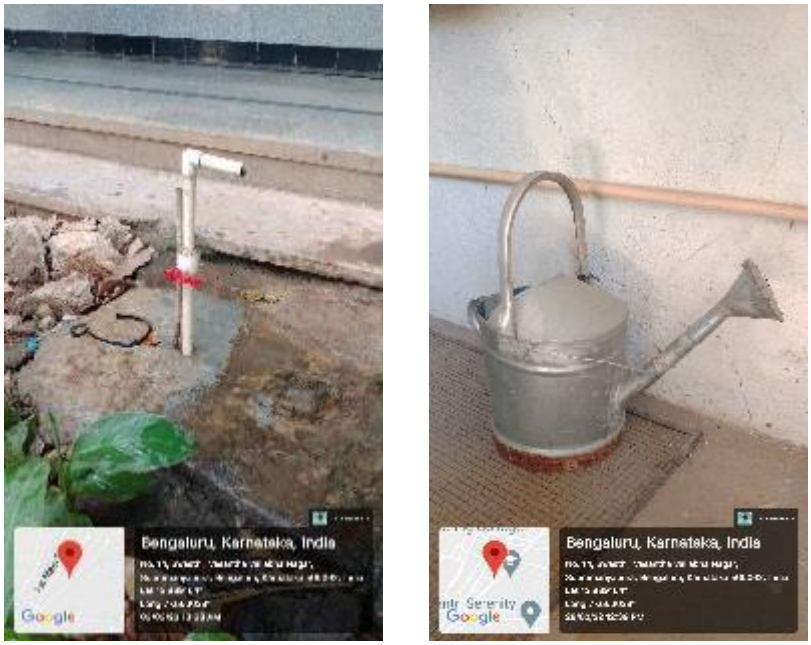


Figure 7-6: Sample image tap and watering can

The sample image of purchase bill for agriculture sprayer is shown in figure 7-7.

Figure 7-7: Purchase bill – Agriculture sprayer

7.2.2. Awareness program – World Environment Day

The NSS units of CEC celebrated the World Environment Day 2021 on 5th of June. Saplings were planted around the college ground by Principal, AO & Faculties. The theme for World Environment Day 2021 was "Ecosystem Restoration".

In association with Department of Civil Engineering an online webinar was arranged on the topic "World Environment Day-2021" for volunteers & students to improve their awareness on the topic.

The webinar was presided by Dr. N T Manjunath, (Env. Engg-IITR), Former Chairman, Department of Studies in Civil Engineering., UBDT College of Engineering, Davangere. Around 40 volunteers participated in the webinar. A poster and video were also circulated among volunteers to create awareness regarding importance of being responsible towards the society.

The sample image of webinar invitation is shown in figure 7-7.

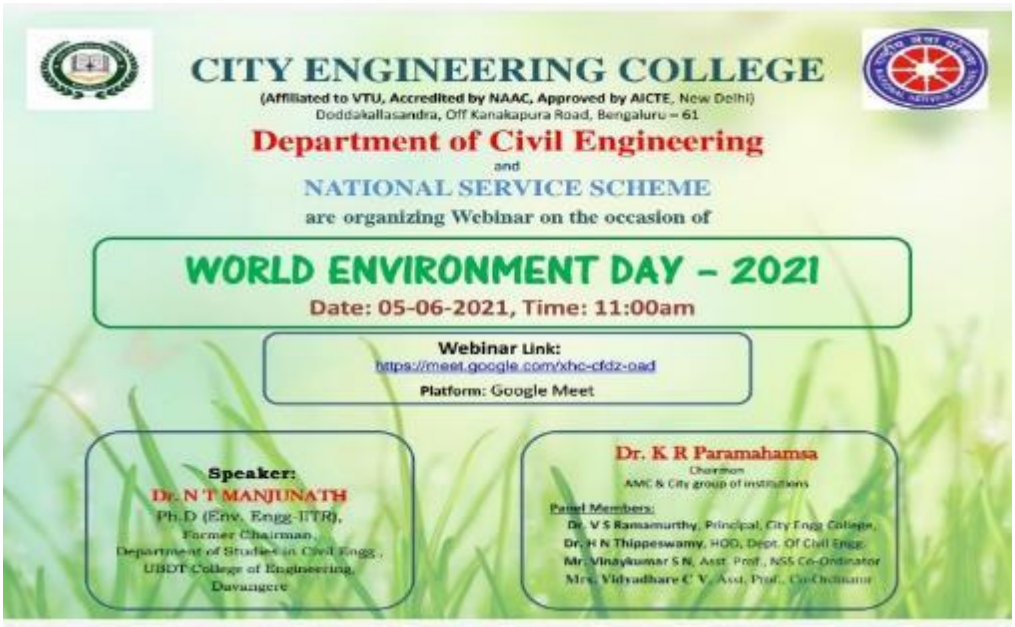


Figure 7-8: Webinar invitation - World Environment Day-2021

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7.3. Recommendations on Green Campus Management

- Encouraging students to recommend creative ideas for making campus more greenery.
- Conducting competition among departments to promote student's ideas in sustainability initiatives
- More number of trees shall be planted inside the campus.
- Co
- Indoor plantations and pot plantations in the corridors are recommended

8. ENVIRONMENT AUDIT (CARBON FOOTPRINT ANALYSIS)

8.1.Facility Description

The carbon footprint is "the total amount of greenhouse gas (GHG) emissions caused by an organization, event or product". Global warming and climate change are the foremost environmental challenges facing the world today. It is our responsibility to minimize the consumption of energy and hence reduce the emissions of greenhouse gases.

To analysis the carbon footprint, transportation details of students and staff are collected as below:

a. Number (or Percentage) of Staff using public transport: 14.8%

b. Number (or Percentage) of Staff using College transport: 3.7%

c. Number (or Percentage) of Staff using Bike: 55.6%

d. Number (or Percentage) of Staff using Car: 25.9 %

e. Number (or Percentage) of Staff using Electric Car: Nil

f. Number (or Percentage) of Staff using Electric bike: Nil

g. Number of students using College transport: 26

h. Number of students using Bike: 89

i. Number of students using Bicycles: 5

j. Number of students using Electric car: 10

k. Number of students using Electric bike: 6

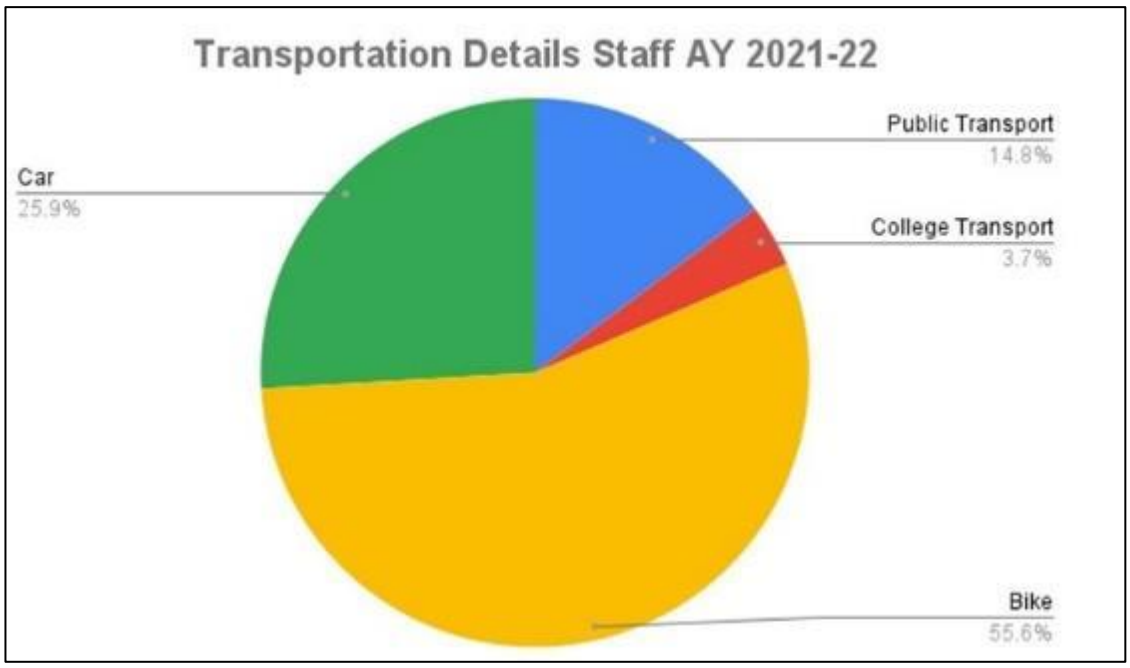

Figure 8-1: Transportation details of staff

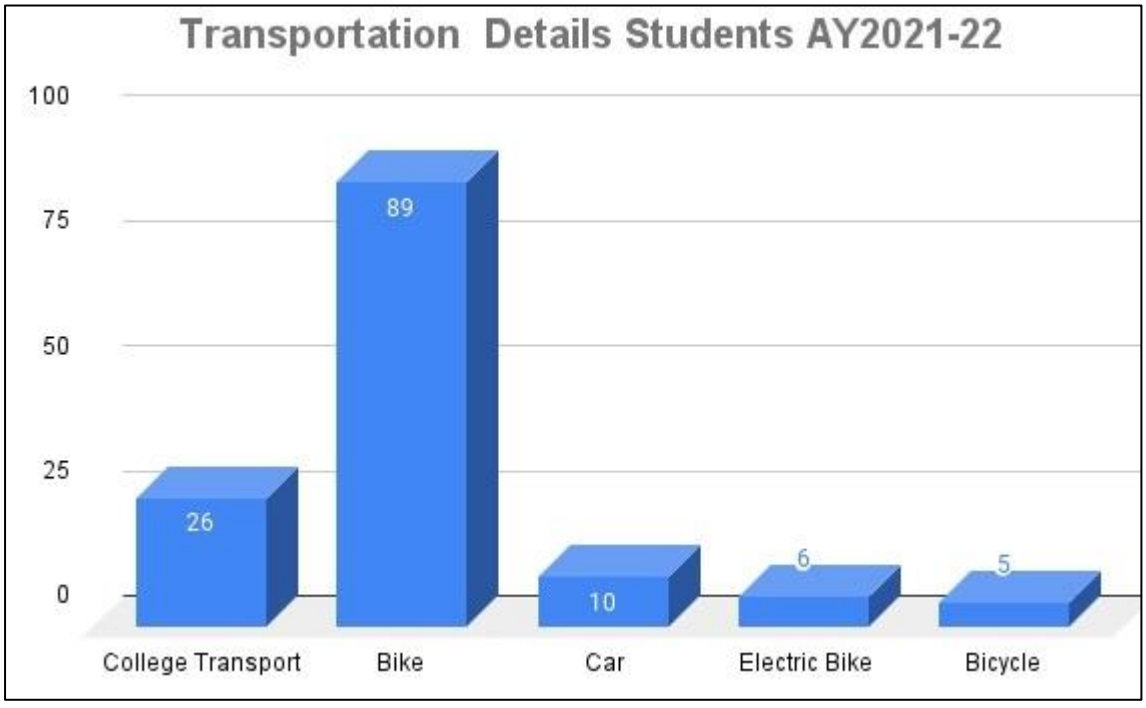

Figure 8-2: Transportation details of students

8.2. Best Practices Implemented for Environment Conservation

8.2.1. Usage Of Transport Facility

- Transport facility to the students and staff is provided. Transport facility is provided at free of cost to students.

- Most of the students and staff prefer public transport (Metro, BMTC bus) for the commute.

8.2.2. Pedestrian Friendly Pathways

The Institute has pedestrian paths on both the sides of the road and also within the campus.

Vehicle parking space is provided at the main entrance of the college campus. As the campus is vehicle free with some exceptions, students and staff experience comfort walking through the pedestrian friendly pathways. The internal roads are lined with trees and lights and they are properly maintained.

The college has pedestrian friendly pathways where all staff & faculty can walk safely. Pedestrian friendly pathways are shown in figure 8-3.

Figure 8-3: Pedestrian friendly pathway

8.2.3. Ramp For Physically Challenged Persons

Wheelchair ramps enable physically disabled as well as elderly people to enjoy complete freedom, as they allow users to move in and around the campus safely. The ramp facility available in Dr. Sir. M. Visveswaraya block and Dr. A.P.J. Abdul Kalam block are shown in figure 8-4 and figure 8-5.

Figure 8-4: Ramp facility at Dr. Sir. M. Visveswaraya block

Figure 8-5: Ramp facility at Dr. A.P.J. Abdul Kalam block

8.2.4. Ban on Use of Plastic

The institute has taken steps for not using plastic inside the campus. Instructions have been given to cafeteria operators to avoid use of plastic. Students are also informed to avoid use of plastic inside the campus. The institute have collaborated with NGO named "Way of life" for Swachh Bharath campaigns and clean the surroundings in and around Bangalore.

8.2.5. Paperless Office

Salary, circulars and fee collection is done online, so paperless office. The instructions have been given to all the departments to avoid using the paper and taking necessary steps to send all the circulars by email. The instructions have been given to all the staff members for uploading notes, assignments, model questions to the ERP-PupilPod.

The students have been given ERP log-in so that they can access to all the notes, assignments and model questions on-line. This helps to students to avoid taking copies of the notes, assignments and model questions.

The college gives emphasis on paperless office to save carbon footprint due to printers.

8.2.6. Usage of Bicycles

Few students are coming to college by bicycle. The sample images of bicycles used by students are shown in figure 8-6.

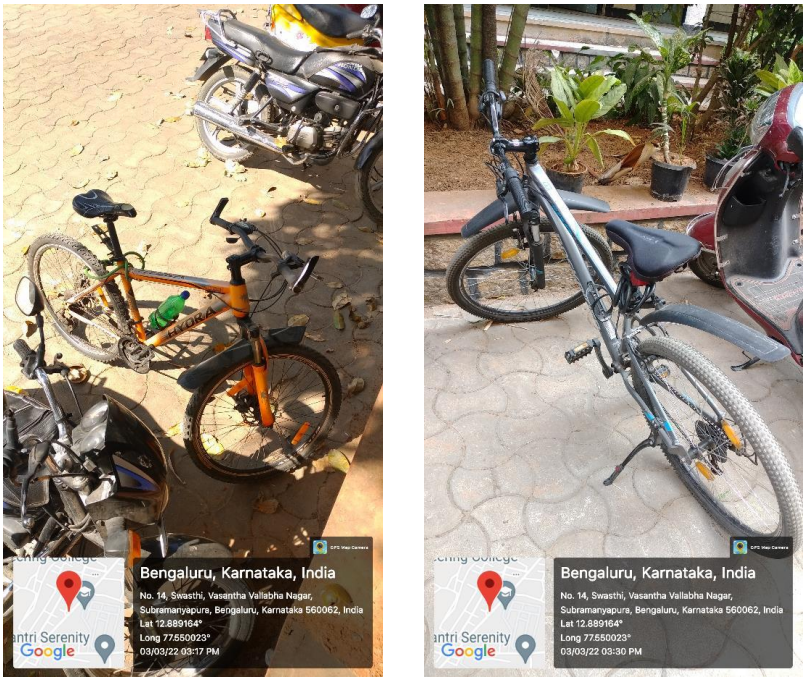

Figure 8-6: Bicycle usage by students

8.2.7. Awareness Program - World Environment Day

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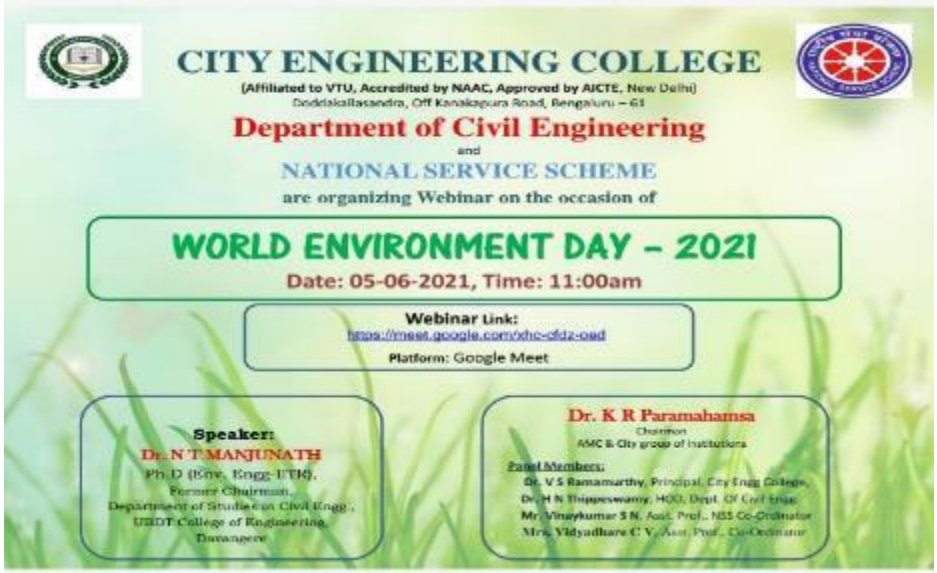

Figure 8-7: Webinar invitation - World Environment Day-2021

The sample image of World Environment day 2022 celebration report and photo are shown in figure 8-8.

CITY ENGINEERING COLLEGE

BENGALURU

NATIONAL SERVICE SCHEME

Date: 10/06/2022

Report on World Environment Day

Led by the United Nations Environment Programme (UNEP) and held annually on 5 June since 1973, World Environment Day is the largest global platform for environmental public outreach and is celebrated by millions of people across the world. This year it is hosted by Sweden.

World Environment Day is a global platform for public outreach, with participation from over 143 countries annually. Each year, the program has provided a theme and forum for businesses, non government organizations, communities, governments and celebrities to advocate environmental causes.

"Only One Earth" was the slogan for the first United Nations Conference on the Human Environment, held in Stockholm in 1972. This put sustainable development on the global agenda and led to the establishment of World Environment Day.

Only one Earth

In the universe are billions of galaxies,
In our galaxy are billions of planets,
But there is #OnlyOneEarth.
Let's take care of it.

NSS club of City Engineering College, Bengaluru, organised world Environment day on 8th June 2022 and with us 2 speaker Dr.N.T.Manjunath sir and Er Ramesh kumar B.N sir gave a introduction about the importance of environment day and our respected principal of our college **Dr. THIPPESWAMY H N** and all the staff members along with chief guest planted a tree to make the Green campus.

We heartily express our thanks toward the head of the institute for his kind and cooperative support all the time.

Figure 8-8: World Environment Day-2022

8.3. Recommendations on Carbon Footprint Analysis

During the study, there was continuous interaction between the audit team, college engineers and staff members to ensure that the suggestions made are realistic, practical and implementable.

- Recommend students and staff to use public transport system
- Recommend students and staff to use bicycle in large numbers
- Recommend staff and students to use electric vehicles
- Recommended to use display boards to conserve fuel and use bicycle.

9. ANNEXURES

9.1. Data Collection Questionnaire

A questionnaire is a checklist used as the primary tool for the collection of data / information in a systematic manner that enables to perform the audit.

9.1.1. General information of the college:

General information of the college needs to be collected to get an overview of the campus for the walk-through purpose. It includes a set of questionnaires as given below.

1. Internal Quality Audit Team: 2020 – 2021

Table 9-1 depicts the format for the collection of Internal Quality Audit team.

S. No.	Name	Designation	Role
1			
2			
3			

Table 9-1: Internal Quality Audit team

2. General Information of the college

General information of the college includes an address of college and head office, contact person details, year of establishment etc., as given in table 9-2.

S. No.	Description	Details
1.	Name of the College and address:	
1.a	Head office address :	
2.	Telephone/Fax No	
3.	Co-ordinating officer:	Name:
		Mob:
		Email:
4.	Year of Establishment:	
5.	Hostel (Available/Not Available)	

S. No.	Description	Details	
6.	No. of Working days/year		
7.	Brief description of Campus		

Table 9-2: General information of the college

3. College Infrastructure

Infrastructure details of the college were gathered from table 9-3.

S. No.	Description	Details
1	Block Name	Class rooms
		Labs
		Staff rooms
		Wash rooms
2		
3		

Table 9-3: Detail Infrastructure of the college

4. Details of Student clubs
5. Details of cells that support students
6. Tentative Schedule of a working day:

   a. No. of working days per year:

   b. List of holidays:

7. Total area of the campus

8. Details of List of Departments and Courses (Faculty wise)

The total number of departments, laboratories, conference hall, Libraries, Auditorium, and Cafeteria are obtained from table 9-5.

S. No.	Description	Details
1	Department	
2	Laboratories	
3	Conference Hall	
4	Libraries	
5	Auditorium	
6	Cafeteria	

Table 9-4: Details of the departments

9. Number of staff

Teaching, non-teaching, supporting staff with a male and female breakup is obtained from table 9-5

S. No.	Teaching Staff		Non-teaching Staff		Support Staff (Security, House Keeping)	
	Male	Female	Male	Female	Male	Female

Table 9-5: Details of the Staff

10. Number of Students

Number of students is collected from table 9-6.

S. No.	Boys	Girls
1		

Table 9-6: Details of the Students

11. Additional infrastructure details have been collected from table 9-7.

S. No.	Description	Details	
1.	Number of blocks available for boys hostel	Nos.	

2.	Number of rooms available for boys hostel	Nos.	
3.	Number of blocks available for girls hostel	Nos.	
4.	Number of rooms available for girls hostel	Nos.	
5.	Whether Laundry is available in the hostel	Yes / No	
6.	If Yes List the Electrical Equipment in Laundry Section of the hostel (like Washing machine, Dry Cleaning Machine, Iron)		
7.	Whether gym/ indoor sports hall is available in hostel	Yes / No	
8.	Whether Solar PV based Power Generation is available in campus (academic or hostel block)	Yes / No	
9.	Whether lifts available in academic block	Yes / No	
10.	Whether Kitchen is available in the academic block	Yes / No	
11.	Whether any food counter (outside caterers) available in academic block	Yes / No	
12.	Whether any commercial shops available in academic block	Yes / No	
13.	Any more information or additional details of academic block you would like to share – kindly elaborate here		

Table 9-7: Details of the departments

9.1.2. Water Audit details:

1. General information

General information required for water management analysis is collected from table 9-8.

S. No.	Description	Details
1	Source of water	
2	Types of water	
3	No of Wells	
4	No of motors used	
5	No of bore wells	
6	Rating of the motors in HP	

S. No.	Description	Details
7	Depth of each bore-well	
8	Water level of bore well	
9	Number of water tanks (overhead & underground tanks)	
10	Capacity of overhead tank	
11	Capacity of underground tank	
12	Quantity of water pumped every day	
13	Any water wastage of water /why?	
14	Water usage for gardening	
15	Waste water sources	
16	Use of waste water	
17	Faith of waste water from labs	
18	Whether waste water from labs mixed with ground water?	
19	Any treatment method available for lab water?	
20	Whether any green chemistry method practiced in labs?	
21	Total number of water coolers	
22	Whether Rain water harvesting system available?	
23	Whether Sewage Treatment Plant (STP) is available?	
24	List of equipment installed in STP (If S.No.23 is Yes)	
25	Whether Solar Hot Water System is available in the campus	
26	Number of units and amount of water harvested	
27	Any leaky taps in the campus	
28	Amount of water lost per day	
29	Any water management plan used?	
30	Any water-saving techniques followed?	
31	Are there any signs reminding peoples to turn off the water?	
32	No. of water flow meters available	
33	Method of water consumption monitoring	
34	Breakup of daily water consumption	

S. No.	Description	Details
35	Attach Month wise water bill for last 2 years	
36	Please attach recent water quality test reports for Bore well water, Drinking Water and STP processed water.	
37	What are the sources of hot water	
38	What are the usage areas of hot water	

Table 9-8: Water management details

2. STP information

STP details are collected from table 9-9

S. No.	Description	Details
1.	Number of STP plants installed	
2.	Capacity of STP	
3.	Technology of STP	
4.	Year of Installation	
5.	Schematic / Layout of STP	
6.	Water flow meters installed	
7.	Quantity of Sludge	
8.	Disposal of Sludge	

Table 9-9: Details of STP

3. RO Plant information

RO Plant details are obtained from table 9-10

S. No.	Location	Quantity	Capacity
1.			
2.			
3.			

Table 9-10: Details of RO Plant

9.1.3. Energy consumption details:

1. Energy consumption details:

The energy consumption details required for the audit is collected, the brief format of the same is given in table 9-11.

S. No.	Type	Units		Value	Cost in Rs.
1	Electricity	kWh	2019		
			2020		
2	LPG	Cylinders			
3	Diesel	Litres (Month wise consumption for the last two years)			
4	Others resources (Please specify)				
5	Total connected load	kW			
6	Contract demand	kVA			
7	Maximum demand recorded	kVA			
8	Average power factor				
9	Energy charges	Rs./kWh			
10	Demand charges	Rs./kVA			
	*** Attach Electricity Bill Copy of last 2 years**				

Table 9-11: Details of Energy consumption

2. Solar Energy details:

The solar energy details required are collected from table 9-12.

S. No.	Building No./ Name	Solar water Heater			Solar PV System		
		Capacity	Working / Not working	Year of Installation	Capacity	Working / Not working	Year of Installation

Table 9-12: Details of Solar Energy

3. Solar Street lights details:

a. Quantity -
b. Capacity -
c. Year of Installation –

4. Electrical Equipment details:

Electrical Equipment like transformers DGs UPS Capacitor Bank, AC, Computers, water coolers, fans, exhaust fans are obtained from the table 9-14.

S. No.	Description	Details	
1.	Number of Transformers Installed	Nos.	
2.	Number of Electrical Panels / Electrical Panel Rooms	Nos.	
3.	Whether Diesel Generator Set Backup Power is Available	Yes / No	
4..	How many number of DG Sets available in the campus (If S.No.3 is Yes)	Nos.	
5.	Whether UPS is available for labs, computers and/or any equipment	Yes / No	
6.	Number of UPS installed with location and capacity (If S.No.5 is Yes)	Nos.	
7.	Whether Capacitor Banks is installed in the electrical panel rooms	Yes / No	
8..	Whether Air Conditioning Units have been installed in the campus	Yes / No	
9.	Type of AC units (split, cassette or packaged) available, capacity and installed location (If S.No.8 is Yes)	Nos.	
10.	Total number of computers available in the campus	Nos.	
11.	Type of computer monitors available (CRT, LCD, LED)	Nos.	
12.	Whether water coolers are installed in the academic blocks	Yes/No	
13.	Type of lamps (Fluorescent Tube Light, CFL, LED, Incandescent, Sodium / Mercury lamps, etc.,) installed in the campus	Nos.	
14.	Type of fans (ceiling, wall mount, standing, exhaust, etc.,) installed in the campus	Nos.	

S. No.	Description	Details	
15.	Whether exhaust fans are installed in hostel / kitchen.(If Yes, share the quantity and installed location)	Yes /No	
16.	Any other electrical equipment's in college buildings.		

Table 9-13: Details of Electrical Equipment

5. List of energy saving initiatives implemented
6. List of energy saving initiatives in plan for future

9.1.4. Waste management details:

Waste management includes the activities and actions required to manage waste from its inception to its final disposal. The various data/ information required for the assessment of waste management is as collected from the following set of questionnaires.

1. Basic information

Basic information for waste management is collected from table 9-14.

S. No.	Description	Yes/ No
1	Whether wet and dry garbage segregation is done inside the campus?	
2	Whether garbage is given to external agencies / municipal agencies?	

Table 9-14: Basic details of waste management

2. Types of Waste generated

Types of waste generated in the college are obtained from table 9-15.

S. No.	Description	Yes / No	Remarks
1	E-Waste (Computers, electrical and electronic parts)		
2	Hazardous / Chemical Waste		
3	Solid Waste (Damaged furniture, paper waste, paper plates)		
4	Dry Leaves		
5	Food Waste		
6	Waste Water (Washing, urinals, bathrooms)		
7	Glass Waste (Broken glass wares from the labs)		
8	Unused Materials		
9	Plastic Waste (Pen, Refill, Plastic water bottles and other plastic containers, wrappers etc.)		

Table 9-15: Types of waste generated

3. Segregation of waste

Segregation of waste information at different locations with quantity is gathered from table 9-17.

S. No.	Location	Bio-degradable	Non-Biodegradable	E-waste	Quantity, kgs/month
1	Office				
2	Labs				
3	Cafeteria / Kitchen				
4	College				

Table 9-16: Segregation of waste

4. Waste generation management

Waste generation management of the college was collected from table 9-18

S. No.	Description	Yes / No	Remarks
1	Composting / Vermicomposting		
2	Recycling		
3	Reusing		
4	Other ways		

Table 9-17: Waste Disposal methods

9.1.5. Green campus management details:

1. Total number of plants and trees

The total number of plantations, garden area, and many more are collected as per the set of questionnaires given in table 9-19

S. No	Description	Details
1	Total number of plant species identified	
2	Total number of plants on the campus	
3	Total number of Trees on the campus	
4	Garden area inside the college –	
5	Total number of medicinal plants /trees on the campus	

6	Total number of vegetables and fruits plantation in the campus	
7	Whether display boards are given to plants and trees for identification	
8	Does Institute celebrate World environment day?	
9	Does Institute celebrate World water day?	
10	Does Institute celebrate World ozone day?	
11	Does Institute celebrate World Earth day?	
12	Total number of aquatic water plants	

Table 9-18: List of plantation details

2. List of plants/ trees

List of plants/ trees with their scientific names obtained from table 9-20.

S. No.	Common/Local Name	Scientific name	No. of Trees/Plants

Table 9-19: List of plants/trees in campus

9.1.6. Carbon footprint management details:

The carbon emission from various activities such as transport, diesel generator usage, LPG consumption, and electricity consumption were collected, as per table 9-21.

S. No	Description	Details
1	Whether college provides transport facility for staff and students (Yes/No)	
2	Number (or Percentage) of staff using transport services provided by college	
3	Number (or Percentage) of students using transport services provided by college	
4	Number (or Percentage) of Staff using public transport	
5	Number (or Percentage) of Staff using Bike	
6	Number (or Percentage) of Staff using Car	
7	Number (or Percentage) of students using Public transport	
8	Number (or Percentage) of students using Car	
9	Number (or Percentage) of students using Bike	
10	Number (or Percentage) of students using Bicycles	
11	Average consumption of diesel per month	
12	Average electricity consumption per month	
13	Average LPG consumption per month	

Table 9-20: Details of Carbon footprint management

9.1.7. Photos required for Audit:

1. General Photos

In various sections, different types of photos are required to validate the existence of things, and hence they are collected from table 9-21.

S. No	Description	Details
1	Photos of student's NSS activities	
2	Photos of Safety policy	
3	Photos of the training program on the use of fire extinguishers	
4	Photos of environmental policies adopted by college	

5	Photos of MoUs for Waste management		
6	Photos of any other policies adopted by college		
7	Photos of water test report	Drinking Water	
		STP processed water	
		Bore-well water	
		Other water Sources (Like Tanker water and any other)	
8	Photos of use of Energy efficient devices like fan, bulbs etc.		
9	Photos of LCD/LED monitors used in Labs		
10	Photos of dry and wet waste collection bins		
11	Photos of celebrating World Environment Day		
12	Photos of celebrating World Water Day		
13	Photos of celebrating World Earth Day		
14	Photos of celebrating World Ozone Day		

Table 9-21: List of photos

GREEN AUDIT AND QUALITY AUDIT REPORT

ON

WATER AUDIT, ENERGY AUDIT,

WASTE MANAGEMENT AUDIT,

GREEN CAMPUS MANAGEMENT AUDIT,

AND ENVIRONMENT AUDIT

OF

CITY ENGINEERING COLLEGE

DODDAKALLASANDRA,

NEAR GOKULAM APARTMENT,

OFF – KANAKAPURA MAIN ROAD,

BENGALURU – 560 061

2021 – 2022

ECO ENERGIME ENGINEERS LLP

ENHANCING RESOURCE EFFICIENCY

GREEN AUDIT AND QUALITY AUDIT REPORT

OF

CITY ENGINEERING COLLEGE

OFF – KANAKAPURA MAIN ROAD,

BENGALURU – 560 061

KARNATAKA

2021 – 2022

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Acknowledgements

We are thankful to the management of **City Engineering College, Bengaluru,** for the support, guidance and, giving us the opportunity to be involved in this very interesting and challenging assignment.

We would be happy to provide any further clarifications, if required, to facilitate the implementation of the recommendations.

We received full co-operation and support from the concerned personnel/ staff members of the college. They took key interest and gave valuable inputs during the course of study. We would like to thank:

Chairman – City Engineering College, Bengaluru

And other Staff in personnel who have given full co-operation and support. They took a keen interest and gave valuable inputs during the course of study.

Smart Solutions for
Sustainable Tomorrow **Eco Energime Engineers LLP**

Certificate

This is to certify that M/s. Eco Energime Engineers LLP, Bengaluru has conducted **Green Audit** and **Quality Audit** of **"City Engineering College, Doddakallasandra, Off – Kanakapura main road, Bengaluru"**, during February 2022 to April 2022. The Audit includes water audit, energy audit, waste management audit, green campus management audit and aspects of environment audit.

The audit involves field visit, measurements and observations, verification of bills, log books, data base, maintenance registers and interview with staffs, and this gives an overview of the existing system. In an opinion and to the best of our information and according to the information given to us, said Quality Audit gives a true and fair view in conformity with auditing principles.

For Eco Energime Engineers LLP

Authorized Signatory

No.14, S-1, 3rd Main, 14th Cross, AECS Layout, B-Block, Singasandra, Bangalore - 560 068, Karnataka
80503 87500 www.eeellp.com info@eeellp.com

EEELLP ACKNOWLEDGEMENT

EEELLP team thanks the management of **City Engineering College, Bengaluru,** for assigning this interesting work to us. We appreciate the cooperation extended to our team during the entire process.

Our special thanks are due to Principal & Team of colleagues for giving us necessary inputs to carry out this very vital exercise. We would like to thank all the head of the departments and staff members who were actively involved while collecting the data and conducting field measurements.

For Eco Energime Engineers LLP

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DISCLAIMER

The Audit Team has prepared this report for City Engineering College, Bengaluru, based on the input data submitted by the representatives of college complemented with the best judgment capacity of the expert team.

While all reasonable care has been taken in its preparation, details contained in this report have been compiled in good faith based on information gathered.

It is further informed that the recommendations are arrived following best judgments and no representation, warranty or undertaking, express or implied is made and no responsibility is accepted by Audit Team in this report or for any direct or consequential loss arising from any use of the information, statements or forecasts in the report

For Eco Energime Engineers LLP

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ABBREVIATION AND ACRONYMS

1.	A	:	Amperes
2.	AC	:	Air Conditioner
3.	APFC	:	Automatic Power Factor Controller
4.	BBMP	:	Bruhat Bengaluru Mahanagara Palike
5.	BESCOM	:	Bangalore Electricity Supply Company
6.	BWSSB	:	Bangalore Water Supply and Sewerage Board
7.	CC Camera	:	Closed Circuit Camera
8.	DG	:	Diesel Generators
9.	EE	:	Energy Efficient
10.	E-Waste	:	Electronic Waste
11.	etc.	:	Etcetera
12.	FTL	:	Fluorescent Tube Light
13.	GHG	:	Green House Gas
14.	Hz	:	Hertz
15.	HP	:	Horse Power
16.	HT	:	High Tension
17.	I	:	Current
18.	ICT	:	Information and Communications Technology
19.	IQAC	:	Internal Quality Assurance Cell
20.	ISO	:	International Organization for Standardization
21.	kgs	:	Kilograms
22.	kL	:	Kilo Liters
23.	kV	:	kilo volt
24.	kVA	:	kilo volt ampere
25.	kVAr	:	Reactive kilo volt ampere
26.	kW	:	Kilo Watt
27.	kWh	:	kilo Watt hour
28.	kWp	:	kilo Watt peak
29.	Lab	:	Laboratory
30.	LCD	:	Liquid Crystal Display
31.	LDPE	:	Low density polyethylene
32.	LED	:	Light Emitting Diode
33.	LT	:	Low Tension
34.	mA	:	Milli Amperes
35.	MoU	:	Memorandum of Understanding
36.	NA	:	Not Applicable
37.	NAAC	:	National Assessment and Accreditation Council
38.	No.	:	Numbers
39.	NSS	:	National Service Scheme

40.	Prim/Sec	:	Primary/Secondary
41.	PF	:	Power factor
42.	PG	:	Post Graduate
43.	Ph.D.	:	Doctor of Philosophy
44.	PV	:	Photo Voltaic
45.	Rs.	:	Rupees
46.	RO	:	Reverse Osmosis
47.	RR. No.	:	Revenue Register Number.
48.	S. No.	:	Serial Number
49.	Sq. Ft.	:	Square Feet
50.	Sq. m.	:	Square Meter
51.	SRTPV	:	Solar Roof Top Photo Voltaic
52.	TL	:	Tube Light
53.	TR	:	Ton of Refrigeration
54.	TV	:	Television
55.	UG	:	Under Graduate
56.	V	:	Volts
57.	W	:	Watts
58.	Wi-Fi	:	Wireless Fidelity
59.	Wp	:	Watt peak
60.	#	:	Number

1. INTRODUCTION

City Engineering College, Bangalore affiliated to Visvesvaraya Technological University (VTU) is centrally located in Bangalore. The College has expanded over the last 20 years with sophisticated infrastructure as a part of the Institution's commitment to provide higher quality education in the area of Engineering. The highly facilitated landmark building – provides a perfect ambience for creativity and learning. City Engineering College is known for its academic excellence, friendly welcoming atmosphere and community spirit. Over large number of full-time students study here in a wide range of programs. It is a center of talented, experienced teachers who inspire and energize the students to achieve the best.

The City Engineering College (CEC) was started in the year 2001 by Jayanagar Education Society, Bengaluru, Karnataka, India. Dr. K. R. Paramahamsa – A Distinguished Academician, Educationist & Philanthropist is the Chairman of Jayanagar Education Society. Dr. K.R. Paramahamsa is an Outstanding Personality with a vision to develop standard educational institutions and to deliver Quality Education in an excellent academic environment from primary to research level. The special focus areas of his efforts are extended to disciplines of Engineering & Technology, Business Management and Administration, Science, Computer Applications and Hospitality Management. The City Engineering College is administered by the Governing Body and Governing Council duly constituted as per norms.

The City Engineering College is Recognized by Government of Karnataka and Approved by AICTE, New Delhi. The college is situated in a sprawling campus spread around 11 acres area located next to Gokulam Apartments, Doddakallasandra off Kanakapura Road, Bengaluru, Karnataka, India. Currently we have 6 UG programmes with a total approved intake of 600; one PG programme with an approved intake of 24 and two Ph.D programmes.

The Institution provides an Excellent Learning echo-system to students through sustained efforts by providing Teaching, Lab, Library and Building Infrastructure facilities and fulfilling Quality expectations. IQAC has been formed to monitor quality aspects. ERP software is employed to monitor Teaching-Learning. The Model Curriculum as per the AICTE guidelines has been implemented from the fresh batch of 2018-19. Study material and Assignment questions for students are hosted on Pupil pod-ERP platform on a regular basis.

Online Grievance-redressal mechanism has been implemented. E-SHIKSHANA, a e-learning platform for Interactive Seminars, Webinars and Conferences has been instituted. The Institution is inching towards out-come based education from being a mere an in-put based.

VISION

Making Remarkable Contribution by Disseminating Knowledge on Emerging Trends in Engineering and Technology through various Programmes, Innovation and Research so as to Excel in Quality both at National and International level and to provide Career Guidance & Training for Employment.

MISSION

- To encourage Knowledge Acquisition and Foster Innovation & Research.
- To Prepare Students for Immediate Employment, leading to Technological and Socio-economic growth.
- To Provide Guidance for a Productive Career under various programmes.

QUALITY POLICY

The Institution believes in providing High Quality Education to the Students using necessary quality benchmarks in the area of Faculty Recruitment, Development and Student Learning processes through sustained efforts.

Committee and Cells

Internal Quality Assurance Cell (IQAC)

The establishment of Internal Quality Assurance Cell (IQAC) by accredited institutions (after the first cycle) is a major step in pushing long-term quality standards. IQAC in any institution is a significant administrative body that is responsible for all quality matters. It is the prime responsibility of IQAC to initiate, plan and supervise various activities that are necessary to increase the quality of the education imparted in an institution or college. The role of IQAC in maintaining quality standards in teaching, learning and evaluation becomes crucial.

The Indian higher education system is on the brink of great transformations to cope with global competence. The overall quality of higher education is the main concern in policy framing and for that it has been made mandatory to obtain accreditation of higher education institutions (HEIs) by the National Assessment and Accreditation Council (NAAC) to improve quality. Maintaining quality is a matter of long-term initiative; to reach this long-term goal, NAAC has established detailed guidelines from time to time. The establishment of Internal Quality Assurance Cell (IQAC) by accredited institutions (after the first cycle) is a major step in pushing long-term quality standards. IQAC in any institution is a significant administrative body responsible for all quality matters. It is the prime responsibility of IQAC to initiate, plan and supervise various activities which are necessary to increase the quality of the education imparted in institutions and colleges. It can promote and determine quality related activities and issues through various

programmes and activities such as seminars, workshops, symposia, conferences, panel discussions, role playing exercises, (model) demonstrations, case studies, academic meetings and any such kind of event or programme for all the stakeholders of the institution. The role of IQAC in maintaining quality standards in teaching, learning and evaluation becomes crucial.

Various committees and cells are listed below:

- Anti-ragging Committee
- Discipline Committee
- Anti-Sexual Harassment Committee
- Industry Institution Interaction Cell
- SC/ST Cell
- Women Empowerment Cell
- Grievance Redressal Committee
- Research & Development Cell

Campus Area and Built-up area

The area of the campus (built up and total) is given in table 1-1.

S. No.	Description	Units	Details
1	Engineering Campus total area	Acres	11

Table 1-1: College area

The details of infrastructure area are given in table 1-2.

PARTICULAR		EXISTING AREA (Sq.m)
CLASS ROOMS	UG	2033 (19 x 107) 1580 (20 x 079)
	PG	0100 (02 x 050)
TUTORIAL ROOMS		0711 (09 x 079)
DRAWING HALL		0158 (02 x 079)
COMPUTER CENTRE		0158 ----
WORKSHOP		0245 ----
PHYSICS LAB		0100 ----
CHEMISTRY LAB		0100 ----
CAED LAB		0158 ----
CCP LAB		0158 ----
CSE LABS 10		1000 ----
ECE LABS 08		1009 ----
MECH LABS 11		1388 ----
CIVIL LABS 08		1000 ----
SEMINAR HALLS **Class Rooms for NEW COURSES**		0940 ---- (3 *160 + 1 * 180 + 1 * 280) 0432 (108x4) + 5210 (AVAILABLE)
TOTAL INSTRUCTIONAL AREA		16480

Table 1-2: Infrastructure area

The details of administrative area are given in table 1-3.

Sl. No.	Particulars	Existing Area in Sq.m.
1.	PRINCIPAL ROOM	052
2.	VICE –PRINCIPAL ROOM	030
3.	ADMISSION ROOM	060
4.	HEAD OF DEPARTMENT ROOM/OFFICE	140 (20x07)
5.	FACULTY ROOM	900
6.	DEPARTMENTAL LIBRARY	Available
7.	STORE ROOM	040
8.	CONFERENCE ROOM	120
9.	MAINTENANCE/ESTATE OFFICE	040
10.	RECEPTION OFFICE	030
11.	COLLEGE OFFICE	350
12.	BOARD ROOM	082
13.	SECURITY	020
14.	HOUSE KEEPING	030
15.	EXAMINATION OFFICE	107
16.	PLACEMENT	182

Table 1-3: Administrative area

The details of campus amenities area are given in table 1-4.

Sl. No.	Particulars	Existing Area in Sq.m.
1.	SPORTS FIELD	20234.3
2.	SPORTS FACILITY	250
3.	GIRL'S COMMON ROOM	108
4.	CAFETERIA	250
5.	TOILETS	625
6.	FIRST AID & MEDICAL ROOM	020
7.	STATIONARY STORE AND REPROGRAPHY	040
8.	AUDITORIUM	8500
9	LIFT FACILITY	FIVE FLOORS
10	RO DRINKING WATER PLANT	1000 Ltrs
11	RAMP FACILITY	FOR SPECIALLY ABLED
12	FREE PARKING/TRANSPORTATION	TR. FOR NEAR BY AREAS

Table 1-4: Details of Campus amenities area

The details of lab area are given in table 1-5.

DEPT	NO.OF LABS	LAB AREA
Computer Science Engineering	16	1600 Sq. m
Electronics & Communication Engineering	09	1109 Sq. m
Mechanical Engineering	11	1388 Sq. m
Civil Engineering	08	1000 Sq. m
Basic Science	06	1019 Sq. m
Library	03	1100 Sq. m

Table 1-5: Details of Lab area

Internal Quality Auditing Team – 2021 – 2022

The college management constitutes the internal Quality Auditing team including students, staff, stakeholders, employees, and alumina's every year. Table 1-6 gives the list of internal Quality Auditing team for the year 2021 – 2022.

S. No.	Name	Designation	Role
1	Dr.H.N.Thippeswamy	Principal	Chairman
2	Dr.P.Jyothi	Vice-principal & HOD, Dept. of Mathematics	Vice-chairman
3	Dr.K.Sujatha	HOD, Dept. of Physics	Member
4	Dr.P.Rajasekhar	HOD, Dept. of Chemistry	Member
5	Mr.Vivekavardhana Reddy	HOD, Dept. of CSE	Member
6	Mr.Mallikarjun	HOD, Dept. of ECE	Member
7	Dr.S.Karunakara	HOD, Dept. of Mechanical Engg.	Member
8	Dr.P.Sowmiya Naik	Executive officer & Professor, Dept. of CSE	Member
9	Dr.Rajasekhar Reddy	HOD, Dept. of Information Science	Member
10	Dr. Vagdevi	HOD, Dept. of AI & ML	Member
11	Mr.Satish Hande	Administrative officer	Member

Table 1-6: Internal Quality Audit Team

Overview of Green Audit:

Green Audit helps college / facility to:

- Understand the usage of electricity, water and other natural resources
- Identify opportunities to conserve various natural resources
- Identify various technological improvements
- Evaluate the techno-commercial of identified conservative measures
- Create awareness among the students and staff
- Disseminate the commitment of management towards saving nature
- Develop a culture among students, staff and management to be socially responsible

2. PRE – AUDIT PHASE

A pre-audit meeting is a prerequisite for the Audit; it helps to meet and discuss about the schedule and documents required during the audit. The pre-audit meeting was conducted at City Engineering College, Off Kanakapura, Bengaluru in the end of February 2022. During the meeting, introduction of team members, scope and objectives of the audit were discussed.

Management Commitment

The Management of the college has shown significant commitment towards Quality Auditing during the pre-audit meeting. They were ready to encourage all green activities. It is decided to promote all activities that are environment friendly such as awareness programmes on the environment, campus farming, planting more trees on the campus etc., after the Quality Auditing.

College administration is vital to the process of realizing campus sustainability, and college policy is an essential instrument for any substantial change in the campus environment.

Scope and goals of Quality Auditing

A clean and healthy environment aids effective learning and provides a conducive learning environment. There are various efforts around the world to address environmental education issues. Quality Auditing is one among them for educational institutions.

Once a baseline is established, the data can serve as a point of departure for further action in campus greening. Existing data will allow the college to compare its programs and operations with those of peer institutions, identify areas in need of improvement, and prioritize the implementation of future projects.

This data will also provide a basis for calculating the economic benefits of resource conservation projects by establishing the current rates of resource use and their associated costs. This audit initiative focused initially on educating colleges and universities through workshops, guidebooks, fact sheets and ensuring compliance through inspections and self-audits.

2.1. Audit Schedule

Quality Audit schedule includes the pre-audit phase, on-site / audit phase and post audit phase. Table 2-1 details the complete Quality Audit schedule.

S. No	Description	Timeline
1.	Pre-audit Phase	28 February 22 to 05 March 22
2.	Onsite-audit Phase	07 March 22 to 19 March 22
3.	Post-audit Phase	22 March 22 to 25 March 22
4.	Presentation	08 April 22

Table 2-1: Audit Schedule

3. ON-SITE AUDIT PHASE

3.1. Scope / Target Areas of Quality Auditing

3.1.1. Water Audit

Water Audit addresses water consumption, water sources, appliances and fixtures. Aquifer depletion and water contamination are taking place at unprecedented rates. It is therefore essential that any environmentally responsible institution should examine its water use practices.

3.1.2. Energy Audit

Energy Audit addresses energy consumption, energy sources, energy monitoring, lighting, appliances, and vehicles. Energy use is clearly an important aspect of campus sustainability.

3.1.3. Waste Management Audit

Waste Audit addresses waste production and disposal, plastic waste, paper waste, food waste, and recycling. Municipal solid waste has a number of adverse environmental impacts, most of which are well known and not in need of elaboration.

3.1.4. Green Campus Management Audit

Green campus initiatives are becoming an integral part of modern day's university systems. Green campus Audit helps in maintaining the air and water clean. It regulates the climatic conditions and provides a healthy and comfortable environment for living.

3.1.5. Environment Audit

Environment Audit addresses the usage of fossil fuels (coal, diesel, petrol and gas). The mode of commute to and from college each day has an impact on the environment through the emission of greenhouse gases into the atmosphere by the burning of fossil fuels.

3.2. Audit Methodology and Approach

The methodology and approach adopted for the study involve various steps that include:

- Review of Document and records
- Review of Policies
- Review of MoU
- Review of various measures implemented
- Site Walkthrough
- Data Collection
- Interviews

3.2.1. Review of Document and Records

Electricity bills, Water bills, equipment register, list of appliances, office registers, internal Quality Audit document, purchase document, were reviewed and relevant data and inputs required for analysis have been collected.

3.2.2. Review of Policies

College has various policies that include safety policy, environment policy, and Anti-ragging policy.

A. Safety Policy:

An organization's safety policy is a recognized, written statement of its commitment to protect the health and safety of the students and employees, as well as the surrounding community. All the students, teaching and non-teaching staff, maintenance and house-keeping staff have been given training to use fire extinguishers in emergency situations of fire and explosion. Fire extinguishing cylinders have been installed in each floor, UPS rooms and in laboratory areas.

Sample photos of fire extinguisher is as shown in figure 3-1.

Figure 3-1: Fire extinguisher

The refilling certificate for the fire extinguishers at college premises is shown in figure 3-2.

Aim Fire Services

FIRE PROTECTION ENGINEERS

REFILLING CERTIFICATE

REFIAIM/140/2020

M/R.City Engineering Collage
Doddakallasandra,Near Gokulam
Apartments, off kanakapura Road,
Bangalore-560061.

Dear Sir,

This is to Certify that the existing Fire Extinguisher at your premises has been Refilling on 4/11/2020-4/11/2021

Sl. N	Type of F/E	Qty	Refilling date	N. Refilling Date
1	Recharging of ABC 1 kg cap. F/E.	2.00	4/11/2020.	3/11/2021.
2	Recharging of ABC 2 kg cap. F/E.	6.00	4/11/2020.	3/11/2021.
3	Recharging of ABC 4 kg cap. F/E.	6.00	4/11/2020.	3/11/2021.
4	Recharging of ABC 5 & 6 kg cap. F/E.	2.00	4/11/2020.	3/11/2021.
5	Recharging of CO2 4.5 kg cap. F/E.	1.00	4/11/2020.	3/11/2021.
6	Recharging of DCP 10 kg cap. F/E.	1.00	4/11/2020.	3/11/2021.

All the above mentioned Fire Extinguisher are ready to use for any emergency and are guaranted against manufacturing defects for a period of One year. (Subject to any tampering or misuse)

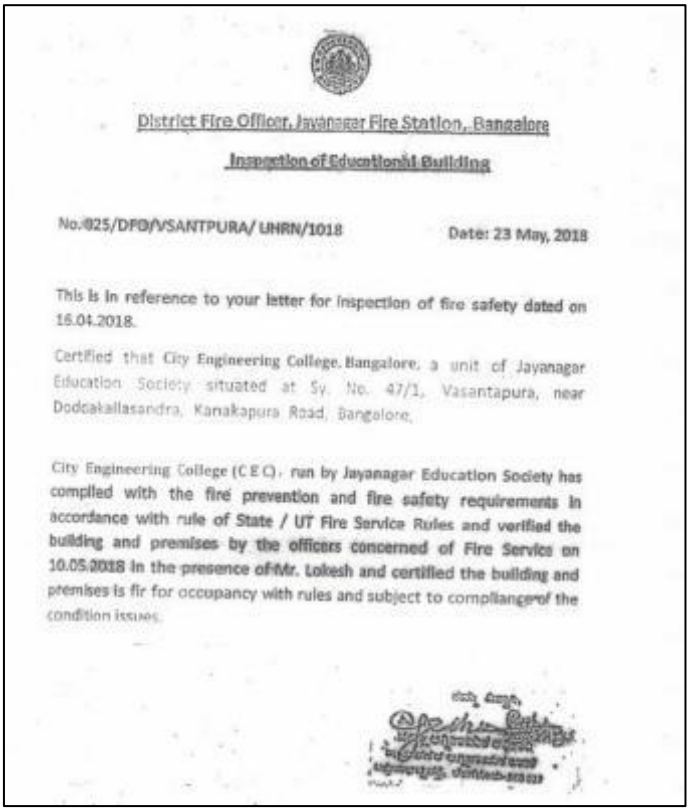
Thanking You
Yours faithfully,

DR. V S RAMAMU RTHY

ISO 9001 / 2015 Certified Company

Figure 3-2: Refilling certificate for fire extinguishers

The certificate for inspection of fire safety issued by district fire officer, Jayanagar fire station is shown in figure 3-3.



District Fire Officer, Jayanagar Fire Station, Bangalore

Inspection of Educational Building

No.025/DFO/VSANTPURA/ UHRN/1018 Date: 23 May, 2018

This is in reference to your letter for inspection of fire safety dated on 16.04.2018.

Certified that City Engineering College, Bangalore, a unit of Jayanagar Education Society situated at Sy. No. 47/1, Vasantapura, near Dodcakallasandra, Kanakapura Road, Bangalore.

City Engineering College (C E C), run by Jayanagar Education Society has complied with the fire prevention and fire safety requirements in accordance with rule of State / UT Fire Service Rules and verified the building and premises by the officers concerned of Fire Service on 10.05.2018 in the presence of Mr. Lokesh and certified the building and premises is fir for occupancy with rules and subject to compliangeof the condition issues.

Figure 3-3: Letter of Inspection of fire safety

B. Anti-Ragging policy:

Ragging in all its forms shall be totally banned in the entire institution, including its departments, constituent units, all its premises (academic, hostel, sports, canteen, etc.) whether located within the campus or outside and in all means of transportation of students whether public or private. Sample photos of anti-ragging posters displayed within the college premises are shown in the figure 3-4.

Figure 3-4: Anti-ragging posters

3.2.3. Review of various measures implemented

During the Green Audit study, it was observed the college has taken various initiatives in conserving natural resources that include:

- Internal Quality Auditing team is available. It is comprised of chairman, vice-chairman and members.
- Usage low flow water taps like pressmatic taps, push type taps and taps with aerators is used to minimize water usage.
- Cleaning activity using bucket & mop is followed instead of using a water hose.
- Regular testing water quality parameters.
- Regular maintenance of RO plant is done.
- Installation of waste segregation bins at all the rooms to separate the dry and wet waste
- Installation of LCD/LED monitors for all the desktops to conserve electricity
- Switching OFF lights and fans whenever not in use to save electricity
- Sensor based solar LED street lights are used.
- De-composter pit is available for decomposing the leaves.

3.2.4. Site Walk through

Site walk through was conducted with staff members, students and audit team members. Staff and students have shown very keen interest in the data collection process and methods to be followed in field data collection. The staff and students have given inputs and suggestions for resource conservation as well.

College Infrastructure

CITY Engineering College campus has two blocks with departments. Each floor has state of the art class rooms, staff rooms, laboratories, libraries and many more. Details of infrastructure are as follows:

Figure 3-5: Infrastructure Details

All the classrooms and staff rooms are well ventilated and the integration of day-light is well utilized. This has helped in optimized usage of electricity for lights and fans during day time.

3.2.5. Inventory Collection

To understand the types of appliances used, inventory collection was carried out by the audit team members. The various types of appliances used are lights, fans, RO water plants etc. The consolidated list of inventories is given in table 3-1.

S. No.	Inventory Type	Wattage	Quantity
1.	FTL	1 x 36 W	537
2.	LED Tube light	1 x 18 W	19
3.	LED	9 W	30
4.	LED solar light	40 W	9
5.	LED Façade light	100 W	3
6.	CFL bulb	1 x 14 W	72
7.	Décor LED lamp	5 w	3
8.	Incandescent bulb	40 W	15
9.	LCD Projector		14
10.	Computer		414
11.	Printer		26
12.	Ceiling Fan	65 W	233
13.	Stand / Wall mount fan		4
14.	Exhaust fan		7
15.	Xerox machine		2
16.	LED TV screen		1
17.	Cassette AC		1
18.	RO Plant (250 lph)		1

Table 3-1: Consolidated list of Inventories

3.2.6. Interviews

To collect the various data, information and operating patterns, interviews were conducted with college staff (Principal, teaching staff, non-teaching staff) and students. The consolidated information from the interviews is given in the following sub-sections.

3.2.6.1. List of Holidays

The lists of holidays were collected during the study and the same is given in figure 3-4 and figure 3-5.

Date	Day	General Holidays 2021
14-01-2021	Thursday	Uttarayana Punyaa kaala, Makara Sankranti Festival
26-01-2021	Tuesday	Republic Day
11-03-2021	Thursday	Maha Shivaratri
02-04-2021	Friday	Good Friday
13-04-2021	Tuesday	Ugadi Festival
14-04-2021	Wednesday	Dr. B R Ambedkar Jayanthi
01-05-2021	Saturday	May Day/ Labour Day
14-05-2021	Friday	Basava Jayanthi/ Akshaya Tritiya, Khutub-E-Ramzan
21-07-2021	Wednesday	Bakrid
20-08-2021	Friday	Last Day of Moharam
10-09-2021	Friday	Varasiddhi Vinayaka Vrata
02-10-2021	Saturday	Gandhi Jayanthi
06-10-2021	Wednesday	Mahalaya Amavasya
14-10-2021	Thursday	Mahanavami, Ayudhapooja
15-10-2021	Friday	Vijayadashami
20-10-2021	Wednesday	Maharishi Valmiki Jayanti, Eid-Milad
01-11-2021	Monday	Kannada Rajyothsava
03-11-2021	Wednesday	Naraka Chaturdashi
05-11-2021	Friday	Balipadyami Deepavalli
22-11-2021	Monday	kanakadasa Jayanti

Figure 3-6: List of Holidays for 2021

VTU Holidays 2022 (General)

Date	Day	General Holidays 2022
15-01-2022	Saturday	Uttarayana Punyaa kaala, Makara Sankranti Festival
26-01-2022	Wednesday	Republic Day
1-03-2022	Tuesday	Maha Shivaratri
02-04-2022	Saturday	Ugadi Festival
14-04-2022	Thursday	Dr. B R Ambedkar Jayanthi, Mahaveera Jayanthi
15-04-2022	Friday	Good Friday
03-05-2022	Tuesday	Basava Jayanthi/ Akshaya Tritiya, Khutub-E-Ramzan
09-08-2022	Tuesday	Last Day of Moharam
15-08-2022	Monday	Independence Day
31-08-2022	Wednesday	Varasiddhi Vinayaka Vrata
04-10-2022	Tuesday	Mahanavami, Ayudhapooja
05-10-2022	Wednesday	Vijayadashami
24-10-2022	Monday	Naraka Chaturdashi
26-10-2022	Wednesday	Balipadyami Deepavalli
01-11-2022	Tuesday	Kannada Rajyothsava
11-11-2022	Friday	kanakadasa Jayanti

Figure 3-7: List of Holidays for 2022

3.2.6.2. Tentative Schedule of College:

The tentative schedule of the college is 09.00 AM to 5:00 PM. The details of the sessions are given in table 3.2.

S. No.	Description	Timings
1	Session – I	09.00 AM to 10.00 AM
2	Session – II	10.00 AM to 11.00 AM
3	Break	11.00 AM to 11.15 AM
4	Session – III	11.15 AM to 12.15 PM
5	Session – IV	12.15 PM to 01.15 PM
6	Lunch	01.15 PM to 02.00 PM
7	Session – V	02.00 PM to 03.00 PM
8	Session – VI	03.00 PM to 04.00 PM
9	Session – VII	04.00 PM to 05.00 PM

Table 3-2: Tentative College Schedule

3.2.6.3. Staff and Students of College:

The number of staff includes teaching, non-teaching, and house-keeping is given in the table 3-3. The number of students includes both boys and girls.

S. No.	Staff	Students
1	109	689

Table 3-3: Number of staff and students

4. WATER AUDIT

4.1. Facility description

The water audit study involved carrying out various observations and analysis, to realistically assess usage of water and potential for water conservation.

Borewell is the main source of water, for facilitating the water supply requirement of the entire campus. No water is purchased from BWSSB and through tankers.

Two borewells are available in campus. From borewells, the water is pumped and filled in sump near Dr. A.P.J. Abdul Kalam block. Then, from sump the water is pumped to overhead tanks using submersible type pumps. The location of borewells and pump capacity are given in table 4.1

S. No.	Location	Name	Pump type / Rating, HP
1	Near School block	Borewell 1	Submersible / 7.5 HP
2	Near Admin block	Borewell 2	Submersible / 7.5 HP

Table 4-1: Details of borewells

From borewell 1, the water is supplied to school block, sump (near Dr. A.P.J. Abdul Kalam block) and garden. For this purpose, valve mechanism is provided at borewell point. The borewell 1 is shown in figure 4-1.

Figure 4-1: Borewell 1 & Control panel (near school block)

From borewell 2, the water is supplied to sump and overhead tanks of admin block. The borewell 2 is shown in figure 4-2.

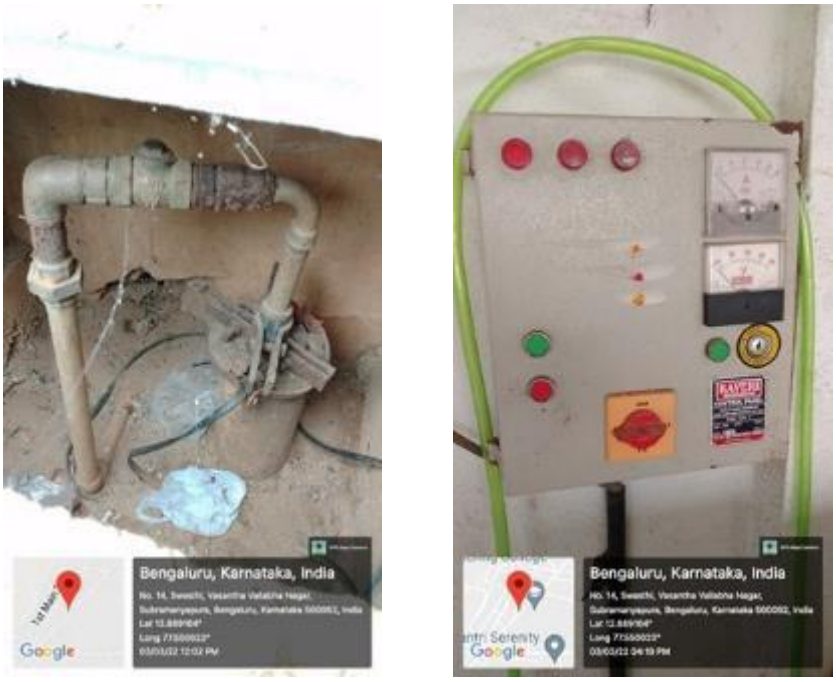


Figure 4-2: Borewell 2 & Control panel (near admin block)

One underground sump is available. The sump is located near Dr. A.P.J. Abdul Kalam block. The capacity of sump is 35 kL. The sump and valve mechanism is shown in figure 4-3 and figure 4-4.

Figure 4-3: Underground sump (near CS/IS block)

Figure 4-4: Valve mechanism for sump

For sump, input water supply is provided using borewell 1 and borewell 2. Primary water supply is done from borewell 1(near school block). In case of maintenance, the water is supplied from borewell 2 (near admin block).

From sump, the water is pumped to overhead tanks of Dr. A.P.J. Abdul kalam block (CS/IS block). In case of maintenance work at borewell 2, the water from sump is pumped to overhead tanks of Dr. Sir. M. Visveswaraya block (Admin block). For pumping, 3 HP submersible type pump is used.

In case of maintenance work at sump, the water from borewells is directly pumped to overhead tanks.

Based on the source, usage and type, water is classified as following types in the college campus that include:

- Raw Water
- Drinking Water
- Hot Water
- Rain Water
- Sewage Water

Details of the various types of water usages are discussed in detail, in the following sections.

4.1.1. Raw Water System

The raw water is consumed in the following areas:

- RO plant Input
- Student's toilets
- Staff toilets
- Laboratories
- Canteen
- Garden

The schematic of overall raw water distribution system of the campus is given in figure 4-5.

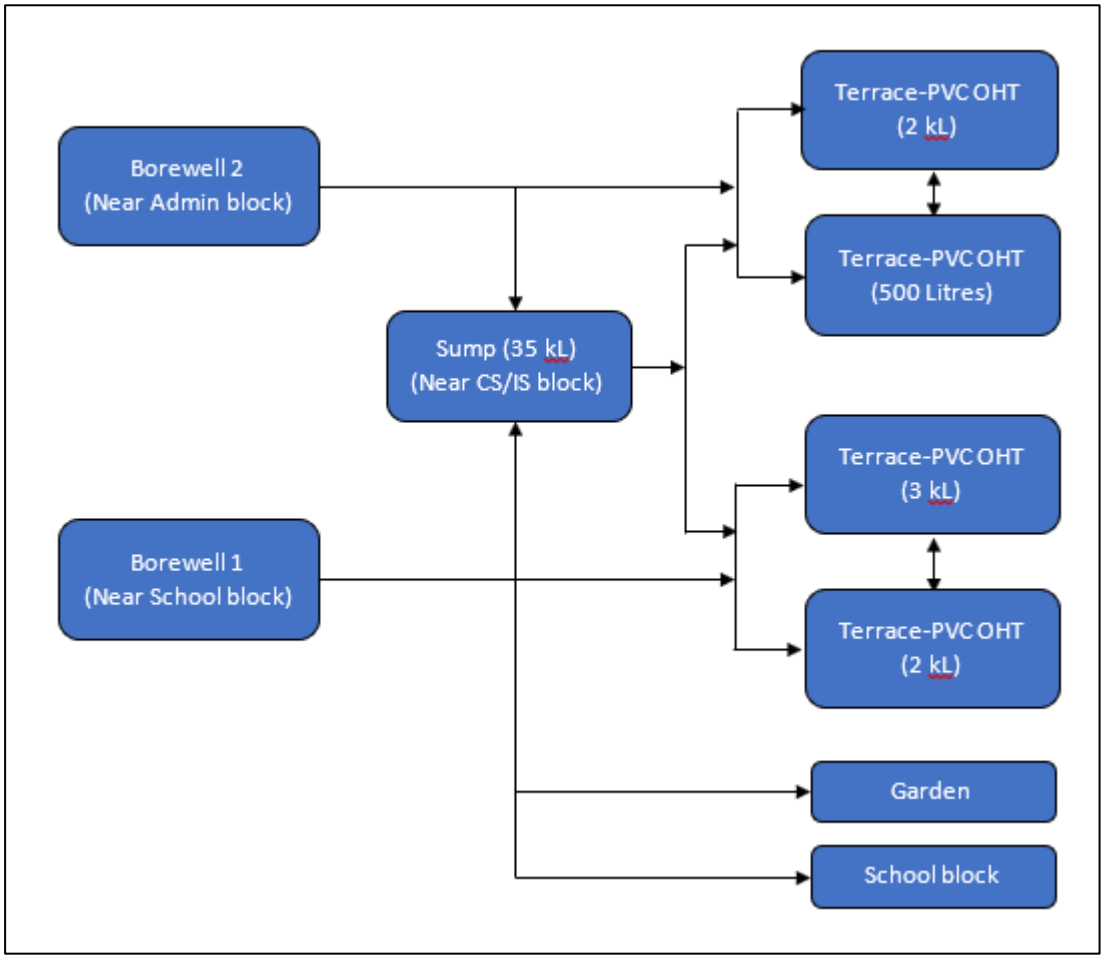


Figure 4-5: Overall schematic of raw water system

Dr. Sir. M. Visveswaraya Block (Admin block):

Borewell 2 is the primary source of water supply for Dr. Sir. M. Visveswaraya block (Admin block). From borewell 2, water is pumped to the two PVC overhead tanks located at the terrace. The capacity of tanks are 2000 litres and 500 litres.

The water from 2000 litres PVC overhead tank is distributed to RO plant input, student's toilets, staff toilets, laboratories, canteen and garden. Dedicated pipeline is provided for RO plant input. The 2000 litres PVC overhead tank is shown in figure 4-6.

Figure 4-6: 2000 litres PVC overhead tank

The water from 500 litres PVC overhead tank is distributed to chairman room, principal chamber, mechanical staff room and civil lab. The 500 litres PVC overhead tank is shown in figure 4-7.

Figure 4-7: 500 litres PVC overhead tank

In case of maintenance at borewell 2, the water is supplied to PVC overhead tanks from sump (near Dr. A.P.J. Abdul Kalam block).

If borewell 1 is under maintenance, then borewell 2 is used to fill the sump.

Dr. A.P.J. Abdul Kalam Block (CS & IS block):

Borewell 1 (near school block) is the primary source of water supply for Dr. A.P.J. Abdul Kalam block (CS & IS block). From borewell 1, water is pumped directly to the two PVC overhead tanks located at the terrace. The capacity of tanks are 3000 litres and 2000 litres. Both tanks are interconnected and provided with valve mechanism. In case of maintenance at borewell 1, water from sump is pumped to the terrace PVC overhead tanks.

The water from PVC overhead tanks is distributed to student's toilets, staff toilets, laboratories, and garden. The PVC overhead tanks are shown in figure 4-8.

Figure 4-8: PVC overhead tanks (3 kL & 2 kL)

The interconnection between tanks with valve control is shown in figure 4-9.

Figure 4-9: Interconnection between tanks with valve control

4.1.2. Drinking water system

To provide drinking water, RO plant is installed at ground floor of Dr. Sir. M. Visveswaraya block (Admin block). The input water for RO plant is supplied from 2000 litres terrace PVC overhead tank. The permeate rate of RO plant is 250 litres per hour. The RO drinking water is stored in 500 litres RO tank. From RO tank, the RO water is filled in 25 litres can and kept at each floor for consumption.

The schematic block diagram RO drinking water system is shown in figure 4-10.

Figure 4-10: Schematic of RO drinking water system

The RO plant and RO tank is shown in figure 4-11.

Figure 4-11: RO plant & RO tank

The 25 litres water cans kept at each department is shown bin figure 4-12.

Figure 4-12: 25 litres water can in each department

The RO reject water is used for watering the garden. The hose is connected at RO reject tap and it is used for watering the garden. The image is shown below in figure 4-13.

Figure 4-13: RO Reject tap with hose

4.1.3. Rain water system

Rain water harvesting system is not available in the campus. Provisions for rain water to drain from terrace is provided in both blocks. The rain water from terrace of buildings directly falls on ground and it is absorbed.

Provisions for draining rain water from terrace to ground in shown in figure 4-14.

Figure 4-14: Rain water pipes at terrace

4.1.4. Waste Water System:

The sources of waste water in the college campus are as follows

- Washrooms
- Toilets
- Labs
- Canteen

The schematic of waste water system is shown in figure 4-15.

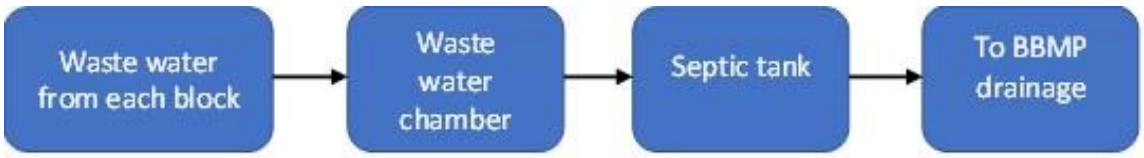


Figure 4-15: Schematic of waste water system

Three waste water tanks are available. First tank is near the Dr. A.P.J. Abdul kalam block, second tank is near transformer yard, and third one near the compound wall of canteen.

Waste water from the wash rooms, toilets and labs are connected to the waste water chambers in each block. Then, from chambers the waste water is collected in a sewage tank. From sewage tank, the overflowing sewage water is made to reach a chamber. Then, from this chamber the sewage reaches the BWSSB drainage system through underground pipes. At present, the underground connection is provided but BWSSB drainage system is yet to be finished.

Whenever the sewage water tank is filled, it is disposed using sewage water disposal tanker lorries. The images of waste water pipeline from rest rooms, waste water chamber and waste water septic tank are shown in figure 4-16 to figure 4-18.

Figure 4-16: Waste water pipeline from rest rooms

Figure 4-17: Waste water chamber

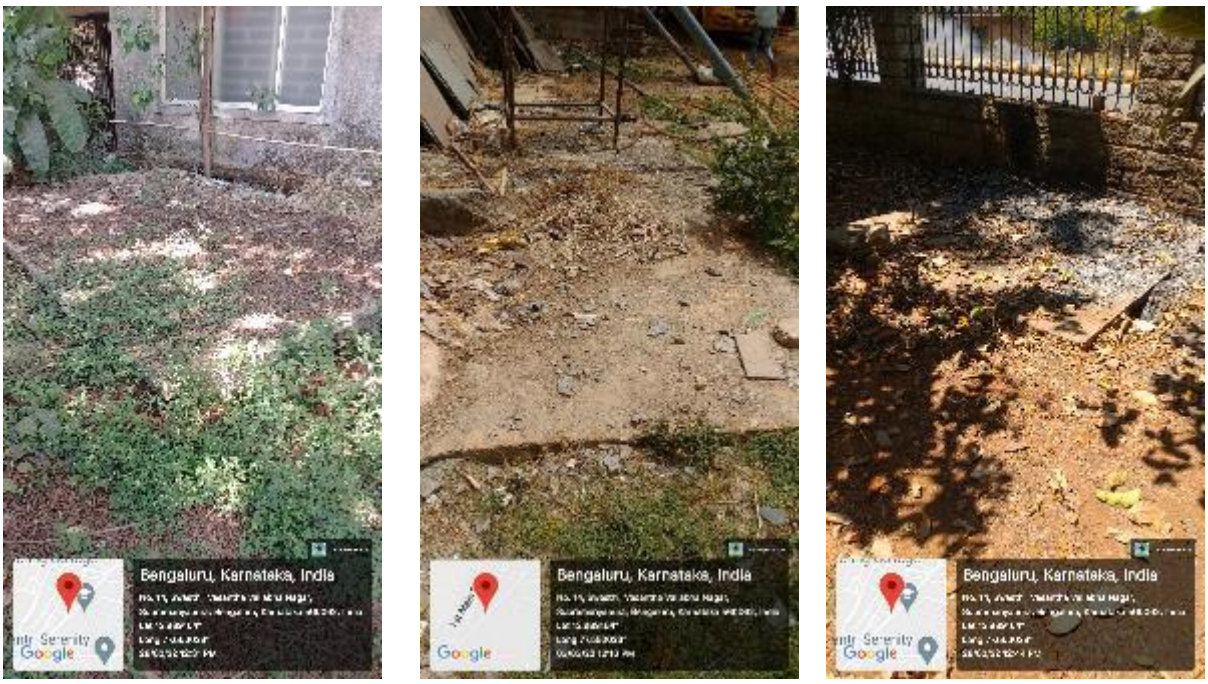


Figure 4-18: Waste water tanks of admin block, CS/IS block & canteen

4.2. Best Practices Implemented for Water Conservation

4.2.1. Aerator for taps

Aerator for taps is installed at labs and in handwash sinks to save water. The image of tap with aerator is shown in figure 4-19.

Figure 4-19: Tap with aerator

The aerator is a small attachment that either fits onto the end of the tap or can be inserted inside of the existing spout. These water saving devices will control the amount of water that flows through the tap without affecting the water pressure as they mix the water with air which will save water and money.

The aerators will separate a single flow of water into many tiny streams which introduces the air in to the water flow. Also, as there is less space for the water to flow through, the water flow is reduced, resulting in water savings. As the water pressure is maintained, most people don't notice a difference in the amount of water coming out of an aerated faucet yet benefit from the water efficiency.

Tap aerators are of most use to those with older taps which run on average around 15 litres of water per minute. Adding an aerator to an older tap can reduce this to as little as 6 litres of water per minute.

The biggest water saving benefit is achieved in the hand wash sinks where you are often turning the taps on and off to wash your hands and for other uses.

4.2.2. Use of Push taps

Push type taps are installed for urinals. This helps to save water.

A push tap is a type of faucet that can be operated by just pushing a button in order to activate the water flow. It's a self-closing faucet which if once pressed, emits water until the pressing is held and automatically shuts off if pressing is released.

The image of push taps installed in boy's toilet is shown in figure 4-20.

Figure 4-20: Push type tap for urinals

Push type taps are designed to control wastage of water caused due to human laxity. Also, it eliminates the risk of the tap being left on by a user.

Push type taps are more water-saving when compared to the other taps because they have a controlled water stream which limits the water use.

4.2.3. Use of Pressmatic taps

Pressmatic taps are installed for handwash basins and for urinals to save water. The pressmatic tap installed is shown in figure 4-21.

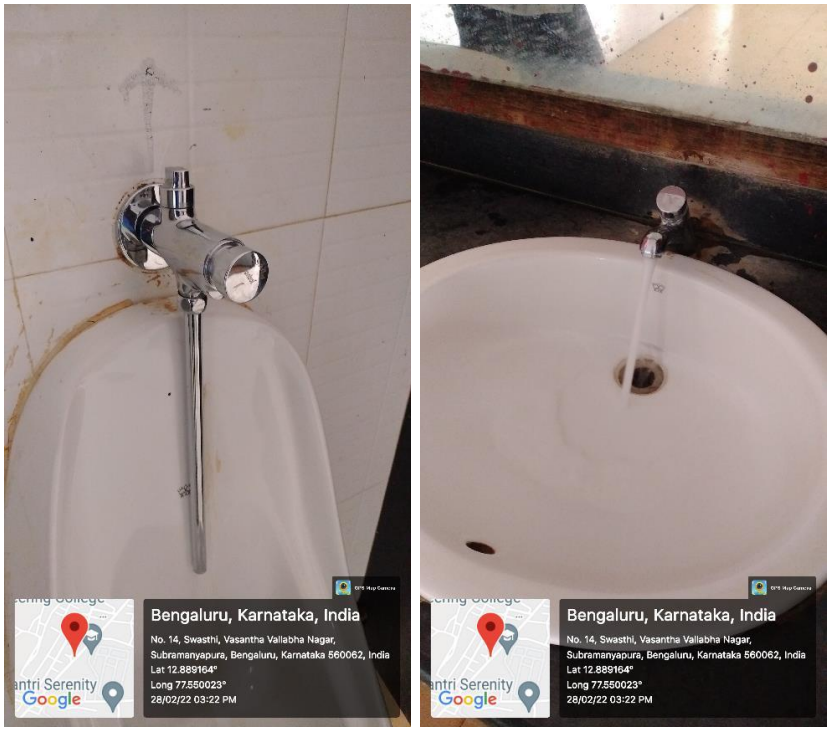


Figure 4-21: Pressmatic tap for urinals & handwash basins

Pressmatic taps helps in saving water using auto closing valve mechanism after 8 to 10 seconds.

Pressmatic taps generally include an aerator in the spout which disperses the water and means that much less is needed for washing than is the case with traditional taps. This means that Pressmatic taps generally have a much lower flow rate than traditional hand-operated basin taps.

4.2.4. Usage of bucket and mop cleaning instead of hose:

For cleaning purpose, using a hose will result in lot of water wastage. In order to avoid wastage of water, cleaning activities are done using a bucket and mop. The sample image of bucket and mop for cleaning is shown in figure 4-22.

Figure 4-22: Bucket and mop

College buses are also cleaned using a wet towel instead of using hose from tap for cleaning. The sample image bus cleaning activity is shown in figure 4-23.

Figure 4-23: Bus cleaning using cloth and bucket water

4.2.5. Regular water testing

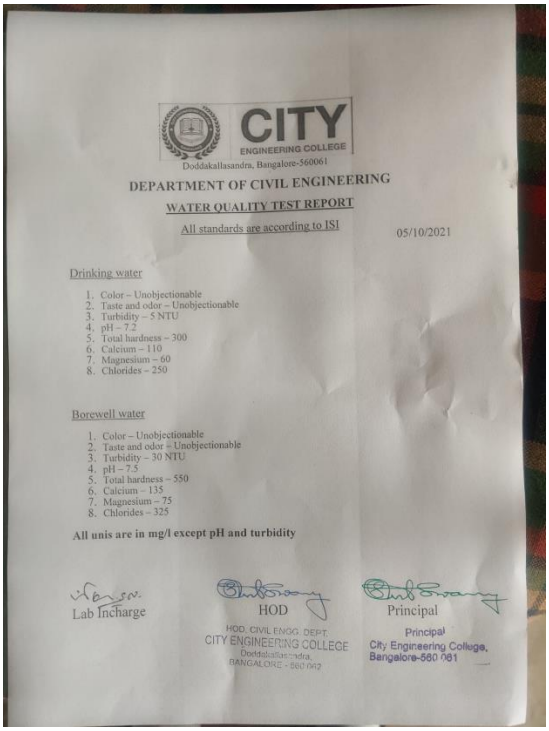
Testing water quality on a regular basis is an important part of maintaining a safe and reliable source. The test result allows to properly addressing the specific problems of a water supply. This will help ensure that the water source is being properly protected from potential contamination, and that appropriate treatment is selected and operating properly.

It is important to test the suitability of water quality for its intended use, whether it be livestock watering, chemical spraying, or drinking water. This will assist in making informed decisions about your water and how you use it.

Regular testing is important to:

- Identify existing problems
- Ensure water is suitable for the intended use, especially if used for drinking by humans and animals
- Track changes over time
- Determine the effectiveness of a treatment system

Water testing is carried out for RO purified water and borewell water. The sample water test report for borewell water and RO purified is shown in figure 4-24



CITY
ENGINEERING COLLEGE
Doddakallasandra, Bangalore-560061

DEPARTMENT OF CIVIL ENGINEERING

WATER QUALITY TEST REPORT

All standards are according to ISI

05/10/2021

Drinking water

1. Color – Unobjectionable
2. Taste and odor – Unobjectionable
3. Turbidity – 5 NTU
4. pH – 7.2
5. Total hardness – 300
6. Calcium – 110
7. Magnesium – 60
8. Chlorides – 250

Borewell water

1. Color – Unobjectionable
2. Taste and odor – Unobjectionable
3. Turbidity – 30 NTU
4. pH – 7.5
5. Total hardness – 550
6. Calcium – 135
7. Magnesium – 75
8. Chlorides – 325

All unis are in mg/l except pH and turbidity

Lab Incharge

HOD

HOD, CIVIL ENGG. DEPT.
CITY ENGINEERING COLLEGE
Doddakallasandra,
BANGALORE - 560 062

Principal

Principal
City Engineering College,
Bangalore-560 061

Figure 4-24: Water test report

4.2.6. Regular maintenance of RO plant

The RO plant is checked regularly. If any maintenance required then it is done at the earliest. The sample image of expense bill for RO maintenance is shown in figure 4-25.

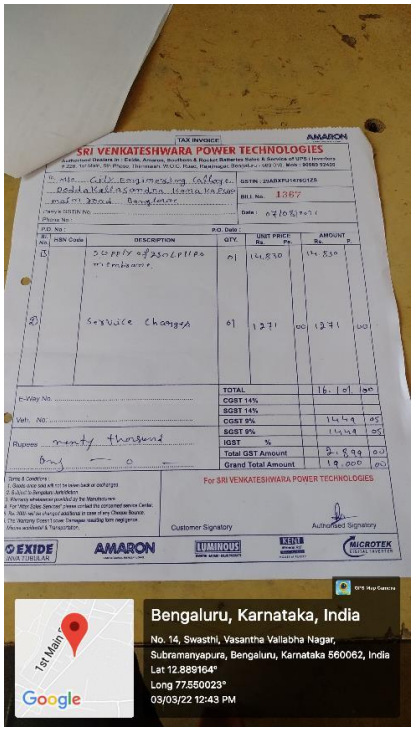


Figure 4-25: RO plant - Maintenance expenses bill

4.2.7. Maintenance Team

The maintenance team consist of five members. The team carry out maintenance activities in concern sections i.e., electrical, water and gardening. The maintenance team list shared by the institution is given in table 4-2.

S. No	Name	Designation
1.	Mr. Lokesh M K	Electrician
2.	Mr. Rangaswamy	Electrician
3.	Mr. Vikas	Plumber
4.	Mr. Chikkanna	Gardener
5.	Mr. Venkateshappa	Gardener

Table 4-2: Details of Maintenance team

4.3. Recommendations

4.3.1. Rain water harvesting

The rain water from terrace of each of blocks is made to drain on ground level through pipes and it is absorbed by earth surface. At present no rain water harvesting system is installed in the campus.

The rain water can be used for recharging the ground water level by constructing an rain water harvesting system or an open borewell recharge pond. This will enhance the ground water level.

Rain water harvesting will help in collection of rain falling on earth surfaces for beneficial uses before it drains away as run-off. Harvested rain water can be utilized immediately or after storage.

However, initiatives have been taken for rain water harvesting system implementation. Implementing rain water harvesting system will help in maintaining ground water level.

4.3.2. Borewell/Ground water recharge System:

Two borewells are available within the college campus. Borewells is the only source of water used in campus. Hence, it is necessary to consider a borewell recharge system so that the ground water level can be well maintained.

Water resource is being categorized as a renewable energy source, which means, natural water resources can be easily replenished back to nature.

Borewell recharging technically focuses on the use of harvested surface water (obtained via rainfall or nearby water bodies) where runoff water begins to pass through a natural filter made up of large and small stones. Then, there is another layer of sand through which water passes and finally, it perforates in the borewell pipe via a fine mesh which is wrapped around the drilled casing pipe. The fine mesh ensures the removal of big and tiny impurities before the water enters the borewell.

Benefits :

- Assured supply of water for irrigation and potable water, in rural and urban areas
- Increased water table reduces pumping costs.
- Recharge of Groundwater, replenishes the deeper layers of the earth's crust which in turn insulates the earth from rise in temperature, reducing global warming
- Groundwater Recharge will bridge the gap between acute shortage & available water during the peak summer months.
- Provides hygienic and safe drinking water(Death and disease, especially in children under the age of five due to unsafe drinking water)
- Reduces hardness , salinity and TDS contents in the bore well
- Reduces significant carbon foot prints
- Prevents water logging in low lying areas.

4.3.3. RO Plant Reject water:

- If RO plant is Single stage, then TDS level of RO reject water will be low. For example: When 100 L of raw water is treated in RO plant, it produces 40 L of drinking water (permeate) and 60 L of reject water (reject).

  This type of system will have low TDS in reject water

- If RO plant is Multi stage, then TDS level of RO reject water will be high. For example: When 100 L of raw water is treated in RO plant, it produces 80 L of drinking water (permeate) and 20 L of reject water (reject).

Hence, it is recommended to check the reject water quality parameters from NABL Accredited Lab. Based on the results the usage of water shall be planned accordingly

Uses of RO plant reject water:

1. **Cleaning and Toilet flushing**

   Every single flush sends approximately 5 to 7 litres of potable water down the drain.RO waste water can be used effectively to reduce this wastage of clean water by using it to flush your toilets. With a periodical clean-up using common toilet cleaners, the chances of discoloration and salt deposits can be avoided.

2. **Floor mopping and cleaning**

   Using the RO waste water for mopping the floor is easy and will definitely save tens of litres of clean water every day. It can be used for all the floor mopping, cleaning windows, work places, etc., If TDS is higher than 2000 PPM then dilute with raw water or use alternate days.

3. **Washing utensils**

   Another useful application for Reverse Osmosis waste water is to wash utensils. Simply store the waste water in bucket or tank, make sure to place the bucket for collecting RO waste water near your washing area so it can be used easily when you clean your utensils.

4. **Cleaning vehicles**

   A single car wash could consume anywhere between 14 litres (for car wash using a bucket) to 75 litres (for car wash using a hosepipe) of water. Simply store the waste water in some tank or bucket and reuse it for washing your car. Water with a TDS level of

1200 – 1500 PPM can be safely used for car washing. If the TDS level of waste water is high you can mix tap water to dilute it.

5. Watering garden or plants

The wastewater can be used for watering your plants to keep your indoor or terrace garden green. For gardening/irrigation use, a TDS level of up to 2100 PPM is permissible. You should also check out the percentage of Sodium, it should be less than 60 % (i.e., Na / Na + Ca + Mg). High Sodium content causes loss of soil porosity and therefore harmful to soil fertility in the long run.

4.3.4. Sewage Treatment Plant

The waste water sources are washrooms, toilets and labs. The waste water from both blocks is sent to septic tank and then to BBMP drainage through underground pipe.

Cost effective and advanced water purification technologies are available to recycle and reuse the waste (sewage) water. Integration of recycled water use in the existing system will result in reduced raw water usage. An STP plant will treat the waste water to make it fit for safe disposal.

At present, raw water is used for watering the garden. If STP is established, the treated water can be used for watering the garden. Also, it can be used in dual piping system for toilet flushing.

Hence, it is advised to establish a Sewage Treatment Plant.

4.3.5. Water flow meters

In college campus, two borewells are used as sources of water. Water is pumped daily from the borewells and distributed to overhead tanks available in each block for usage.

However, data regarding the quantity of water used per day is not accounted. With the presence of flow meters, it is possible to measure quantity of water used per day. Installing water flow meters at each block will quantify the water used in individual blocks. Whereas, installing flow meters in borewells will help in quantifying overall water consumption.

Measurement is the first step towards conservation of water. Hence, water usage has to be measured by installing proper metering and monitoring systems.

4.3.6. Waterless urinals

Traditional water-based urinals are one of the major waters consuming area in any facility. Apart from the normal water usage, the cost for handling raw water to the urinals is an added expenditure. Also, maintaining the water taps and flushes for urinals will add to maintenance cost as well.

To overcome these challenges and as part of water conservation measure, implementation of waterless urinals can be incorporated in the campus.

Waterless urinals may look similar to regular flush urinals, but they use no water and have no flush valves. The sample image of waterless urinals is shown in figure 4-26.

Figure 4-26: Waterless urinals

Schematic of Water less urinals functioning:

Figure 4-27 shows the functioning of waterless urinals.

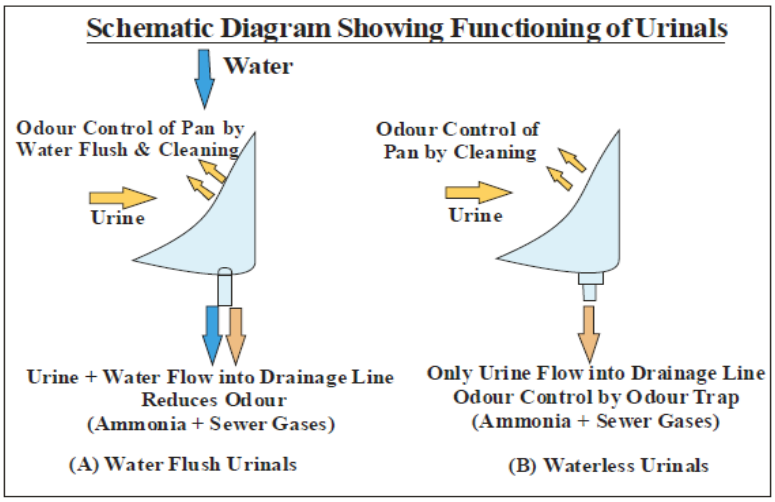


Figure 4-27: Schematic of function of Waterless urinals

The advantages of water less urinals are as follows:

- Reduces water bill
- Reduces usage of chemicals
- Improves overall bathroom hygiene
- Save enormous quantities of freshwater
- Enhance efficiencies of sewer lines and wastewater treatment plants
- Optimize cost of plumbing accessories at supply & consumption ends
- Conserve electricity used for pumping water & treating wastewater

Types of Waterless urinals and Pricing:

1. Sealant Liquid Traps
    a. Sealant liquids have lower specific gravity than urine, these allow passage of urine but prevent odour emitted by drainage lines.
    b. The sealant liquid needs refilling as they evaporate and also get washed away owing to the urine flow.
    c. The cost of one waterless urinal pans with sealant liquid trap ranges from Rs 7000/- to Rs 18,000/-.
2. Membrane based Traps
    a. Membrane based traps use rubber, silicone or LDPE (low density polyethylene) in the shape of tubes is used for controlling odour.
    b. The cleaning frequency depends directly on the number of uses per day.
    c. Membranes need to be replaced between three months to six months depending on quantum of usage
    d. The approximate trap costing is around Rs.250/-. The current trap design fits only to low-cost basins from the bottom

Checklist for water less urinals:

- Regular cleaning
- Do not use brushes, towels or abrasive cleaners
- Never put water down a waterless urinal
- Use the correct cleaning products

4.3.7. Awareness posters and campaigns

In order to create awareness regarding water conservation, sign boards / posters indicating not to waste water can be made available at appropriate locations like handwash area, drinking water tap points.

Similarly, posters indicating the importance of water can be made available throughout the campus.

To create awareness about the water conservation among new students and staff, awareness programs/campaigns need to be conducted inside the campus on a periodic basis.

5. ENERGY AUDIT

5.1. Facility Description

City Engineering College – Bannerghatta Road, receives power supply from the state electricity board (BESCOM – Bangalore Electricity Supply Company Limited) ISRO Layout substation at HT 11 kV. CEC has availed power supply, with connection – RR. No 0413062796 (S5HT37) with 1HT2C1tariff.

Incoming power supply from BESCOM is received at the transformer yard inside the college premises. The 11 kV rated HT power supply is stepped down to LT 433V, by one number of 250 kVA rated transformer. Transformer unit installed inside college premises is as shown in the figure 5-1.

Figure 5-1: Transformer unit Installed in the campus

The name plate details of transformer are given in table 4-1.

S. No.	Description	Units	Details
1	Rated Capacity	kVA	250
2	Rated Voltage Prim/Sec	kV	11/0.433
3	Rated Current Prim/Sec	A	13.12 / 333.4
4	Type of Cooling	-	ONAN
5	Frequency	Hz	50
6	Impedance volts%	-	2.5%
7	Phase	-	3
8	Make	-	Vivekanand Electrical Industries Pvt. Ltd.

Table 5-1: Name plate details of transformer

The LT supply from the transformer is taken to the main distribution panel inside the DG room located near transformer yard. Electrical panel room is as shown in the figure 5-2.

Figure 5-2: Main panel in DG room

Power supply cables from the electrical panel room is distributed to the various distribuition panels placed inside the campus. From main panel room, power supply is catered to sub

distribution panels of admin block and CS/IS block.The sub distribution panels at admin block is shown in figure 5-3

Figure 5-3: Sub-distribution panels for admin block

The sub distribution panels at CS/IS block is shown in figure 5-4.

Figure 5-4: Sub -distribution panels for CS/IS block

In each floor, MCBs are provided for load distribution. The load distribution box MCBs are shown in figure 5-5.

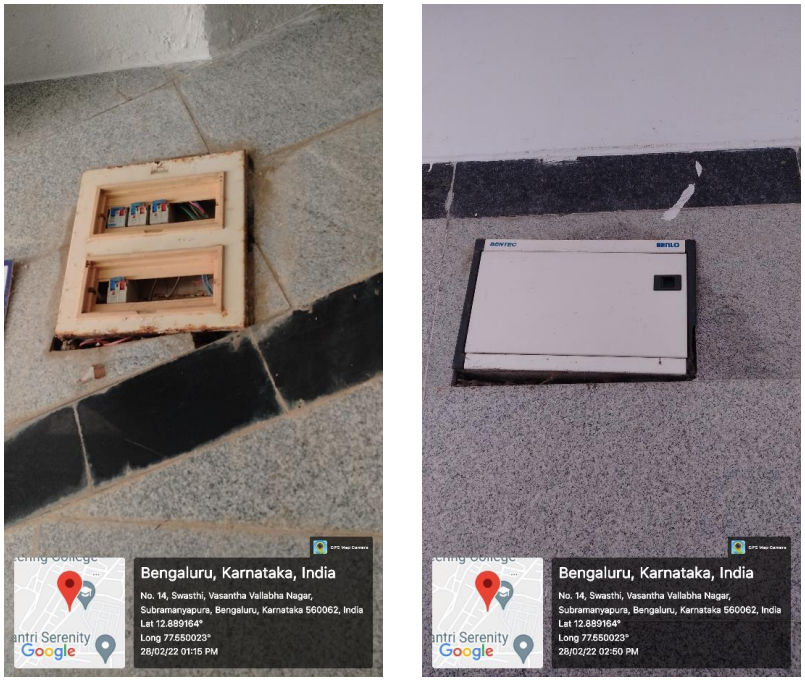


Figure 5-5: Load distribution box MCBs at each floor

One number of DG (Diesel Generator) sets are used for backup power supply, during power failure from BESCOM. DG set installed at the college premises is shown in the figure 5-6. The name plate specification rating of the DG set is shown in the table 5-6.

Figure 5-6: Diesel Generator (DG) sets

S. No.	Description	Unit	Details
1	Rated Capacity	kVA	125
2	Rated voltage	Volts	415
3	Rated current	Ampere	173.9
4	Frequency	Hz	50
5	Power factor	-	0.80
6	Rated Demand	kVA	125
7	Rated Power	kW	100
8	Make	-	Kirloskar

Table 5-2: DG set specifications

UPS is available in the campus to give the backup power supply for all the critical loads like computer labs, server rooms etc. Sample picture of the UPS room at admin block is shown in the figure 5-7.

Figure 5-7: UPS in computer Lab - Admin block

Sample picture of the UPS room at CS/IS block is shown in the figure 5-8.

Figure 5-8: UPS room in Dr. A.P.J. Abdul Kalam block

List of UPS system with its rated capacity are shown in figure 5-9.

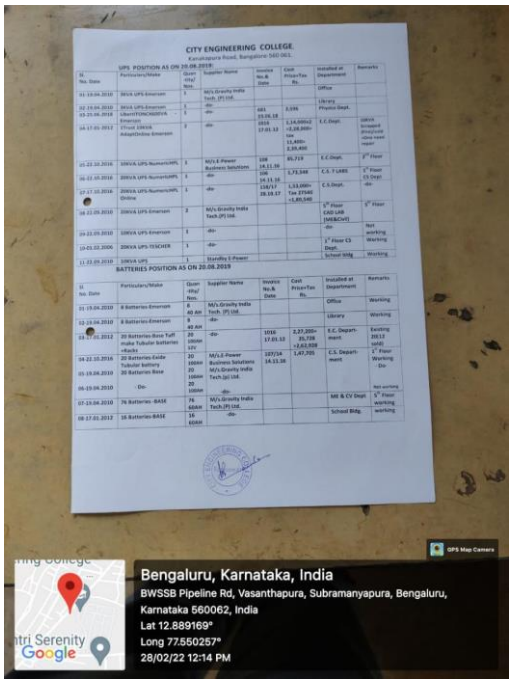


Figure 5-9: List of UPS details

Note: ***As part of regular practice the inverters and batteries are always kept in a separate room and electrical panel rooms are separate.***

5.1.1. Tariff Structure

The sanctioned contract demand of the campus is 80 kVA at specified voltage of 11 kV. Electricity supply from BESCOM is billed under HT2(c)(ii) schedule of tariffs. The tariff includes demand charges of Rs. 240 per kVA (Earlier Rs. 220 per kVA), and energy charges of Rs.7.20 per kWh for the submeter 3236222806 and Rs.9.25 per kWh for the submeter 0668407874.

The kVA demand charges @ Rs. 240/kVA of maximum demand recorded during the month or 85% of the contract demand, whichever is higher

5.1.2. Electricity Consumption Data

Details of electricity consumption for the last one year have been collected and Salient features of electrical energy details are given in table 5-3.

S. No.	Description	Unit	Details
1	Contract Demand	kVA	80
2	Demand Charges	Rs./kVA	240
3	Maximum Demand Recorded during last one year	kVA	38
4	Average Monthly Energy Consumption during last one year	kWh	9013.8
5	Average System Power Factor		0.945
6	Average Energy Charges considered for savings calculations	Rs./ kWh	8.39

Table 5-3: Electricity Bill Parameters

Figure 5-10 indicates the month wise recorded maximum demand and month wise energy consumption of the college campus for the last one year (Jan 2021 to Jan 2022).

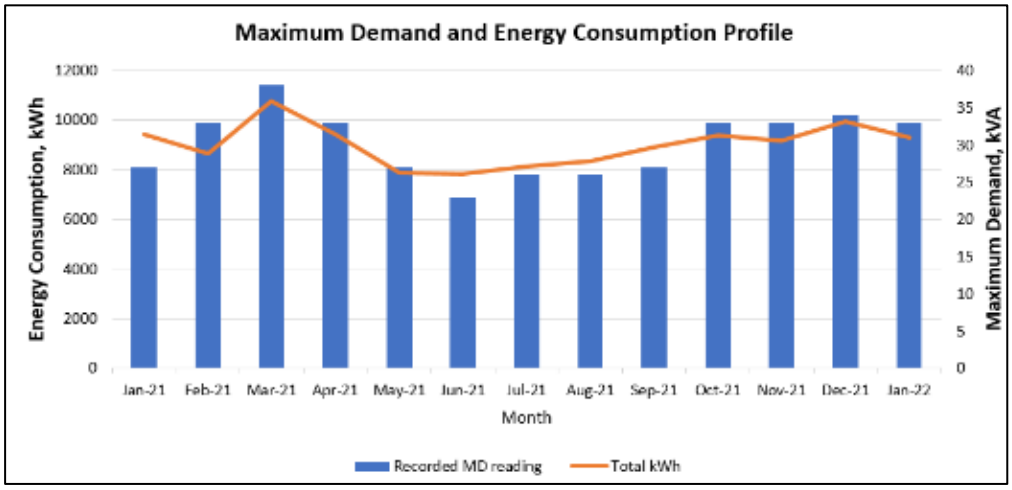


Figure 5-10: Month wise Recorded Maximum Demand and Energy Consumption

From the month-wise maximum demand curve, it was observed that maximum demand registered during the month of March 2021 was found to be **38 kVA** and is the peak demand during the last one year of billing period. Average of registered maximum demand during January-2021 to January 2022 is **30.23 kVA.**

From the month-wise energy consumption profile, it was observed maximum energy consumption was registered during March 2021. Average monthly energy consumption is **9013.8 kWh**.

5.2. Best Practices Implemented for Energy Conservation

During the study, observations were carried out on the usage of the inventories in the college building premises. In the intension of saving the electricity, various measures have been adopted in the college. Computers and AC units are used only during the working hours, after completion of class hours – fans, lights, computers and AC units are found to be turned OFF. This practice is followed across the college premises (class rooms, labs, staff rooms, office rooms, library and seminar halls).

5.2.1. Day-light Integration:

During the audit phase classrooms, staff-rooms, laboratories, seminar hall, UPS & batteries room and library areas were surveyed for illumination levels and fresh air-circulation. It was observed most of the rooms are well ventilated and day-light integrated; sample photos are shown in figure 5-11 to figure 5-15.

Figure 5-11: Day-light integrated Class room

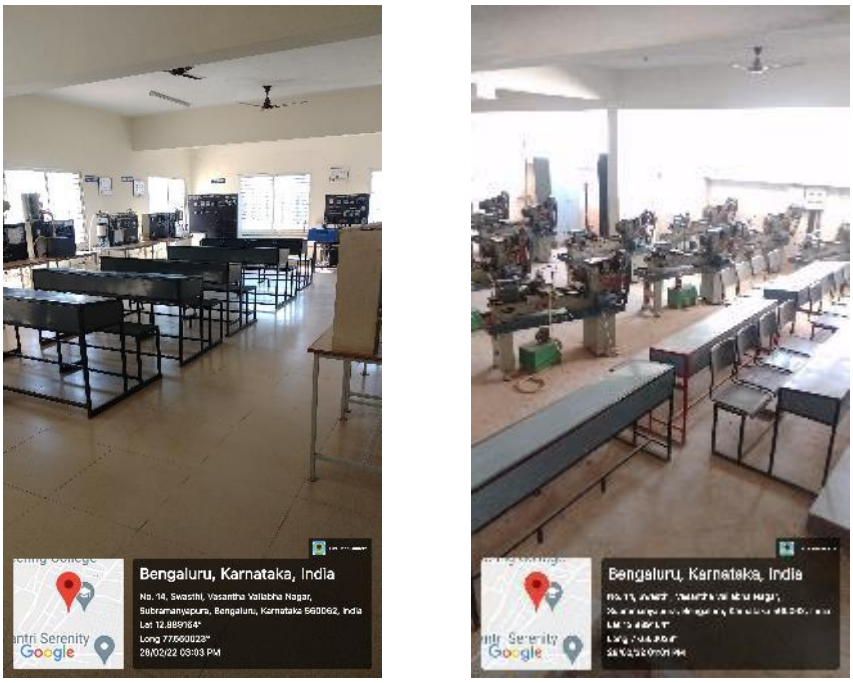


Figure 5-12: Well-ventilated and day-light integrated labs

Figure 5-13: Well-ventilated and day-light integrated Seminar Hall

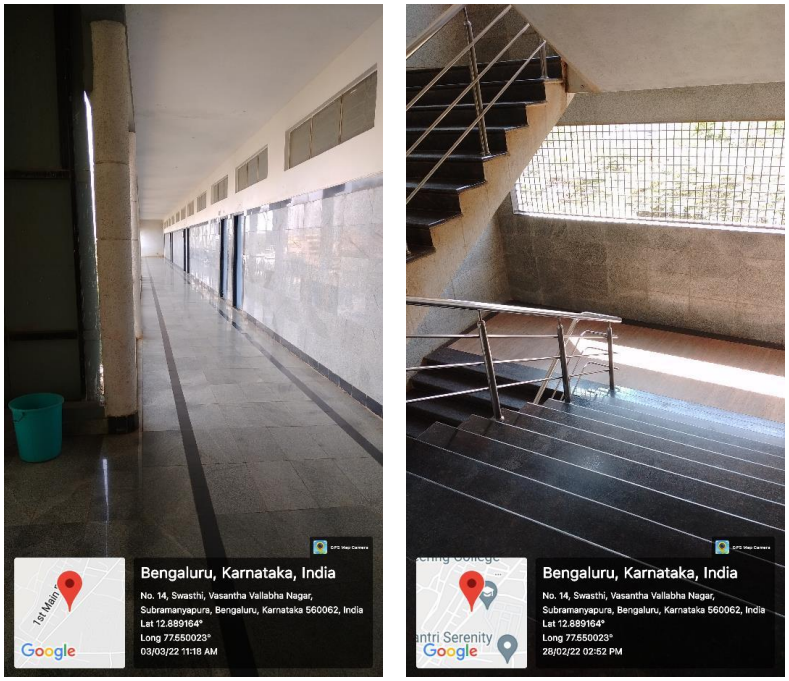


Figure 5-14: Well-ventilated and day-light integrated campus

Figure 5-15: Well-ventilated and day-light integrated campus

5.2.2. Installation of LED lights

LED tube lights and bulbs are used in the office rooms, staff-rooms, rest rooms areas. Building façade lightings are LED type. Sample photo of façade LED light used in the college area is shown in figure 5-16.

Figure 5-16: Use of facade LED lights

The cost savings by existing 20W LED tube lights are given in table 5-4.

S. No.	Description	Unit	Values
1	Rated Wattage of LED lamps installed	W	20
2	Quantity of LED lamps installed	Nos	19
3	Rated wattage of lamps used earlier	W	40
4	Savings per lamp by installation of LED lamps	W	20
5	Total savings	kW	0.38
6	Working hours per day	hours	9
7	No. of working days per year	days	250
8	Annual electricity savings	kWh	855
9	Average electricity cost	Rs. /kWh	8.39
10	Annual cost savings achieved per year	Rs. lakh/year	0.07
11	CO2 mitigations per year	Tons/year	0.73

Table 5-4: Annual cost savings by existing LED tube lights

The cost savings by existing 9W LED bulbs are given in table 5-5.

S. No.	Description	Unit	Values
1	Rated Wattage of LED lamps installed	W	9
2	Quantity of LED lamps installed	Nos.	30
3	Rated wattage of CFL lamps used earlier	W	14
4	Savings per lamp by installation of LED lamps	W	5
5	Total savings	kW	0.15
6	Working hours per day	hours	9
7	No. of working days per year	days	250
8	Annual electricity savings	kWh	337.5
9	Average electricity cost	Rs. /kWh	8.39
10	Annual cost savings achieved per year	Rs. lakh/year	0.03
11	CO2 mitigations per year	Tons/year	0.29

Table 5-5: Annual cost savings by existing LED bulbs

5.2.3. Installation of LED/LCD monitors

LED/LCD monitors are used for all the desktop computers in staff rooms and in computer labs. Sample photos of the computer labs are as shown in the figure 5-17.

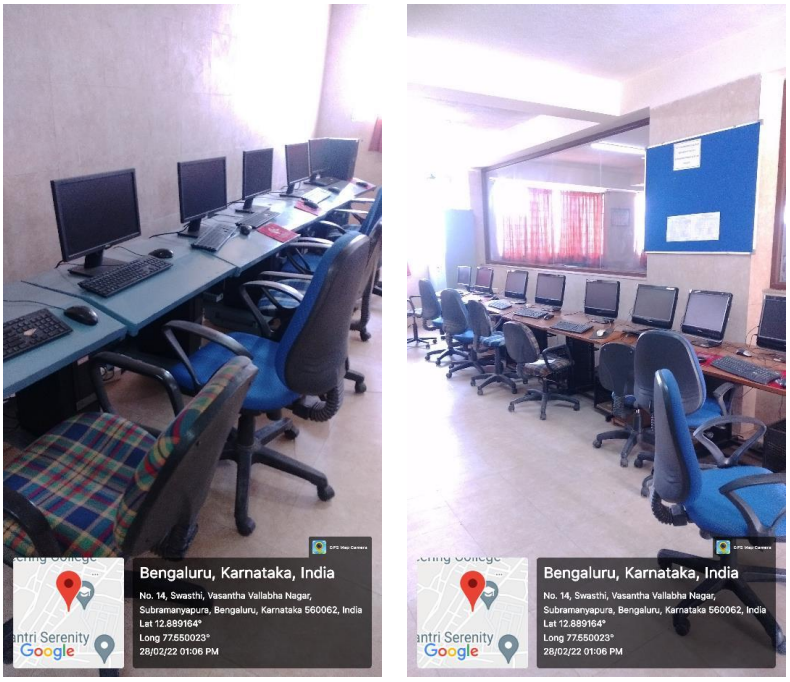


Figure 5-17: Use of LED/LCD monitors in the computer labs

5.2.4. LED Street Lights

Solar street lights with sensors have been installed inside the campus. Each LED Street light consists of sensor and LED light. In college campus, nine solar LED lights are available. Sample photos of the street lights are shown in figure 5-18.

Figure 5-18: Solar LED Street lights with sensors

Savings achieved due to installation of LED street lights is given in table 5-6.

S. No.	Description	Unit	Values
1	Rated Wattage of LED street light installed	W	40
2	Quantity of LED lamps installed	Nos	9
3	Rated wattage of lamps used earlier	W	150
4	Savings per lamp by installation of LED lamps	W	110
5	Total savings	kW	0.99
6	Working hours per day (6pm to 6am)	hours	12
7	No. of working days per year	days	365
8	Annual electricity savings	kWh	4336.2
9	Average electricity cost	Rs./kWh	8.39
10	Annual cost savings achieved per year	Rs. lakh/year	0.36
11	CO2 mitigations per year	Tons/year	3.69

Table 5-6: Annual cost savings by LED street lights

5.2.5. Maintenance of Earth pits

Separate earth pits are available for HT pole, transformer, HT metering cubicle, DG set, main power control panel and lift. The earth pits are well maintained and covered properly with lids. The sample images of earth pits are shown in figure 5-19 and figure 5-20.

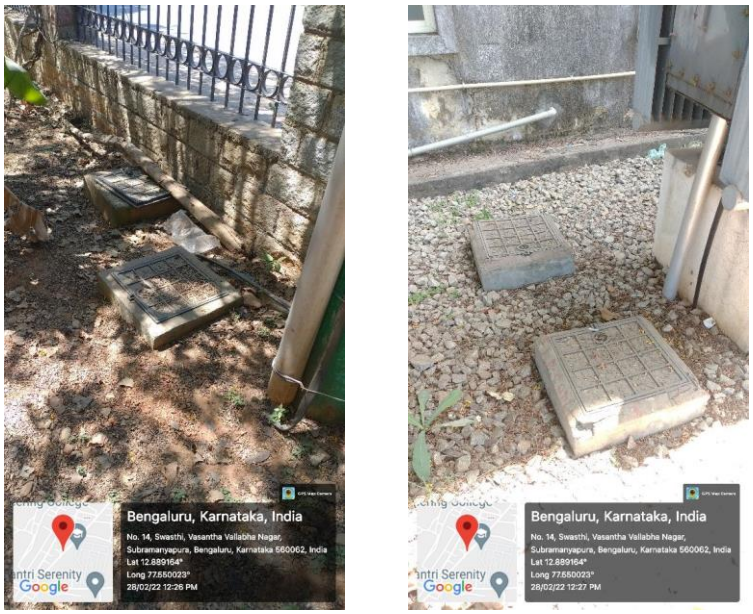


Figure 5-19: Earth pits for HT pole and transformer yard

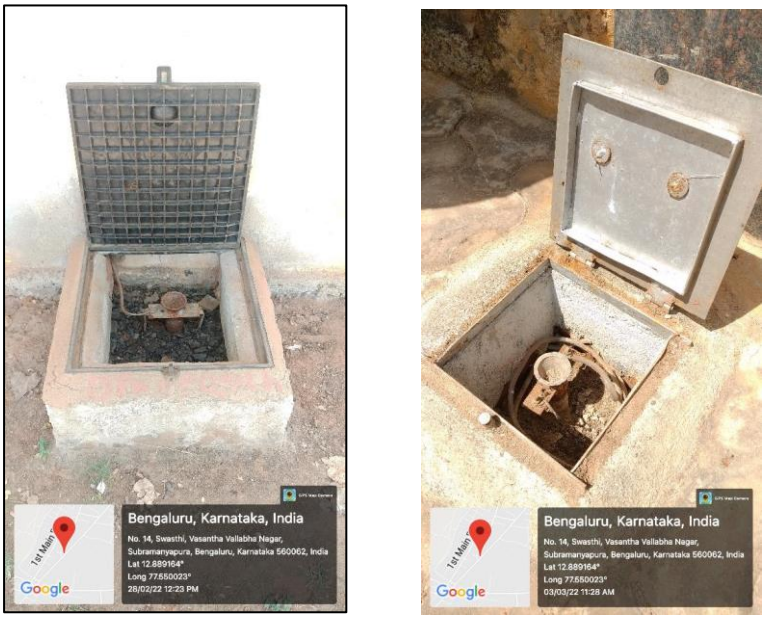


Figure 5-20: Earth pits for DG set and Lift

5.2.6. DG set log register

The hours of operation of DG set are logged on register regularly. Any problems on DG set are rectified immediately. The DG operating hours register is shown in figure 5-21.

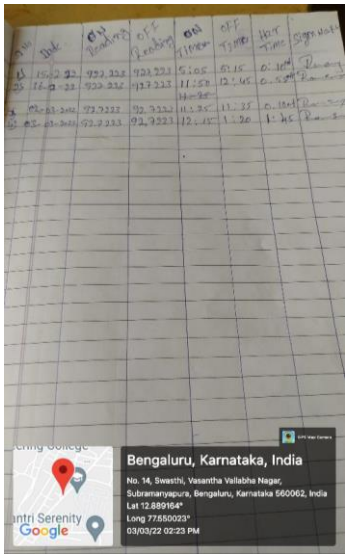


Figure 5-21: DG operating hours Register

The sample image DG set field service report is shown in figure 5-22.

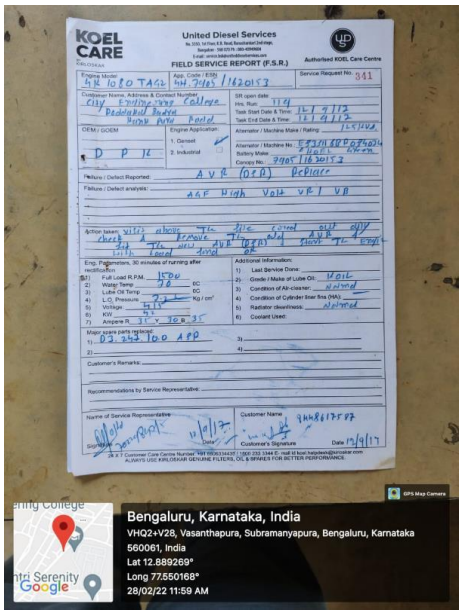


Figure 5-22: DG set - Field service report

5.2.7. Preventive maintenance for Lift

Lift facility available at the Dr. Sir. M. Visveswaraya block (admin block). The preventive maintenance is done regularly. The lift invoice copy and preventive maintenance report is shown in figure 5-23 and figure 5-24.

Figure 5-23: Lift - Invoice copy

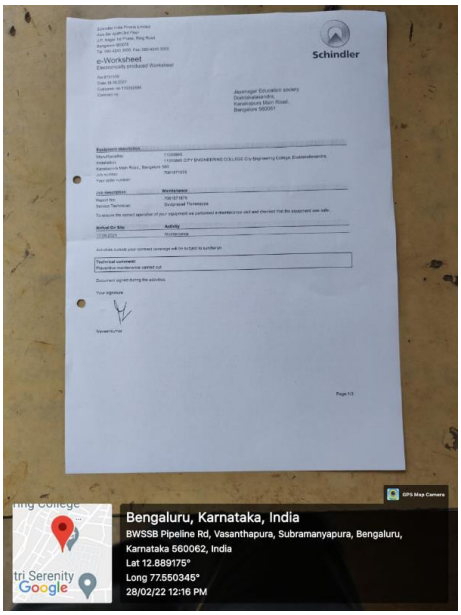


Figure 5-24: Lift- Preventive maintenance report

The AMC contract for lift is shown in figure 5-25.

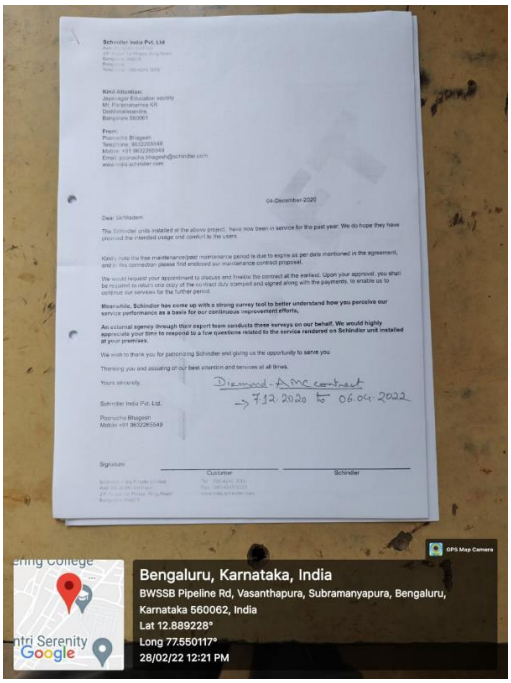


Figure 5-25: Lift- AMC Contract

5.3. Recommendations for Energy Audit

5.3.1. Replacement of conventional FTL with EE LED lamps

Background

From the inventory data; collected during study it is observed conventional FTL lighting fixtures are used in the campus. The total number of 1x40W FTL fixtures is 537. The power consumed by FTL in comparison with LED fixtures is 50% higher. Replacing the existing FTL with LED will result in energy savings.

Recommendation

It is recommended to replace the existing 1x40W FTL lamps with 1x20W LED tube lights.

Energy Savings

The energy savings and investment cost for replacement of FTL with LED fixtures and its payback period are given in table 5-7.

S. No.	Description	Unit	Details
1	Total no. of 1x40W FTL	No.	537
2	Power consumption by 1x40W FTL	kW	21.48
3	% of savings if all FTL replaced by LED fixtures	%	50
4	% of savings in kW if replaced by LED fixtures (Considering all fixtures)	kW	10.74
5	% of Lights found to be ON during working hours	%	50
6	Energy savings for fixtures in ON condition (4 x 5%)	kW	5.37
7	Total working hours per day	hours	9.0
8	Annual savings (6 x 7 x 250 days)	kWh/Annum	12082.5
9	Average energy cost per kWh	Rs. / kWh	8.39
10	Annual cost savings	Rs. lakh	1.0
11	Cost of LED per fixture	Rs.	350.0
12	Total Investment cost for 537 LED fixtures	Rs. lakh	1.9
13	Simple payback period (12 / 10)	Years	1.85

Table 5-7: LED replacement cost and payback period calculations

5.3.2. Replacement of conventional fans with energy efficient fans

Background

1x65W conventional fans have been used in almost all the rooms of the college. Total number of 1x65W fans used accounts to around 233 numbers. Hence, replacing the 1x65W conventional fans with 1x35W energy efficient fans will result in energy savings.

Recommendation

It is recommended to replace 65 W fans with 35 W EE fans, as procurement practice. Whenever the existing fans fails, while procuring 35W EE fans shall be procured.

Energy Savings

The energy savings and investment cost for replacement of 65 W fans with 35 W EE fans and its payback period are given in table 5-8.

S. No.	Description	Unit	Details
1	Total no. of 1x65W Fans	No	233
2	Power consumption by 1x65W Fan	W	65
3	Total power consumed by all the fans (1x2/1000)	kW	15.145
4	% of savings achieved by EE fans	%	45
5	% of savings in kW if replaced by EE fans (Considering all fans) (3 x 45%)	kW	6.815
6	% of fans found to be ON during working hours	%	50
7	Energy savings for fans in ON condition (5 x 6)	kW	3.4
8	Total working hours per day	hours	9
9	Annual savings (7 x 8 x 250 days)	kWh/Annum	**7650**
10	Average energy cost per kWh	Rs./kWh	8.39
11	Annual cost savings	Rs. lakh	**0.64**
12	Cost of one EE fan	Rs.	2500
13	Total Investment cost for 233 EE fans	Rs. lakh	5.82
14	**Simple payback period (13 / 11)**	**Years**	**9.06**

Table 5-8: EE Fans replacement and payback period calculations

5.3.3. Solar Roof Top PV (SRTPV) system

At present grid power supply and stand-by DG set power supply are the sources of electricity for the college. Installation of SRTPV (Solar Roof Top Photo Voltaic) system will result in renewable energy generation inside the campus and also reduces the electricity bill.

Estimation of SRTPV installation for the campus is given in table 5-9.

S. No.	Description	Unit	Values
1	Rated Capacity of SRTPV system	kWp	200
2	Average units generated per day	kWh/day/kWp	3
3	No. of working days per annum	days	365
4	Annual energy generation from SRTPV	kWh/ annum	2,19,000
5	Average energy cost	Rs./kWh	8.39
6	Annual cost savings due to installation of SRTPV	Rs. Lakh / annum	18.37
7	Investment cost for 200 kWp SRTPV system	Rs. Lakh	180
8	Simple payback period (7 / 6)	Years	9.80

Table 5-9: Estimation of SRTPV system

5.3.4. Other Recommendations for Energy Conservation

- Conduct training and awareness programs on energy conservation
- Posters stating 'Switch off lights, Fans & appliances when not in use' or 'Use electricity wisely' or 'Once the Electricity is used -It cannot be regained' etc., needs to be sticked to the walls at all the appropriate places.
- Conduct Seminars and workshops on a regular basis among all the staffs and students to create awareness about Energy conservation and proper usage.

6. WASTE MANAGEMENT AUDIT

6.1.Facility Description

The study involved carrying out various analyses to realistically assess waste generation. There are different types of waste generated in the college and is tabulated in table 6-1.

S. No.	Description	Yes / No	Details
1	E-Waste	Yes	Vendors
2	Hazardous / Chemical Waste	No	NA
3	Solid Waste	Yes	BBMP
4	Dry Leaves	Yes	Compost Unit
5	Food Waste	Yes	Compost Unit
6	Waste Water	Yes	Drainage
7	Glass Waste	No	NA
8	Unused Materials	No	-
10	Plastic Waste	Yes	BBMP

Table 6-1: Types of waste generated in the college

6.1.1. Dry Waste Management

Separate bins are used across the campus for Dry and Wet wastes. Each room (Staff, class rooms, office, restrooms, library and corridors) is provided with the dustbin to segregate waste. The housekeeping staffs cleans and collect the wastes generated inside the campus and dumps them into the larger waste bins in segregated manner at disposal point. From, there the wastes are taken by the BBMP vehicles.

Old newspapers, exam papers, academic records etc., are disposed yearly or two years once. The dry wastes are disposed through local vendor. This activity is managed by the admin office. The revenue generated is used for campus maintenance.

6.1.2. Wet Waste Management

To manage the wet waste produced in the college, which is produced from the canteen in campus, from the remains of the tiffin boxes brought by the students, teachers, & staff of the college, the college management has thought of a very novel way to make a difference, create cleaner healthier campus, and provide an opportunity to see a fresh campus.

The house keeping Staff collects all the wet waste produced in the college and dumps in larger bins. Then it is disposed to the BBMP vehicles.

6.1.3. E- Waste Management

E-Waste produced in the campus is stored at separate place in both Admin block and CS/IS block. All e-waste generated is dumped into e-waste storage place. Based on the quantity of e-waste, it is disposed to the local vendor yearly or two years once. This activity is managed by the admin office. The revenue generated is used for campus maintenance.

E-waste at admin block in shown in figure 6-1.

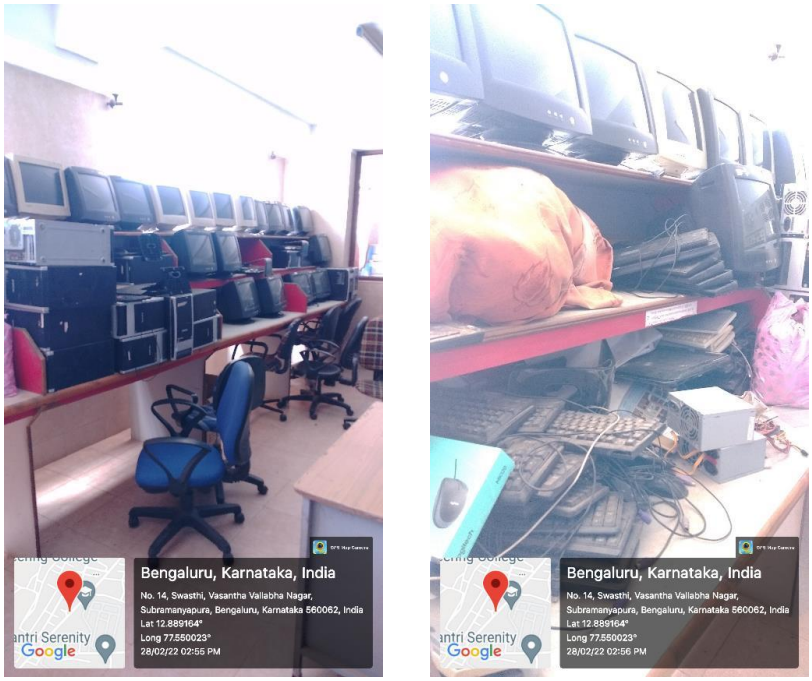


Figure 6-1: E-waste at admin block

E-waste at CS and IS block is shown in figure 6-2.

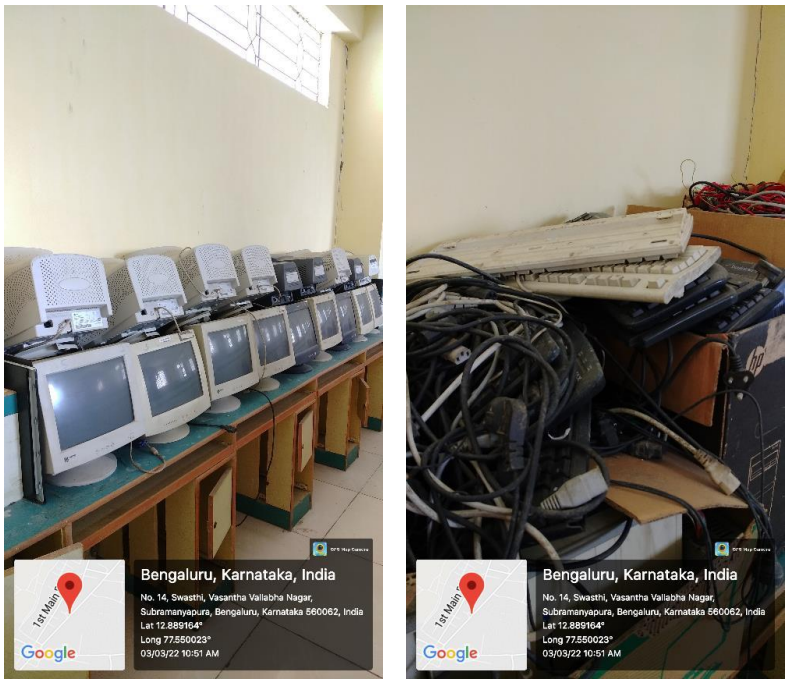


Figure 6-2: E-waste at CS/IS block

The sample bills for e-waste disposal to vendor is shown in figure 6-3.

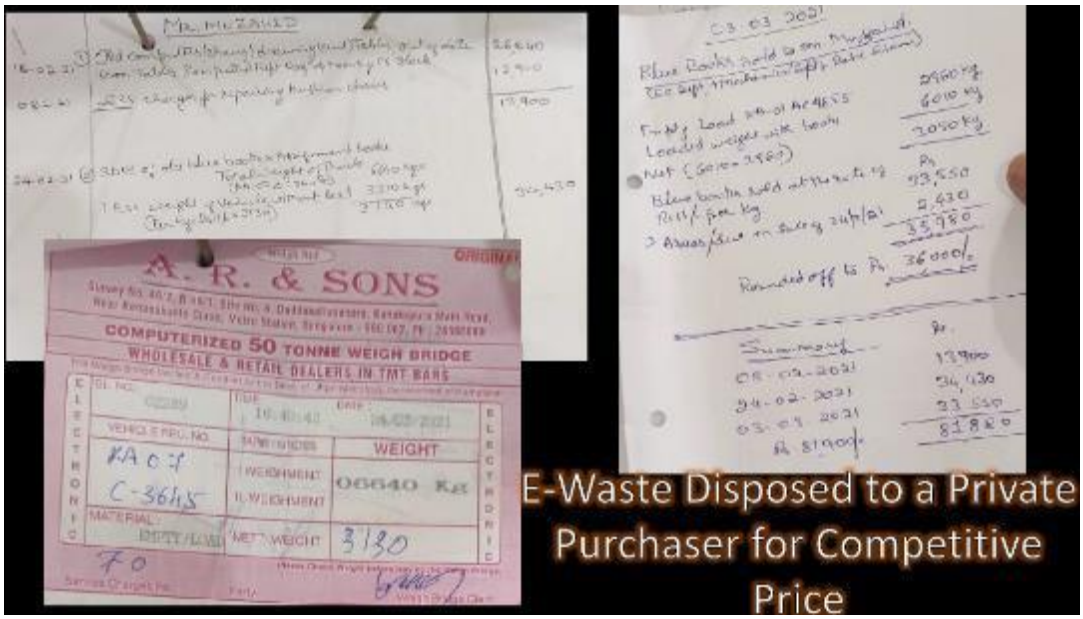


Figure 6-3: Sample bill for e-waste disposal to vendors

6.1.4. Bio- Waste Management:

As part of maintaining hygienic environment for the girl's, the management has provided the sanitary napkin vending machine and sanitary napkin incinerator in ladies lounge room at Dr. A.P.J. Abdul Kalam block. The napkin vending machine is shown in figure 6-4.

Figure 6-4: Bio – waste management - Napkin vending machine

The napkin incinerator is shown in figure 6-5.

Figure 6-5: Bio – waste management - Napkin incinerator

Usage of napkin incinerator machine gives the following advantages,

- Complete disposal of used napkin by burning
- Self-disposal by user by directly putting into the incinerator.
- Gets rid of the embarrassment of finding out ways to dispose used napkins.
- Eco-friendly disposal
- Less than 1gm of ash per cycle.

6.2. Best Practices Implemented for Waste management

6.2.1. Waste Collection Bins

The waste segregation is done at source level itself. Separate waste bins for dry waste, wet waste, and plastic waste are kept at appropriate locations of the campus. This helps to maintain the college premises clean & hygiene. Figure 6-6 shows the waste segregation bins and figure 6-7 shows the waste collection bins at different locations of college campus.

Figure 6-6: Sample photo of dustbin in classroom

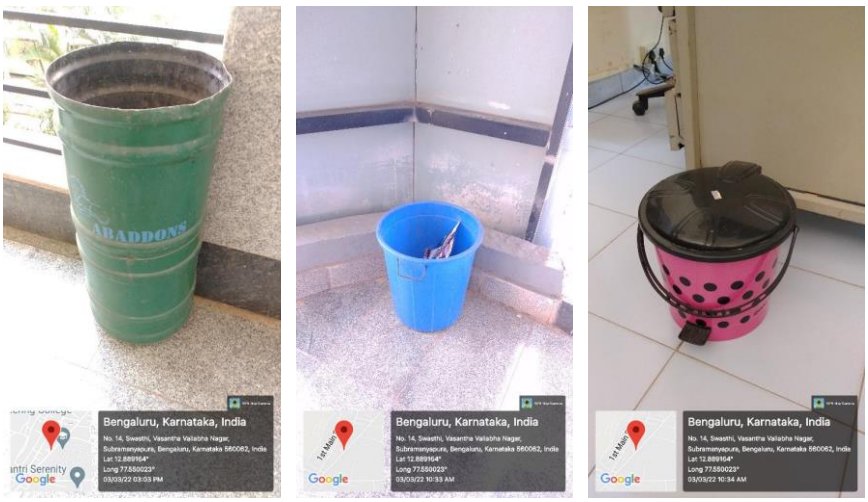


Figure 6-7: waste collection bins at different places

6.2.2. De-composter pit for dry leaves

The fallen leaves from trees and plants within the campus is cleaned daily. The dry leaves are collected and dumped into a de-composter pit located near playground. The depth of de-composter pit is around 8 feet. The stems and leaves collected during the maintenance activity is also dumped into this pit. After dumping it covered with soil and left natural de-composting. The de-composted waste is used as manure for trees and plants. The de-composer pit is shown in figure 6-8.

Figure 6-8: De-composter unit

6.2.3. Sign boards to use dustbin

Sign boards indicating to use dustbin is kept all around the campus. The sample image of sign board is shown in figure 6-9.

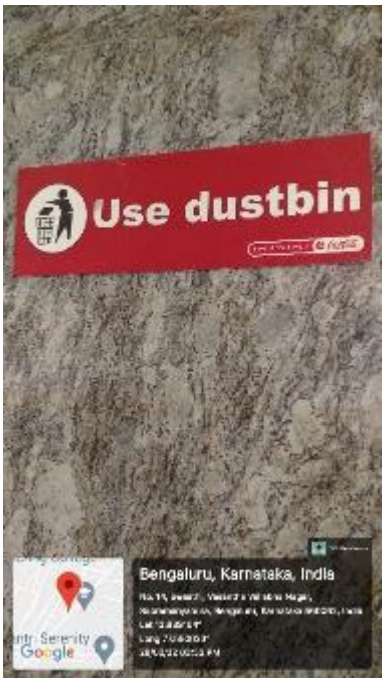


Figure 6-9: Sign boards - Use dustbin

6.2.4. Usage of blowers and suction cleaner

To maintain dust free library and laboratories, machineries like suction cleaner and blowers are used. This helps to keep the campus atmosphere at finest clean. The blower machine is shown in figure 6-10.

Figure 6-10: Blower machine

The suction cleaner machine is shown in figure 6-11.

Figure 6-11: Suction cleaner machine

6.2.5. Regular cleaning of campus

Regular cleaning of campus is done to maintain overall hygiene. Cleaning activities are carried out using chemicals wherever necessary. Purchase of brooms, chemicals, phenyls, mop etc., are done based on requirement. The sample image of cleaning activity is shown in figure 6-12.

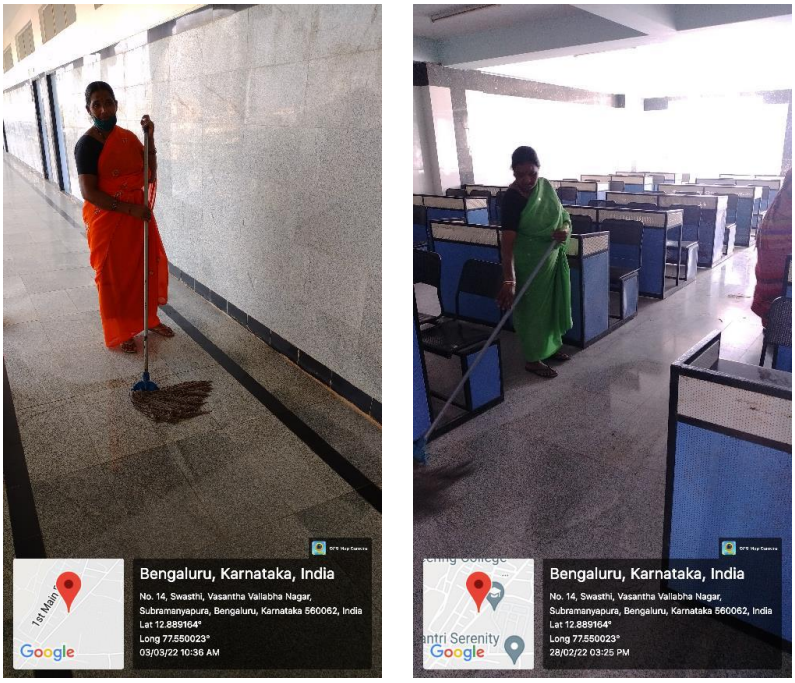


Figure 6-12: Cleaning activity in campus

The sample bills for purchase of chemicals and other cleaning items are shown in figure 6-13.

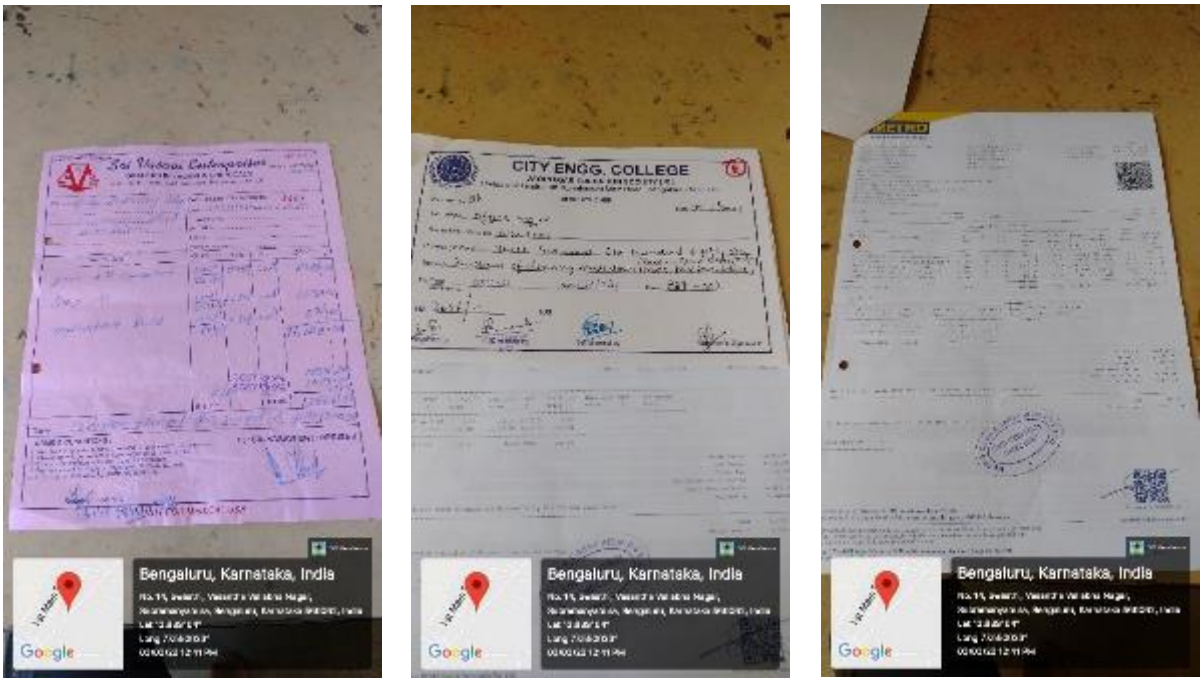


Figure 6-13: Sample bills for purchase of cleaning materials

6.2.6. Awareness Program - Clean India Activity

NSS of City Engineering College, Bengaluru, organized Clean India activity on October 25th at 2.00 p.m. at College Campus.

A total of 22 NSS volunteers participated in the programme. Vinaykumar S N, Programme Coordinator, NSS, CEC welcomed the gathering. Dr Thippeswamy H N, Principal, CEC, initiated cleaning activities among volunteers. He motivated students towards 'Clean India' by his inspirational talk.

The volunteers along with some of the faculties and non-teaching staff cleaned the entire campus and collected almost one bucket of plastic for safe disposal. The volunteers were instructed to clean their hands with soap at the end of programme.

The images of Clean India activity are shown in figure 6-14.

Figure 6-14: Clean India Activity - 2021

6.3. Recommendations on Waste Management Audit

6.3.1. Color Code Bins

Different color code bins for the waste segregation (Dry, Wet, Bio-medical/Sanitary) at the source itself will make the segregation easy and hence it is recommended to place standard color code bins at all waste collection points of the campus.

6.3.2. Posters on Plastic Ban

Different posters on 'Plastic Ban' can be placed in and around the blocks of the campus. So that the students, staff and trespassers are aware of the college is Plastic Free zone.

6.3.3. Replacement of plastic with Steel Cutlery

To give a logical behavioral solution to substitute or recycle that had to be accepted and practiced by the institution; management has to take a step ahead and inform all the vendors not to use the single use plastic and replace it with reusable utensils in the canteen and inside the campus.

6.3.4. Conducting waste management (collection) drives & awareness programs

Keeping the environment clean is not a one-man job, it is the responsibility of every person inside the society/campus. Hence, it is necessary to create awareness programs and waste management drives often and often for the institutions to keep the environment clean, green and hygiene.

Use of posters stating 'Proper usage of dustbins' to create awareness among students and staff regarding waste management.

6.3.5. Usage of awareness signboards

Use of more sign boards to create awareness for better waste management like 'Plastic ban', 'Do not litter', 'Think clean and use dustbin' etc., shall be placed at appropriate locations.

7. GREEN CAMPUS MANAGEMENT AUDIT

7.1.Facility Description

The students and faculty are encouraged to adopt cleanliness, making the campus garbage and plastic free zone. Tree plantation programs help in encouraging eco-friendly environment, which provides pure oxygen within the institute.

The maintenance team takes care of the up-keeping of the environment and ensures to keep the surroundings clean. They maintain all the plantations by employing the cleanliness and watering regularly.

7.1.1. Landscaping with Trees and Plants

Entire campus of the college has been made green by planting trees and plants. By this, the green campus concept offers the City Engineering College to take the lead in redefining its environmental culture and developing new paradigms by creating sustainable solutions to environmental, social and economic needs of the mankind.

Tree Plantation is done every year through NSS. The college has nurtured number of trees of different variety.

Figure 7-1: Sample photos of Trees around the campus

Figure 7-2: Sample photos of plantations around different blocks

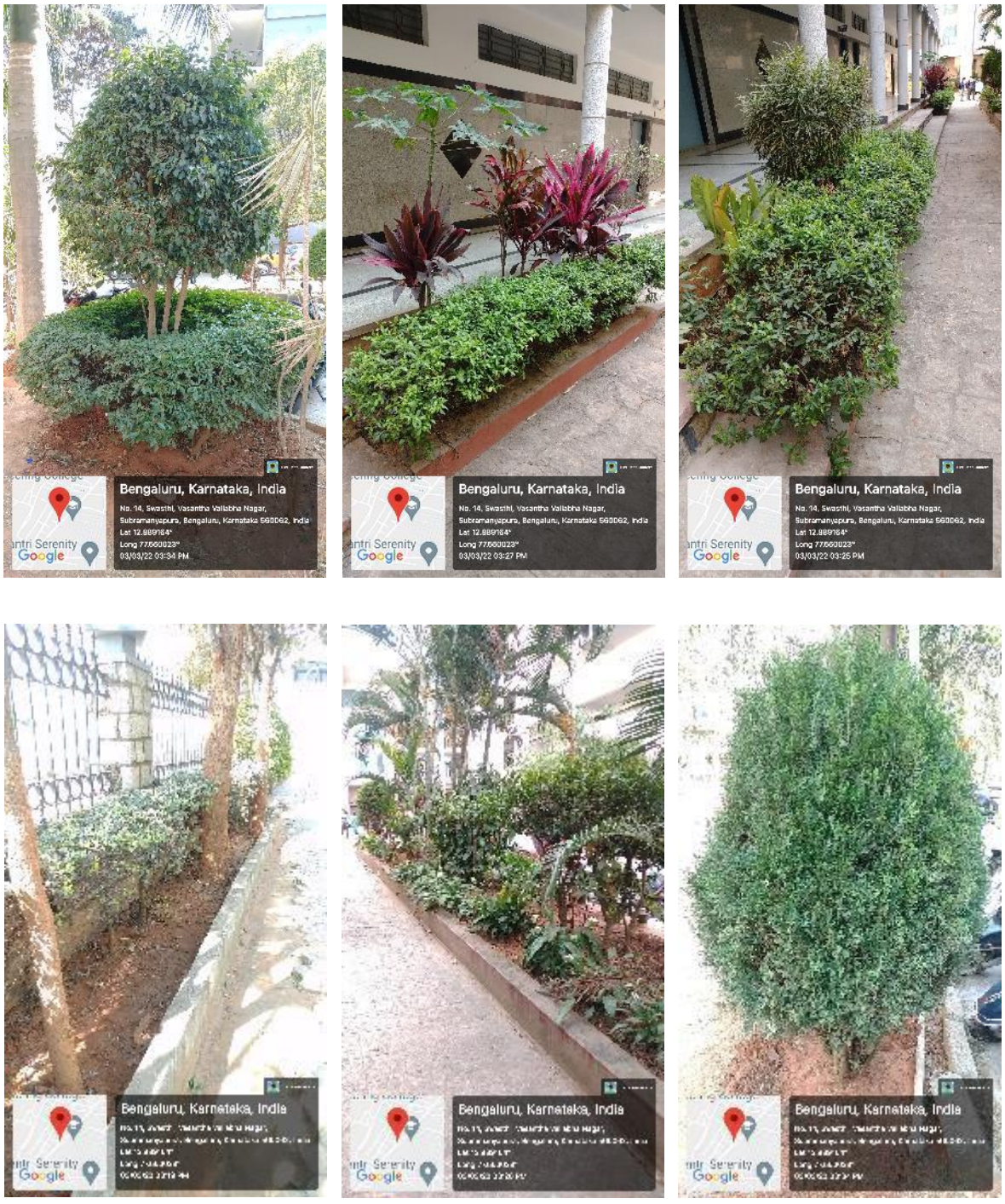


Figure 7-3:Sample photos of Lawn and plantations

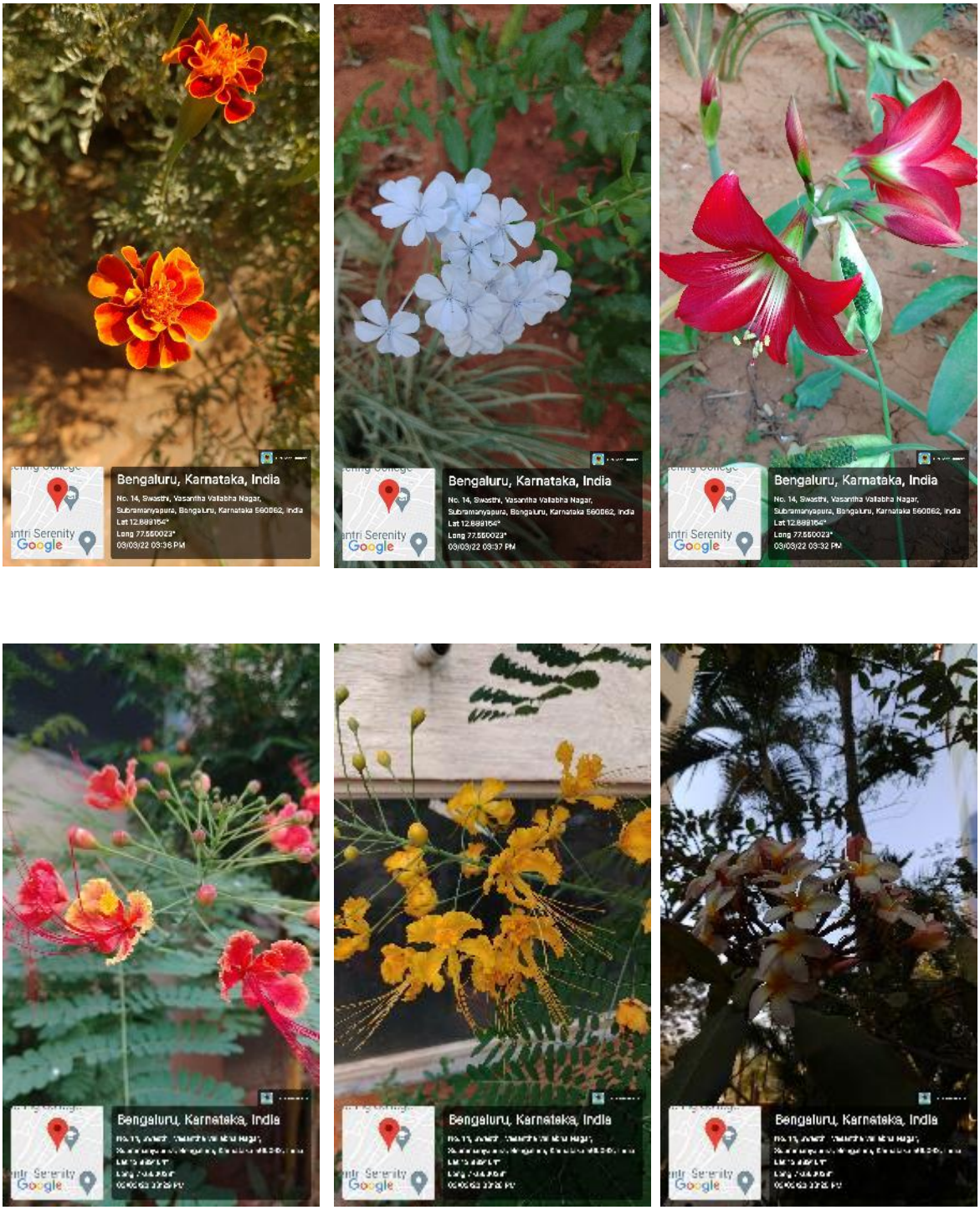


Figure 7-4: Sample Flower plantations

Table 7-1 indicates the details of type and quantities of trees inside the campus as per the data shared by the institution.

S. No.	Name of Tree / Plant	No.
1.	Jack fruit tree	5
2.	Almond tree	4
3.	Coconut tree	3
4.	Jamaican cherry tree	10
5.	Silver oak tree	10
6.	Baniyan tree	2
7.	Sacred fig tree	1
8.	Nerium Oleander flower plants	25
9.	Show tree	13
10.	Neem tree	12
11.	Blue berry tree	12
12.	Indian beech tree	10
13.	Papaya tree	10
14.	Banana plants	20
15.	Palm tree	8
16.	Guava tree	8
17.	Lemon tree	4
18.	Sweet like tree	3
19.	Ceylon Ironwood / Champak tree	6
20.	Avocado tree	1
21.	Mango tree	4
22.	Bambo tree	6
23.	Night blooming Cereus	2
24.	Regina cherry tree	13
25.	Pomegranate tree	1
26.	Malabar neem wood tree	5
27.	Indian gooseberry	2
28.	Amla tree	2

Table 7-1 : Details of type and quantity of trees

7.2. Best Practices Implemented for Green Campus Management

7.2.1. Regular maintenance of greeneries

The greeneries within the campus are maintained properly with dedicated garden maintenance staff. They proper maintenance like weeding, lawn care and watering etc., The sample image of garden maintenance is shown in figure 7-5.

Figure 7-5: Sample image of garden maintenance

The tap and water can used for watering the garden is shown in 7-6.

Figure 7-6: Sample image tap and watering can

7.2.2. Awareness program – World Environment Day

The NSS units of CEC celebrated the World Environment Day 2021 on 5th of June. Saplings were planted around the college ground by Principal, AO & Faculties. The theme for World Environment Day 2021 was "Ecosystem Restoration".

In association with Department of Civil Engineering an online webinar was arranged on the topic "World Environment Day-2021" for volunteers & students to improve their awareness on the topic.

The webinar was presided by Dr. N T Manjunath, (Env. Engg-IITR), Former Chairman, Department of Studies in Civil Engineering., UBDT College of Engineering, Davangere. Around 40 volunteers participated in the webinar. A poster and video were also circulated among volunteers to create awareness regarding importance of being responsible towards the society.

The sample image of webinar invitation is shown in figure 7-7.

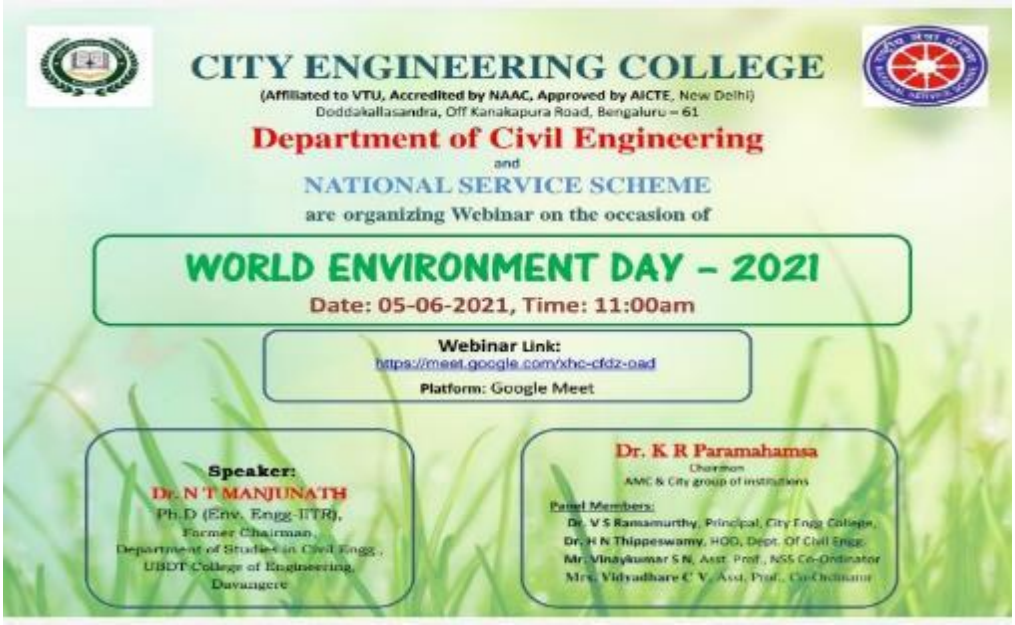


Figure 7-7: Webinar invitation - World Environment Day-2021

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7.3. Recommendations on Green Campus Management

- Encouraging students to recommend creative ideas for making campus more greenery.
- Conducting competition among departments to promote student's ideas in sustainability initiatives
- More number of trees shall be planted inside the campus.
- Co
- Indoor plantations and pot plantations in the corridors are recommended

8. ENVIRONMENT AUDIT (CARBON FOOTPRINT ANALYSIS)

8.1.Facility Description

The carbon footprint is "the total amount of greenhouse gas (GHG) emissions caused by an organization, event or product". Global warming and climate change are the foremost environmental challenges facing the world today. It is our responsibility to minimize the consumption of energy and hence reduce the emissions of greenhouse gases.

To analysis the carbon footprint, transportation details of students and staff are collected as below:

a. Number (or Percentage) of Staff using public transport: 14.8%

b. Number (or Percentage) of Staff using College transport: 3.7%

c. Number (or Percentage) of Staff using Bike: 55.6%

d. Number (or Percentage) of Staff using Car: 25.9 %

e. Number (or Percentage) of Staff using Electric Car: Nil

f. Number (or Percentage) of Staff using Electric bike: Nil

g. Number of students using College transport: 26

h. Number of students using Bike: 89

i. Number of students using Bicycles: 5

j. Number of students using Electric car: 10

k. Number of students using Electric bike: 6

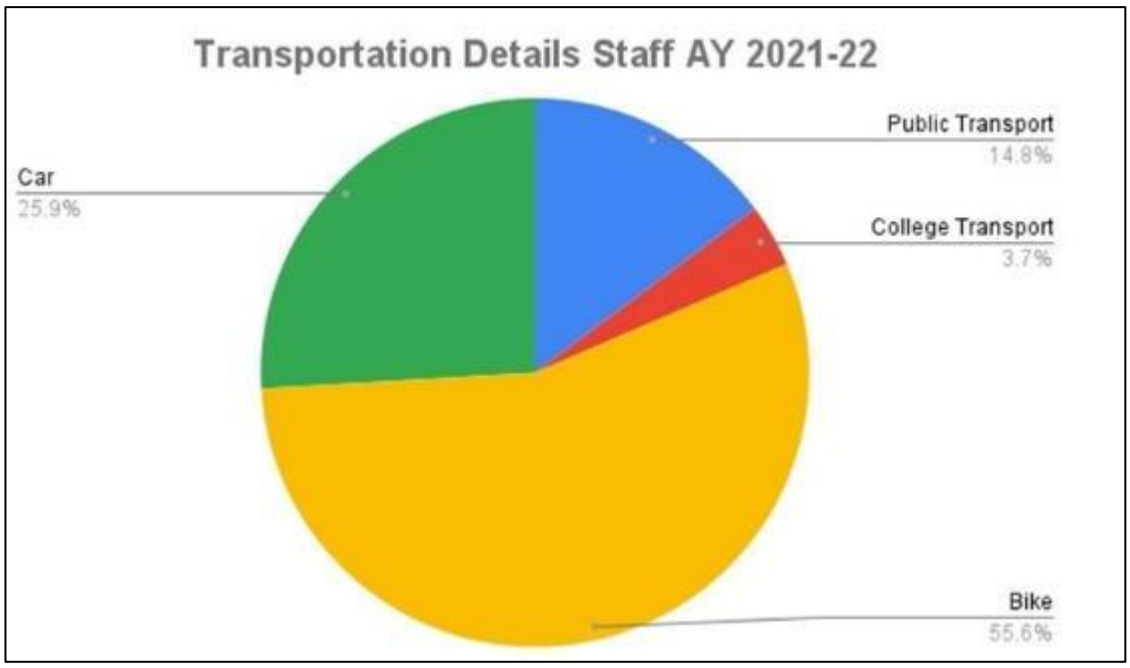

Figure 8-1: Transportation details of staff

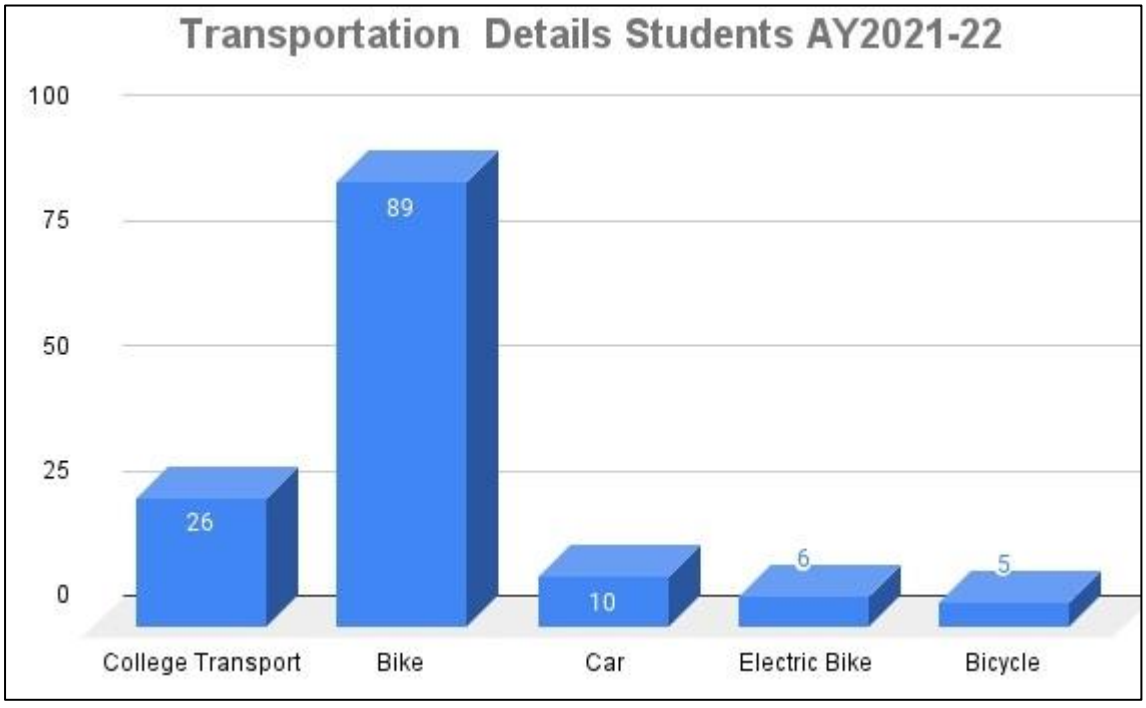

Figure 8-2: Transportation details of students

8.2. Best Practices Implemented for Environment Conservation

8.2.1. Usage Of Transport Facility

- Transport facility to the students and staff is provided. Transport facility is provided at free of cost to students.

- Most of the students and staff prefer public transport (Metro, BMTC bus) for the commute.

8.2.2. Pedestrian Friendly Pathways

The Institute has pedestrian paths on both the sides of the road and also within the campus.

Vehicle parking space is provided at the main entrance of the college campus. As the campus is vehicle free with some exceptions, students and staff experience comfort walking through the pedestrian friendly pathways. The internal roads are lined with trees and lights and they are properly maintained.

The college has pedestrian friendly pathways where all staff & faculty can walk safely. Pedestrian friendly pathways are shown in figure 8-3.

Figure 8-3: Pedestrian friendly pathway

8.2.3. Ramp For Physically Challenged Persons

Wheelchair ramps enable physically disabled as well as elderly people to enjoy complete freedom, as they allow users to move in and around the campus safely. The ramp facility available in Dr. Sir. M. Visveswaraya block and Dr. A.P.J. Abdul Kalam block are shown in figure 8-4 and figure 8-5.

Figure 8-4: Ramp facility at Dr. Sir. M. Visveswaraya block

Figure 8-5: Ramp facility at Dr. A.P.J. Abdul Kalam block

8.2.4. Ban on Use of Plastic

The institute has taken steps for not using plastic inside the campus. Instructions have been given to cafeteria operators to avoid use of plastic. Students are also informed to avoid use of plastic inside the campus. The institute have collaborated with NGO named "Way of life" for Swachh Bharath campaigns and clean the surroundings in and around Bangalore.

8.2.5. Paperless Office

Salary, circulars and fee collection is done online, so paperless office. The instructions have been given to all the departments to avoid using the paper and taking necessary steps to send all the circulars by email. The instructions have been given to all the staff members for uploading notes, assignments, model questions to the ERP-PupilPod.

The students have been given ERP log-in so that they can access to all the notes, assignments and model questions on-line. This helps to students to avoid taking copies of the notes, assignments and model questions.

The college gives emphasis on paperless office to save carbon footprint due to printers.

8.2.6. Usage of Bicycles

Few students are coming to college by bicycle. The sample images of bicycles used by students are shown in figure 8-6.

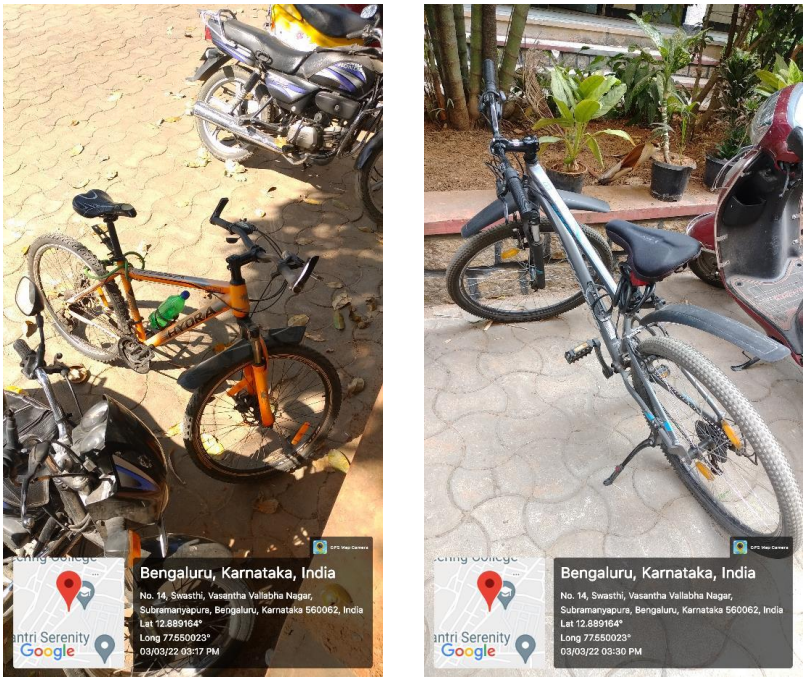

Figure 8-6: Bicycle usage by students

8.2.7. Awareness Program - World Environment Day

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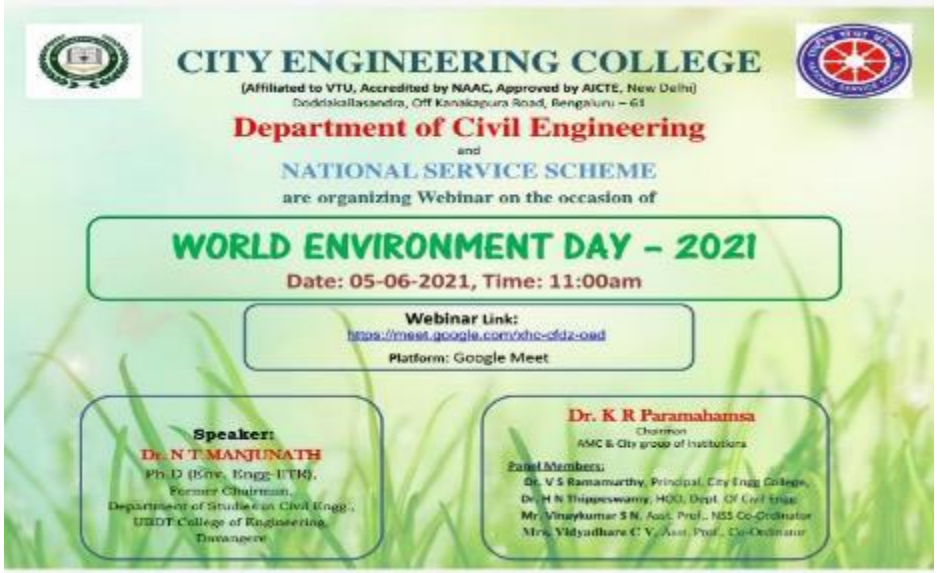

Figure 8-7: Webinar invitation - World Environment Day-2021

8.3. Recommendations on Carbon Footprint Analysis

During the study, there was continuous interaction between the audit team, college engineers and staff members to ensure that the suggestions made are realistic, practical and implementable.

- Recommend students and staff to use public transport system
- Recommend students and staff to use bicycle in large numbers
- Recommend staff and students to use electric vehicles
- Recommended to use display boards to conserve fuel and use bicycle.

9. ANNEXURES

9.1. Data Collection Questionnaire

A questionnaire is a checklist used as the primary tool for the collection of data / information in a systematic manner that enables to perform the audit.

9.1.1. General information of the college:

General information of the college needs to be collected to get an overview of the campus for the walk-through purpose. It includes a set of questionnaires as given below.

1. Internal Quality Audit Team: 2020 – 2021

Table 9-1 depicts the format for the collection of Internal Quality Audit team.

S. No.	Name	Designation	Role
1			
2			
3			

Table 9-1: Internal Quality Audit team

2. General Information of the college

General information of the college includes an address of college and head office, contact person details, year of establishment etc., as given in table 9-2.

S. No.	Description	Details
1.	Name of the College and address:	
1.a	Head office address :	
2.	Telephone/Fax No	
3.	Co-ordinating officer:	Name:
		Mob:
		Email:
4.	Year of Establishment:	
5.	Hostel (Available/Not Available)	

S. No.	Description	Details	
6.	No. of Working days/year		
7.	Brief description of Campus		

Table 9-2: General information of the college

3. College Infrastructure

Infrastructure details of the college were gathered from table 9-3.

S. No.	Description	Details
1	Block Name	Class rooms
		Labs
		Staff rooms
		Wash rooms
2		
3		

Table 9-3: Detail Infrastructure of the college

4. Details of Student clubs
5. Details of cells that support students
6. Tentative Schedule of a working day:

   a. No. of working days per year:

   b. List of holidays:

7. Total area of the campus

8. Details of List of Departments and Courses (Faculty wise)

The total number of departments, laboratories, conference hall, Libraries, Auditorium, and Cafeteria are obtained from table 9-5.

S. No.	Description	Details
1	Department	
2	Laboratories	
3	Conference Hall	
4	Libraries	
5	Auditorium	
6	Cafeteria	

Table 9-4: Details of the departments

9. Number of staff

Teaching, non-teaching, supporting staff with a male and female breakup is obtained from table 9-5

S. No.	Teaching Staff		Non-teaching Staff		Support Staff (Security, House Keeping)	
	Male	Female	Male	Female	Male	Female

Table 9-5: Details of the Staff

10. Number of Students

Number of students is collected from table 9-6.

S. No.	Boys	Girls
1		

Table 9-6: Details of the Students

11. Additional infrastructure details have been collected from table 9-7.

S. No.	Description	Details	
1.	Number of blocks available for boys hostel	Nos.	

2.	Number of rooms available for boys hostel	Nos.	
3.	Number of blocks available for girls hostel	Nos.	
4.	Number of rooms available for girls hostel	Nos.	
5.	Whether Laundry is available in the hostel	Yes / No	
6.	If Yes List the Electrical Equipment in Laundry Section of the hostel (like Washing machine, Dry Cleaning Machine, Iron)		
7.	Whether gym/ indoor sports hall is available in hostel	Yes / No	
8.	Whether Solar PV based Power Generation is available in campus (academic or hostel block)	Yes / No	
9.	Whether lifts available in academic block	Yes / No	
10.	Whether Kitchen is available in the academic block	Yes / No	
11.	Whether any food counter (outside caterers) available in academic block	Yes / No	
12.	Whether any commercial shops available in academic block	Yes / No	
13.	Any more information or additional details of academic block you would like to share – kindly elaborate here		

Table 9-7: Details of the departments

9.1.2. Water Audit details:

1. General information

General information required for water management analysis is collected from table 9-8.

S. No.	Description	Details
1	Source of water	
2	Types of water	
3	No of Wells	
4	No of motors used	
5	No of bore wells	
6	Rating of the motors in HP	

S. No.	Description	Details
7	Depth of each bore-well	
8	Water level of bore well	
9	Number of water tanks (overhead & underground tanks)	
10	Capacity of overhead tank	
11	Capacity of underground tank	
12	Quantity of water pumped every day	
13	Any water wastage of water /why?	
14	Water usage for gardening	
15	Waste water sources	
16	Use of waste water	
17	Faith of waste water from labs	
18	Whether waste water from labs mixed with ground water?	
19	Any treatment method available for lab water?	
20	Whether any green chemistry method practiced in labs?	
21	Total number of water coolers	
22	Whether Rain water harvesting system available?	
23	Whether Sewage Treatment Plant (STP) is available?	
24	List of equipment installed in STP (If S.No.23 is Yes)	
25	Whether Solar Hot Water System is available in the campus	
26	Number of units and amount of water harvested	
27	Any leaky taps in the campus	
28	Amount of water lost per day	
29	Any water management plan used?	
30	Any water-saving techniques followed?	
31	Are there any signs reminding peoples to turn off the water?	
32	No. of water flow meters available	
33	Method of water consumption monitoring	
34	Breakup of daily water consumption	

S. No.	Description	Details
35	Attach Month wise water bill for last 2 years	
36	Please attach recent water quality test reports for Bore well water, Drinking Water and STP processed water.	
37	What are the sources of hot water	
38	What are the usage areas of hot water	

Table 9-8: Water management details

2. STP information

STP details are collected from table 9-9

S. No.	Description	Details
1.	Number of STP plants installed	
2.	Capacity of STP	
3.	Technology of STP	
4.	Year of Installation	
5.	Schematic / Layout of STP	
6.	Water flow meters installed	
7.	Quantity of Sludge	
8.	Disposal of Sludge	

Table 9-9: Details of STP

3. RO Plant information

RO Plant details are obtained from table 9-10

S. No.	Location	Quantity	Capacity
1.			
2.			
3.			

Table 9-10: Details of RO Plant

9.1.3. Energy consumption details:

1. Energy consumption details:

The energy consumption details required for the audit is collected, the brief format of the same is given in table 9-11.

S. No.	Type	Units		Value	Cost in Rs.
1	Electricity	kWh	2019		
			2020		
2	LPG	Cylinders			
3	Diesel	Litres (Month wise consumption for the last two years)			
4	Others resources (Please specify)				
5	Total connected load	kW			
6	Contract demand	kVA			
7	Maximum demand recorded	kVA			
8	Average power factor				
9	Energy charges	Rs./kWh			
10	Demand charges	Rs./kVA			
	*** Attach Electricity Bill Copy of last 2 years**				

Table 9-11: Details of Energy consumption

2. Solar Energy details:

The solar energy details required are collected from table 9-12.

S. No.	Building No./ Name	Solar water Heater			Solar PV System		
		Capacity	Working / Not working	Year of Installation	Capacity	Working / Not working	Year of Installation

Table 9-12: Details of Solar Energy

3. Solar Street lights details:

a. Quantity -
b. Capacity -
c. Year of Installation –

4. Electrical Equipment details:

Electrical Equipment like transformers DGs UPS Capacitor Bank, AC, Computers, water coolers, fans, exhaust fans are obtained from the table 9-14.

S. No.	Description	Details	
1.	Number of Transformers Installed	Nos.	
2.	Number of Electrical Panels / Electrical Panel Rooms	Nos.	
3.	Whether Diesel Generator Set Backup Power is Available	Yes / No	
4..	How many number of DG Sets available in the campus (If S.No.3 is Yes)	Nos.	
5.	Whether UPS is available for labs, computers and/or any equipment	Yes / No	
6.	Number of UPS installed with location and capacity (If S.No.5 is Yes)	Nos.	
7.	Whether Capacitor Banks is installed in the electrical panel rooms	Yes / No	
8..	Whether Air Conditioning Units have been installed in the campus	Yes / No	
9.	Type of AC units (split, cassette or packaged) available, capacity and installed location (If S.No.8 is Yes)	Nos.	
10.	Total number of computers available in the campus	Nos.	
11.	Type of computer monitors available (CRT, LCD, LED)	Nos.	
12.	Whether water coolers are installed in the academic blocks	Yes/No	
13.	Type of lamps (Fluorescent Tube Light, CFL, LED, Incandescent, Sodium / Mercury lamps, etc.,) installed in the campus	Nos.	
14.	Type of fans (ceiling, wall mount, standing, exhaust, etc.,) installed in the campus	Nos.	

S. No.	Description	Details	
15.	Whether exhaust fans are installed in hostel / kitchen.(If Yes, share the quantity and installed location)	Yes /No	
16.	Any other electrical equipment's in college buildings.		

Table 9-13: Details of Electrical Equipment

5. List of energy saving initiatives implemented
6. List of energy saving initiatives in plan for future

9.1.4. Waste management details:

Waste management includes the activities and actions required to manage waste from its inception to its final disposal. The various data/ information required for the assessment of waste management is as collected from the following set of questionnaires.

1. Basic information

Basic information for waste management is collected from table 9-14.

S. No.	Description	Yes/ No
1	Whether wet and dry garbage segregation is done inside the campus?	
2	Whether garbage is given to external agencies / municipal agencies?	

Table 9-14: Basic details of waste management

2. Types of Waste generated

Types of waste generated in the college are obtained from table 9-15.

S. No.	Description	Yes / No	Remarks
1	E-Waste (Computers, electrical and electronic parts)		
2	Hazardous / Chemical Waste		
3	Solid Waste (Damaged furniture, paper waste, paper plates)		
4	Dry Leaves		
5	Food Waste		
6	Waste Water (Washing, urinals, bathrooms)		
7	Glass Waste (Broken glass wares from the labs)		
8	Unused Materials		
9	Plastic Waste (Pen, Refill, Plastic water bottles and other plastic containers, wrappers etc.)		

Table 9-15: Types of waste generated

3. Segregation of waste

Segregation of waste information at different locations with quantity is gathered from table 9-17.

S. No.	Location	Bio-degradable	Non-Biodegradable	E-waste	Quantity, kgs/month
1	Office				
2	Labs				
3	Cafeteria / Kitchen				
4	College				

Table 9-16: Segregation of waste

4. Waste generation management

Waste generation management of the college was collected from table 9-18

S. No.	Description	Yes / No	Remarks
1	Composting / Vermicomposting		
2	Recycling		
3	Reusing		
4	Other ways		

Table 9-17: Waste Disposal methods

9.1.5. Green campus management details:

1. Total number of plants and trees

The total number of plantations, garden area, and many more are collected as per the set of questionnaires given in table 9-19

S. No	Description	Details
1	Total number of plant species identified	
2	Total number of plants on the campus	
3	Total number of Trees on the campus	
4	Garden area inside the college –	
5	Total number of medicinal plants /trees on the campus	

6	Total number of vegetables and fruits plantation in the campus	
7	Whether display boards are given to plants and trees for identification	
8	Does Institute celebrate World environment day?	
9	Does Institute celebrate World water day?	
10	Does Institute celebrate World ozone day?	
11	Does Institute celebrate World Earth day?	
12	Total number of aquatic water plants	

Table 9-18: List of plantation details

2. List of plants/ trees

List of plants/ trees with their scientific names obtained from table 9-20.

S. No.	Common/Local Name	Scientific name	No. of Trees/Plants

Table 9-19: List of plants/trees in campus

9.1.6. Carbon footprint management details:

The carbon emission from various activities such as transport, diesel generator usage, LPG consumption, and electricity consumption were collected, as per table 9-21.

S. No	Description	Details
1	Whether college provides transport facility for staff and students (Yes/No)	
2	Number (or Percentage) of staff using transport services provided by college	
3	Number (or Percentage) of students using transport services provided by college	
4	Number (or Percentage) of Staff using public transport	
5	Number (or Percentage) of Staff using Bike	
6	Number (or Percentage) of Staff using Car	
7	Number (or Percentage) of students using Public transport	
8	Number (or Percentage) of students using Car	
9	Number (or Percentage) of students using Bike	
10	Number (or Percentage) of students using Bicycles	
11	Average consumption of diesel per month	
12	Average electricity consumption per month	
13	Average LPG consumption per month	

Table 9-20: Details of Carbon footprint management

9.1.7. Photos required for Audit:

1. General Photos

In various sections, different types of photos are required to validate the existence of things, and hence they are collected from table 9-21.

S. No	Description	Details
1	Photos of student's NSS activities	
2	Photos of Safety policy	
3	Photos of the training program on the use of fire extinguishers	
4	Photos of environmental policies adopted by college	

5	Photos of MoUs for Waste management		
6	Photos of any other policies adopted by college		
7	Photos of water test report	Drinking Water	
		STP processed water	
		Bore-well water	
		Other water Sources (Like Tanker water and any other)	
8	Photos of use of Energy efficient devices like fan, bulbs etc.		
9	Photos of LCD/LED monitors used in Labs		
10	Photos of dry and wet waste collection bins		
11	Photos of celebrating World Environment Day		
12	Photos of celebrating World Water Day		
13	Photos of celebrating World Earth Day		
14	Photos of celebrating World Ozone Day		

Table 9-21: List of photos