Sushant University

Key Indicator – 7.1 Institutional Values and Social Responsibilities

(50)

7.1.6 Quality audits on environment and energy are regularly undertaken by the institution as follows:

1.Green audit /Environment audit
2. Energy audit
3. Clean and green campus initiatives
4. Beyond the campus environmental promotion and sustainability activities

(5)

Criterion 7 – Institutional Values and Best Practices

(100)

Sushant University

Appendix – IV

Report & Certificate on

Green Audit/Energy Audit/Environment Audit/Water Audit & Thermal Imaging

GREEN / ENVIRONMENTAL AUDIT 2021

Sushant University
Erstwhile Ansal University Gurugram

Environment and Green Audit

Sushant University
Erstwhile Ansal University Gurugram

SUSHANT UNIVERSITY

SECTOR - 55, GURUGRAM – 122003 (HARYANA)

CONDUCTED BY :

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Executive Summary

A nation's growth starts from its educational institutions, where the ecology is thought as a prime factor of development associated with environment. A clean and healthy environment aids effective learning and provides a conducivelearning environment. Educational institutions now a day are becoming more sensitive to environmental factors and more concepts are being introduced to make them eco-friendly. To preserve the environment within the campus, various viewpoints are applied by the several educational institutes to solve their environmental problems such as promotion of the energy savings, recycle of waste, water reduction, water harvesting etc. The activities pursued by university can also create a variety of adverse environmental impacts.

Environmental auditing is a process whereby an organisation's environmental performance is tested against its environmental policies and objectives.

Green audit is defined as an official examination of the effects a university has on the environment. As a part of such practice, internal environmental audit (Green Audit) is conducted to evaluate the actual scenario at the campus.

Green audit can be a useful tool for a university to determine how and where they are using the most energy or water or resources; the university can then considerhow to implement changes and make savings. It can also be used to determinethe type and volume of waste, which can be used for a recycling project or toimprove waste minimization plan. Green auditing and the implementation ofmitigation measures is a win-win situation for all the university, the learners and the planet. It can also create health consciousness and promote environmentalawareness, values and ethics. It provides staff and students betterunderstanding of Green impact on campus. Green auditing promote financialsavings through reduction of resource use. It gives an opportunity for thedevelopment of ownership, personal and social responsibility for the students and teachers.

If self-enquiry is a natural and necessary outgrowth of a quality education, it could also be stated that institutional self enquiry is a natural and necessary outgrowth of a quality educational institution. Thus it is imperative that the university evaluate its own contributions toward a sustainable future. As environmental sustainability is becoming an increasingly important issue for the nation, the role of higher educational institutions in relation to environmental sustainability is more prevalent.

Introduction

In SUSHANT UNIVERSITY GURUGRAM the audit process involved initial interviews with management to clarify policies, activities, records and the cooperation of staff and students in the implementation of mitigation measures.

This was followed by staff interviews, review of records, observation of practices and observable outcomes. In addition, the approach ensured that the management and staff are active participants in the green auditing process in the university.

The baseline data prepared for the SUSHANT UNIVERSITY GURUGRAM will be a useful tool for campus greening, resource management, planning of future projects, and a document for implementation of sustainable development of the university. Existing data will allow the university to compare its programmes and operations with those of peer institutions, identify areas in need of improvement, and prioritize the implementation of future projects. We expect that the management will be committed to implement the green auditrecommendations.

Water is a very precious commodity and merely by un-restricted drawing of water from bore wells and its very low subsidized tariff from municipal authority is a main impediment in water conservation in India.

Though, water is renewable and is replenished through water cycle but increasing population and industrial requirement are posing a very serious threat on availability of water for all on the Earth.

It is excellent that the management of SUSHANT UNIVERSITY GURUGRAM and other staff has great respect for sustainable living and are always acting at the right time for remedial measures for protection of Environment and ultimately caring for Society by reduction of resource use.

The Mantra followed is ***REDUCE-REUSE AND RECYCLE***.

General Recommendations

- Display of Green Policy at following prominent locations inside the premises.
  a. Near main gate
  b. At main entrance of Administrative Building
  c. All Hostels/Mess
  d. Academic Blocks
  e. Auditorium
  f. Canteen/Cafeteria.
- Signage for Tobacco free campus be displayed at prominent locations in campus.
- Signage for Food wastage be displayed at important locations of Canteen/Messes and Cafeteria in campus.
- Signage for Water conservation be displayed at important locations in campus.
- Signage for plastic free campus
- Signage for Segregation of waste.
- Provision of different dust bins as a set at a common location.
- Stack Height of DG set exhaust is not as per CPCB requirement.
- Fume exhaust hoods are not provided in chemistry lab which is not proper. It should be discharged above building height. Presently fumes are dispersing around building affecting local environment.

Environmental & Green Policy– Sushant University Gurugram

Policy Statement

The Sushant University, Gurugram is committed to managing its estates in accordance with responsibilities to the environment. These responsibilities shall be demonstrated within the following areas as a minimum:

1. **Tobacco Free premises** : The college administration pledges to make the premises totally tobacco free. No smoking or other type of tobacco products shall be allowed to inside the University campus.

2. **Purchasing:** In purchasing its services, materials, equipment and consumable items, the University will, where possible, purchase items produced in ways which do least environmental harm, which are not supplied with excessive packaging; which are benign or at least harmless in their effect on the environment. Where possible, preference will be given to local or regional suppliers to maximize the university input to the local community as well as reduction of environmental impact due to transportation.

3. **Cleaning**: The University shall use cleaning products based on environmental considerations as well as cost and suitability. It will monitor its working practices with a view to administering dosages so as to reduce the risk of over concentration and excess residue of unused cleaning mixtures finding their way into piped waste disposal systems.

4. **Waste Disposal and Recycling**: The University will seek to minimize its generation of waste by reduction of purchased materials where this does not compromise its primary functions, or by re-use of materials within or outside the university campus. Where reduction or re-use is not feasible, materials will be recycled wherever possible.

5. **Energy**: The University is environmentally responsible for its use of energy, and will therefore consider the sources, type, origin and destination of energy input and output throughout the College. This will require careful monitoring of consumption, the elimination of excessive or unnecessary use, and an ongoing program of energy

conservation. There is already renewable energy solar PV plants installed and in future also efforts shall be made to use renewable energy to the extent possible for mitigation of impact of energy use by university on environment.

6. **New Build and Building Refurbishment:** The College will ensure that whenever new construction or refurbishment, work is planned and executed in a manner which reflects environmentally-responsible approaches defined by the National Building Code-2016.

7. **Green Travel Plan**: The University actively promotes the use of public transport, walking and cycling. The College owns vehicle and requires staff where possible to use public transport when on College assignments. This plan is regularly reviewed. The travel of students shall also be encouraged through public transport.

8. **Food Policy** : The College, will ensure that decisions pertaining to the purchase of food, together with the use and disposal of plastic crockery/cutlery, should at all times include environmental implications as well as such factors as cost and nutritional value.

9. **Environmental Rules and Guidelines**: The College commit to ensure compliance to extant pollution control and other applicable environmental guidelines.

10. **Water Use**: The University intends to promote optimization of water use by avoidance of wastage, treatment and re-use of black water for other possible uses.

11. **The college also commits for Plastic free environment in college premises**.

The policy shall be reviewed annually or as per requirement.

Description of Campus

There are following blocks constructed in campus

1. Administration Building
2. A-Block
3. B and C Block
4. D -Block
5. E-Block
6. Hostel Block
7. LT Panel Area

Pre Audit meeting

A pre-audit meeting provided an opportunity to reinforce the scope and objectives of the audit and discussions were held on the practicalities associated with the audit. This meeting is an important prerequisite for the green audit because it is the first opportunity to meet the University concerned personnel for audit and deal with any concerns.

Management's Commitment

The Management of the university has shown the commitment towards the green auditing during the pre-audit meeting. They were ready to encourage all green activities. It was decided to promote all activities that are environment friendly. Awareness programs on the environment are regularly conducted, the management of the University was willing to formulate policies based on green auditing report.

Scope and Goals of Green and Environment 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. Green Audit is the most efficient and ecological way to manage environmental problems. It is a kind of professional care which is the responsibility of each individual who are the part of economical, financial, social, environmental factor. It is necessary to conduct green audit in university campus because students become aware of the green audit, its advantages to save the planet and they become good citizen of our country. Thus Green audit becomes necessary at the university level.

Benefits of the Green and Environment Auditing

- More efficient resource management
- To provide basis for improved sustainability
- Financial savings through a reduction in resource use
- Enhance the alertness for environmental guidelines and duties
- Development of ownership, personal and social responsibility for the University and its environment
- Enhancement of university profile
- To create a green campus
- To enable waste management through reduction of waste generation, solid- waste and water recycling
- To create plastic free campus and evolve health consciousness among the stakeholders
- Recognize the cost saving methods through waste minimizing and managing and monitoring of environmental and sustainable development
- Developing an environmental ethic and value systems in youngsters.
- Point out the prevailing and forthcoming complications
- Authenticate conformity with the implemented laws
- Empower the organizations to frame a better environmental performance
- Impart environmental education through systematic environmental management approach and Improving environmental standards
- Benchmarking for environmental protection initiatives
- Green audit is a valuable tool in the management programs of the university.

Target Areas of Green and Environment Auditing

Green audit forms part of a resource management process. Although they are individual events, the real value of green audits is the fact that they are carried out, at defined intervals, and their results can illustrate improvement or changeover time. Eco-campus concept mainly focuses on the efficient use of energy and water; minimize waste generation or pollution and also economic efficiency.

All these indicators are assessed in process of "Green Auditing of educational institute". Eco-campus focuses on the reduction of contribution to emissions, procure a cost effective and secure supply of energy, encourage and enhance energy use conservation, promotes personal action, reduce the institute's energy and water consumption, reduce wastes to landfill, and integrate environmental considerations into all contracts and services considered to have significant environmental impacts. Target areas included in this green auditing are water, energy, waste, green campus and carbon footprint.

Auditing for Energy Management

Energy cannot be seen, but we know it is there because we can see its effects in the forms of heat, light and power. This indicator addresses energy consumption, energy sources, energy monitoring, lighting, appliances, and vehicles. Energy use is clearly an important aspect of campus sustainability and thus requires no explanation for its inclusion in the assessment. An old incandescent bulb uses approximately 60W to 100W while an energy efficient light emitting diode (LED) uses only less than 10 W. Energy auditing deals with the conservation and methods to reduce its consumption related to environmental degradation. It is therefore essential that any environmentally responsible institution examine its energy use practices. **LED use also has a peculiar advantage towards environment that LED's are not using any mercury as the case of CFL's or Fluorescent tubes.**

There is an endeavour to check, manage and optimize energy use for mitigating the impact of university activities on Environment.

Also the university has taken a lead for producing green energy from Solar PV panels already installed

Auditing for Waste Management

The university has entered into a contract with agency for Solid waste management handling.

Pollution from waste is aesthetically unpleasing and results in large amounts of litter in our communities which can cause health problems. Plastic bags and discarded ropes and strings can be very dangerous to birds and other animals.

This indicator addresses waste production and disposal, plastic waste, paper waste, food waste, and recycling. Solid waste can be divided into two categories:

General waste and hazardous waste

General wastes include what is usually thrown away in homes and schools such as garbage, paper, tins and glass bottles. Hazardous waste is waste that is likely to be a threat to health or the environment like cleaning chemicals and petrol. Unscientific landfills may contain harmful contaminants that leach into soil and water supplies, and produce greenhouse gases contributing to global climate change.

Furthermore, solid waste often includes wasted material resources that could otherwise be channelled into better service through recycling, repair, and reuse. Thus the minimization of solid waste is essential to a sustainable campus. The auditor diagnoses the prevailing waste disposal policies and suggests the best way to combat the problems. It is therefore essential that any environmentally responsible institution examine its waste processing practices.

E-Waste: The old computers are sold back to vendor which is again put to beneficial use by repairing and it is good sustainable practice. Material not reusable is re cycled as per extant guidelines.

Presently authorised vendors who can handle E-waste are not engaged for management of E-waste

Key Boards and mouse which become un-serviceable are also disposed off. **It is required to be ensured that vendor dealing with E-waste is authorised to collect E-waste.**

Hazardous Waste: Lead Acid Cell Batteries are returned to Vendors for re-cycling of lead

and other constituents.

Fluorescent tubes are handed over to Junk dealer who in turn should send them to Local re-cycling units. Storage of Fluorescent tubes in university should be as per recommended practice.

Auditing for Green Campus Management

Unfortunately, biodiversity is facing serious threats from habitat loss, pollution, over consumption and invasive species. Species are disappearing at an alarming rate and each loss affects nature's delicate balance and our quality of life. Without this variability in the living world, ecological systems and functions would break down, with detrimental consequences for all forms of life, including human beings. Newly planted and existing trees decrease the amount of carbon dioxide in the atmosphere. Trees play an important ecological role within the urban environment, as well as support improved public health and provide aesthetic benefits to cities. In one year, a single mature tree will absorb up to 48 pounds of carbon dioxide from the atmosphere, and release it as oxygen. The amount of oxygen that a singletree produces is enough to provide one day's supply of oxygen for people. So while you are busy studying and working on earning those good grades, all the trees on campus are also working hard to make the air cleaner for us. Trees on our campus impact our mental health as well; studies have shown that trees greatly reduce stress, which a huge deal is considering many students are under some amount of stress.

E-Waste disposal

The record of use and handling of E-waste is maintained .While disposing/Auction or sale of E-waste credential of purchaser should be documented to ensure that vendor is authorised for collection and ensuring re cycling of E-waste as per extant guidelines.

- **Hazardous waste (toxic)-yes**

  For safe handling and management of hazardous waste in an environmentally sound manner, Govt. of India has notified the Hazardous Waste (Management & Handling) Rules, 1989, under the Environment (Protection) Act, 1986. However, these Rules were suppressed with re notification of the Hazardous Wastes (Management, Handling and Trans boundary Movement) Rules, 2008. Under the said Rules, hazardous waste has been defined as those wastes which by reason of any of its physical, chemical, reactive, toxic,

flammable, explosive or corrosive characteristics causes danger or is likely to cause danger to health or environment, whether alone or when in contact with other wastes or substances, and shall include wastes as specified in Schedules of the Rules.

- Solid waste-yes-Extra waste removed through truck and disposed in municipal waste collection points
- Dry leaves-Yes-Used in university for making manure/compost
- Canteen waste-yes-Used for Compost in university
- Liquid waste-yes-Preserved and used in university
- Glass-Yes-sent for recycling.
- Unused equipment-yes-Returned to vendors through sale
- Plastic waste-Yes-Segregated and removed

Canteen Waste-Handling practice

There are no signs provided in Mess and Cafeteria for avoiding food wastage and take food as per requirement and there should not be any food wastage. These signage are required to be provided in all area where food is served or consumed.

1. All Hostel Mess
2. Canteen
3. Cafeteria

Food Procurement And Disposal

1. Food is prepared in Canteen/Mess and any food waste that is generated is now planned to be filled in compost pits for preparation of natural manure.
2. A good effort has been made to maintain all waste data for food. Record for all other types of wastes is also required to be maintained for better management.
3. Effort should be made for reduction of onsite wastages.

Consumer Level:

As per the present observed practice at consumer level in the society at large, often, the used lamps are collected by the kabari from the households and collectively handed over to the glass recyclers for the recovery of glass material.

This is all operative in a highly unorganized sector. It has, also, been observed that, the used lamps are thrown in the garbage bins and finally into the municipal garbage dumpsites, contaminating air, water and soil. Most of the used lamps are broken either at transit solid waste bins (provided by local civic authority) or broken during the transport to the final disposal site.

A portion of the mercury, in vapor form, is released into the air; whereas rest of the mercury is released onto the soil with further possibility of getting into the surface and/or ground water bodies through the leachate from soil.

User Awareness:

All the consumers, individual domestic consumers and bulk consumers (offices, institutions, large residential complexes, etc.) should get fully aware about the potential health impact of mercury-bearing lamps, through audio-visual media and the product leaflets. The precautions, to be taken while cleaning up the broken FLs should, also, be known to the consumers. As a part of such awareness programs, the consumers, even at individual level, are expected to participate actively with constructive suggestions and provide the feedback, for the overall success of mercury management in fluorescent lamp

Collection: The collection of used lamps may be done mainly by two ways: (i) Collection of used lamp (FLs) from bulk consumers may either be arranged by the management of above set-up (institutions, etc.) for direct disposal to LRU or by the LRU which may arrange to pick up used lamps from such collection sites through an identified collection agency. (ii) Collection of used lamps (FLs) from individual domestic consumer may be arranged by the LRU, either through kabaris (individuals appointed for the purpose by LRU) or an identified collection agency for door to door pickup. Transportation: (i) The Handler (e.g. Kabari or representative of LRU) of used FLs in transit should take care of selection of proper vehicle and carriage so as to minimize breakage of used FLs.

(ii) There should not be any intermediate transfer of materials in the transit stage. The collected used FLs should be straight transported to the LRF for further processing. (iii) The Handler should be trained to take care of mercury spills, if any, that takes place en-route the journey to LRU.

Noise Pollution

1. Sounds of Normal Conversations:

Sound Intensity: 40-60 dB

Health Hazard: Sound less than 80 dB is safe for the ear.

2. Sounds emanating from Tape recorders or an Orchestra:

Sound Intensity: 70 dB

Health Hazard: It is safe for ear.

3. Sounds of Heavy Traffic:

Sound Intensity: 90 dB

Health Hazard: Constant exposure to sound greater than 80 dB causes temporary hearing loss and if they are not treated immediately, causes permanent impairment.

4. Sounds of Pneumatic drills and other machines:

Sound Intensity: 100 dB

Health Hazard: Constant exposure causes temporary hearing loss and if they are not treated immediately, causes permanent impairment.

5. Sounds of Aircraft engine:

Sound Intensity: 100-200 dB

Health Hazard: Higher noise level of 160 dB cause total deafness, rupturing eardrums, damaging inner ear. It also causes high blood pressure, ulcer in stomach, palpitation, nervous problems, irritation, anger, and affects pregnant women's embryo.

6. Sounds of Rockets during Take off:

Sound Intensity: 200 dB

Health Hazard: It is dangerously causing total deafness by rupturing the eardrums and damaging the inner ear. It also causes high blood pressure, ulcer in stomach, palpitation, nervous problems, irritation, anger, and affects pregnant women's embryo.

Decibels Measurement – Sushant University

Sr.No.	Location	Decibel level Measurement	Remarks
1	Administration office	48	Satisfactory
2	LT Panel Room	47	Satisfactory
3	Girls Hostel common room	48	Satisfactory
4	Outside VC office	49	Satisfactory
5	Lecture Theatre-D-113	46.5	Satisfactory
6	Block B and C 103	48	Satisfactory
7	A block Ground Floor	49.5	Satisfactory
8	E Block Room	52.7	Satisfactory
9	E-Block faculty room	51.3	Satisfactory
10	D-Block Chemistry Lab	51.0	Satisfactory
11	Near Main Gate	50.5	Satisfactory

Sound/Decibel level measured is satisfactory and there is no adverse impact of the same on occupants.

Custodial Chemical Use

Chemical for one year requirement are used in Labs and these are stored in a separate store. The store requires to be ventilated and hazard analysis should be got done through Material Specification Data Sheet and record should be maintained. Proper ventilation with hoods should be designed.

There is practice of burial of chemical waste in the soil in the university campus, This causes pollution of soil. The chemicals collected be disposed as per guidelines so that there is

Transportation Practices

Most of students are using shared transport , there is a university bus arranged to ferry students from nearest Metro station to university campus., which is sustainable. Students are using Buses, Shared auto. There is only one bus owned by the university. The consumption of HSD by buses is monitored for optimised consumption.

Teaching and Non Teaching faculty is also sensitized for using pooled transportation for working towards sustainability and reducing resource use and encouragement of resource conservation.

Procurement Practices To Be Followed

Presently there is no practice to consider impact of procurement of different items on the Environment.

Procurement team is required to be made aware regarding procurement of goods and services that are sustainable. The sensitization is required for all purchases in a way that optimized utilisation of natural resources is possible.

1. Paper with Recycle content
2. AC's using refrigerant with Zero ODP Refrigerant
3. Environmental friendly Housekeeping Chemicals
4. Paints, Adhesives, sealants with recommended percentage of volatile organic compound.

Paper Use and Printing Goals

1. There are efforts already directed through use of E-Books for reducing the use of paper.
2. Students are encouraged to make use of E- Library.
3. There are instructions to staff and student to resort to printing only if it is absolutely un-avoidable.
4. Papers should be purchased that have recycled content.

Recommended Paper use and Printing Goal to be followed. All concerned are required to be sensitized for adhering to these practices.

1. Distribute memos, reports, purchase orders and brochures electronically.
2. Encourage re-use of scrap paper for printing and note taking. Larger printers should have one dedicated tray for the reuse of scrap paper.
3. Print on letterhead paper only as needed; use electronic letterhead whenever possible
4. Network all printing to shared copiers/printers and eliminate stand-alone printers where possible
5. Discourage reckless printing and copying by requiring use of an account/password
6. Promote a 'Think before you Print' culture
7. Desktop drafting and editing of documents
8. Reduce default margin settings
9. Use toner-saving fonts (e.g. Eco Font) or smaller-sized fonts
10. Encourage increased use of Blackboard /Electronic Board as a paper-free resource
11. Training and Adherence - Distribute (an) email(s) with detailed instructions, including "screen shots" on how to change settings on computers, copiers, faxes, printers
12. Establish duplex (two-sided) copying and printing as standard
13. Phase out meeting handouts and distribute/project them electronically (this needs to be better defined).
14. Digitize forms and administrative and admission processes. Continue replacing paper based processes and administration.
15. Double-sided student assignments as standard (with electronic submission, grading & return)
16. Faxes: phase out fax machines, utilize computer faxing, end use of fax cover pages (research applicable technology/software: Win fax? E-fax?)
17. Increase electronic archiving and record keeping (this needs to be better defined and targets identified; work with Purchasing, Personnel, Academic Department and/or Student Records to be determined)

E-Library

E-books v/s Traditional books data and year wise history to moving from traditional to E-system.

There is constant endeavour to promote use of E-Books which is a very positive effort.

Despite fewer in numbers the e-books have advantage of being used by multiple students/ faculty simultaneously and thus creating better impact on sustainability in contrary to hard copy that can be read by only one person at a time.

The following recommendations are made

1. Use of E-books be promoted for students and faculty members specially in present Covid situation.
2. No. of E-books made available should be increased continuously.
3. Training on sustainability should be provided.
4. Adaption be promoted considering it to be a new normal.
5. Targets for increasing E-books should be fixed on continual basis.

Training and Awareness

The university is regularly conducting awareness program for students and faculty members.

Governance

Through enactment Waste Management and Green Initiative policy and its circulation to all stake holders, sustainability can be achieved. The results are regularly required to be verified at Periodical intervals. These can be managed through internal or external audits.

Plantation at Sushant University Gurugram

Plantation Inventory

Total Large tree counted on site are 122 Nos.

There is regular plantation program in vogue.

Air Quality

CPCB GUIDELINES

Exhausts of DG Sets are required to be raised as per CPCB requirement.

There is no record of air quality testing done earlier. Generally the dust level is found to higher than normal and is causing abnormal conditions.

As per WHO guidelines the following should be the limits for Air Quality

Particulate matter

Guidelines	
$PM_{2.5}$:	10 µg/m³ annual mean 25 µg/m³ 24-hour mean
PM_{10}:	20 µg/m³ annual mean 50 µg/m³ 24-hour mean

Air Quality Measurement

Sr. no	Location	PM-2.5	PM - 10	Particles	CO-2	HCHO	Remarks
1	Admin Office	60.1	88.3	6940	851	2.245	Higher HCHO-Formaldehyde-Higher PM
2	LT Panel Room Cabin	59.4	89.8	7092	1023	0.147	Higher PM
3	Out Side VC Room	54.5	82.7	6872	745	0.027	Higher PM
4	Lecture Theater D - 113	57.4	87.6	6417	752	0.021	Higher PM
5	Block - B & C Room C - 103	57.1	88.8	6245	761	0.001	Higher PM
6	A Block Room Ground Floor	55.5	82.3	6718	755	0.018	Higher PM
7	E Block Faculty Room	28	45.5	2828	666	0.02	Higher PM
8	D Block	22.9	38.2	2849	779	0.077	Higher PM
9	D Block Chemistry Lab	24.9	36.8	2953	780	0.45	Higher PM
10	Girls Hostel Common Room	70.2	102.3	7744	790	0.028	Higher PM
11	Canteen Area	60.3	90.7	7422	810	0.005	Higher PM

The values of PM-2.5 and PM-10 are y high and limits are dangerous for human beings. Values of CO2 and Formaldehyde are generally satisfactory except for Admn. area. There is not much that can be done by University for management of particulate matter. Only any loose soil or construction material inside premises should be sprinkled with water to mitigate to some extent.

Significance of Refrigerant for Environment

Table depicting properties of Refrigerants

Refrigerant	Global Warming Poetential	Ozone Depletion Potential
R 22	1810	Medium
R 410A	2088	Nil
R 32	675	Nil
R 134A	1430	Nil
R 290	3	Nil
R 600A	3	Nil

Refrigerant	Type	ODP	GWP	Atmospheric lifetime (years)
R12	CFC	0.9	8500	102
R22	HCFC	0.06	1700	13.3
R134a	HFC	0	1300	14
R407C	HFC blend	0	1610	36
R410A	HFC blend	0	1900	36
Ammonia (R717)	Natural compound	0	0	< 1
Propane (R290)	HC	0	3	< 1
R1234yf	HFC unsat.	0	6	Very low
R1234ze	HFC unsat.	0	6	Very low

Detail of Refrigerant used in installed Air Conditioners

Data of Refrigerants not maintained. It is recommended that in future all procurement for AC's, Water cooler etc. be made with consideration for Environment friendly refrigerants.

Recommendations

1. It is recommended that in future care should be taken to purchase Air conditioners with refrigerants for which GWP is low and ODP is nil.
2. Life cycle cost should be considered for making decision about purchase of Air Conditioners.
3. All AC's that were procured more than 8 years ago should be replaced with best in class energy efficient Air Conditioners after taking into consideration Life Cycle Cost. This will eliminate existing AC's impact on environment through low impact refrigerant and also with low consumption of Electricity thus reducing

ECO Friendly House Keeping Materials

Presently chemicals not complying to Green Pro certification are used. It is recommended that in future housekeeping chemicals with Green Pro standard certification be only used.

It is recommended that Eco Friendly material and Sustainable material as per NBC-2016 guidelines be procured and used.

CII
Confederation of Indian Industry

GreenPro

GreenPro Certification Standard for

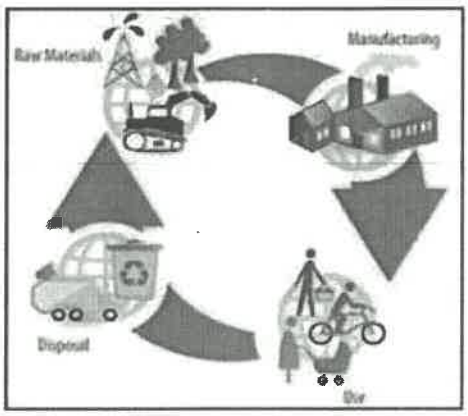
Cleaning Chemicals

Version 1.0

GreenPro Certification – Life Cycle Approach

The Green Products Rating adopts a holistic approach based on the 'Life Cycle' of the product. The rating system encourages the product manufacturers to implement measures that would result in environmental, health and wellbeing benefits at the following stages of the life cycle of the products.

1. Product Design
2. Raw materials
3. Manufacturing Process
4. Product Performance during use
5. Disposal / Recycling



For Users

Use of rated Green products leads to significant tangible and intangible benefits for the end users.

Some of the benefits for the users are highlighted as below:

1. Time and effort in carrying out due diligence in selecting a green product is saved
2. The user is assured of the performance of the product and equipment
3. Ensures Toxic and hazardous substances free products which in turn decrease "health and wellbeing" risks of the users
4. Improved product performance during use to reduce resource consumption and environmental impacts
5. Recognition and credits for achieving national and international Certification for the buildings

National Priorities addressed in Certification

GreenPro Certification addresses the following which are priorities of the Government at the National level:

Water:

Water is a major concern in most part of the country. Implementation of water efficiency measures and "zero Liquid Discharge" are being encouraged to address the water related issues.

Land:

Availability of land and increase in land pollution are major areas of concern. The Certification system demands for increased recycling of material after use which would result in reduction in landfills and hence reduction in land pollution.

Energy Efficiency:

The Certification system encourages the product manufacturers to adopt energy efficiency improvement measures and reduce their energy consumption which is in line with the National Mission on Enhanced Energy Efficiency. This also addresses

The key objective of the council is to facilitate Green product market transformation in India through 'Green Product Certification'.

The initial focus of the council will be on Green building products and related technologies. Over a period of time, the council will expand its focus to other areas such as Industrial products, consumer items, services etc.

Why GreenPro Certification?

The GreenPro Certification is a tool for facilitating Green Product market transformation in the country. The GreenPro Certification is expected to:

1. Enable green building projects in selecting the right product and equipment
2. Increase the market demand for the Green products
3. Put a system in place for a product to be called 'green'

Eliminate exposure to prohibited substances that can lead to long term health effects either through respiration / direct contact.

Mandatory Requirement Manufacturer to provide Material Safety Data Sheet (MSDS) for the products. The MSDS should have the following details:

1. Chemical Identify
2. Manufacturer's information
3. Hazardous ingredients / Identify information
4. Physical, Chemical characteristics
5. Fire and explosion hazard data
6. Reactivity data
7. Health hazard data
8. Precautions of safe handling and use
9. Control measures
10. Emergency and first aid procedures

General Purpose Cleaners

Presently there is no practice for procurement of Eco Friendly chemical.

Eco friendly housekeeping materials are recommended to be used for all cleaning application should be Green Pro or any similar Indian standard should be procured in future and records of such procurement b documented for future references.

The cleaning material may be required for following applications and also may be some other in addition to these.

1. Glass Cleaners
2. Bathroom Cleaners
3. Disinfectants and Sanitizers
4. Cleaner/Degreasers
5. Carpet and Upholstery Cleaners
6. Floor Cleaners
7. Liquid Hand Soap
8. Furniture Polish

Ventilation Assessment

There is no area which is not Air conditioned. Mechanical ventilation has since been provided.

Fire Safety:

No halon based fire extinguishers have been used, it is very good initiative. As a future guideline It is recommended that of fire suppression system is to be used for any fire extinguishing system, only clean agents with minimum environmental impact should be installed.

Sustainable Development Goals

Sustainable development should always be practiced in all activities of university.

Consideration for New Constructions

There are no construction presently going on and is also not mooted in near future.

There should be an effort to Encourage use of local materials

Always encourage use of locally available material. With this we will help local population and their Social Development Index will get a boost. Also low energy shall be expanded on transportation that will ultimately save fossil fuels and make decision of an organization more sustainable.

Low VOC (Volatile Organic Compound)%

The following material contains VOC

1. Paints
2. Adhesives
3. Sealants
4. Other materials

It should be ensured that while procurement or issuing PO's for work it should be ensured that only material with permitted percentage of VOC are procured or used in of works awarded. Special conditions in contract/specifications shall be incorporated.

Team responsible for PMC shall ensure that material brought to site and used in execution of work is in compliance to Green specifications.

Use of Low Impact material and Zero ODP material

Where ever relevant and applicable care should be taken to include in specifications use of low impact material and only zero ODP material shall be procured or used in execution of works by contractor /Vendors.

Guidelines for Environment Friendly and Green Initiatives

Annexure I

VOC limits of materials

Type of Material	VOC Limit (g/L less water)
Paints	
Non- Flat (Glossy) paint	150
Flat (Mat) paint	50
Anti- corrosive/ anti-rust paints	250
Varnish	350
Adhesives	
Glazing adhesives	100
Tiles adhesives	65
Wood adhesive	30
Wood flooring adhesive	100

Annexure I

Minimum Ventilation Rates in Various Functional Zones*

Occupancy Category	People Outdoor Air Rate	Area Outdoor Air Rate
	Cfm/person	Cfm/ sq.ft
Correctional Facilities		
Dayroom, Guard station	5	0.06
Booking/ waiting	7.5	0.06
Education Facilities		
Daycare (through age 4), daycare sickroom, Art Classroom, science laboratories, college laboratories, wood, metal shop	10	0.18
Classrooms (ages 5-8), (age 9+), computer lab, media centre	10	0.12
Lecture Room/ hall (fixed seating)	7.5	0.06
Music/ theater/ dance,	10	0.06
Multi use assembly	7.5	0.06
Food & Beverages Services		
Restaurant dining rooms/ cafeteria/ fast food dining/ Bars/ Cocktail Lounges	7.5	0.18
General		
Break Rooms, Coffee stations, conference/ meeting	5	0.06
Corridors	-	0.06
Storage Rooms	-	0.12
Hotels, Motels, Resorts, Dormitories		
Bedroom/ living room, barracks sleeping areas	5	0.06
laundry rooms	5	0.12
Lobbies/ prefunction	7.5	0.06
Multipurpose assembly	5	0.06

Occupancy Category	People Outdoor Air Rate	Area Outdoor Air Rate
	Cfm/person	Cfm/ sq.ft
Office Building		
Office Spaces, Reception Areas, Telephone, data entry, Main entry Lobbies	5	0.06
Electrical Equipment rooms	-	0.06
Elevator machine rooms	-	0.12
Pharmacy (prep area)	5	0.18
Photo Studios	5	0.12
Shipping/ receiving	-	0.12
Telephone closets	-	0.00
Transportation waiting	7.5	0.06
Warehouses	-	0.06
Public Assembly Spaces		
Auditorium seating area, Place of religious worship, Courtrooms, Legislative Chambers, Lobbies	5	0.06
Libraries	5	0.12
Museums (children's)	7.5	0.06
Museum/ galleries	7.5	0.06
Retail		
Sales	7.5	0.12
Mall common Areas	7.5	0.06
Barber Shop	7.5	0.06
Beauty & nail salons	20	0.12
Pet Shops (animal areas)	7.5	0.18
Super Market, Coin operated Laundries	7.5	0.06

Occupancy Category	People Outdoor Air Rate	Area Outdoor Air Rate
	Cfm/person	Cfm/ sq.ft
Sports & Entertainment		
Sports arena (Play Area), Gym, stadium (play area)	-	0.30
Spectator area	7.5	0.06
Swimming (pool & deck)	-	0.48
Disco/dance floor/ health club/ aerobics room/ weight rooms	20	0.06
Bowling alley (seating)	10	0.12
Gambling casinos/ game arcades	7.5	0.18
Stages, studios	10	0.06

* *Total outdoor air flow in functional zone =*

$$\left\{\begin{array}{c}\text{Outdoor air flow rate required per person as per the above table} \\ \times \\ \text{Zone population}\end{array}\right\} + \left\{\begin{array}{c}\text{Outdoor air flow rate required per unit area as per the above table} \\ \times \\ \text{Net occupiable zone area}\end{array}\right\}$$

Landscape Water Demand Reduction

Plant factor for various species

Plant species	Plant factor
Lawns	1
Native grass	0.45
Existing native trees	0
Newly planted native shrubs	0.3
Newly planted exotic shrubs	0.9
Newly planted native trees	0.15
Newly planted exotic trees	1.65

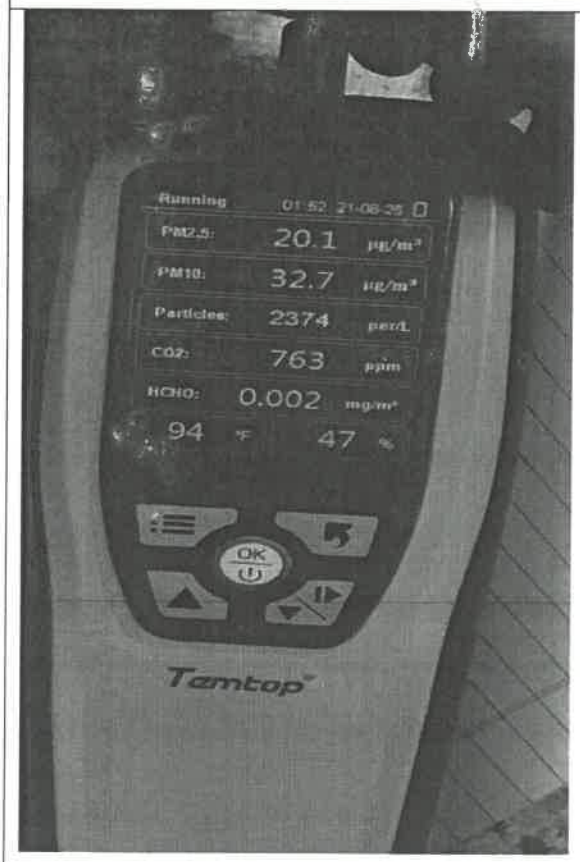
Plant species	Plant factor
Vertical gardens	0.35
Newly planted native shrubs on podium	1.3
Newly planted exotic shrubs on podium	1.9
Newly planted native trees on podium	1.15
Newly planted exotic trees on podium	2.65
Note: For potted plants, calculate the water requirement as volume of pot and divide it by 4.	

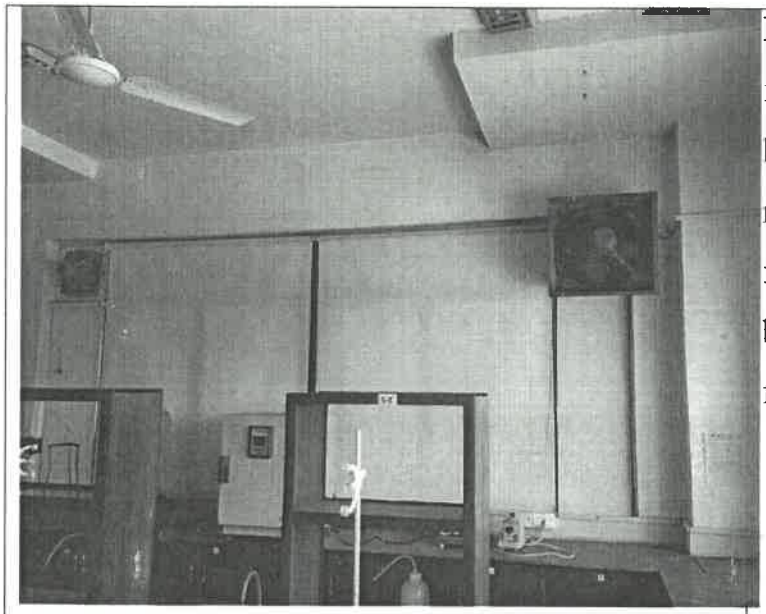
Table 2 Irrigation system efficiency

Type of irrigation system	Efficiency (%)
Flood	65
Furrow	80
Sprinkler	85
Drip	90

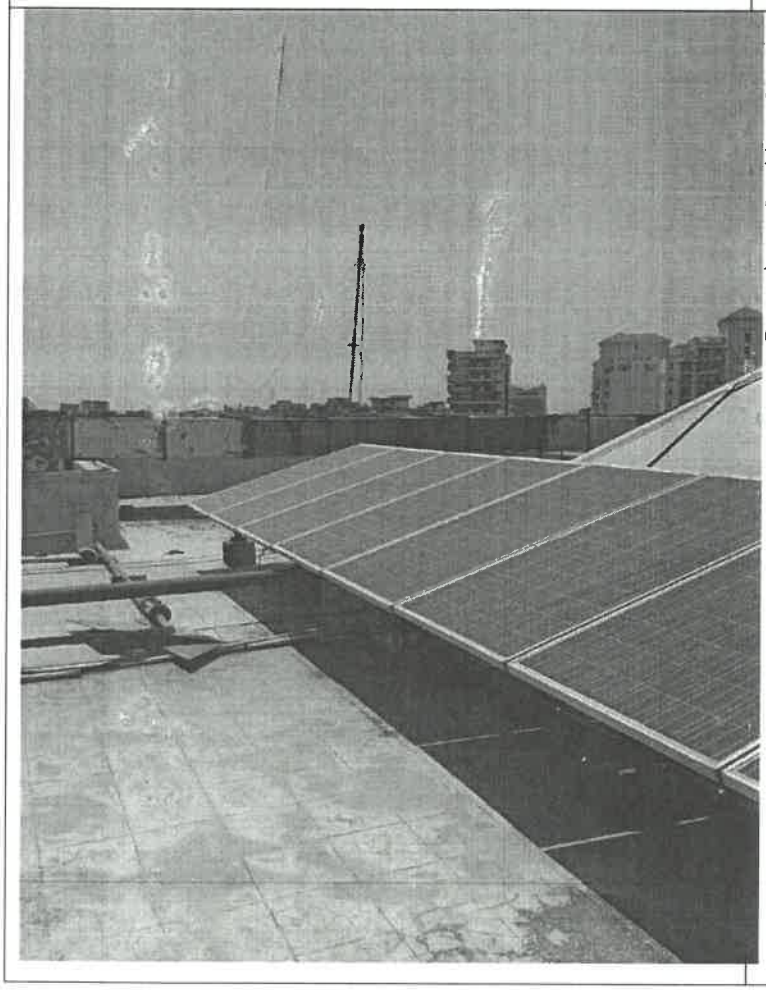
Photographs - Environmental Concerns

Photographs Depicting Issues Related To Green And Environment Audit Sushant University Gurugram	
	Single type of Bins have been provided for segregation of waste at source bins as shown in next photograph should be provided.
	PREFERRED BINS - Onsite segregation of waste is not presently practiced. These type of bins should be provided at all locations.

	Stack of DG sets are not as per requirement of CPCB Guidelines. These are required to be taken above height of building and stack height should be as following formula Ht. of Stack = Ht of Building+ 0.2 * sq. root of kVA of DG set
	Environment Parameters measurement -PM2.5, PM-10, CO2 and Formaldehyde and Total Particulate matter



Exhaust hoods of Labs not provided for chemistry Lab fumes. The fume hood is required to be provided raised to level above building. The final exhaust should be raised above building for proper dispersion of fumes.



Cool roof may be provided with covering at roof level for exposed roof with broken china mosaic tiles. The Air conditioning energy for the top floor shallbe reduced to the extent of 15 %

ENERGY AUDIT
2021

Sushant University
Erstwhile Ansal University Gurugram

Detailed Energy Audit Report

Sushant University
Erstwhile Ansal University Gurugram

JULY 2021

SUSHANT UNIVERSITY

SECTOR - 55, GURUGRAM – 122003 (HARYANA)

Conducted By

A-Z ENERGY ENGINEERS PVT. LTD.

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SUSHANT UNIVERSITY

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ABBREVIATIONS

AC	Air Conditioning
APFC	Automatic Power Factor Control
CFL	Compact Fluorescent Lamp
CFM	Cubic Feet per Minute
CoP	Coefficient of Performance
CO_2	Carbon Dioxide
CT	Cooling Tower
CW	Cooling Water
DG	Diesel Generator
EE	Energy Efficient
EER	Energy Efficiency Ratio
ENCON	Energy Conservation Measures
EPI	Energy Performance Index
FRP	Fibre Reinforced Plastic
FTL	Fluorescent Tube Light
HP	Horse Power
HPSV	High Pressure Sodium Vapour
HT	High Tension
HVAC	Heating, Ventilation and Air conditioning
ID	Induced Draft
IEEE	Institute of Electrical and Electronics Engineers
INR	Indian Rupees
IRR	Internal Rate of Return
kVA	Kilovolt Ampere
kVAh	Kilovolt Ampere Hour
kVAR	Kilovolt Ampere Reactive
kWh	Kilowatt Hour
LED	Light Emitting Diode
LT	Low Tension
MH	Metal Halide
Mkcal	Million Kilo Calories
PF	Power Factor
THD	Total Harmonic Distortion
TR	Ton of refrigeration
TRh	Ton of refrigeration in one hour
TOD	Time of Day
VFD	Variable Frequency Drive
WBT	Wet Bulb Temperature

BACKGROUND

Most of present human activities draw its energy from fossil fuel energy sources. The secondary form of energy, the Electricity, which is mainly generated from fossil fuel, is the lifeline of today's modern and highly mechanized lifestyle. Energy is a basic requirement for economic development in almost all major sectors of economy i.e. agriculture. Industry, transport, commercial, and residential (domestic); Consequently, consumption of energy in different forms has been steadily rising all over the country, and more so in Commercial Buildings, which has maintained a steady growth pattern in the past and the trend is likely to continue in future as well. However major concern is that the fossil fuel based sources of Energy are limited and these sources will get exhausted soon. Therefore Every nation whether developed or under-developed is very much concerned about optimal utilization of energy resources. Energy conservations is one of the initiatives which is a proven measure to optimize the uses to retard the depletion of energy resource.

Therefore considering the vast potential of energy saving and benefits of energy efficiency, the Government of India enacted the Energy Conservation Act, 2001 in October 2001. The Energy Conservation Act.2001, become effective from 1st March 2002. The Act provides for institutionalizing and strengthening delivery mechanism for energy efficiency programs in the country and provides a framework for the much needed coordination between various government entities. As per the EC Act, Government of India established "Bureau of Energy Efficiency" (BEE) with the mission to develop policy and strategies with a thrust on self-regulation and market principles, within the overall frame work of the Energy Conservation Act (EC Act) 2001 with the primary objective of reducing the energy intensity of the Indian economy.

ACKNOWLEDGEMENT

We are thankful to the Management of Sushant University for awarding the energy audit study of this university to A-Z Energy Engineers Pvt. Ltd. Energy Audit was conducted in the month of July 2021. This report captures the outcomes of Energy Audit conducted at Sushant University.

We are thankful and appreciative of the keen interest and commitment of Management and we convey our special thanks to;

Name	Designation	Mobile
Mr. Dheeraj Kuamar	Manager Facility	9118123549
Mr. B. K. Jha	Manager	9818157294

We also thank to each & every official of Engineering Section for showing keen interest and co-operation during the course of our study.

AUDIT TEAM

Audit team for this assignment consisted of Energy Auditors, Engineers and Experts namely Dr. P.P. Mittal, Accredited Energy Auditor (AEA-0011), Sh. Pankaj Chauhan, Sr. Energy Consultant & Sh. Alok Tiwari, Sr. Engineer.

NOTE: It is intimated that this whole exercise is for Identifying Energy Saving Potential and for Quality of Power.

Place: **DELHI** Date: **JULY 2021**

1. Project Background & Introduction

1.1 The Project

With the advent of energy crisis and exponential hikes in the costs of different forms of energy, Energy Audit is manifesting its due importance in every establishment. Energy Audit helps to understand more about the way's energy is used in any establishment and helps in identifying areas where waste may occur and scope for improvement exists.

It was with this objective that "**M/s. A-Z Energy Engineers Pvt. Ltd.**, Plot No.12, 4860-62, Harbans Singh Street, Kothi No. 24, Ward No. II, Darya Ganj, New Delhi-11002, was entrusted with the job of conducting Energy Audit of "Sushant University", Gurugram.

Sushant University is located in the foothills of Aravalli Range on the Golf Course Road with facilities on a 12.85-acre campus.

1.2 Scope of work

The present audit laid emphasis on the following areas to identify energy saving opportunities:

- ✓ Power Distribution System
- ✓ Lighting system
- ✓ ACs & Ventilation
- ✓ Water Pumping and treatment System
- ✓ Transformers
- ✓ DG Sets
- ✓ APFC
- ✓ Renewable Energy

1.3 Instruments Used for Energy Audit

The following portable instruments were used for data measurement:

- ✓ 3 – phase Power Analyzer
- ✓ Single phase Power Analyzer
- ✓ Anemometer
- ✓ Hygrometer
- ✓ Digital Thermometer
- ✓ Pressure gauge
- ✓ Lux Meter
- ✓ Thermograph Camera
- ✓ Flow Meter
- ✓ Earth Tester

1.4 Object of Study

The purpose of this study is to demonstrate the technical and financial feasibility of implementation of energy efficiency measures in Sushant University. The purpose of this report is:–

(i) to analyze the present energy consumption pattern

(ii) to investigate for energy conservation measures without compromising the production level

(iii) to assess the techno-economic feasibility of the energy conservation measure

2. Approach & Methodology

2.1 Approach

A team of 2 engineers was involved in carrying out the study, the general scope of which was as follows:

- Identify areas of opportunity for energy saving and recommend an action plan to bring down total energy cost
- Conduct energy performance evaluation and process optimization study
- Conduct efficiency test of equipment's and make recommendations for replacement (if required) by more efficient equipment with projected benefits
- Suggest improved operation & maintenance practices
- Provide details of investment for all the proposals for improvement
- Evaluate benefits that accrue through investment and payback period
- Analyze various energy conservation measures and to prioritize based on the maximum energy saving & investment i.e. short, medium and long term.

PRIORITIZATION	PAYBACK PERIOD
Short Term Project	Less than 1 year
Medium Term Project	Between 1 and 3 years
Long Term Project	More than 3 years

2.2 Methodology

The general methodology followed is captured in the following figure –

The study was conducted in 3 stages:

- Stage 1: Walk through audit to understand process energy drivers, measurability and formulation of audit plan
- Stage 2: Detailed Energy Audit
- Stage 3: Off-site work for data analysis and report preparation

3. Point of Appreciation

The engineering wing is aware of importance of energy conservation, and eager to learn innovative ways of reducing the electricity consumption further;

1. Premises is using LED Lights at various locations at indoor as well as outdoor.
2. 225 nos. Air conditioners are star rated.
3. Electrical Panel Maintenance is good.
4. All Panel and Equipment's are properly numbered
5. Logbooks proper maintained
6. The DG sets are excellently maintained.
7. 100 kWP Rooftop Solar PV already installed.
8. STP of 250 KL has also been installed and STP water is being used in gardening

4. About the energy audit location

Sushant University erstwhile Ansal University (AU), formerly Ansal Institute of Technology (AIT), is a private university situated in Gurgaon, National Capital Region (NCR), India. It was established in 2012 through the Haryana Private Universities Act (Amendment) 2012. It is located in the foothills of Aravalli Range on the Golf Course Road with facilities on a 12.85 acre campus

PARTICULARS	UNITS	DETAILS
Name of the establishment	-	Sushant University
Address	-	Sector-55, Gurugram–122003 (Haryana)
Contact Person	-	Sh. B.K.Jha, Manager
Daily Operating Hours	Days/Week	5
Operating Hours	Hours/Days	8
Source of Electricity	-	Dakshin Haryana Bijli Vitran Nigam (DHBVN)
Coordinates		28.431°N 77.111°E

5. Base Line Data

Contact Details		
Brief description of Assignment	:	Detailed Energy Audit of Electrical Systems & Utility Equipment's
Name & Address of the Building	:	Sushant University
Operational Days	:	5
Contact Officer	:	Sh. B.K.Jha, Manager
Power		
Source	;	Dakshin Haryana Bijli Vitran Nigam (DHBVN)
AC No.	:	7786034085
Sanctioned Load	:	2000 kW
Annual Purchased Power Consumption	:	
May 2020 to May. 2021	:	495938.00 KWH
May 2020 to May. 2021	:	539712.00 KVAH
Annual Purchased Power Bill	:	
May 2020 to May. 2021	;	Rs. 7910021.00
Average Purchased Power Cost	:	
May 2020 to May. 2021	:	Rs. 16.3 per KWh
May 2020 to May. 2021		Rs. 15.0 per KVAh
Energy Charge		Rs. 6.75 per KVAh

6. Present Energy Scenario

6.1 Purchased Power

Sushant University draws power from the Dakshin Haryana Bijli Vitran Nigam (DHBVN) at 11 kV; subsequently the voltage is stepped down by transformers from 11 KV to 0.415 KV. The sanctioned load is 2000 KW. Billing is done on 11 KV.

6.2 Power Consumption

Sushant University draws power from the Dakshin Haryana Bijli Vitran Nigam (DHBVN) at 11 kV; for campus comprising of various blocks i.e. A, B, C, D, E, Law College and Hostels etc. The campus is being billed on kVAh basis; therefore the effect of power factor is inbuilt in the billing structure.

6.3 Self-generated Power

The premises has 3 Nos. DG Sets of 500 KVA x 2 nos., and 750 KVA x 1 no. are installed for in-house power generation during power cut. The operation of the DG Sets is during in power cut & testing only.

6.4 Solar PV

The University management has installed 100 KWp solar panel on building roof.

7. Executive Summary

The Electricity, HSD and solar are sources of energy for the campus. The Sushant University is getting electrical power supply from Dakshin Haryana Bijli Vitran Nigam Ltd. (DHBVN) at 11 kV supply. There are three transformers of 1500 KVA, 1000 kVA& 750 kVA (11kV/ 0.415 kV) installed and feed to campus. The premise is also having three diesel generators of 500 KVA x 2 nos. & 750 KVA 1 no. provide power supply during power failure/emergency. The one-year electrical bill analysis indicates there is very variation in MDI. The major energy consuming equipment's in the premises are lights, A/C unit, water pumping system, Computer, Printer and other equipment's etc.

- *The Detailed Energy Audit of Sushant University was carried out in the month of June-July 2021 to find out the energy saving potential and the performance level of campus. The report provides the major highlights on potential energy saving opportunities available in the campus and quality of power.*
- *Sushant University draws power from the DHBVN, at 11 kV; subsequently the voltage is stepped down by two transformers of 400 KVA from 11 KV to 0.415 KV. The Connected load of premises is 167 KVA.*
- *The campus is being billed on KVAh basis; therefore, the effect of power factor is inbuilt in the billing structure. There are two APFC Panels installed in substation. During the Year, the operating power factor varied from 0.793 to 0.993. However, if we look at the overall average power factor is around 0.922, which is at lower side.*

  APFC Panel or the capacitor banks wherein the delivery is poor (less than 70%) or out of order may be replaced, so that the overall system power factor is maintained at around 0.99 (lag). Improvement in the power factor would subsequently reduce the KVAh consumption, the resultant benefits in terms of energy savings. The details of measurement is given in Capacitor chapter.

- *The harmonics levels in main incomer has been measured and found within range limits in both voltage & current.*

Harmonic Level of Main Supply			
Voltage	**Max.**	**Min.**	**Ave.**
THD Phase1 (V)	2.4	1.6	2.2
THD Phase2 (V)	2.5	1.7	2.1
THD Phase3 (V)	1.9	1.5	1.8
Current			
THD Phase1 (A)	9.2	5.5	7.3
THD Phase2 (A)	10.4	6.8	9.1
THD Phase3 (A)	7.8	5.8	6.7

- *The Building Management is highly conscious about its Energy Efficiency and cost and has initiated several measures to reduce the energy consumption, which include replacement of conventional lamps with LEDs*
- *Around 5333 No's of LED Fixture and non LED Fixture installed in premises at different locations and LED Light, Street Light, Flood Light, PL, etc. Energy Efficient LED Lights offer reduction in the power consumption besides excellent color rendering properties and high luminous efficacy*
- *During the site visit, measurements were taken to record the load profile of the building, which included the variations in the voltage, current, power factor, harmonics etc. Analysis of the recordings indicated that the average voltage level was around 238 Volts. This may be an adequate voltage for motive loads like motors etc., but for the lighting systems normally, the voltage should be around 220 volts (phase to neutral). A reduction of around 15% in the lighting voltage can reduce the power consumption by around 20%.*
- *Although there is no simpler way to reduce the amount of energy consumed by lighting system than to manually turn OFF whenever not needed, this is not done as often as it could be. In response, automatic lighting control strategies like installation of occupancy sensors can be considered to Control light in response to the presence or absence of people in the space. Quantification of energy savings on this account is not possible.*

- *The Management is highly conscious with regard to its energy efficiency levels and they have initiated several measures to reduce the energy consumption. There are 339 nos. Split/Window AC of various capacity & type installed in the complex and 225 ACs are of 3 to 5 Star rating. A-Z Energy Engineers Pvt. Ltd. acknowledges and appreciates the commitment of the management towards conservation of Energy.*
- ***The Management is highly conscious about its Energy Efficiency Levels and they have initiated several measures to reduce the energy consumption, which include amongst others the use of LED lights, Star Rated AC etc. A-Z Energy Engineers Pvt. Ltd., acknowledges and appreciates the commitment of the management towards conservation of Energy***

The summary of recommendations are as under:

1. APFC panel required to be maintained properly with adequate numbers of capacitors to improve the Power Factor upto 0.999
2. Installation of capacitors at load-end to raise Power Factor.
3. Proper maintaining of record regarding unit generation from DG Set.
4. Light Sensor be used in office areas.
5. Replacing left-over non-star rated Lighting Fixture with LEDs fixtures and non-star rated ACs with Star rated ACs.
6. Installation of additional Solar PV panels, as the campus has lot of space/shed areas where Solar PV could be installed.
7. Use of smart building management system.
8. Energy Management Certification (ISO 50001 Certification) of the Campus.
9. Cleaning of all light points.
10. Switching of lights in day time where ever not required
11. Switching off lights in day time at locations where there is enough light.
12. Street-light should be in automatic mode, providing the necessary sensors.

8. Energy Input & Savings

8.1 Energy inputs

Electricity (Utility & Solar PV)	For various machines, equipment, illumination system- offices and work place lighting, platforms, colony, motors, pumps, Instruments etc.
HSD	DG Sets
Renewable Energy	Solar PV

8.1.1 Energy Consumption

There are two source of Energy i.e. Grid supply & own generation through Solar and DG Sets. The Electricity is major Energy input of the premises. The historical consumption pattern for last 12 months are as per following details:

Table.1: Details of Electrical Energy uses from power utility

Sr. No.	Billing Month	MDI	Power factor	Total electricity consumed (kWh)	Total electricity consumption (kVAh)
1	May 2021	326.0	0.976	46262.0	47410.0
2	April 2021	207.2	0.946	51400.0	54326.2
3	Mar. 2021	150.4	0.968	39685.6	40980.0
4	Feb. 2021	169.2	0.993	46382.2	46713.6
5	Jan. 2021	444.4	0.839	29824.0	35532.0
6	Nov. 2020	292.4	0.793	43893.8	55334.4
7	Oct. 2020	344.8	0.972	49628.0	51040.0
8	Sept. 2020	253.2	0.950	53100.0	55920.0
9	Aug. 2020	172.8	0.820	40920.2	49903.6
10	Jul. 2020	129.6	0.854	37644.0	44072.0
11	June 2020	90.0	0.970	30638.4	31592.4
12	May 2020	78.4	0.988	26560.0	26887.6
	Total			**495938**	**539712**
	Avg.	**221.5**	**0.922**	**41328.2**	**44976.0**
	Max	**444.4**	**0.993**	**53100.0**	**55920.0**
	Min	**78.4**	**0.793**	**26560.0**	**26887.6**

Table. 2: Details of Electrical Energy from Solar PV

Srl.	Month	Unit Generated (kWh)
1	May 2020	16390
2	June 2020	13716
3	July 2020	13412
4	Aug. 2020	11100
5	Sept. 2020	13482
6	Oct. 2020	12495
7	Nov. 2020	10108
8	Dec. 2020	10336
9	Jan. 2021	9688
10	Feb. 2021	11962
11	Mar. 2021	15011
12	April 2021	15642
13	May 2021	14039
	Total	167381

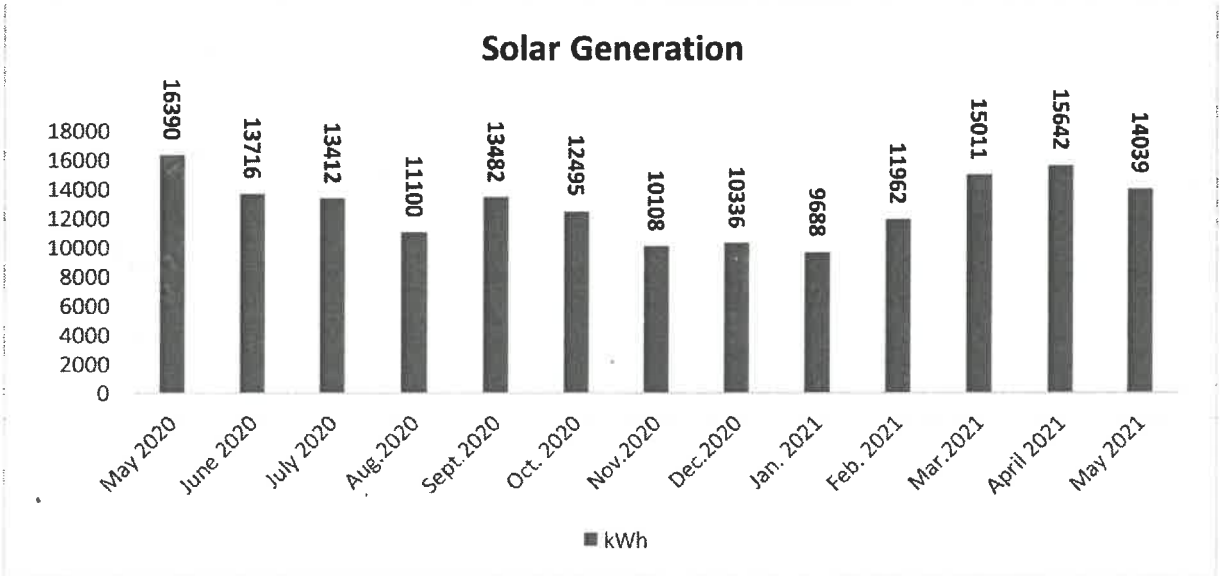
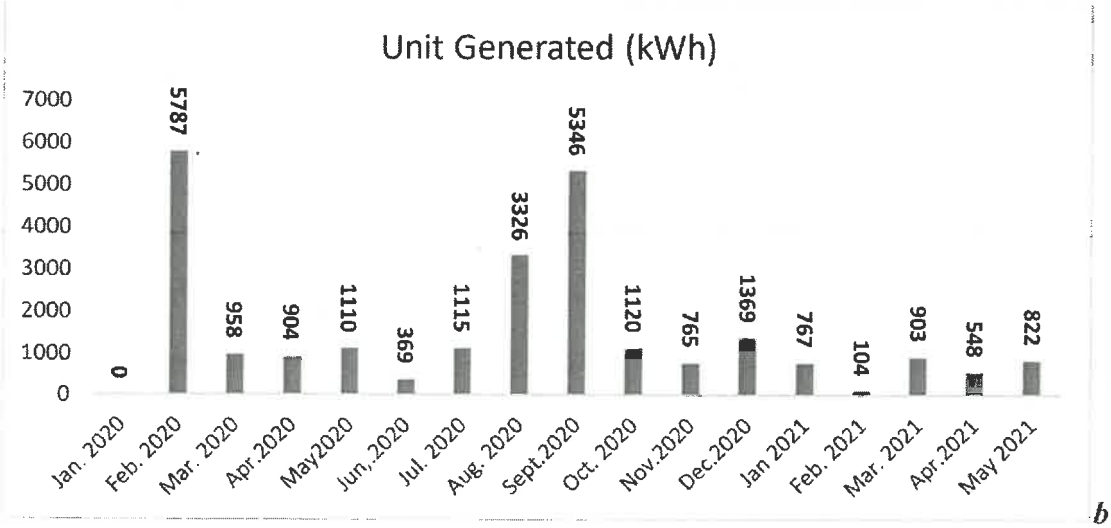


Table. 3: Details of Electrical Energy from DG

Srl.	Month	Unit Generated (kWh)	Diesel Consumption Ltr
1	Jan. 2020	0	0.0
2	Feb. 2020	5787	2260.0
3	Mar. 2020	958	370.0
4	Apr. 2020	904	658.0
5	May 2020	1110	640.0
6	Jun. 2020	369	180.0
7	Jul. 2020	1115	655.0
8	Aug. 2020	3326	1635.0
9	Sept. 2020	5346	2430.0
10	Oct. 2020	1120	440.0
11	Nov. 2020	765	525.0
12	Dec. 2020	1369	725.0
13	Jan 2021	767	334.0
14	Feb. 2021	104	91.0
15	Mar. 2021	903	340.0
16	Apr. 2021	548	340.0
17	May 2021	822	435.0
	Total	**25313**	**12058.00**

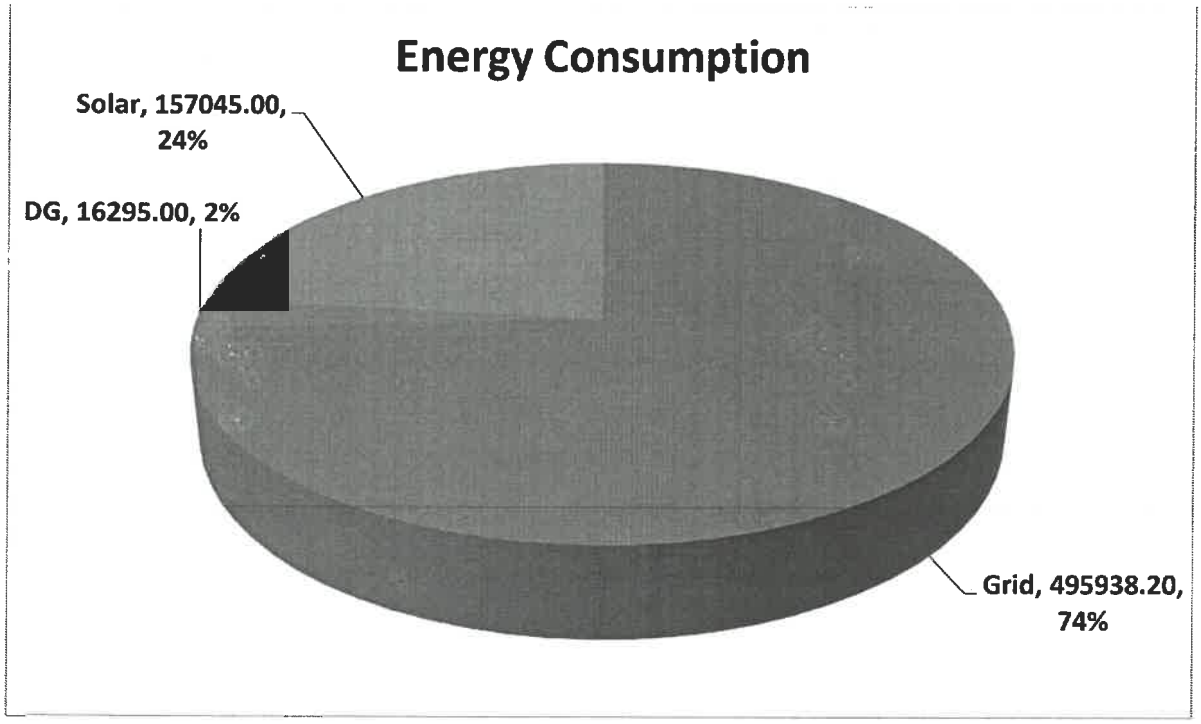


b

Table. 4: Summary Energy Consumption Pattern

Sr. No.	Month	Grid	DG	Solar	TOTAL
1	May 2021	46262.0	822	14039	61123.00
2	April 2021	51400.0	548	15642	67590.00
3	Mar. 2021	39685.6	903	15011	55599.60
4	Feb. 2021	46382.2	104	11962	58448.20
5	Jan. 2021	29824.0	767	9688	40279.00
6	Nov. 2020	43893.8	765	10108	54766.80
7	Oct. 2020	49628.0	1120	12495	63243.00
8	Sept. 2020	53100.0	5346	13482	71928.00
9	Aug. 2020	40920.2	3326	11100	55346.20
10	Jul. 2020	37644.0	1115	13412	52171.00
11	June 2020	30638.4	369	13716	44723.40
12	May 2020	26560.0	1110	16390	44060.00
	Total	495938.2	16295.0	157045.0	669278.20

NOTE : 12 Months Data (May 2020 to May 2021 – as Dec. 2020 no units from grid)



8.2 Proposed Summary of Savings

Table.5: Summary of savings

S. No.	Proposed energy conservation measures	Quantity (nos.)	Annual energy savings (kVAh)	Annual monetary savings (INR)	Anticipated investment (INR)	Simple payback period (Month)
1	Improvement of Power Factor to 0.999	-	43277.0	649157	200000	3-4
2	Installation of Solar PV System 50 kWp	-	69000.0	6.90 Lacs	25.0 Lacs	43-44
3	Replacement of T-8 (36W) with 18W LED Tube Lights	884	32673	490095	464100	11
4	Replacement of T-5 (36WX2) with 18WX2 LED Tube Lights	354	26168	392520	371700	11
5	Replacement of T-5 (36WX2) with 18WX2 LED Tube Lights	539	11642	174636	226380	16

9. Lighting Details

Lighting fixtures are installed in different areas and locations. Premises has already installed energy efficient LED Lights at most of the places. But still some lighting fixtures needs to be replaced with LEDs. Energy Efficient LED Lights offer reduction in the power consumption besides excellent color rendering properties and high luminous efficacy.

Table 6: Types of LED Light

Srl	Fixture	Power Rating (Watt)
1	LED Tube (18W)	18
2	LED Tube (18Wx2)	36
3	LED Tube (12W)	12
4	LED Bulb (5W)	5
5	LED Bulb (9W)	9
6	LED COBE (18W)	18
7	LED Round (36W)	36
8	LED-36W (2'x2')	36
9	Fancy LED	25
10	LED Light (30W)	30
11	LED Light (150W)	150
12	Mirchi Bulb (50W)	50
13	T5 Tube (14Wx2)	28
14	T5 Tube Light (28W)	28
15	T8 Tube Light (36W)	36
16	T8 Tube Light (36Wx2)	72
17	T5 Tube Light (28W)	28
18	T-5 Tube Light (28Wx2)	56
19	Halogen (250W)	250
20	Halogen (400W)	400
21	CFL (9W)	9
22	CFL (11Wx2)	22
23	CFL (13Wx2)	26
24	CFL 18W (4 pin)	18
25	CFL (18Wx2)	36
26	CFL-36WX3 (2'x2')	36
27	CFL (65W)	65

Note: Light details is enclosed in Annexure-III

9.1 Timed Based Control or Daylight Linked Control

Timed-turnoff switches are the least expensive type of automatic lighting control. In some cases, their low cost and ease of installation makes it desirable to use them where more

efficient controls would be too expensive. Newer types of timed-turnoff switches are completely electronic and silent. The best choice is an electronic unit that allows the engineering staff to set a fixed time interval behind the cover plate. This system is recommended for street Lighting application in the building. Photoelectric cells can be used either simply to switch lighting on and off, or for dimming. They may be mounted either externally or internally. It is however important to incorporate time delays into the control system to avoid repeated rapid switching caused, for example, by fast moving clouds. By using an internally mounted photoelectric dimming control system, it is possible to ensure that the sum of daylight and electric lighting always reaches the design level by sensing the total light in the controlled area and adjusting the output of the electric lighting accordingly. If daylight alone is able to meet the design requirements, then the electric lighting can be turned off. The energy saving potential of dimming control is greater than a simple photoelectric switching system

9.2 Localized Switching

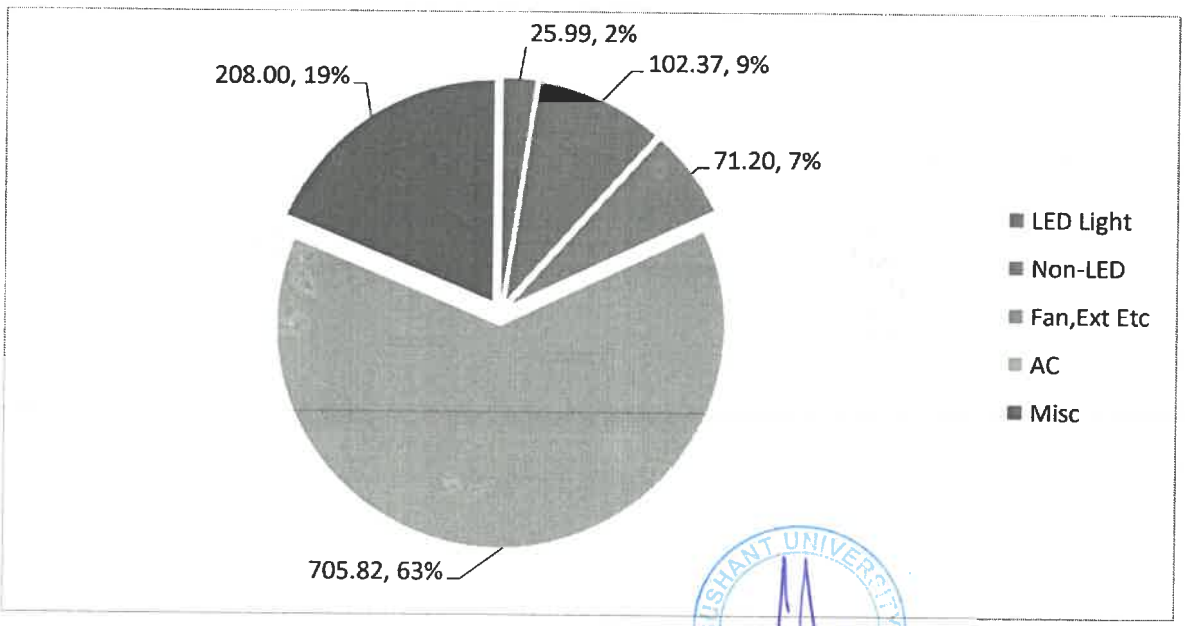
Localized switching should be used in applications, which contain large spaces. Local switches give individual occupants control over their visual environment and also facilitate energy savings. By using localized switching it is possible to turn off artificial lighting in specific areas, while still operating it in other areas where it is required, a situation which is impossible if the lighting for an entire space is controlled from a single switch.

9.3 Percentage load of Equipment's

Table 7: Load of Equipment

Srl	Fixture	Qty (nos.)	Power Rating (Watt)	Total Watt	Total (kW)	% share Load	
1	LED Tube (18W)	89	18	1602	1.60	0.14	%
2	LED Tube (18Wx2)	277	36	9972	9.97	0.90	%
3	LED Tube (12W)	7	12	84	0.08	0.01	%
4	LED Bulb (5W)	204	5	1020	1.02	0.09	%
5	LED Bulb (9W)	129	9	1161	1.16	0.10	%
6	LED COBE (18W)	348	18	6264	6.26	0.56	%
7	LED Round (36W)	21	36	756	0.76	0.07	%
8	LED-36W (2'x2')	8	36	288	0.29	0.03	%
9	Fancy LED	21	25	525	0.53	0.05	%
10	LED Light (30W)	19	30	570	0.57	0.05	%
11	LED Light (150W)	25	150	3750	3.75	0.34	%
12	Mirchi Bulb (50W)	16	50	800	0.80	0.07	%
13	T5 Tube (14Wx2)	24	28	672	0.67	0.06	%

14	T5 Tube Light (28W)	20	28	560	0.56	0.05	%
15	T8 Tube Light (36W)	884	36	31824	31.82	2.86	%
16	T8 Tube Light (36Wx2)	354	72	25488	25.49	2.29	%
17	T5 Tube Light (28W)	12	28	336	0.34	0.03	%
18	T-5 Tube Light (28Wx2)	22	56	1232	1.23	0.11	%
19	Halogen (250W)	2	250	500	0.50	0.04	%
20	Halogen (400W)	8	400	3200	3.20	0.29	%
21	CFL (9W)	55	9	495	0.50	0.04	%
22	CFL (11Wx2)	278	22	6116	6.12	0.55	%
23	CFL (13Wx2)	231	26	6006	6.01	0.54	%
24	CFL 18W (4 pin)	72	18	1296	1.30	0.12	%
25	CFL (18Wx2)	539	36	19404	19.40	1.74	%
26	CFL-36WX3 (2'x2')	33	36	1188	1.19	0.11	%
27	CFL (65W)	50	65	3250	3.25	0.29	%
28	Fan	1059	60	63540	63.54	5.71	%
29	Wall Fan	29	60	1740	1.74	0.16	%
30	Fresher	7	40	280	0.28	0.03	%
31	Ext	47	120	5640	5.64	0.51	%
32	AC 3*(S)	87	1920	167040	167.04	15.00	%
33	AC 2*(S)	27	2080	56160	56.16	5.04	%
34	AC (S)	107	2364	252948	252.95	22.72	%
35	AC 3*(W)	111	1920	213120	213.12	19.14	%
36	AC (W)	7	2364	16548	16.55	1.49	%
37	Geyser	104	2000	208000	208.00	18.68	%
		5333	**TOTAL**	**1113375**	**1113.38**	**100.00**	



10.Saving in Lighting System

As premises has already installed energy efficient LED Lights at most of the places. But still some lighting fixtures needs to be replaced with LEDs. Some of the energy conservation option in lighting system is as;

10.1 Replacement of T8 Tube Lights (36W) with LED based Tube Lights (18W)

T8 tube lights with magnetic choke can be replaced with LED based tube lights (18 W) as they provide similar lux levels with further enhanced energy savings. Ballasts are used to provide higher voltage during the starting and also limit the current during normal operation. In electronic ballast the losses are 1 to 2 watts

Recommendation

The replacement of T8 (36 W+ choke) with LED based tube lights (18 W) will result in close to 55 percent energy savings without compromising on light levels.

Energy and Financial Savings

The following parameters and assumptions have been considered while estimating the energy savings and financial viability of this option

Table 8: Savings in replacements of T8 (36W) tube lights with LED tube lights (18W)

Assumptions and Input parameters		
Cost parameters		
Particulars	**Unit**	**Value**
Exiting T8 (36W) installed in the campus Building	Number	884
Cost of LED based lights (18W)	INR/ piece	500
Installation Cost	% of capital cost	5
Operating parameters		
Particulars	**Unit**	**Value**
Number of running hours	Per day	6
Number of operating days	Per year	280
Average life of LED based lights (18 W)	Hours	50,000
Average life of LED based lights (18 W)	Years	8
Average electricity tariff	INR/kWh	15
Energy and financial savings		
Parameters	**Unit**	**Value**

Power consumption of T8 tube lights (40 W)	W/piece	40
Power consumption of LED (18W)	W/piece	18
Energy savings	W/piece	22
Annual energy saving	kWh/year	32,673
Annual monetary saving	INR/year	4,90,095
Total investment requirement	INR	4,64,100
Simple payback period	Months	11.0
Internal rate of return	%	94.92

An energy saving of 55 percent can be achieved by replacing the existing Tube lights T-8 (36 W) with LED based tube lights (18 W). Implementation of this measure needs an investment of INR 4,64,100 and will have a simple payback period of 11 months. Additionally, the IRR comes out to be 94.92 %.

10.2 Replacement of T8 Tube Lights (36Wx2) with LED based Tube Lights 18WX2

T8 tube lights with magnetic choke can be replaced with LED based tube lights (18 W) as they provide similar lux levels with further enhanced energy savings. Ballasts are used to provide higher voltage during the starting and also limit the current during normal operation. In electronic ballast the losses are 1 to 2 watts

Recommendation

The replacement of T8 (36 Wx2+choke) with LED based tube lights (18 Wx2) will result in close to 55 percent energy savings without compromising on light levels.

Energy and Financial Savings

The following parameters and assumptions have been considered while estimating the energy savings and financial viability of this option

Table 9: Savings in replacements of T8 (36WX2) tube lights with LED tube lights (18WX2)

Assumptions and Input parameters		
Cost parameters		
Particulars	**Unit**	**Value**
Total T-8 (36WX2) installed in the campus Building	Number	354
Cost of LED based lights (18WX2)	INR/ piece	1000

Installation Cost	% of capital cost	5
Operating parameters		
Particulars	**Unit**	**Value**
Number of running hours	Per day	6
Number of operating days	Per year	280
Average life of LED based lights (18 W)	Hours	50,000
Average life of LED based lights (18 W)	Years	8
Average electricity tariff	INR/kWh	15
Energy and financial savings		
Parameters	**Unit**	**Value**
Power consumption of T8 tube lights (36Wx2)	W/piece	80
Power consumption of LED (18Wx2)	W/piece	36
Energy savings	W/piece	44
Annual energy saving	kWh/year	26,168
Annual monetary saving	INR/year	3,92,520
Total investment requirement	INR	3,71,700
Simple payback period	Months	11
Internal rate of return	%	94.92

An energy saving of 55 percent can be achieved by replacing the existing Tube lights T-8 (36WX2) with LED based tube lights (18WX2). Implementation of this measure needs an investment of INR 3,71,700 and will have a simple payback period of 11 months. Additionally, the IRR comes out to be 94.92 %.

10.3 Replacement of CFL (18WX2) Cob light with LED based Light (18W) Cob light

The premises has also installed CFLs (18Wx2). Though it is an energy efficient option, the energy efficiency can be further improved by replacing these CFLs with LED based Cob lights (18W) as they provide similar or better lux levels with further enhanced energy savings

Recommendation

The replacement of CFLs (18Wx2) with LED cob light (18W) will result in close to **50 percent energy savings** without compromising on light levels.

Energy and Financial Savings

The following parameters and assumptions have been considered while estimating the energy saving financial viability of this option:

Table 10: Savings in replacement of CFL (18WX2) cobe with LED 18 Watt cobe light

Assumptions and Input parameters		
Cost parameters		
Particulars	**Unit**	**Value**
Existing CFL (18Wx2) need to be replaced	Number	539
Cost of LED Light (18W)	INR/ piece	400
Installation Cost	% of capital cost	5
Operating parameters		
Particulars	**Unit**	**Value**
Number of running hours	Per day	5
Number of operating days	Per year	240
Average life of LED based lights (18 W)	Hours	50,000
Average life of LED based lights (18 W)	Years	8
Average electricity tariff	INR/kWh	15
Energy and financial savings		
Parameters	**Unit**	**Value**
Power consumption of CFL (18Wx2) lights	W/piece	36
Power consumption of LED Light (18W)	W/piece	18
Energy savings	W/piece	18
Annual energy saving	kWh/year	11642.40
Annual monetary saving	INR/year	174636
Total investment requirement	INR	226380
Simple payback period	Months	16
Internal rate of return	%	69.06%

11.Improvement in operating Power Factor

The premises is being billed on kVAh basis; therefore the effect of power factor is inbuilt in the billing structure. Based on the electrical bills the operating power factor on the main incomer is varies from 0.793 - 0.993, the average power factor was around 0.922, which appears to be on the lower side. It is thus recommended to install more capacitor banks on the main feeder so that the overall system power factor is maintained at around 0.99 (lag). Improvement in the power factor would subsequently reduce the KVAh consumption, resulting in energy savings as follows:

Table 11: Historical Pattern of power factor

Sr. No.	Billing Month	Power Factor
1	May 2021	0.976
2	April 2021	0.946
3	Mar. 2021	0.968
4	Feb. 2021	0.993
5	Jan. 2021	0.839
6	Nov. 2020	0.793
7	Oct. 2020	0.972
8	Sept. 2020	0.950
9	Aug. 2020	0.820
10	Jul. 2020	0.854
11	June 2020	0.970
12	May 2020	0.988
	Avg.	**0.922**
	Max	**0.993**
	Min	**0.793**

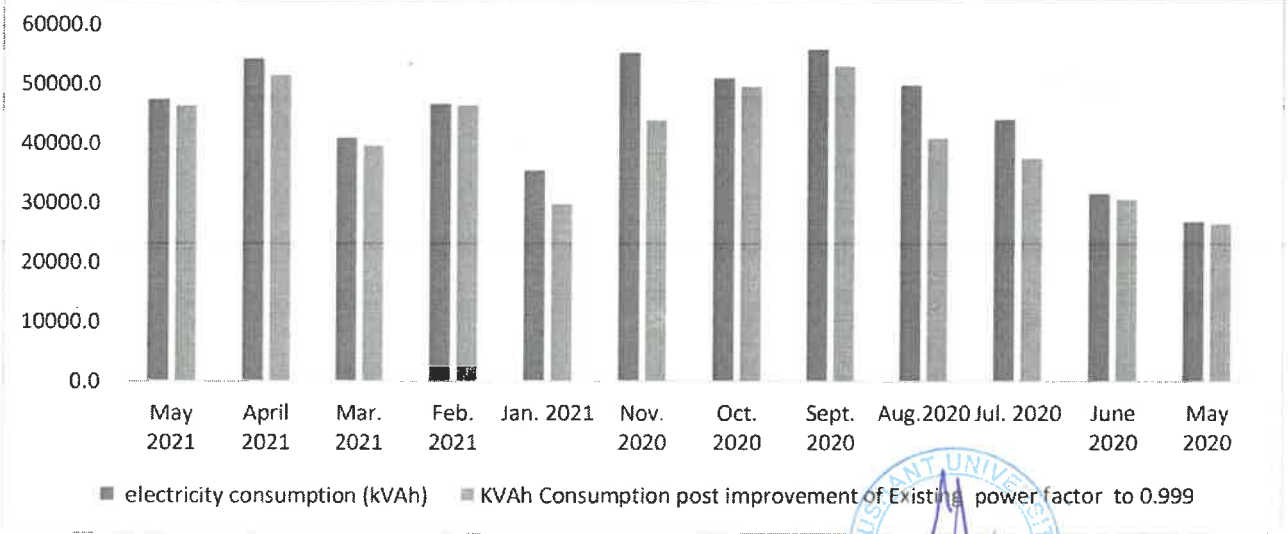
11.1 Improvement in the Operating Power Factor

The campus is being billed on KVAh basis; therefore, the effect of power factor is inbuilt in the billing structure. However, it is recommended that capacitor (200 KVAR) are required to be installed/shifted at load center-end for improving the power factor. Based from the electricity bills, it was observed that the power factor varies from 0.793 - 0.993 and the average Power Factor was around 0.922, which is slightly lower.

It is thus recommended to install additional capacitor banks on the APFC Panel or the capacitor banks wherein the delivery is poor (less than 70%) or out of order may be replaced, so that the overall system power factor is maintained at around 0.99 (lag). Improvement in the power factor would subsequently reduce the KVAh consumption, resulting in energy savings as follows:

Table 12: Energy saving potential to improved power factor

Month	electricity consumption (kVAh)	Present Power Factor	KVAh Consumption post improvement of Existing power factor to 0.999	Net Reduction in KVAh Consumption	Corresponding reduction in Energy Charges (Rs)
May 2021	47410.0	0.976	46308.3	1101.7	16525.4
April 2021	54326.2	0.946	51451.5	2874.7	43121.2
Mar. 2021	40980.0	0.968	39725.3	1254.7	18820.1
Feb. 2021	46713.6	0.993	46428.6	285.0	4274.6
Jan. 2021	35532.0	0.839	29853.9	5678.1	85172.2
Nov. 2020	55334.4	0.793	43937.7	11396.7	170949.9
Oct. 2020	51040.0	0.972	49677.7	1362.3	20434.8
Sept. 2020	55920.0	0.950	53153.2	2766.8	41502.7
Aug. 2020	49903.6	0.820	40961.2	8942.4	134136.6
Jul. 2020	44072.0	0.854	37681.7	6390.3	95854.8
June 2020	31592.4	0.970	30669.1	923.3	13850.0
May 2020	26887.6	0.988	26586.6	301.0	4515.2
TOTAL	**539712**	**0.922**	**496434.6**	**43277.2**	**649157.5**



11.2 Energy Saving

Average Power Consumption at Present	539712 KVAh
Average Operating Power factor at present	0.922
Average Power Consumption post improvement of power factor from 0.922 to 0.99	496434.6 KVAh
Net Reduction in Power Consumption per Annum	43277.2 KVAh per annum
Total Monitory Benefit per annum	Rs. 6.5 Lakhs
Estimated Investments [for replacement of dead Capacitor & additional capacitors]	Rs 2 Lakhs
Simple Payback Period	3-4 months

12. Window/Split AC Units Specification

Split / Window AC's are installed at several locations in the campus. The details of AC are as follows:

Table 13: Details of AC's

Location	AC 3*(S)	AC 2*(S)	AC (S)	AC 3*(W)	AC (W)
BLOCK-A_IInd Floor					
A-202	7				
A-203	2				
A-204	2				
A-205	5				
A-207&6	6				
A-208	2				
	2		4		
A-109	1				
A-110	4				
A-111	4				
A-112	4				
A-108	2				
A-107,106	4				
A-105	5				
Dean room	2				
A-103			2		
A-001			5		
A-003			2		
A-004	2				
A-005			1		
Room-111			1		
A-112					1
A-113			2		2
Room			4		
A-015	3				
Room			1		
Room		1			
A-018		1			
Room			1		
A-020		1			
Himanshu Sanghai (Associate Dean)					1
A-017			2		
A-023			1		
BLOCK-B_IInd Floor					
Faculty Room				1	
B-204			1		
B-205			1		
B-203	2				
B-202	2				
B-101			3		
B-102A		2			

Location	AC 3*(S)	AC 2*(S)	AC (S)	AC 3*(W)	AC (W)
B-103					1
B-104				1	
B-102	3				
B-105			2		
Ground Floor					
Lobby					
Library	6	3	6		
Reception			4		
BLOCK-C 2nd Floor					
UPS			1		
Faculty Room			1		
Faculty Room	1				
Room			5		
Ist Floor					
Room 101			1		
C-108			1		
C-105			2		
Room			1		
Ground Floor					
Server room	3				1
Theater			1		
BLOCK–D 5th Floor					
D - 510			3		
D - 513			1		
D - 512			1		
D - 507	1		1		
4th Floor					
D - 410			1		
D - 409			1		
D - 408			3		
D - 406			1		
D - 405			1		
D - 403, 402		1	1		
D - 414		1			
D - 413			1		
3rd Floor					
D - 309			1		
D - 308			1		
D - 303, 302			2		
D - 307		4			
D - 313			2		
IT Head		1			
IT Department			2		
2nd Floor					
D - 210			1		
D - 209			1		
D - 206			1		
D - 203 (Registrar Office)			1		
D - 202			1		
D - 214		1	1		

Location	AC 3*(S)	AC 2*(S)	AC (S)	AC 3*(W)	AC (W)
D - 213			1		
1st Floor					
D-109			1		
D-110			1		
D-107			1		
D-104			1		
D-102			1		
D-108		3	1		
D-115		1			
Ground Floor					
D - 021		1			
D - 019 Kitchen		1			
Bar		2			
D - 006		1			
D - 007			1		
D - 008			1		
Room		1			
D - 002			1		
D - 001			1		
CCTV		1			
Facility Manager	1		2		
HOSTEL					
Rooms (48 +48)				96	
Guest Room				8	
Warden				3	
Law College					
2nd Floor					
Faculty Room - 12	2				
Food Court - 13	3				
Class Room - 11	3				
1st Floor					
Faculty Room - 08	1		3		
Room - 7					1
Room - 6			1		
Room - 5			2		
Ground Floor					
Class Room - 1	2				
Class Room - 2			4		
A/c Maint.				1	
Library					

Indicative TR Load Profile for Air Conditioning

Small Office Cabins	:	0.1 TR m^2
Medium Size Office with 10-30 people occupancy with Central A/c	:	0.06 TR/m^2
Large Multistoried office complex with Central A/c	:	0.04 TR/m^2

There are 339 nos. Split AC of various capacity & type installed in the complex. Out of these 339 nos. ACs, 225 are of 2 & 3 Star rated ACs and 114 are non-star rated ACs installed in the building. Some Air conditioning system is not operating during the energy audit. AZ Energy Engineers Pvt. Ltd. acknowledges and appreciates the commitment of the management towards conservation of Energy. Further it is recommended to replace left-over non-star rates ACs with Star Rated ACs, resulting further saving in energy,

Recommendation/ Observation of AC System

- Monthly cleaning schedule Air Filters
- Replace Damage filters.
- Yearly service
- Check and clean condenser coils
- Check and clean air filters
- Check pipe Insulation

13. Self-Power Generation (D.G)

The campus has three nos. DG Sets of 500 kVA x 2 nos. & 750 kVA 1 no. installed for in-house power generation & supply during power cut, power failure and backup during day/night operations. The technical details of these DG sets are as under:

13.1 D.G. Rated Specification

Table 14: Technical details of DG sets

Name Plate Data		DG-1	DG-2	DG-3
ALTERNATOR				
Rated	kVA	500	500	750
	KW	400	400	600
Voltage	L/V	415	415	415
Amp.	L.V	696	696	1043
Phase		3	3	3
P.F		0.8	0.8	0.8
RPM		1500	1500	1500
Frequency	Hz	50	50	50
Excitation	Volts	48	48	52
Excitation	Amps	2.3	2.3	2.5

Historical data of DG set running hours and fuel consumption given below.

13.2 Performance Assessment of D.G

During the audit we measured the specific fuel consumption (kWh/Ltr) of DG sets. The load profile of the electrical parameters was recorded by using a portable 3-phase power analyzer. During the recording, the power analyzer recorded all the electrical parameters for further detailed analysis. The analysis of the different parameters recorded 45 Minute reading at the L.T incoming main supply and during this period the diesel consumption was also recorded empty tank method.

Particular	Unit	DG-2
Time 11:00 TO 11:45)	Min	45
Unit Generate	kWh	236
Fuel Consumption	Ltr	75.0
SEC	kWh/Ltr	**3.1**

13.3 Historical Fuel Analyses Data

Analyses of last one-year DG log book details for Jun. 2020 to May. 2021. Specific energy consumption shows in below table as per standard

Table 15: Historical Energy Consumption of DG set

Srl.	Month	Unit Generation (kWh)	Diesel Consumption (Ltr)	Running Hours	Specific kWh Generation kWh/Ltr
1	Jan. 2020	0	0.0	0.00	2.56
2	Feb. 2020	5787	2260.0	51.05	2.59
3	Mar. 2020	958	370.0	11.47	1.37
4	Apr.2020	904	658.0	26.15	1.73
5	May2020	1110	640.0	31.55	2.05
6	Jun,.2020	369	180.0	8.40	1.70
7	Jul. 2020	1115	655.0	26.05	2.03
8	Aug. 2020	3326	1635.0	37.35	2.20
9	Sept.2020	5346	2430.0	72.50	2.55
10	Oct. 2020	1120	440.0	9.15	1.46
11	Nov.2020	765	525.0	15.30	1.89
12	Dec.2020	1369	725.0	18.48	2.30
13	Jan 2021	767	334.0	17.15	1.14
14	Feb. 2021	104	91.0	3.05	2.66
15	Mar. 2021	903	340.0	16.25	1.61
16	Apr.2021	548	340.0	13.27	1.89
17	May 2021	822	435.0	20.15	2.56
	Total	**25313**	**12058**	**307**	
	Avg.				**2.09**

Further observations and recommendations are as under:

1. The specific fuel consumption (SFC) of DG sets in the range of 2.66 to 1.37 kWh/ltr, as present Average SPC of all DG set is 2.09 kWh/Ltr. which is okay.
2. D.G. sets are neat & clean
3. DG set room have been with Proper Ventilation
4. However, there is No-Load Testing schedule

13.4 Fuel Gas Analyses

1. TYPICAL DIESEL EXHAUST GAS COMPOSITION

Component		Typical Component Concentration Range in Diesel Exhaust Gas	Component Concentration in Natural Dry Ambient Air
Nitrogen	N_2	75 – 77 %-vol	78.08 %-vol
Oxygen	O_2	11.5 – 15.5 %-vol	20.95 %-vol
Carbon dioxide	CO_2	4 – 6.5 %-vol	0.038 %-vol
Water	H_2O	4 – 6 %-vol	
Argon	Ar	0.8 %-vol	0.934 %-vol
Totally		> 99.7 %-vol	

%-vol: Concentration, percentage, volume basis

ppm-vol: Concentration, parts per million, volume basis

Additional components found in diesel exhaust – typical concentration range (steady state, high load, residual and distillate fuel oil):

Nitrogen oxides	NO_x:	1000 - 1500 ppm-vol
Sulphur oxides	SO_x	30 - 900 ppm-vol. Fuel composition related
Carbon monoxide	CO	20 - 150 ppm-vol
Total Hydrocarbons	THC (as CH_4)	20 - 100 ppm-vol
Volatile org.comp.	VOC (as CH_4)	20 - 100 ppm-vol
Particulates *)	PM	20 - 100 mg/Nm³, dry, 15% O_2; Fuel composition related

Smoke: Related to low load (<50% load), start-up and fast load increase

13.5 Diesel Generator Stack Height

DG sets emit some amounts of oxides of Nitrogen, Carbon Monoxide, Sulphur Dioxide, and other particulate matter, which can harm the surrounding habitat and organisms. This is why the CPCB has laid down a specific formula for deriving a minimum stack height of the DG sets' exhaust outlet with respect to the height of the facility it is installed in to ensure that the emissions don't come on contact with the surrounding habitat.

Calculating Stack Height of DG sets For A Facility:

The minimum height of stack to be provided with each generator set can be worked out using the following formula:

$H = h+0.2 \times \sqrt{KVA}$

Where:

H = Total height of stack in meter

h = Height of the building in meters where the generator set is to be installed

KVA = Total generator capacity of the set in KVA

This is an explicit formula for DG SET stack height calculation, irrespective of the type of industries where the generator set is installed.

Based on the above formula the minimum stack height to be provided with different range of generator sets

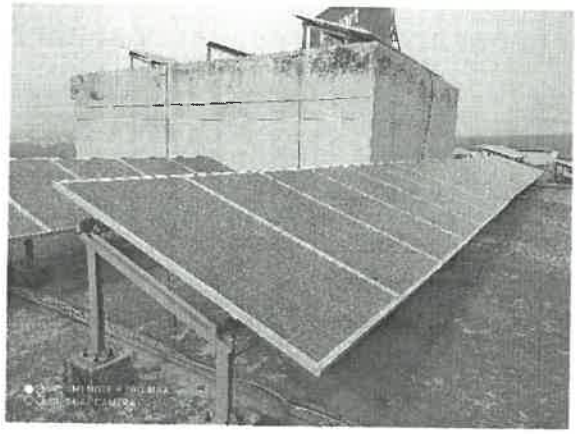
	DG Set exhaust not provided as per CPCB requirement. It should be raised to a height required as per norms

Recommendations for Energy Efficiency Measures in DG Sets

1. Ensure Steady load condition on the DG set and avoid idle running.
2. Improve air filtration.
3. Ensure fuel oil storage, handling and preparation as per manufacturers' guidelines/oil company data.
4. Calibrate and overhaul fuel injectors and injection pumps regularly as recommended by manufacturer.
5. Ensure compliance with maintenance checklist
6. Ensure steady load conditions, avoiding fluctuations, imbalance in phases, harmonic loads.
7. Carryout regular field trials to monitor DG set performance, and maintenance planning as per requirements.
8. Efficiency of DG Set can be increase by loading 70-80% load
9. The starting current of squirrel cage induction motor is as much as six times the rated current for a few seconds with direct-on-line starters. In practice, it has been found that the starting current value should not exceed 200% of the full load capacity of the alternator. The voltage and frequency throughout the motor starting interval recovers and reaches rated values usually much before the motor has picked up full speed

10. It is always recommended to have the load as much balanced as possible, since the unbalanced loads can cause heating of the alternator, which may result in unbalanced output voltage. The maximum unbalanced load between phases should not exceed 10% of the capacity of the generating sets.
11. The electricity rules clearly specify that two independent earths to the body and neutral should be provided to give adequate protection to the equipment in case of an earth fault and to drain away any leakage of potential from the equipment to the earth.

14. Solar Photovoltaic Cell



The campus has already installed 100 kWP Solar PV. Solar generation power is connected to the panel and consumed energy in-house plant. A photovoltaic power system is an electricity generating Solar PV power system that is connected to the main LT panel. The total generation recorded since installation up to the time of energy audit is as follows:

Table 16: Details of Power Generation from Solar Plant

Month	No. of Days	Girls' Hostel	Boys' Hostel	B - Block	D Block	Total Unit Generated	CUF (%)
May 2020	31	5208	1775	1697	7710	16390	22.0
June 2020	30	4632	1517	1447	6120	13716	19.1
July 2020	31	4596	1547	969	6300	13412	18.0
Aug.2020	31	3888	1286	706	5220	11100	14.9
Sept.2020	30	4500	1481	1411	6090	13482	18.7
Oct. 2020	31	4140	1373	1252	5730	12495	16.8
Nov.2020	30	3276	1074	1078	4680	10108	14.0
Dec.2020	31	3468	1074	1114	4680	10336	13.9
Jan. 2021	31	3348	1041	1009	4290	9688	13.0
Feb. 2021	28	4188	1330	1104	5340	11962	17.8
Mar.2021	31	*4980*	*1647*	*1694*	*6690*	15011	20.2
Apr. 2021	30	5136	1717	1679	7110	15642	21.7
Total	**365**	**51360**	**16862**	**15160**	**69960**	**153342**	**AVG =17.5**

The units or kWh output of a solar panel will depend on the panel efficiency and availability of sunlight in a location. The factor that defines this output is called CUF (or Capacity Utility Factor). For India, it is typically taken as 19% and the calculation of units goes as:

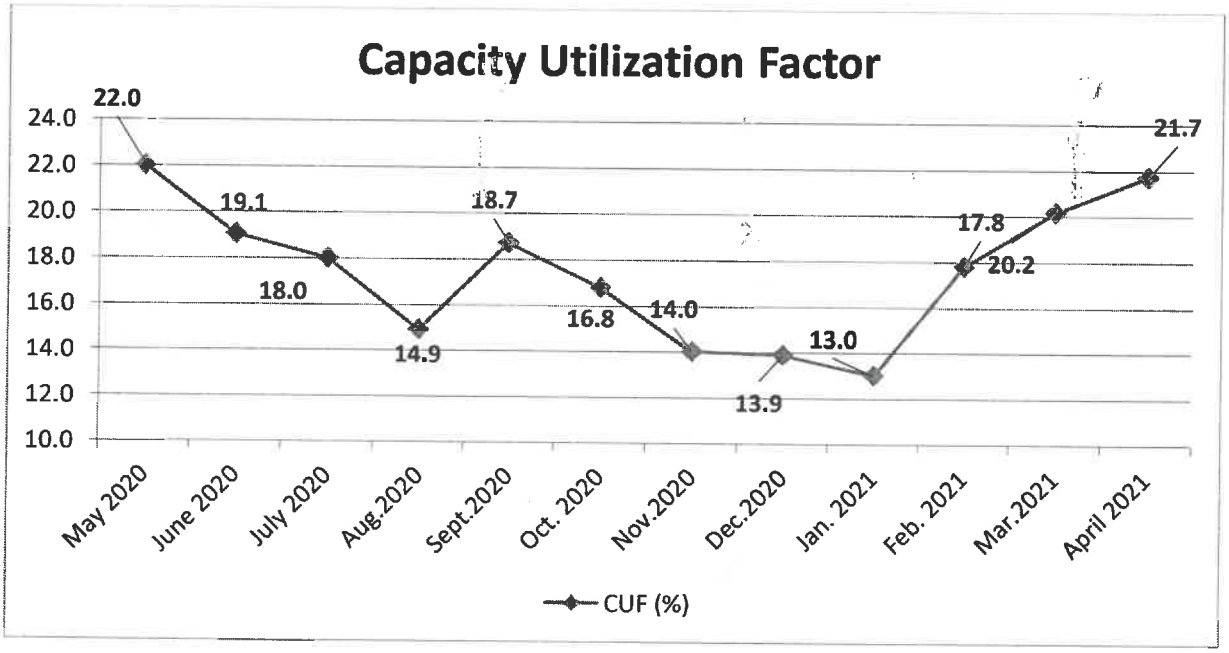
Capacity Utilization Factor (C.U.F) = (Actual energy from the plant(kwh))

(Plant Capacity (kwp) x 24 x 395)

Solar photovoltaic technologies convert solar energy into useful energy forms by directly absorbing solar photons—particles of light that act as individual units of energy—and either converting part of the energy to electricity.

Average solar irradiation in HARYANA state is 1156.39 W / sq.m. 1 kWp solar rooftop plant will generate on an average over the year 4.6 kWh of electricity per day (considering 5.5 sunshine hours)

The performance of Solar PV plant is national average of 19%. It is therefore, suggested to regularly clean these panels for better performance.



The less generation of units is due to inadequate maintenance of Solar panel, as dust, found deposited on the surface of solar plates, which act as shield from sun rays thus effecting the Power generation badly. We suggest to regular cleaning of Solar Panels.

The Campus has lot of space at roof-top / shed area. Where additional solar PV panels can be installed. So typically a 1 kW capacity solar system will generate 1600-1700 kWh of electricity per year. This can provide electricity for 25 years.

Around 50 kW of solar PV based power plant can be installed in the areas as recommended above. There are various options for capital Investment

• Total Capacity of SPV	= 50 KW
• Area required per KW	= 10 m2/ KW
• Area required for 50 KW	= 500 m2
• Facing	= Shadow free South facing
• CUF/PLF	= 19%
• 1 kWp solar rooftop	= 4.6 kWh

Table 17: Energy saving potential in Solar PV

Inputs	Unit	Value
Capacity of Plant	kWp	50
CUF/PLF	%	19%
1kWp solar rooftop	kWh	4.6
Inputs	**Unit**	**Value**
Capacity of Plant	kWp	50
Cost (Per Kw)	₹	50000
Electricity Tariff	₹ /Unit or kWh	10.0
Average Yearly generation	kWh (Units)	69000
Total Generation in 25 Years	kWh (Units)	1725000
Tariff rate (Avg over 25 Years)	₹	10.0
Average Monthly Savings	₹	57500
Average Annually Savings	₹	690000
Total Savings over 25 years	₹	17250000
Total Capital Investment	₹	2500000
Simple Payback	**Months**	**43-44**

It is recommended to install a Solar Photovoltaic Cell (50 KW) in the premises. The resultant benefits in terms of energy savings workout to **Rs. 6.90 Lakhs per annum** with an estimated investment of Rs. **25 Lakhs** and simple payback period of **43-44 months.**

15. Power Quality

15.1 HARMONICS

Harmonics are the periodic steady-state distortions of the sine wave due to equipment generating a frequency other than the standard 50 cycles per second as now a day's equipment became more sophisticated and with the proliferations of non-linear loads, harmonics have become a pronounced problem on many power systems. Now a-days in many areas non-linear load are approaching significantly.

The Effects of the Harmonics current are:

- Additional copper losses
- Increased core losses
- Increased electromagnetic interference with communication circuits.

The Effects of the Harmonics Voltage are:

- Increased dielectric stress on insulation
- Electro static interference with communication circuits
- Resonance between reactance and capacitance

Causes: There are many sources of harmonics in Power system but all harmonics sources share a common characteristic. This is a non-linear voltage current operating relationship and any device that alters the sinusoidal wave form of voltage or current is harmonics producer. The following are the source of harmonics: **Electronic ballasts; non—linear loads; variable frequency drives, diodes, transistors, thyrusters, rectifier output, frequency conversion, Transformers; circuit breakers; phone systems; capacitor banks; motors, Computers (power supplies) PC, laptop, mainframe, Servers, Monitors, Video display, Copiers, scanners, FAX machines, printers, plotters, lighting controls, UPS systems, battery charges & data centers etc. etc.**

Effects: Overheating of electrical equipment; random breakers tripping, High Neutral current due to 3rd Harmonics, interference with communication, non-proper recording of metering, increase in cooper loss, heating of equipment's such as transformer & generators, breakers & fuse operation occur.

Harmonics contents can place serious Burden on power distribution system. If harmonics distortion may suppose 35%, the distribution of harmonics then will be 5th order 27% 7th order 5%, 11th order – 2 % and 13th order 1%.

Solutions: Harmonics filters employ the use of power electronic technology, which monitors the nonlinear load and dynamically corrects a wide range of harmonics, such as the 3rd to 51st harmonics orders. By the injection of a compensating current into the load, the waveform is restored which dramatically reduce distortion to less than 5% THD, meeting IEEE 519 standards. Further to meet other power quality demand surge protection, metering, relay protection, control, SCADA and communication can be one of the solution. Solution can range from simply tightening connections in a switchboard to help overheating of conductors, to use of a 200% rated neutral in a panel board.

The total harmonic distortion (THD) of current or voltage is equal to the effective value of all the harmonics divided by the effective value of the fundamental.

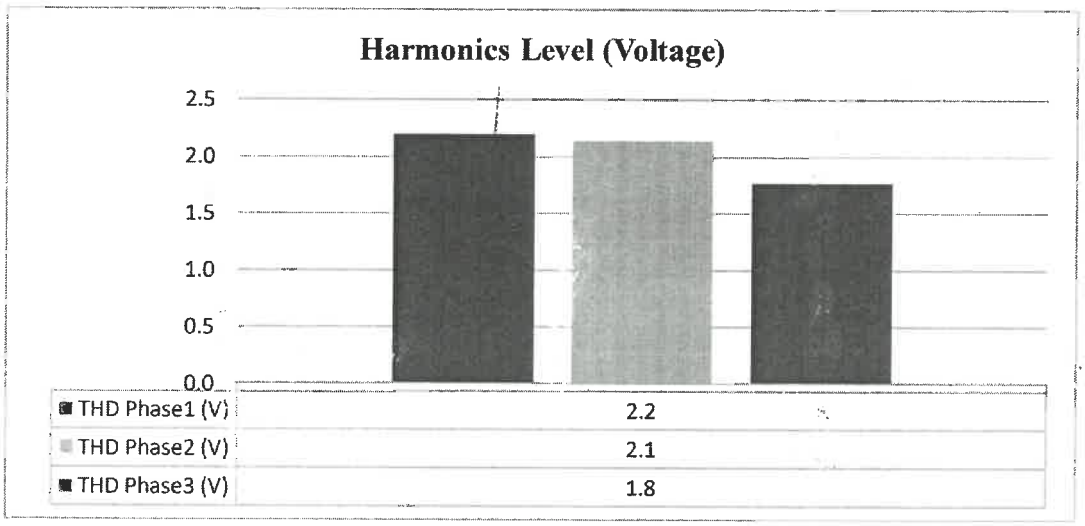


Figure 15.1: Trend of Transformers harmonics in Voltage

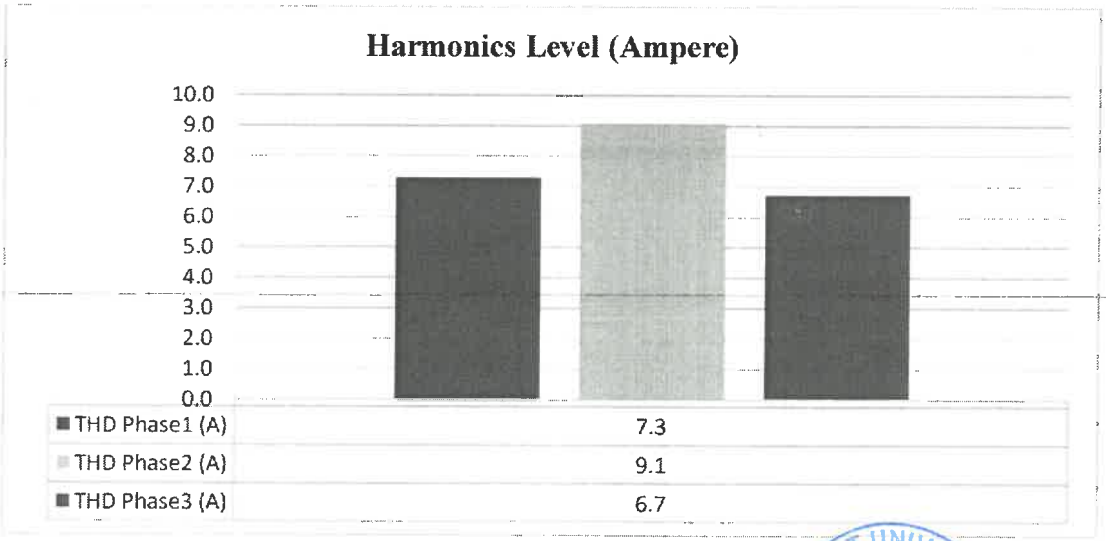


Figure 15.2: Trend of Transformers harmonics in Current

As per IEEE 519-992& IEEE C-57.110-1986 The current harmonics should be less than 8% as higher value may result in mal-operation of electronics system like control & protection etc. and may result in de-rating of transformer, the most preferred international standard of harmonic for Voltage should not be more than 3% and for current it should not be more than 8%.

HARMONIC CAN BE LIMITED WITH FOLLOWING METHODS:

1. 12 Pulse drives
2. Harmonic filters
3. High-end performance drives
4. Power re-distribution

Further:

1 Every harmonic can create problem, the nature of problem can be different. Due to higher voltage harmonic there can be components failure in electronic circuits, in higher current harmonics there can be high heat generation, which can lead to burning and fire, again due to higher third & ninth harmonic there will be higher neutral current which can be very dangerous for maintenance team, due to higher negative harmonic there can be mechanical problems which leads to machine failures etc. Therefore, it will be incorrect to say any harmonic is to be given more preference. Mitigation to harmonic should always be specific to the problem and of course be just not more and not less. This is where many people get mislead by marketing team.

2. Every machine has inbuilt capacity to withstand certain amount of harmonics, be it voltage or current. IEEE 519 A& B gives more details on the subject, though there is nothing much mentioned in Indian standard on the subject (To the best of my knowledge). As per thumb rule, voltage harmonic should be less than 3% and current harmonics should be less than 8%. All odd harmonics are dangerous. As I mentioned earlier third & ninth harmonic will increase neutral current and related problems as these are generated mostly by single phase loads and the circuit is completed through the neutral. Other odd harmonics (5th, 7th, 11th, 13th etc.) will be either positive harmonics or negative harmonics. Besides higher current and heat (Other problems will also be there) the negative harmonics will also cause mechanical problems to complicate the problems further. So the danger level is to be analyzed depending upon the situation and problem at hand.

15.2 Power factor

The concept of power factor in the case of sinusoidal voltages and currents, relates to the real power, reactive power, and apparent power associated with a load consisting of resistance and reactance bringing about a direct phase shift between the voltage and current.

Capacitor is a device that generates reactive current and consumes very less power. Installing capacitor will improve the power factor and will also reduce the kVA demand of the system and will increase the capacity of the network i.e. the network cables can be loaded further. Reduction in reactive current will result in reduction of I^2R losses and efficiency of the system will improve.

So it is recommended to keep 50% PF the capacitor at down stream (Load end) of the electrical distribution network and balance 50% at up stream (power house) end with automatic features (APFC). It is the best suited reactive compensating method as it will reduce distance transport of reactive power. It is also recommended to replace all the capacitors which have more than 35% reduction in rated capacity.

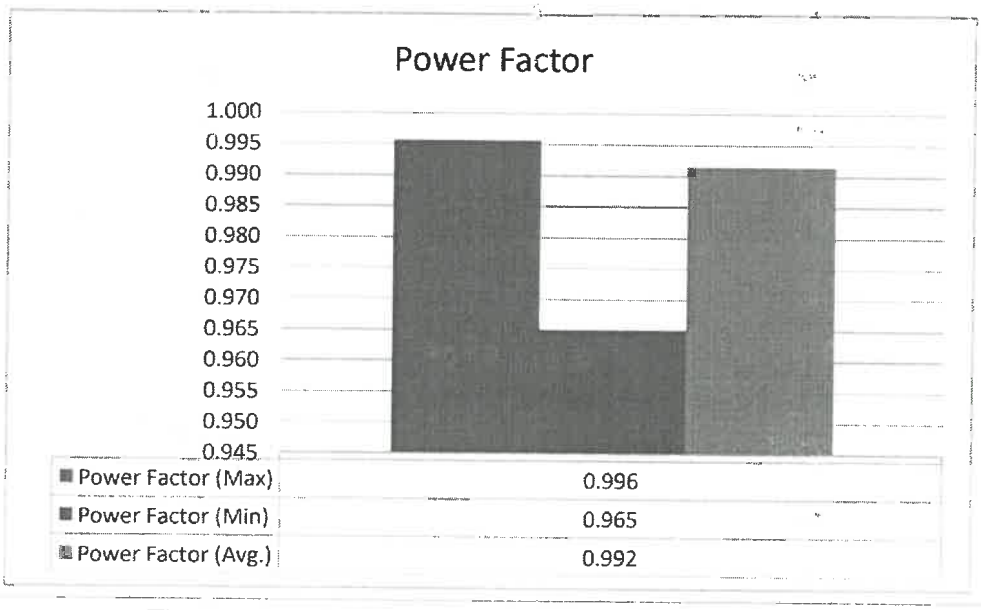


Figure 15.3: Trend of power factor of Transformers

It is recommended that instead of installing all the capacitors at the beginning 50% should be shifted to load center immediately. As at the main supply system also average power factor recorded is found to be 0.910, it is recommended that at individual locations power factor correction system be installed after conducting

detailed study at the time of operation of Air Conditioning system. The location of power factor correction should by taking following into account:

1. It should be on the main distribution board.
2. It should be either on sub-distribution board
3. It should be at the load end.

The benefits of power factor can be summarized as under:

1. Rebate from State Electricity Board
2. Improvement in Voltage
3. Reduction in maximum demand charges
4. Reduce heat loss

16. Cables

The electric current corresponds to Total Power (kVA) that depends on power factor, flows from utility-supply point to various load points of the unit through power cables (mostly made of aluminum). During the above power transport, considerable power is wasted to oppose the resistance of the cable. The cable resistance increases with length but decreases with cross-section i.e. increase in size. Therefore, the cable capacity has to be selected accordingly to keep the loss within 0.75% and it is only active load which cause the change in PF from no load to full load. By applying capacitor, we will change the PF of supply system hence I^2R of the old cable between supply source and motor.

14.1 Flowing current in feeders

The cable loss is proportional to I^2R (square of current flow and resistance of cable). Normally the current rating given by manufacturer is to withstand thermal stress. Energy conservation point of view, the above needs to be devalued based on length i.e. to curtail excess energy loss caused by off centered powerhouse, longer cables are to carry lesser than the rated current.

14.2 Reducing loss

There are two methods to reduce I^2R cable loss in feeders. They are: (i) reducing the current in cables by adding capacitors near to load or bifurcating the overloaded feeders (ii) reducing the resistance of cable by increasing its size or running additional run of cable of equal size.

14.3 Capacitor shifting/addition

It is possible to reduce current; thereby I^2R losses in cable by providing additional capacitors near to feeder end/ motor end.

17. Energy Demand Management

The energy audit study was under taken at this complex comprising of offices, platforms areas etc. Electricity is the main energy source for this complex. Electricity is used for meeting requirements of equipment's, machines, lightings, fans, air-conditioning, Water pumps & office equipment etc.

17.1 Electricity Bill Analysis

The Campus is getting electrical power supply from Dakshin Haryana Bijli Vitran Nigam (DHBVN) at 11 kV supply.

There are three step down transformers of 1000 kVA, 750 KVA &1500 kVA (11kV / 0.415kV) to meet the demand of whole complex. The premise is also having three diesel generators to provide power supply during power failure /emergency to the campus.

Table 18: Technical details of Connection

Parameter	Details
Consumer Name	M/s Chiranjiv Charitable Trust
Address	Sector-55, Gurugram
Supply From	Gurugram Circle-2
Supply Type	11 KV-HT
A/C No.	7786034085
K.No.	2123053946X
Meter No	637205
Sanctioned Load (kW)	2000
Tariff type	NDS

Table 19: Historical Electrical Bill Analysis

Sr. No.	Billing Month	MDI	Power factor	Total electricity consumed (kWh)	Total electricity consumption (kVAh)	Energy Charge	Fixed Charges
1	May 2021	326.0	0.976	46262.0	47410.0	320017.50	315616.32
2	April 2021	207.2	0.946	51400.0	54326.2	366701.85	326136.86
3	Mar. 2021	150.4	0.968	39685.6	40980.0	276615.00	294575.23
4	Feb. 2021	169.2	0.993	46382.2	46713.6	315316.80	326136.86
5	Jan. 2021	444.4	0.839	29824.0	35532.0	239841.00	326136.86
6	Nov. 2020	292.4	0.793	43893.8	55334.4	373507.20	347177.95
7	Oct. 2020	344.8	0.972	49628.0	51040.0	344520.00	315616.32
8	Sept. 2020	253.2	0.950	53100.0	55920.0	377460.00	326136.86
9	Aug. 2020	172.8	0.820	40920.2	49903.6	336849.30	326136.86
10	Jul. 2020	129.6	0.854	37644.0	44072.0	297486.00	315616.32
11	June 2020	90.0	0.970	30638.4	31592.4	213248.70	326136.86
12	May 2021	78.4	0.988	26560.0	26887.6	181491.30	315616.32
	Total			**495938**	**539712**	**3643055**	**3861040**
	Avg.	**221.5**	**0.922**	**41328.2**	**44976.0**	**303587.9**	**321753.3**
	Max	**444.4**	**0.993**	**53100.0**	**55920.0**	**377460.0**	**347178.0**
	Min	**78.4**	**0.793**	**26560.0**	**26887.6**	**181491.3**	**294575.2**

Sr. No.	Billing Month	Fuel Surcharge	Meter Service Charge	Electricity Duty	Municipal Tax	Total Payable Amount	Inr/Unit kVAh	Inr/Unit kWh
1	May 2021	17116.94	1560.00	4626.20	13055.02	671992.00	14.2	14.5
2	April 2021	19018.00	1612.00	5140.00	14237.13	732846.00	13.5	14.3
3	Mar. 2021	14683.67	1456.00	3968.56	11717.48	603016.00	14.7	15.2
4	Feb. 2021	17161.41	1612.00	4638.22	13172.30	678038.00	14.5	14.6
5	Jan. 2021	11034.88	1612.00	2982.40	11540.25	593147.00	16.7	19.9
6	Nov. 2020	16240.71	1716.00	4389.38	14738.52	757770.00	13.7	17.3
7	Oct. 2020	18362.36	1560.00	4962.80	13569.97	698591.00	13.7	14.1
8	Sept. 2020	19647.00	1612.00	5310.00	14464.88	744630.00	13.3	14.0
9	Aug. 2020	15140.47	1612.00	4092.02	13562.53	697393.00	14.0	17.0
10	Jul. 2020	13928.28	1560.00	3764.40	12540.61	644896.00	14.6	17.1
11	June 2020	11336.21	1612.00	3063.84	11014.44	566412.00	17.9	18.5
12	May 2021	9827.20	1560.00	2656.00	10138.70	521290.00	19.4	19.6
	Total	**183497**	**19084**	**49594**	**153752**	**7910021.00**		
	Avg.	**15291.43**	**1590.33**	**4132.82**	**12812.65**	**659168.42**	**15.0**	**16.3**
	Max	**19647.00**	**1716.00**	**5310.00**	**14738.52**	**757770.00**	**19.4**	**19.9**
	Min	**9827.20**	**1456.00**	**2656.00**	**10138.70**	**521290.00**	**13.3**	**14.0**

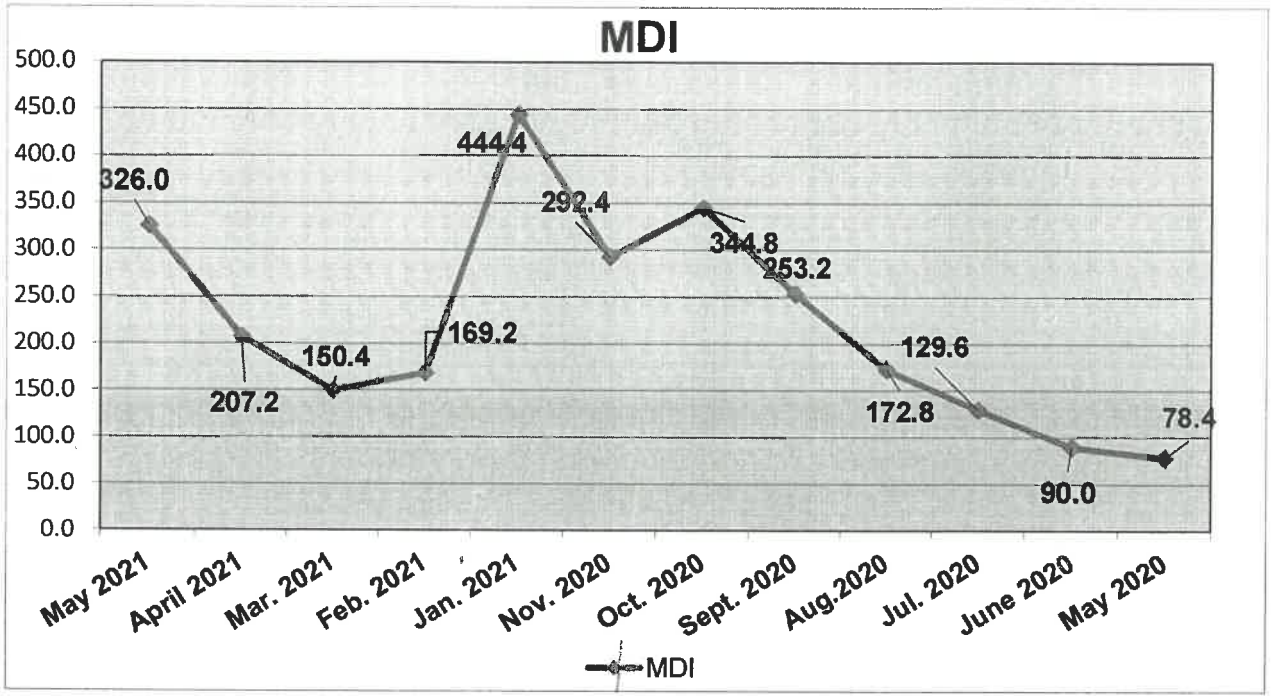


Figure 17.4: Historical MDI variation

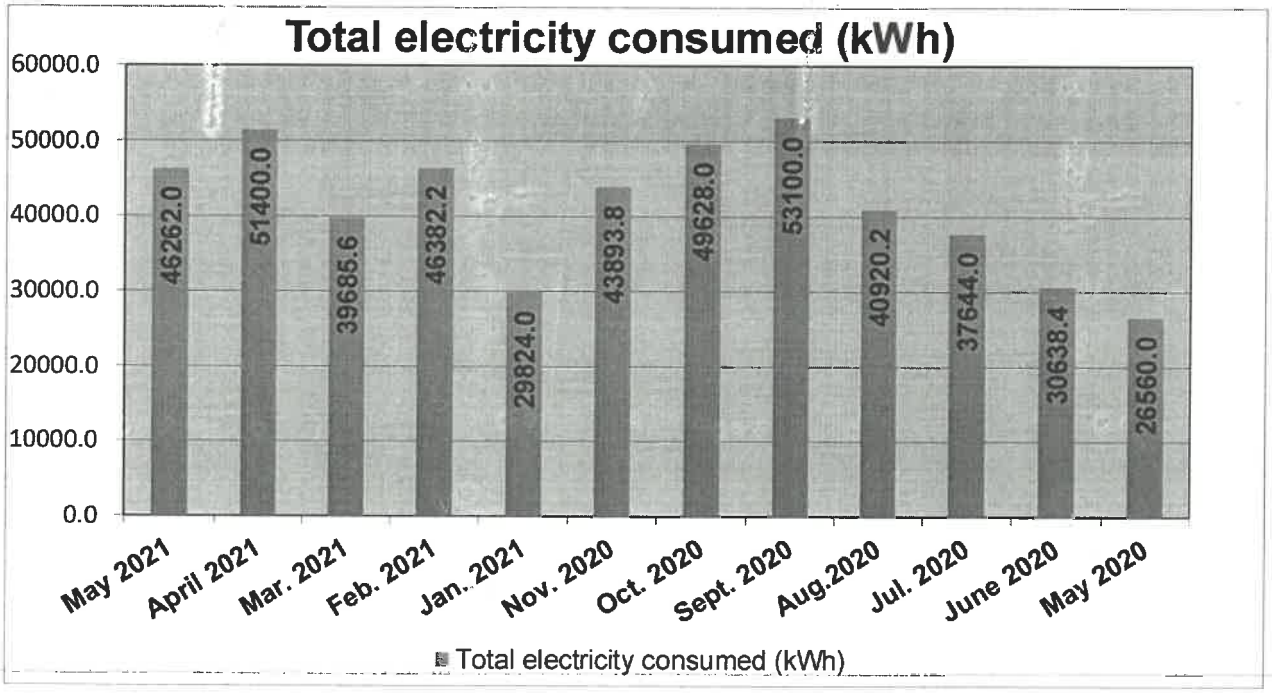


Figure 17.5: Historical trends of Active Power Consumption

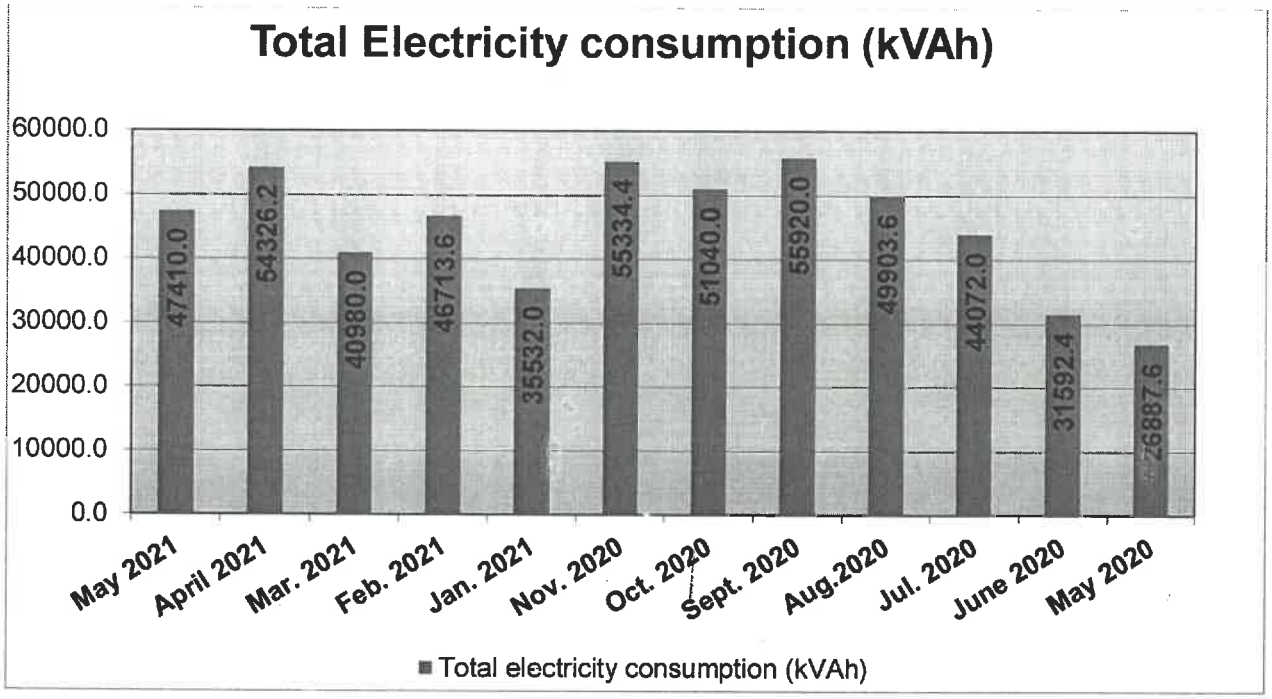


Figure 17.6: Historical trends of Reactive Power Consumption

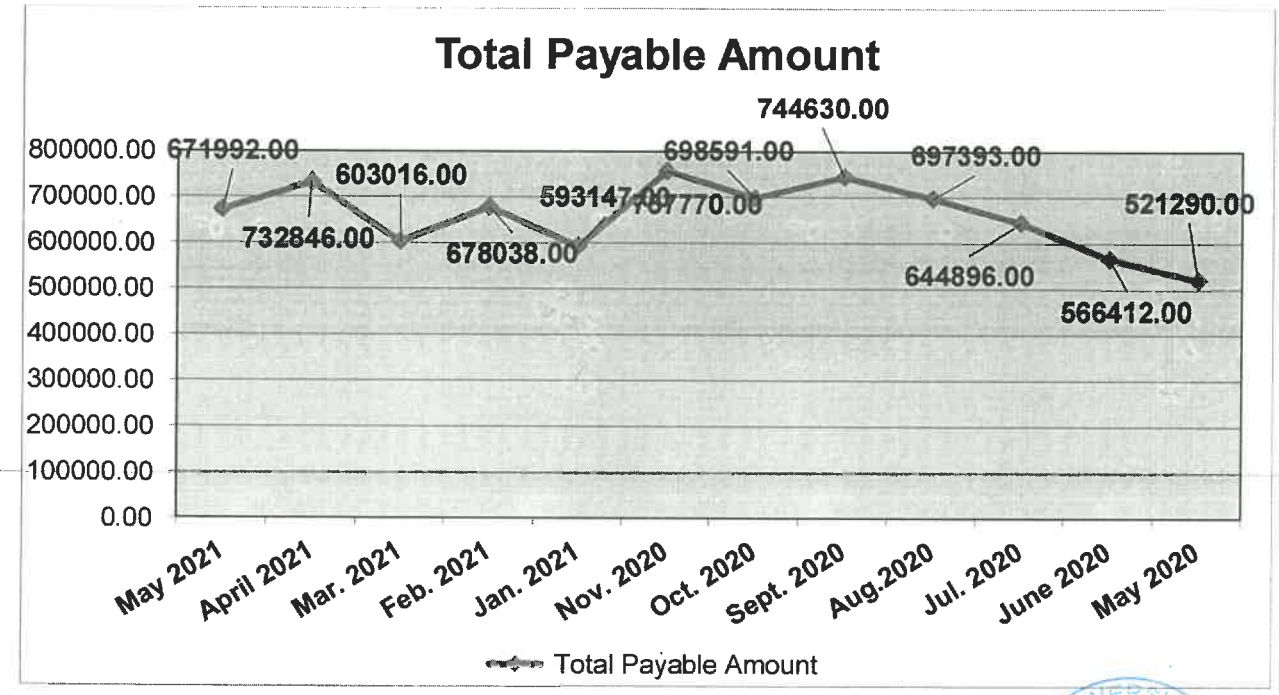


Figure 17.7: Historical Trends of Electricity cost

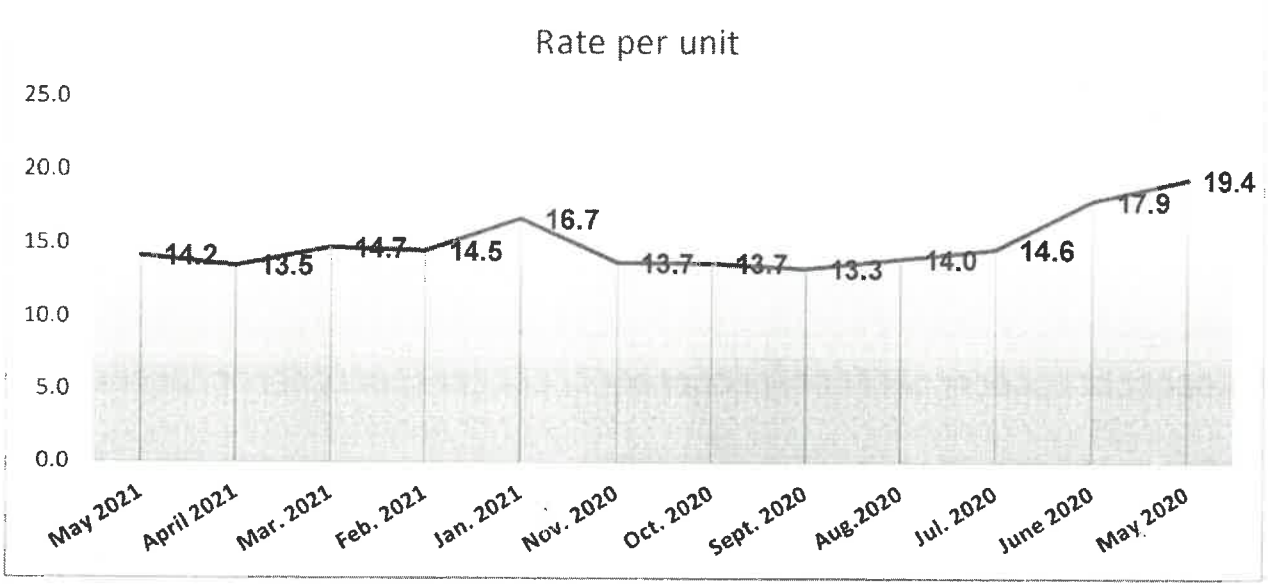


Figure 17.8: Historical Trends of rate per unit

- Average monthly consumption of the premises is 0.44 Lakhs kVAh /month. For fulfilling energy needs campus has been paying Rs. 6.59 lakhs/Month while annually campus is paying Rs 79.10 Lakhs.
- Incoming supply voltage is 11 kV which is further stepped down to 415 V with the help of transformer.
- Average demand of the premises is 221.5 KVA, while variation of M.D. is within 78.4 to 444.4 KVA respectively.

NOTE

It is suggested the demand of the Industry to reduce Electricity cost. This can be achieved as below:

a. Re-schedule the load
b. Staggering of motor load
c. Shedding of non-essential load.
d. Operation of captive power generation
e. To install reactive power compensator
f. Use demand controller
g. Switching off non-essential loads.

18. Illumination & LUX Levels

To study, analyze and identify energy conservation options in lighting, a study of the unit lighting load was conducted. The purpose of the study was to determine the lighting load and its distribution in various sections of the buildings, determine the quality of illumination provided, and recommend measures to improve illumination and reduce electricity consumption.

A high quality and accurate digital LUX meter was used to measure the illumination level at various sections of the building during working hours. Other performance indicators such as type of lamps used, luminaries, mounting height, physical condition of lamps, use of day lighting, etc. were also noted down.

Major reasons for poor illumination levels at selected locations of the building are as follows:

- Poor reflectors/no reflector installed for the tube lights.
- Large height of installed fittings from the working plane.
- Reduction in illumination due to ageing.
- Very old fittings and dust deposition on luminaries

Table 20: Table of assessment of lighting Load

Sr. No	Location	Lux Level
1	A-202	140-180
2	A-203	150-210
5	A-001	135-190
6	A-003	160-210
7	B-101	150-210
8	B-102A	130-220
9	D - 501	170-230
10	D - 504	140-200
11	D - 210	120-160
12	D - 209	130-165
13	Law College Class Room – 09	.135-185
14	Law College Class Room - 10	140-220
15	Law College Class Room - 1	120-200
16	Law College Class Room - 2	110-190
17	E - 205	150-240
18	E - 206	140-235

Sr. No	Location	Lux Level
19	E - 207	130-210
20	E - 205	120-220

Assessment of Lighting System

Example : Room

Lux Measured = Average Lux = 286

Length of the Room = 18ft.

Width of the Room = 14ft

Working Place Height = 10ft

287	284

STEP 1	Measure the Floor area of the interior :	Area = 18 x 14 = 252 sqft
STEP 2	Calculate the Room Index 18 x 14 / 10 (18 + 14) = .78	RI = .78
STEP 3	Determine the total circuit watts of the installation by a power meter if a separate feeder for lighting is available. If the actual value is not known a reasonable approximate can be obtained by totaling up the lamp wattage including the ballasts	Total Circuit watts 54 W x 16 = 864 32 W x 4 = 128 TOTAL = 992W
STEP 4	Calculate Watts per square meter, Value of Step 3 ÷ Value of Step 1	W/m^2 = 3.9
STEP 5	Ascertain the average maintained luminance by using Lux Meter, Eav. Maintained	Eav.maint = 286
STEP 6	Divide 5 by 4 to calculate Lux per Watt per square Meter	Lux/W/m^2 = 72.77
STEP 7	Obtain target Lux/W/M^2 lux for type of the type of interior/ application and RI (2)	Target Lux/W/m^2 = 36
STEP 8	Calculate Installed Load Efficacy Ratio (6 ÷ 7)	ILER = 2.02

ILER 0.75 or over = Satisfactory to Good

Measuring Units Light Level – illuminance

Illuminance is measured in foot candles (ftcd, fc, fcd) or lux in the metric SI system). A foot candle is actually one lumen of light density per square foot, one lsux is one lumen per square meter.

- 1 lux = 1 lumen / sq meter = 0.0001 phot = 0.0929 foot candle (ftcd, fcd)
- 1 phot = 1 lumen / Sq centimeter = 10000 lumens / sq meter = 10000 lux
- 1 foot candle (ftcd, fcd) = 1 lumen / sqft = 10.752 lux

Common Light Level Outdoor

Common light levels outdoor at day and night can be found in the table below :

Table 21: Lux level of different natural occasions

Condition	Illumination	
	(ftcd)	(lux)
Sunlight	10,000	107,527
Full Daylight	1,000	10,752
Overcast Day	100	1075
Very Dark Day	10	107
Twilight	1	10.8
Deep Twilight	.1	1.08
Full Moon	.01	.108
Quarter Moon	.001	.0108
Starlight	.0001	.0011
Overcast Night	.0001	.0001

Common and Recommended Light Levels Indoor

The outdoor light level is approximately 10,000 lux on a clear day. In the building, in the area closes to windows, the light level may be reduced to approximately 1,000 lux. In the middle area its may be as low as 25- 50 lux. Additional lighting equipment is often necessary to compensate the low levels.

Earlier it was common with light levels in the range 100 -300 lux for normal activities. Today the light level is more common in the range 500 – 1000 lux – depending on activity. For precision and detailed works, the light level may even approach 1500 – 2000 lux.

The table below is a guidance for recommended light level in different work spaces:

Table 22: Required lux level for various activities

Activity	Illumination (lux, lumen/m^2)
Public areas with dark surroundings	20 -50
Simple orientation for short visits	50 -100
Working areas where visual tasks are only occasionally performed	100 -150
Warehouse, Homes, Theaters, Archives	150

Easy Office work, classes	250
Normal Office work, PC work, Study library, Groceries, show room, laboratories	500
Supermarkets, Mechanical workshops, Office landscapes	750
Normal Drawing work, very detailed mechanical works	1000
Detailed drawing work, very detailed mechanical works	1500 -2000
Performance of visual tasks of low contract and very small size for prolonged periods of time	2000 -5000
Performance of visual tasks of low contract and very small size for prolonged period of time	2000 -5000
Performance of very prolonged and exacting visuals tasks	5000 – 10000
Performance of very special visual tasks of extremely low contract and small size	10000 - 20000

19. Energy Balancing

Energy balancing starts from energy accounting and it is one of the principal activities integrated with energy management system aimed to help the energy manager in preparation of an energy balance sheet. Energy balance sheet helps to identify and fix energy guzzlers and take corrective measures. ***It is not possible to prepare an energy balance sheet without metering set-up at important nodes. It is an important activity for the management to initiate and install such metering facilities at least at selected important nodes*** of electrical distribution network starting from transformers outgoing point to motor end. Energy accounting could be done either by manual process or with the aid of data acquisition system supported by menu driven specially software packages to monitor, record and control the process sequences and thereby energy. The diesel storage and distribution system has no measurement, records and monitoring system. The diesel consumed by individual DG set are not measured and recorded, which is not proper practice both for energy efficiency and economic prospective.

20. Transformers and load profile

20.1 Transformers

The Campus is getting electrical power supply from Dakshin Haryana Bijli Vitran Nigam (DHBVN) at 11 kV supply.

There are three step down transformers of 1000 kVA, 750 KVA &1500 kVA (11kV / 0.415kV) to meet the demand of whole complex. The premise is also having three diesel generators to provide power backup during day/night. Load profile of power shown in below graphs.

Table 23: Technical Specifications of transformers

Name Plate Data		TRF-1	TRF-2	TRF-3
Rated	kVA	1000	750	1500
Voltage	H.V	11000	11000	11000
	L.V	433	433	433
Amp.	H.V	52.49	39.38	78.73
	L.V	1333.4	1000	2000.11
Impedance Volt	%	5.4	4.75	
Phase		3	3	3
Frequency	HZ	50	50	50
Cooling Type		ONAN	ONAN	ONAN
Vector Group		Dyn11	Dyn11	Dyn11
Mfg.	Year	2014	2007	2021
Make		ESENNAR	ITE	MPIPL

20.2 Load profile for Main Incomer (Transformer)

The load profile of the electrical parameters was recorded by using a portable 3-phase power analyzer. During the recording, the power analyzer recorded all the electrical parameters for further detailed analysis. The analysis of the different parameters recorded 24 hours reading at the L.T. incoming main supply is given below.

20.2.1 Real power (kW) and apparent power (kVA) profile

Load (real power) profile and apparent power profile is the variation in the electrical load versus time. In any electrical system, the vector sum of the active power (kW) and reactive power (kVAR) make up the total (or apparent) power (kVA) used. This is the power generated by a generation station for the user to perform a given amount of work. The total power is measured in kVA (Kilo Volts-Amperes) and the load or active power is measured in kW (kilowatts) and they become equal as and when the power factor approaches unity. Total electricity charges (units and demand) are based on the load or active power (kW) and apparent power (kVA).

During the energy audit studies, the total operating load at the transformer was recorded to find out the variation in the load at different times of the day. The following graph depicts the variation in the load and apparent power of the premises:

Load Profile Real power (kW & kVA) profile of main incomer

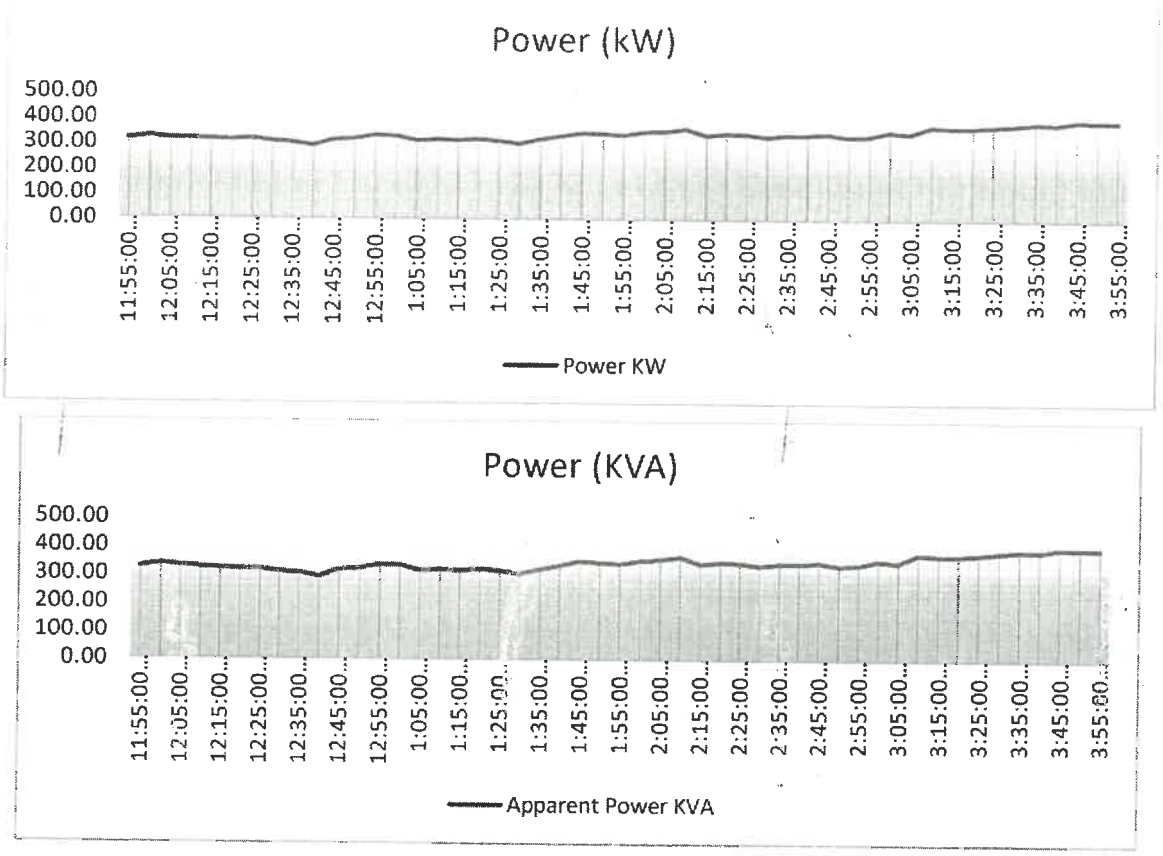


Figure 20.9: Trends of active and reactive power

The observations taken from the graph:

- The load (kW) variation ranges from 292.7 kW to 400.1 kW during the Load hours of measurement period and Average 341.7
- The apparent power (kVA) varies from 294.3 kVA to 401.9 kVA during the Load hours of measurement period and Average 344.5

Table 24: Maximum and minimum Values of active and reactive Power

	Power (KW)	Apparent Power (KVA)
Max.	400.1	401.9
Min.	292.7	294.3
Ave.	341.7	344.5

20.2.2 Power factor profile

Under the current tariff system, the billed units are in kVAh and the demand charges for apparent power (kVA) depend on the power factor. If the facility has a low power factor, then the demand drawn from the grid will increase and consequently the facility will incur more demand charges. The variation in the power factor was recorded to explore opportunities for improvement. The graph below presents the variations in the power factor of the power supply to the building:

Power factor profile for the main Incomer

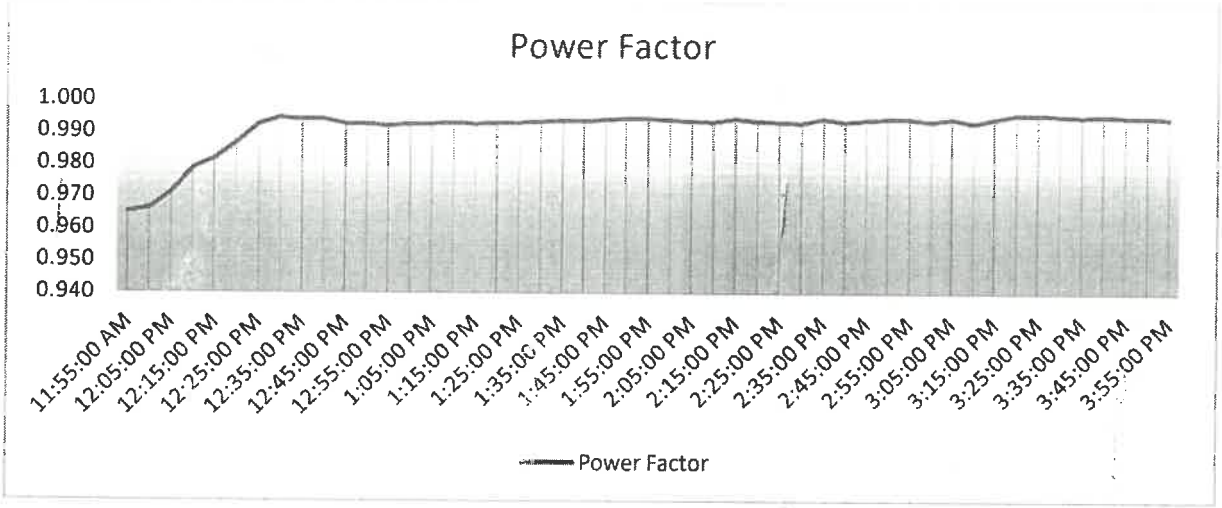


Figure 20.10: Trends of Power Factor Variation

The observations taken from the above graphs:

- The power factor varied from 0.965 to 0.996 during the load hours of measurement period and Average 0.992.

20.2.3 Current profile

Current profile is the variation in the electrical current versus time. The current variations in all the three phases (R, Y and B) were recorded at the main panel of the transformer. The graphs below present the variations in the current:

Current Profile- Phase wise of the main Supply

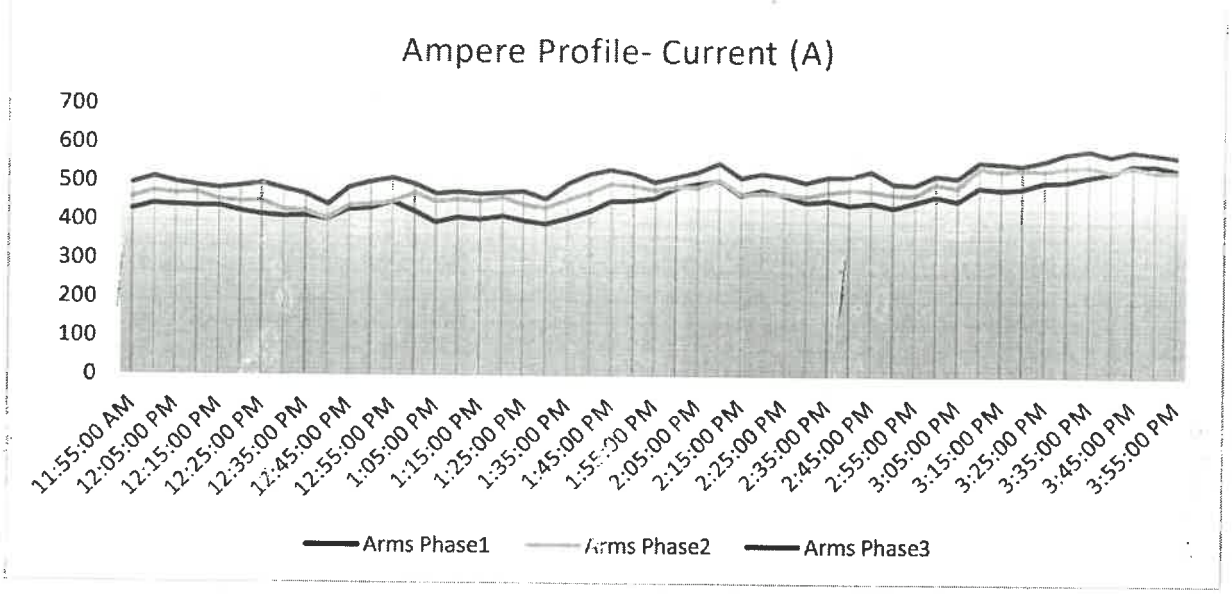


Figure 20.11: Pattern of recorded current Profile

The observations taken from the above graphs:

- There is a considerable current variation in the different phases and hence the phase-to-phase load is not balanced. The Current variation ranges. during the load hours of measurement period.

Table 25: Maximum and minimum values of current

	Amp. Phase (R)	Amp. Phase (Y)	Amp. Phase (B)
Max.	550.1	546.6	587.7
Min.	392.2	404.0	441.1
Ave.	454.7	479.6	514.2

20.2.4 Voltage profile

All electrical equipment has a designed range of operating voltage. Therefore, it is important to operate all electrical equipment, within the specified voltage range. The voltage variations in all the three phases (R, Y and B) were recorded at the main Supply. The graphs below depict the variations in the voltage

Voltage Profile- Phase wise (V)

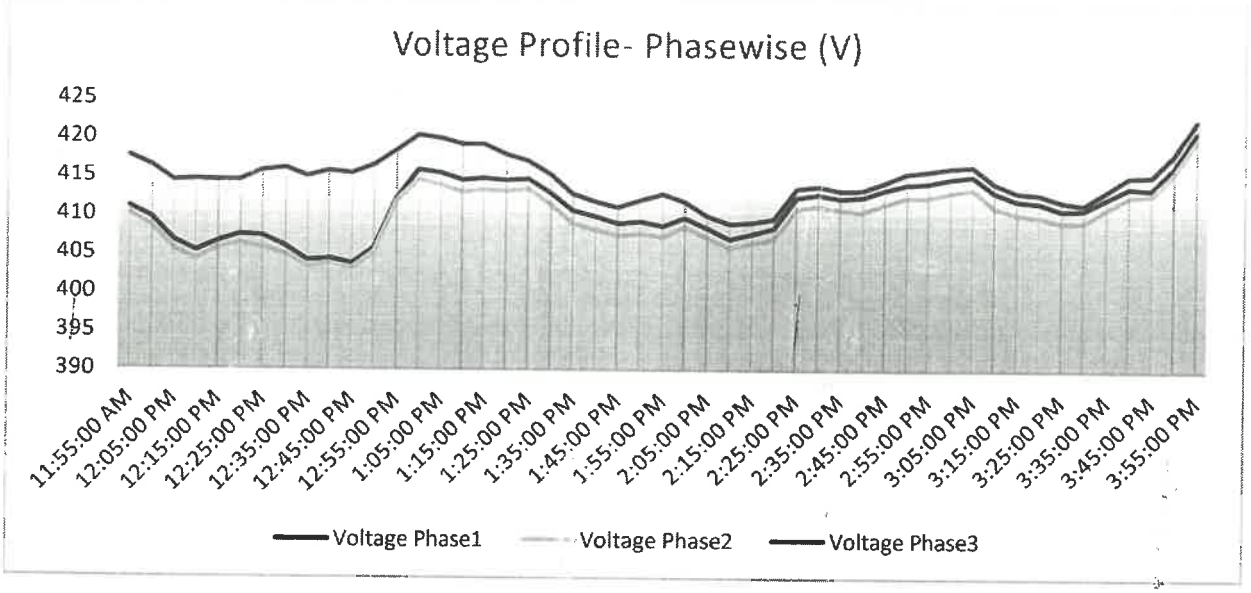


Figure 20.12: Pattern of voltage Variation

The observations taken from the above graphs:

- There was a slight variation in phase-to-phase voltage.
- The average voltage recorded

Table 26: Maximum and minimum values of recorded voltage

	Voltage (R) Phase	Voltage(Y) Phase	Voltage(B) Phase
Max.	421.0	420.0	422.5
Min.	403.7	403.1	409.0
Ave.	411.0	409.7	414.8

20.2.5 Frequency profile

The variations recorded in the frequency during the 24 hours of measurement period are provided below:

Frequency profile of the main Incomer for load hours

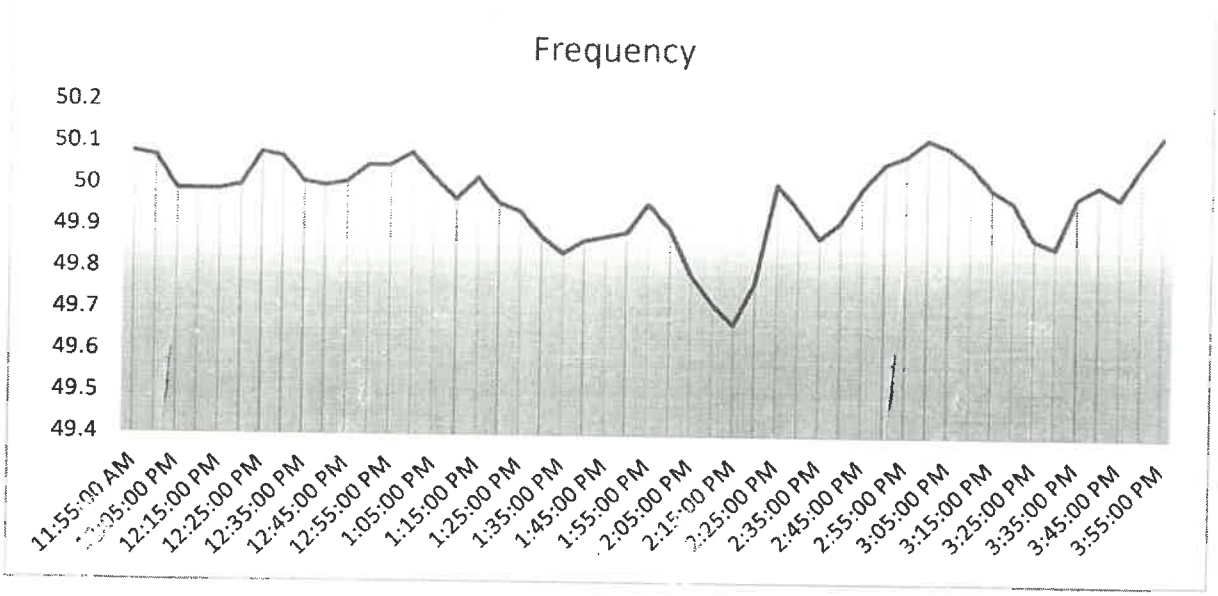


Figure 20.13: Trends of frequency variations

The observations taken from the above graphs:

- There was a minimal variation in the recorded frequency during the measurement period.
- The frequency varied from 49.7 Hz to 50.1 Hz and the average frequency recorded was 50.0 Hz.

20.2.6 Harmonics

Harmonics are the periodic steady-state distortions of the sine wave due to equipment generating a frequency other than the standard 50 cycles per second as now a day's equipment became more sophisticated and with the proliferations of non-linear loads, harmonics have become a pronounced problem on many power systems. Now a-days in many areas non-linear load are approaching significantly.

The Effects of the Harmonics current are:

- Additional copper losses
- Increased core losses
- Incresed electromagnetic interference with communication circuits.

The Effects of the Harmonics Voltage are:

- Incresed dielectric stress on insulation
- Electro static interference with communication circuits
- Resnance between reactance and capcitance

- **Causes:** There are many sources of harmonics in Power system but all harmonics sources share a common characteristic. This is a non-linear voltage current operating relationship and any device that alters the sinusoidal wave form of voltage or current is harmonics producer. The following are the source of harmonics: **Electronic ballasts; non—linear loads; variable frequency drives, diodes, transistors, thyristors, rectifier output, frequency conversion, Transformers; circuit breakers; phone systems; capacitor banks; motors, Computers (power supplies) PC, laptop, mainframe, Servers, Monitors, Video display, Copiers, scanners, FAX machines, printers, plotters, lighting controls, UPS systems, battery charges & data centers etc. etc.**
- **Effects:** Overheating of electrical equipment; random breakers tripping, High Neutral current due to 3rd Harmonics, interference with communication, non-proper recording of metering, increase in cooper loss, heating of equipment's such as transformer & generators, breakers & fuse operation occur.

Harmonics contents can place serious Burden on power distribution system. If harmonics distortion may suppose 35%, the distribution of harmonics then will be 5th order 27% 7th order 5%, 11th order – 2 % and 13th order 1%.

Solutions: Harmonics filters employ the use of power electronic technology, which monitors the nonlinear load and dynamically corrects a wide range of harmonics, such as the 3rd to 51st harmonics orders. By the injection of a compensating current into the load, the waveform is restored which dramatically reduce distortion to less than 5% THD, meeting IEEE 519 standards.

Further to meet other power quality demand surge protection, metering, relay protection, control, SCADA and communication can be one of the solution. Solution can range from simply tightening connections in a switchboard to help overheating of conductors, to use of a 200% rated neutral in a panel board:

The percentage of total current and voltage harmonic distortion in all the three phases (R, Y and B) were recorded at the main incoming panel. The graphs below depict the percentage of total harmonic distortion in the electrical distribution system:

Percentage of Total Harmonic Distortion (THD) - Phase wise voltage

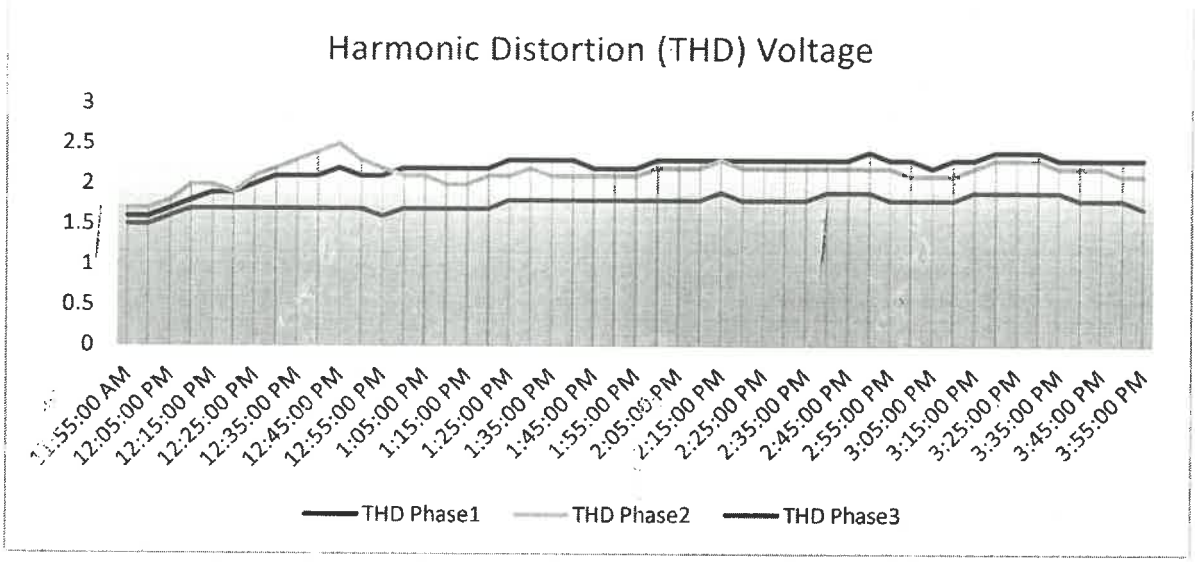


Figure 20.14: Pattern of harmonics levels in voltage

Percentage of Total Harmonic Distortion (THD) - Phase wise current

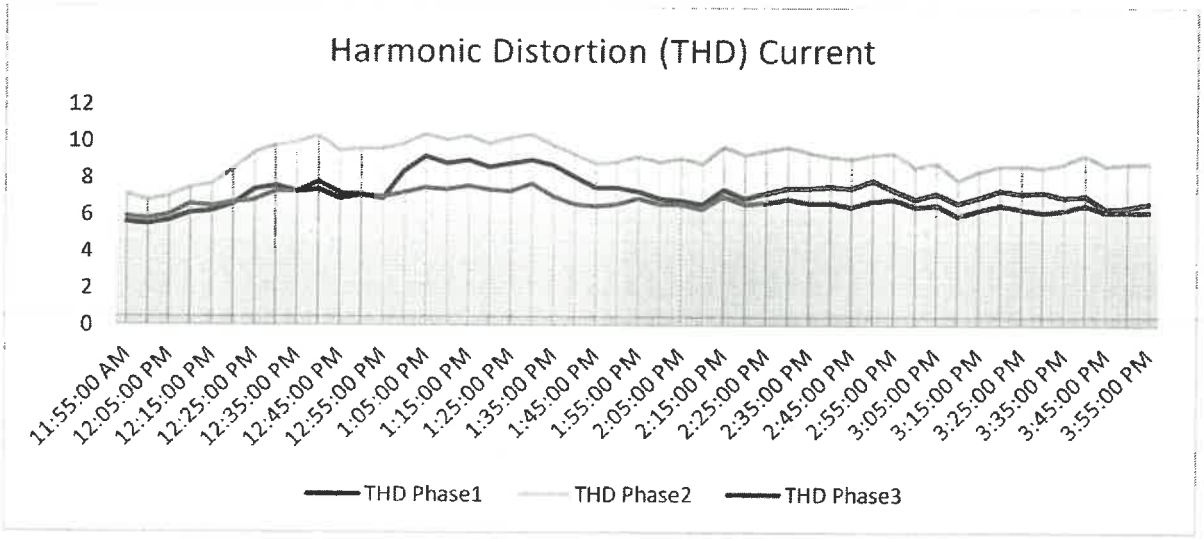


Figure 20.15: Patterns of harmonics levels in current

	Voltage Harmonics %			Current Harmonics %		
Max.	2.4	2.5	1.9	9.2	10.4	7.8
Min.	1.6	1.7	1.5	5.5	6.8	5.8
Ave.	2.2	2.1	1.8	7.3	9.1	6.7

Table 27: Measured Harmonics levels

The observations taken from the above graphs:

- The percentage of average voltage THD is in the range of 1.5 % to 2.5 %. This is well within the recommended limits as per IEEE Standards i.e. 4% variation for voltage & 15% variation for current.
- The percentage of average current THD is in the range of 5.5 % to 10.4 %. The current harmonics in the system are more than the recommended limits as per IEEE Standards. So, it is recommended to install the harmonics controller in the system to bring the Voltage harmonics with in limit & current THD levels within limits.

The observations taken from the above as:

- Transformer temperature is Normal
- Silica Gel ok.
- Oil level ok.
- Harmonics Level with in limit

Overall power quality

The analysis of various power quality parameters given above indicates that the overall quality of power received by the facility is good and most of the parameters are within the desired range except the current harmonics in the system.

It is recommended that regular de-hydration of transformer oil should be carried out to remove the moisture. This de-hydration should be got done at regular interval based on condition monitoring.

Transformer losses and efficiency

The efficiency of the transformer not only depends on the design, but also on the effective operating load. Transformer losses consist of two parts No-Load loss and Load loss.

1. No-Load loss (also called core loss): These losses occur whenever the transformer is energized. It does not vary with load.
2. Load-Loss (also called copper loss): It is the power lost in the primary and secondary winding of the transformer. Whenever the transformer remained energized and it varies with square of the current.

21. Capacitor

Capacitor is a device that generates reactive current and consumes very less power. Installing capacitor will improve the power factor, will also reduce the kVA demand of the system and will increase the capacity of the network. Capacitor is passive equipment very useful to reduce the load current by improving PF.

There are two APFC Panels installed i.e. 250 KVAr x 2 nos. The power factor shown in the APFC panel is 0.99.

Table 28: Status of capacitors

APFC PANEL-01						
Sr. No.	Capacity (kVAr)	Rated Current (amp)	Measured			Remark
			Measured-R	Measured-Y	Measured-B	
CB-1	25	32.8	30.0	29.0	30.0	**OK**
CB-2	25	32.8	28.0	29.0	30.0	**OK**
CB-3	25	32.8	28.0	28.0	29.0	**OK**
CB-4	25	32.8	**11.0**	**11.4**	**10.4**	**De-Rated**
CB-5	25	32.8	**10.0**	**10.2**	**10.2**	**De-Rated**
CB-6	25	32.8	**0.0**	**0.0**	**0.0**	**De-Rated**
CB-7	25	32.8	-	-	-	**NA**
CB-8	25	32.8	-	-	-	**NA**
CB-9	25	32.8	**0.0**	**0.0**		**De-Rated**
CB-10	25	32.8	30.0	31.0	30.0	**OK**
Total	**250**					
APFC PANEL-02						
Sr. No.	Capacity (kVAr)	Rated Current (amp)	Measured			Remark
			Measured-R	Measured-Y	Measured-B	
CB-1	25	32.8	23.0	24.0	23.0	**OK**
CB-2	25	32.8	-	-	-	**Disconnect**
CB-3	25	32.8	**0.0**	**0.0**	**0.0**	**De-Rated**
CB-4	25	32.8	-	-	-	**Contactor Burn**
CB-5	25	32.8	-	-	-	**Contactor Burn**
CB-6	25	32.8	30.0	31.0	30.0	**OK**
CB-7	25	32.8	32.0	32.0	31.0	**OK**
CB-8	25	32.8	**0.0**	**0.0**	**0.0**	**De-Rated**
CB-9	25	32.8	31.0	33.0	32.0	**OK**

CB-10	25	32.8	32.0	31.0	32.0	**OK**
Total	**250**					

The advantages of Power Factor improvement by capacitor

- A Reactive component of the network are reduced and so also the total current in the system from the source end.
- I2R power losses are reduced in the system because of reduction in current.
- Voltage level at the load end is increased.
- kVA loading on the source generators as also on the transformers and line upto the capacitors reduces giving capacity relief. A high power factor can help in utilities the full capacity of the electrical system.

Cost benefits of Power Factor improvement

- Reduced kVA (Maximum Demand) charges in electricity bill
- Reduced distribution losses (kWh) within the plant network
- Better voltage at motor terminals and improved performance of motors
- A high power factor eliminates penalty charges imposed when operating with low power factor
- Investment on system facilities such as transformers, cables, switchgears etc for delivering load is reduced.

22. Earthing

The electricity rules clearly specify that two independent earths to the body and neutral should be provided to give adequate protection to the equipment in case if an earth fault, and also to drain away any leakage of potential voltage from the equipment to the earth for safe working.

As there is no standard of earth resistance value, it varies on different type of soil resistivity, ideally it should be Zero but for different kind of soil for electrical equipment it should be better to below .8 Ohm and for electronics equipment it should be below .4 Ohm but best value is .1 Ohm.

Table 29: Details of Earth Resistance at various locations

Sr. No.	Location	Ohm
1	TRANSFORMER -1 BODY EARTH	1.8
2	TRANSFORMER -1 NEUTRAL GROUNDING	**70.5**
3	TRANSFORMER -2 BODY EARTH	**84.5**
4	TRANSFORMER -2 NEUTRAL GROUNDING	**24.20**
5	TRANSFORMER -3 BODY EARTH	0.16
6	TRANSFORMER -3 NEUTRAL GROUNDING	1.1
7	DG SET - 1 BODY EARTH	7.2
	DG SET -1 NEUTRAL GROUNDING	**53.2**
8	DG SET - 2 BODY EARTH	**14.5**
	DG SET -2 NEUTRAL GROUNDING	0.14
9	DG SET - 3 BODY EARTH	0.81
10	DG SET -3 NEUTRAL GROUNDING	0.38
11	LT Panel-1 Out side	6.3
12	APFC Panel	11.6
13	Lightning Arrester for Solar	**O/L**
14	Solar PV Panels	**240**
15	Solar PV Panels	**83.5**
16	Solar Lighting Panel	**15.4**

23. General Tips for Energy Conservation

23.1 Electricity

- Schedule your operations to maintain a high load factor
- Minimize maximum demand by tripping loads through a demand controller
- Use standby electric generation equipment for on-peak high load periods.
- Correct power factor to at least 0.99 under rated load conditions.
- Set transformer taps to optimum settings.
- Shut off unnecessary computers, printers, and copiers at night.

23.2 Motors

- Properly size to the load for optimum efficiency.
- (High efficiency motors offer of 4 - 5% higher efficiency than standard motors)
- Check alignment.
- Provide proper ventilation
- (For every 10°C increase in motor operating temperature over recommended peak, the motor life is estimated to be halved)
- Check for under-voltage and over-voltage conditions.
- Balance the three-phase power supply.
- (An Imbalanced voltage can reduce 3 - 5% in motor input power)
- Demand efficiency restoration after motor rewinding.

23.3 Drives

- Use variable-speed drives for large variable loads.
- Use high-efficiency gear sets.
- Use precision alignment.
- Check belt tension regularly.
- Eliminate variable-pitch pulleys.
- Use flat belts as alternatives to v-belts.
- Use synthetic lubricants for large gearboxes.
- Eliminate eddy current couplings.
- Shut them off when not needed.

23.4 Fans

- Use smooth, well-rounded air inlet cones for fan air intakes.
- Avoid poor flow distribution at the fan inlet.
- Minimize fan inlet and outlet obstructions.

- Clean screens, filters, and fan blades regularly.
- Use aerofoil-shaped fan blades.
- Minimize fan speed.
- Use low-slip or flat belts.
- Check belt tension regularly.
- Eliminate variable pitch pulleys.
- Use variable speed drives for large variable fan loads.
- Use energy-efficient motors for continuous or near-continuous operation
- Eliminate leaks in ductwork.
- Minimize bends in ductwork
- Turn fans off when not needed.

23.5 Blowers

- Use smooth, well-rounded air inlet ducts or cones for air intakes.
- Minimize blower inlet and outlet obstructions.
- Clean screens and filters regularly.
- Minimize blower speed.
- Use low-slip or no-slip belts.
- Check belt tension regularly.
- Eliminate variable pitch pulleys.
- Use variable speed drives for large variable blower loads.
- Use energy-efficient motors for continuous or near-continuous operation.
- Eliminate ductwork leaks.
- Turn blowers off when they are not needed.

23.6 Pumps

- Operate pumping near best efficiency point.
- Modify pumping to minimize throttling.
- Adapt to wide load variation with variable speed drives or sequenced control of smaller units.
- Stop running both pumps -- add an auto-start for an on-line spare or add a booster pump in the problem area.
- Use booster pumps for small loads requiring higher pressures.
- Increase fluid temperature differentials to reduce pumping rates.
- Repair seals and packing to minimize water waste.
- Balance the system to minimize flows and reduce pump power requirements.
- Use siphon effect to advantage: don't waste pumping head with a free-fall (gravity) return.

23.7 Chillers

- Increase the chilled water temperature set point if possible.
- Use the lowest temperature condenser water available that the chiller can handle.
- (Reducing condensing temperature by 5.5°C, results in a 20 - 25% decrease in compressor power consumption)
- Increase the evaporator temperature
- (5.5°C increase in evaporator temperature reduces compressor power consumption by 20 - 25%)
- Clean heat exchangers when fouled.
- (1 mm scale build-up on condenser tubes can increase energy consumption by 40%)
- Optimize condenser water flow rate and refrigerated water flow rate.
- Use water-cooled rather than air-cooled chiller condensers.
- Use energy-efficient motors for continuous or near-continuous operation.
- Specify appropriate fouling factors for condensers.
- Do not overcharge oil.
- Install a control system to coordinate multiple chillers.
- Study part-load characteristics and cycling costs to determine the most-efficient mode for operating multiple chillers.
- Run the chillers with the lowest operating costs to serve base load.
- Avoid oversizing -- match the connected load.
- Isolate off-line chillers and cooling towers.
- Establish a chiller efficiency-maintenance program. Start with an Energy & Safety Audit and follow-up, then make a chiller efficiency-maintenance program a part of your continuous energy management program.

23.8 HVAC (Heating / Ventilation / Air Conditioning)

- Tune up the HVAC control system.
- Consider installing a building automation system (BAS) or energy management system (EMS) or restoring an out-of-service one.
- Balance the system to minimize flows and reduce blower/fan/pump power requirements.
- Eliminate or reduce reheat whenever possible.
- Use appropriate HVAC thermostat setback.
- Use building thermal lag to minimize HVAC equipment operating time.
- In winter during unoccupied periods, allow temperatures to fall as low as possible without freezing water lines or damaging stored materials.
- In summer during unoccupied periods, allow temperatures to rise as high as possible without damaging stored materials.
- Improve control and utilization of outside air.
- Use air-to-air heat exchangers to reduce energy requirements for heating and cooling of outside air.

- Reduce HVAC system operating hours (e.g. -- night, weekend).
- Optimize ventilation.
- Ventilate only when necessary. To allow some areas to be shut down when unoccupied, install dedicated HVAC systems on continuous loads (e.g. -- computer rooms).
- Provide dedicated outside air supply to kitchens, cleaning rooms, combustion equipment, etc. to avoid excessive exhausting of conditioned air.
- Use evaporative cooling in dry climates.
- Clean HVAC unit coils periodically and comb mashed fins.
- Upgrade filter banks to reduce pressure drop and thus lower fan power requirements.
- Check HVAC filters on a schedule (at least monthly) and clean/change if appropriate.
- Check pneumatic controls air compressors for proper operation, cycling, and maintenance.
- Isolate air conditioned loading dock areas and cool storage areas using high-speed doors or clear PVC strip curtains.
- Install ceiling fans to minimize thermal stratification in high-bay areas.
- Relocate air diffusers to optimum heights in areas with high ceilings.
- Consider reducing ceiling heights.
- Eliminate obstructions in front of radiators, baseboard heaters, etc.
- Check reflectors on infrared heaters for cleanliness and proper beam direction.
- Use professionally-designed industrial ventilation hoods for dust and vapor control.
- Use local infrared heat for personnel rather than heating the entire area.
- Use spot cooling and heating (e.g. -- use ceiling fans for personnel rather than cooling the entire area).
- Purchase only high-efficiency models for HVAC units.
- Put HVAC window units on timer control.
- Don't oversize cooling units. (Oversized units will "short cycle" which results in poor humidity control.)
- Install multi-fueling capability and run with the cheapest fuel available at the time.
- Consider dedicated make-up air for exhaust hoods. (Why exhaust the air conditioning or heat if you don't need to?)
- Minimize HVAC fan speeds.
- Consider desiccant drying of outside air to reduce cooling requirements in humid climates.
- Seal leaky HVAC ductwork.
- Seal all leaks around coils.
- Repair loose or damaged flexible connections (including those under air handling units).
- Eliminate simultaneous heating and cooling during seasonal transition periods.
- Zone HVAC air and water systems to minimize energy use.
- Inspect, clean, lubricate, and adjust damper blades and linkages.
- Establish an HVAC efficiency-maintenance program. Start with an Energy & Safety Audit and follow-up, then make an HVAC efficiency-maintenance program a part of your continuous energy management program.

23.9 Lighting

- Reduce excessive illumination levels to standard levels using switching,de-lamping, etc. (Know the electrical effects before doing de-lamping.)
- Aggressively control lighting with clock timers, delay timers, photocells, and/or occupancy sensors.
- Install efficient alternatives to incandescent lighting, mercury vapor lighting, etc. Efficiency (lumens/watt) of various technologies range from best to worst approximately as follows: low pressure sodium, high pressure sodium, metal halide, fluorescent, mercury vapor, incandescent.
- Select ballasts and lamps carefully with high power factor and long-term efficiency in mind.
- Upgrade obsolete fluorescent systems to Compact fluorescents and electronic ballasts
- Consider lowering the fixtures to enable using less of them.
- Consider day-lighting, skylights, etc.
- Consider painting the walls a lighter color and using less lighting fixtures or lower wattages.
- Use task lighting and reduce background illumination.
- Re-evaluate exterior lighting strategy, type, and control. Control it aggressively.
- Change exit signs from incandescent to LED.

23.10DG Sets

- Optimize loading
- Use waste heat to generate steam/hot water /power an absorption chiller or preheat process or utility feeds.
- Use jacket and head cooling water for process needs
- Clean air filters regularly
- Insulate exhaust pipes to reduce DG set room temperatures
- Use cheaper heavy fuel oil for capacities more than 1MW

23.11Buildings

- Seal exterior cracks/openings/gaps with caulk, gasketing, weatherstripping, etc.
- Consider new thermal doors, thermal windows, roofing insulation, etc.
- Install windbreaks near exterior doors.
- Replace single-pane glass with insulating glass.
- Consider covering some window and skylight areas with insulated wall panels inside the building.
- If visibility is not required but light is required, consider replacing exterior windows with insulated glass block.
- Consider tinted glass, reflective glass, coatings, awnings, overhangs, draperies, blinds, and shades for sunlit exterior windows.

- Use landscaping to advantage.
- Add vestibules or revolving doors to primary exterior personnel doors.
- Consider automatic doors, air curtains, strip doors, etc. at high-traffic passages between conditioned and non-conditioned spaces. Use self-closing doors if possible.
- Use intermediate doors in stairways and vertical passages to minimize building stack effect.
- Use dock seals at shipping and receiving doors.
- Bring cleaning personnel in during the working day or as soon after as possible to minimize lighting and HVAC costs.

23.12Water & Wastewater

- Recycle water, particularly for uses with less-critical quality requirements.
- Recycle water, especially if sewer costs are based on water consumption.
- Balance closed systems to minimize flows and reduce pump power requirements.
- Eliminate once-through cooling with water.
- Use the least expensive type of water that will satisfy the requirement.
- Fix water leaks.
- Test for underground water leaks. (It's easy to do over a holiday shutdown.)
- Check water overflow pipes for proper operating level.
- Automate blow-down to minimize it.
- Provide proper tools for wash down -- especially self-closing nozzles.
- Install efficient irrigation.
- Reduce flows at water sampling stations.
- Eliminate continuous overflow at water tanks.
- Promptly repair leaking toilets and faucets.
- Use water restrictors on faucets, showers, etc.
- Use self-closing type faucets in restrooms.
- Use the lowest possible hot water temperature.
- Do not use a heating system hot water boiler to provide service hot water during the cooling season -- install a smaller, more-efficient system for the cooling season service hot water.
- If water must be heated electrically, consider accumulation in a large insulated storage tank to minimize heating at on-peak electric rates.
- Use multiple, distributed, small water heaters to minimize thermal losses in large piping systems.
- Use freeze protection valves rather than manual bleeding of lines.
- Consider leased and mobile water treatment systems, especially for de-ionized water.
- Seal sumps to prevent seepage inward from necessitating extra sump pump operation.
- Install pretreatment to reduce TOC and BOD surcharges.
- Verify the water meter readings. (You'd be amazed how long a meter reading can be estimated after the meter breaks or the meter pit fills with water!)
- Verify the sewer flows if the sewer bills are based on them.

23.13Miscellaneous

- Meter any unmetered utilities. Know what is normal efficient use. Track down causes of deviations.
- Shut down spare, idling, or unneeded equipment.
- Make sure that all of the utilities to redundant areas are turned off -- including utilities like compressed air and cooling water.
- Install automatic control to efficiently coordinate multiple air compressors, chillers, cooling tower cells, boilers, etc.
- Renegotiate utilities contracts to reflect current loads and variations.
- Consider buying utilities from neighbors, particularly to handle peaks.
- Leased space often has low-bid inefficient equipment. Consider upgrades if your lease will continue for several more years.
- Adjust fluid temperatures within acceptable limits to minimize undesirable heat transfer in long pipelines.
- Minimize use of flow bypasses and minimize bypass flow rates.
- Provide restriction orifices in purges (nitrogen, steam, etc.).
- Eliminate unnecessary flow measurement orifices.
- Consider alternatives to high-pressure drops across valves.
- Turn off winter heat tracing that is on in summer.

ANNEXURES

Annex I –Certification

This part shall indicate certification by Accredited Energy Auditor stating that:

(i) The data collection has been carried out diligently and truthfully;

(ii) All data monitoring devices are in good working condition and have been calibrated or certified by approved agencies authorized and no tempering of such devices has occurred

(iii) All reasonable professional skill, case and diligence had been taken in preparing the energy audit report and the contents thereof are a true representation of the facts;

(iv) Adequate training provided to personnel involved in daily operations after implementation of recommendations; and

(v) The energy audit has been carried out in accordance with the Bureau of Energy Efficiency (Manner and Intervals of Time for the Conduct of Energy Audit) Regulations, 2010.

(Dr. P.P. Mittal)

Accredited Energy Auditor AEA-011

Annex II –Certificate of Accreditation

BUREAU OF ENERGY EFFICIENCY

Examination Registration No. : EA-6851

Accreditation Registration No.: AEA-0011

Certificate of Accreditation

This is to certify that Mr./Ms. Prem Prakash Mittal having its trade/registered office at Delhi has been given accreditation as accredited energy auditor. The certificate shall be effective from 26th day of February 2013.

The certificate is subject to the provisions of the Bureau of Energy Efficiency (Qualifications for Accredited Energy Auditors and Maintenance of their List) Regulations, 2010.

This certificate shall be valid until it is cancelled under regulation 9 of the Bureau of Energy Efficiency (Qualifications for Accredited Energy Auditors and Maintenance of their List) Regulations, 2010

On cancellation, the certificate of accreditation shall be surrendered to the Bureau within fifteen days from the date of receipt of order of cancellation.

Your name has been entered at AEA No. 0011 in the register of list of accredited energy auditors. Your name shall be liable to be struck out on the grounds specified in regulation 8 of the Bureau of Energy Efficiency (Qualifications for Accredited Energy Auditors and Maintenance of their List) Regulations, 2010.

Given under the seal of the Bureau of Energy Efficiency, Ministry of Power, this 26th day of May 2014.

Secretary,
Bureau of Energy Efficiency
New Delhi

ANNEX III–Lighting Load Details

Location	LED Tube (18W)	LED Tube (18Wx2)	LED Tube (12W)	LED Bulb (5W)	LED Bulb (9W)	LED COBE (18W)	LED Round (36W)	LED-36W (2'x2')	Fancy LED	LED Light (30W)	LED Light (150W)	Mirchi Bulb (50W)	T5 Tube (14Wx2)	T5 Tube Light (28W)	T8 Tube Light (36W)	T8 Tube Light (36Wx2)	T5 Tube Light (28W)	T-5 Tube Light (28Wx2)	Hallozan (250W)	Hallozan (400W)	CFL (9W)	CFL (11Wx2)	CFL (13Wx2)	CFL 18W (4 pin)	CFL (18Wx2)	CFL-36WX3 (2'x2')	CFL (65W)	Fan	Wall Fan	Fresher	Ext	Geyser
BLOCK-A IInd Floor																																
A-202															26													7				
A-203															14													4				
A-204															14													4				
A-205															31													9				
A-207&6															21													7				
A-208															6													2				
															22													10				
A-210																											7	7				
Room																											10	11				
Gallery																						20										
Ist Floor																																
A-109															3													3				
A-110															14							3						15				
A-111															17													14				
A-112															28													13				
															7													2				
Lobby															4							1						1				
A-108															7													4				
A-107,106															34													10				
A-105															30													14				
Gallery																						20										

A-114															8													4				
Dean room															14													5				
A-103															14													5				
Toilet															1						3											
G. Floor																																
A-001															12	4						7						9				
A-003															4													1				
A-004															4													1				
A-005															1	1												3				
Lobby															2	1						30						1				
Room-111															14													4				
A-112															12													2				
A-113															12													4				
															14													5				
A-015																18												12				
Lobby																						3										
Room															14													8				
Room															15													7				
A-018																											2	1				
Room															7													3				
A-020	3														9													8				
Himanshu Sanghai (Associate Dean)																						4					2		1			
A-017															34													15				
A-023															4													2				
Wash room															2													1		1		
BLOCK-B_IInd Floor																																
Faculty Room															4													5				
Wash room(G)															1																1	
Wash room(L)															2																2	
															2																	
Room															1						4										2	
B-204															2													4				

B-205															2													4				
B-203															9													9				
B-202															7													8				
Gallery																						9										
Ist Floor																																
Corridoor																						7										
B-101															12													8				
B-102A															14													6				
B-103															4													4				
B-104															4													4				
B-102															8													9				
B-105															6													6				
B-106															1														1			
Toilet (B)																					4										2	
Toilet (G)																					4										2	
Ground Floor																																
Lobby																						2										
Library	39									19																		21				
Reception																								28		4		3				
BLOCK - C IInd Floor																																
UPS															1													1				
C-202																											6	4				
C-203															8													5				
Faculty Room															2													1				
Faculty Room																											3	3				
Room																											14	8				
Ist Floor																																
Lobby																										3						
Room 101															2													2				
C-108															1													2				
C-102																6									5				3			
C-103																8								17								
C-105															13													9				

Room															10													5				
Ground Floor																																
Lobby																										2						
Admission Office																																
Lobby																								5								
Counceling room	4				4			4																4			6	7	1			
Server room								4																								
Theater						6																						1				
BLOCK - D_5th Floor																																
D - 501															1							19										
D - 504		1																										1				
D - 505																																
Wash Room																																
D - 507																																
D - 508						16																						8				
D - 509		8																										4				
Lobby																				7				63								
D - 515													1									18										
D - 524 (micro-biology)		9																						2				5			1	
D - 524 (Central Store)		3																										2				
D - 524 (Pharma-ceutical analysis)		7																										5			1	
D - 510		11																										5				
Wash Room (G)															1									5							2	
Wash Room (L)															1									5							2	
Store																																
D - 517																																
D - 516																																
D - 514																3						14						1				
D - 513															2													1				
D - 512															2													1				

D - 511																1																
D - 507																							2									
4th Floor																																
D- 412															2								18									
D - 411																2							14					1				
D - 410															2													1				
D - 409														1	2													1				
D - 408																11												5				
D -407																1												6				
D - 404			1																													
D - 406															2													1				
D - 405																8												6				
D - 403, 402	1														2										6			1				
D - 401														1									19									
Lobby																						7		7	67							
D - 422																8												4				
D - 421																																
D - 418															1													2				
D - 417															1													2				
D - 414													7												5				1			
D - 413																9							10					10				
D - 413 (B)																13												10				
3rd Floor																																
D - 311	2																						18									
D - 310																3									14			1				
D - 309															2													1				
D - 308			1													1												1				
D - 306															1																	
Lobby																						2			67							
D - 304																									2						1	
D - 305																10												8				
D - 303, 302	2													1	1										6			2				
D - 301														3									19									
D - 322																8												3				

D - 321															11										6								
D - 320															9										8								
D - 307															11										6								
D - 317														1								2							2				
D - 316														1								2							2				
D - 313													7											4				1					
D - 312 (A)														3	3									3				4					
D - 312 (B)															10										4								
D - 312 (C)															11										4	1							
IT Head			2																					1									
IT Department																				3				1				4					
2nd Floor																																	
D - 212												3									18												
Director (HR)															2									10				1					
D - 210														2														1					
D - 209														2														1					
D - 208															8																		
D - 207														1																			
D - 204			1																														
D - 206														2	1													1					
D - 205															8										5								
D–203 (Registrar Office)	2																							7				1					
D - 202	2																							7				1					
D - 201												3									18												
D - 223															8										8								
D - 222 (Debate Room)																																	
D - 221 (Physics Lab)															11										6								
D - 221 Human Anotomy)															9										6								
D - 216 (Toilet-G)														1										3						1			

D - 217 (Toilet-L)															1										3						1	
D - 214													8												4				4			
D - 213															1							28			4			11			7	
Lobby															1							6			65							
1st Floor																																
D-113														3									18									
D-112																																
D-111																5									5			1	1			
D-109															2													1				
D-110															3													1				
D-111																2									8			1				
D-107															1																	
D-106																									1						1	
D-105	2															8												6				
D-104																									6			1				
D-103														1											2			1				
D-102																																
D-101														2									18									
D-124																8												8				
D-123																11												6				
D-122																9												6				
D-108																11												6				
D-119															1										5						2	
D-118															1										5						2	
D-116																																
D-115																							4						1			
D-114						8									2	4									29			6	1			
Lobby																						5			63							
Ground Floor																																
Wash Room (L)															1										2						2	
Wash Room (G)															1										2						2	
D - 021	1															2													1			

D - 019 Kitchen	2				5	10										21								1			1					
Restaurant												8															5					
Bar					5							8												12								
Toilet																								1						1		
Elect. Room															1																	
D - 006																2												1				
D - 009			2																					7			2	1				
D - 007						1									2												1					
D - 008															2												1					
Room													2														1					
D - 002																					6						4					
D - 001																					1						1					
Lobby				12	19	43															4			16								
CCTV		10																									2					
Facility Manager														1	3												2	1		1		
HOSTEL																																
Rooms (48 +48)				192	96										192												192				96	
Common Area																					40											
Guest Room															6								10								6	
Warden															6																2	
Mash (B)																				20					5							
Mash (G)																				20					5							
Law College																							10									
IInd Floor																																
Faculty Room - 12		2																									3					
Food Court - 13		11																									9					
Lobby		4				4															4											
Class Room - 09																9					4						4					
Class Room - 10																8					5						9					
Class Room - 11		8																									5					
Toilet															5														2			
Ist Floor																																

Faculty Room - 08																		9				1						3	4			
Room - 7																		3										2				
Washroom																									1					1		
Corridor																		4				13										
Room - 6																		2										1				
Room - 5																		4										3				
Kitchen																						1								1		
Class Room - 4																						5				4		4				
Class Room - 3																						15				7		4				
Gents Wash Room																						3				2				1		
Ladies Wash Room																						2				1				1		
Ground Floor																																
Class Room - 1	7															9						2						8				
Class Room - 2																4												4				
Toilet																																
A/c Maint.																	2											1				
Library																20						8			5			10	1			
Toilets (HE)	1																														1	
Toilet (She)	1																														1	
E - Block																																
2nd Floor																																
Room - 204		6				3																						6				
E - 205		9				3																						6				
E - 206		9				3																						6				
E - 207		9				3																						6				
E - 208		6				6																						6				
Corridor						27																										
5th Floor		39				45																						30				
4th Floor		39				45																						30				
3th Floor		39				45																						30				
1st Floor		39				45																						30				
Ground floor																																

Library							21																					16				
Lift lobby & Corridor						35			21																							
G-06		8																										4				
Basement	20														20		10											10				
Maintenance Office															5	3												3			4	
Out side											5								2	8												
Cricket net											20																					

ANNEXURE IV–Venders List

The details of suppliers/manufacturers of energy efficient technologies are provided below.

Srl.	Product / Equipment	Agency Name / Address
1	DG Synchronization, Automation and capacitors	SGS Industrial Controls & Solutions Pvt. Ltd. Floor-II, MadanpurKhadar, SaritaVihar, New Delhi Tel. 011-29942516, 41402992
2	Eco-Ventilators	Nu Plast Pipes &profilies SCF – 124, Sector – 17 Market, Faridabad - 121002 Tel. 0129-6456217, 4070023
3	Electrical measurement Instrument	Riken Instrument Ltd. 369, Industrial Area, Phase –II, Panchkula Haryana Tel. : 0172-2591651, 2592028 www.rikeninstrumentation.com
4	Energy Management & Control System	Manaco Energy Solutions (P) Ltd. A-6, Shanti Apts. 21 & 22,1st Cross St.TTKRoad, Alwarpet Chennai-18, Tel. 044-42316164 www.mesco.co.in
5	Energy Saving Products	Gautam Enterprises 205, VinayIndl. Est. ChicholiBunder Link Road, Malad(W) Mumbai – 6, India
4	Energy Saving Products	Techmark Engineers & Consultants K-1/28, Ground Floor, Chittaranjan Park, New Delhi – 110019Tel. 011-26238349
5	Flue Gas Analyzer/ Oxygen Analyzer	Nevco Engineers Pvt. Ltd. 90A, (2nd Floor) Amritpuri B, main Road, East of kailash, Opp. Iskcon Temple, New Delhi – 110 065 Tel. 26226328, 26213009 www.nevco.co.in
6	Flue Gas Analyzer/ Oxygen Analyzer	ACE Instruments & Controls 1 Birandari, Above Kashi Dairy MG Road,

		Ghatkopar (W) Mumbai – 400 086 Tel. 5125153, 5122762
7	FRP Blades & Cooling Tower accessories	Eneertech Engineers SCO 144 – 145, Sector – 34A, Chandigarh Tel. 0172-5018077, 9876022225
8	HVAC related instruments Thermocouples pipe fittings pressure gauges	Waaree, 36 Damjishamji Industrial Complex, Off Mahakali caves Road, Andheri (E) Mumbai tel. 02266963030, 26874778
9	Infrared Temperature Meters (600 °C to 1800 °C	Toshniwal Industries Pvt. Ltd. Industrial Area MahU.Pupura, Ajmer – 305 002 Tel. 91145 2695171, 91145 2695205
10	Infrared Temperature Meters (upto 1500 °C)	KusamMeco, G-17, Bharat Industrial Area, T.J. Road, Sewree Mumbai – 400015 Tel. 02224156638, 24124540
11	AC Drives	Rockers Control System SCO 819 2nd Floor, NAC Manimajra, Chandigarh – 160101 Tel. 0172-2730900, 5071627
12	AC Drives	Allen Bradley India Ltd. C – 11, Industrial Area, Site – IV, Sahibabad, Ghaziabad
13	AC Drives	Asea Brown Boveri Ltd. Guru Nanak Foundation Building, 15 – 16, Qutab Institutional Area, SaheedJeet Singh Sansnwal Marg, New Delhi 110 067
14	AC Drives	Crompton Greaves Ltd. Machine 3 Division, A – 6 / 2, MIDC Area, Ahmednagar
15	Automation, Panel Meters	Conzerv System 44P, Electronic City Phase –II, East Hosur Road, Banglore – 560100
16	Automation, Panel Meters	Selec controls Pvt. Ltd. E-121 Ansa Industrial Estate, Saki Vihar Road, Mumbai 400072

		Tel.: 022-28471882, 28476443 www.selecindia.com
17	Building Automation, sensors, twilight Switches	Electro Art Plot No. K-11, MIDC Area, Ambad, Nasik – 422010 Tel. 0253-5603954, 2380918, www.electronicswitchesindia.com
18	Burners	Wesman Engineering (P) Ltd. 503-504 Eros Apartments, 56, Nehru Place, New Delhi – 110019 Tel. : 26431723, 26434577
19	Burners, Furnace RecuperatorsHor air Generation, Heating & Pumping unit Laddle pre-heating	ENCON 12/3, Mathura Road, Faridabad – 121003 Tel. : 0129-25275454 www.encon.co.in
20	Capacitors	Asian Electronics Ltd. Plot No. 68, MIDC, Satpur, Nasik – 422 007
21	Capacitors	Shreem Capacitors Pvt. Ltd. /39, VikramVihar, Lajpat Nagar-IV, New Delhi – 110024
22	Capacitors & APFC Panels	Matrix Controls & Engineers Pvt. Ltd. E-725, DSIDC Industrial Complex, Narela, GT Road, Delhi – 011-27786945 / 46 / 47 Rajeev Batra 9811624440, Rajeev@matrixcapacitor.com
23	Capacitors & APFC Panels	Standard Capacitors B-70/43, DSIDC Complex, Lawrence Road, Industrial Area,, Delhi – 110035Tel: 011-27181490, 27151027 www.standardcapacitors.com
24	Capacitors & APFC Panels	Saif Electronics 174, Hira Building, 1st Floor, Carnac Road, Opposite Police Commissioner Officer Mumbai Tel. 022-22064626, 22086613 www.saifel.com
25	Insulations	Llyod Insulations (India) Ltd. PB NO. 4321, Kalkaji Industrial Area,

		Punj Sons Premises, New Delhi Tel. : 26430746-7
26	Insulations	Hirnal Supply (India) Ltd. 168, Rajagarden, New Delhi – 110015 Tel: 011-25438602, 25448602
27	Insulations	Technical & Management Consultancy Center SCO – 324, 2nd Floor, Cabin – 203, Sector – 9, Panchkula Ry_tmcc@yahoo.com
28	LED Lighting	Synergy Solar (P) Ltd. SCO 133, Sector 28D, Chandigarh Tel. : 0172-6451133, www.synergysolars.com
29	Lighting system	Philips India Ltd. Regional Office-North, 9th Floor Ashoka Estate, 24, Barakhamba Road, New Delhi – 110 001 Tel. : 3353280, 3317442
30	Lighting system	Crompton Greaves Ltd. Lighting Business Group, 405, Concorde, RC Dutt Road, Baroda – 390 007
31	Lighting system	Osram India Ltd. Signature Towers, 11th Floor, Tower B, South City-I, Gurgaon -122001Tel.: 0124-6526175, 6526178, 6526285
32	Lighting system	Asian Electronics Surya Place, First Floor, K-185, Sarai Julena New Friends Colony, New Delhi – 110 025
33	Lighting system	Philips India Limited, Technopolis Knowledge Park, Nelco Complex, Mahakali Caves Road, Chakala, Andheri (E) Mumbai – 400 093 Tel : 022 56912000
34	Lighting system	Surya Roshni Ltd. Padma Tower_I, Rajendra Palace, New Delhi – 110 006
35	Lighting system	Wipro Limited

		SCO – 196-197, Sector – 34-A, Chandigarh – 160 022
36	Lighting Voltage Control Systems	Jindal Electric & machinery Corporation C – 57, Focal Point, Ludhiana – 141010 Tel. : 2670250, 2676890
37	Lighting Voltage Control System	ES Electronics (India) Pvt. Ltd. Plot No. 82, KIADB Industrial Area, Bommasandra – Jigani Link Road, JiganiHobli Banglore – 562 106

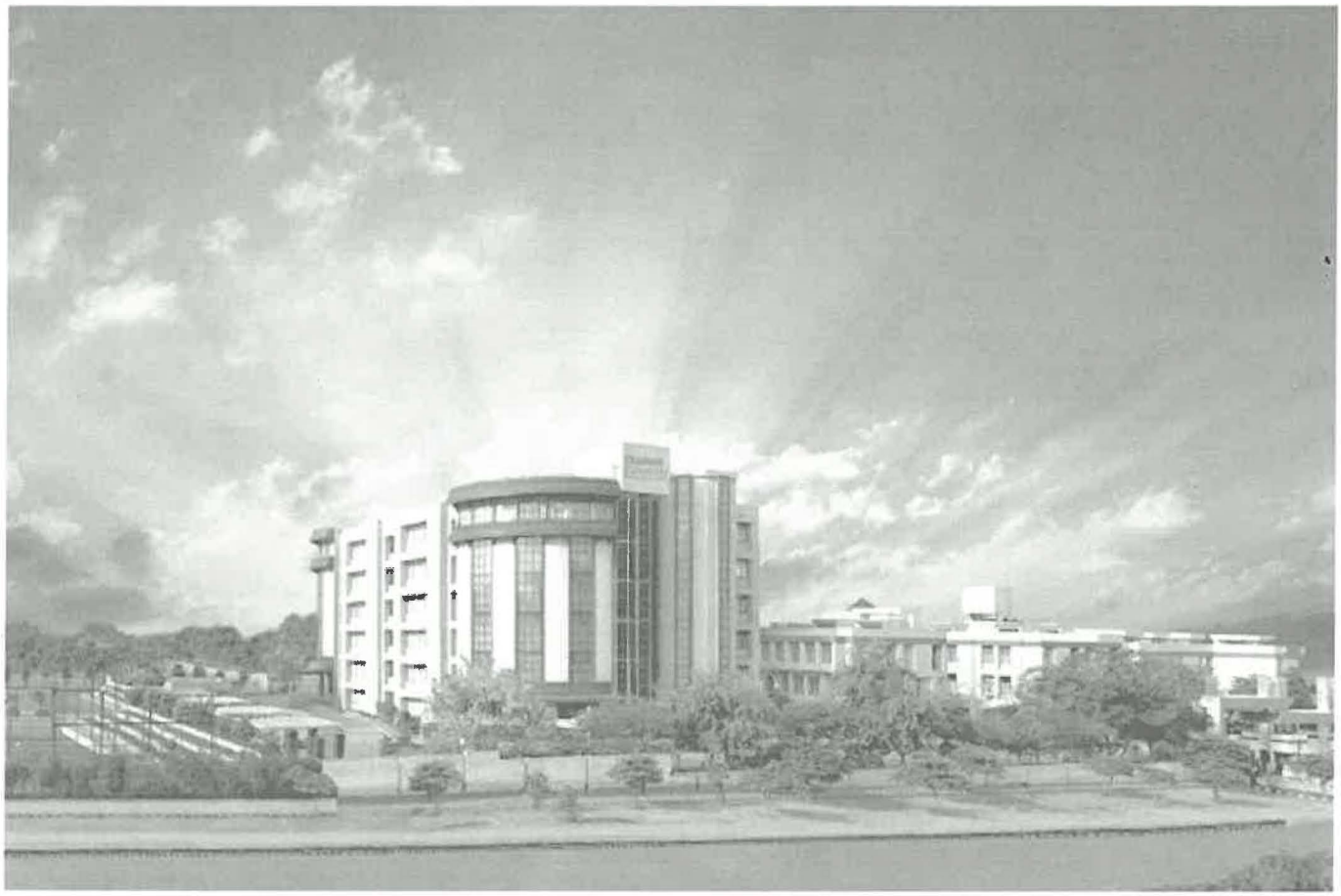
GREEN/ ENVIRONMENTAL AUDIT
2023 - 2024

Sushant University

Sushant University

GREEN AUDIT REPORT

2023- 2024



SUSHANT UNIVERSITY

SECTOR - 55, GURUGRAM – 122003 (HARYANA)

CONDUCTED BY :

A-Z ENERGY ENGINEERS PVT. LTD.

PLOT NO. 12, 4860-62, HARBANS SINGH STREET, KOTHI NO. 24, WARD NO. II, DARYA GANJ, NEW DELHI-11002

011-23240541, 9811402040 pp_mittal@yahoo.com

Contents

(2013)

एक कदम स्वच्छता की ओर

Save Energy Save Earth

A-Z ENERGY ENGINEERS PVT. LTD.

(An ISO 9001:2015 Certified Company)

Winner

- Best Entrepreneur Award By Hon'ble Prime Minister of India
- Best Entrepreneur Award By Hon'ble Chief Minister, Haryana
- Awards by AEE Atlanta, USA in 2016, 2018, 2020 & 2021
- National Energy Conservation Award – 2016, 2015 & 2013
- Haryana State Energy Conservation Award – 2012, 2017 & 2018

Corporate Identity Number : U40300DL2012PTC236342

ACCREDITED BY BEE No.: 0011 **EMPANELMENT NO. EmAEA-0024** **ESCO BY BEE : 980/20AUG2020**

Certificate

This is to certify that Team of A-Z Energy Engineers Pvt. Ltd. Delhi, Headed by Dr. P.P. Mittal, Accredited Energy Auditor and his team had carried out **Green, Energy and Environment Study** of **Sushant University**, Sector 55, off Golfcourse road, Near AIT Chowk, Gurugram (Haryana)-122003,in the month of April 2024.

It is further intimated that the data collection had been carried out diligently and truthfully. All reasonable professional skill, case and diligence had been taken in preparing the reports and the contents thereof are a true representation of the facts.

26th April 2024

Dr. P. P. MITTAL
Director

HEAD OFFICE: 4860-62, Harbans Singh Street Plot No. 12, Kothi No.24, Ward No.II, Darya Ganj, Delhi – 110002
CORPORATE OFFICE: 423, SECTOR 21A, FARIDABAD – 121001 TEL. 0129-4046120,+91 9811402040
pp mittal@yahoo.com, info@energyengineers.co.in, www.energyengineers.co.in

Executive Summary

A nation's growth starts from its educational institutions, where the ecology is thought as a prime factor of development associated with environment. A clean and healthy environment aids effective learning and provides a conducive learning environment. Educational institutions now a day are becoming more sensitive to environmental factors and more concepts are being introduced to make them eco-friendly. To preserve the environment within the campus, various viewpoints are applied by the several educational institutes to solve their environmental problems such as promotion of the energy savings, recycle of waste, water reduction, water harvesting etc. The activities pursued by university can also create a variety of adverse environmental impacts.

Environmental auditing is a process whereby an organisation's environmental performance is tested against its environmental policies and objectives.

Green audit is defined as an official examination of the effects a university has on the environment. As a part of such practice, internal environmental audit (Green Audit) is conducted to evaluate the actual scenario at the campus.

Green audit can be a useful tool for a university to determine how and where they are using the most energy or water or resources; the university can then consider how to implement changes and make savings. It can also be used to determine the type and volume of waste, which can be used for a recycling project or to improve waste minimization plan. Green auditing and the implementation of mitigation measures is a win-win situation for all the university, the learners and the planet. It can also create health consciousness and promote environmental awareness, values and ethics. It provides staff and students better understanding of Green impact on campus. Green auditing promote financial savings through reduction of resource use. It gives an opportunity for the development of ownership, personal and social responsibility for the students and teachers.

If self-enquiry is a natural and necessary outgrowth of a quality education, it could also be stated that institutional self-enquiry is a natural and necessary outgrowth of a quality educational institution. Thus, it is imperative that the university evaluate its own contributions toward a sustainable future. As environmental sustainability is becoming an increasingly important issue for the nation, the role of higher educational institutions in relation to environmental sustainability is more prevalent.

Google Earth image of Sushant University Campus

Introduction

In SUSHANT UNIVERSITY GURUGRAM the audit process involved initial interviews with management to clarify policies, activities, records and the cooperation of staff and students in the implementation of mitigation measures.

This was followed by staff interviews, review of records, observation of practices and observable outcomes. In addition, the approach ensured that the management and staff are active participants in the green auditing process in the university.

The baseline data prepared for the SUSHANT UNIVERSITY GURUGRAM will be a useful tool for campus greening, resource management, planning of future projects, and a document for implementation of sustainable development of the university. Existing data will allow the university to compare its programmes and operations with those of peer institutions, identify areas in need of improvement, and prioritize the implementation of future projects. We expect that the management will be committed to implement the green audit recommendations.

Water is a very precious commodity and merely by un-restricted drawing of water from bore wells and its very low subsidized tariff from municipal authority is a main impediment in water conservation in India.

Though, water is renewable and is replenished through water cycle but increasing population and industrial requirement are posing a very serious threat on availability of water for all on the Earth.

It is excellent that the management of SUSHANT UNIVERSITY GURUGRAM and other staff has great respect for sustainable living and are always acting at the right time for remedial measures for protection of Environment and ultimately caring for Society by reduction of resource use.
The Mantra followed is ***REDUCE-REUSE AND RECYCLE***.

General Recommendations

- Display of Green Policy at following prominent locations inside the premises.
  a. Near main gate
  b. At main entrance of Administrative Building
  c. All Hostels/Mess
  d. Academic Blocks
  e. Auditorium
  f. Canteen/Cafeteria.
- Signage for Tobacco free campus be displayed at prominent locations in campus.
- Signage for Food wastage be displayed at important locations of Canteen/Messes and Cafeteria in campus.
- Signage for Water conservation be displayed at important locations in campus.
- Signage for plastic free campus
- Signage for Segregation of waste.
- Provision of different dust bins as a set at a common location.
- Stack Height of DG set exhaust is not as per CPCB requirement.
- Fume exhaust hoods are not provided in chemistry lab which is not proper. It should be discharged above building height. Presently fumes are dispersing around building affecting local environment.

Environmental & Green Policy– Sushant University Gurugram

Policy Statement

The Sushant University, Gurugram is committed to managing its estates in accordance with responsibilities to the environment. These responsibilities shall be demonstrated within the following areas as a minimum:

1. **Tobacco Free premises** : The college administration pledges to make the premises totally tobacco free. No smoking or other type of tobacco products shall be allowed to inside the University campus.

2. **Purchasing:** In purchasing its services, materials, equipment and consumable items, the University will, where possible, purchase items produced in ways which do least environmental harm, which are not supplied with excessive packaging; which are benign or at least harmless in their effect on the environment. Where possible, preference will be given to local or regional suppliers to maximize the university input to the local community as well as reduction of environmental impact due to transportation.

3. **Cleaning**: The University shall use cleaning products based on environmental considerations as well as cost and suitability. It will monitor its working practices with a view to administering dosages so as to reduce the risk of over concentration and excess residue of unused cleaning mixtures finding their way into piped waste disposal systems.

4. **Waste Disposal and Recycling**: The University will seek to minimize its generation of waste by reduction of purchased materials where this does not compromise its primary functions, or by re-use of materials within or outside the university campus. Where reduction or re-use is not feasible, materials will be recycled wherever possible.

5. **Energy**: The University is environmentally responsible for its use of energy, and will therefore consider the sources, type, origin and destination of energy input and output throughout the College. This will require careful monitoring of consumption, the

1. elimination of excessive or unnecessary use, and an ongoing program of energy conservation. There is already renewable energy solar PV plants installed and in future also efforts shall be made to use renewable energy to the extent possible for mitigation of impact of energy use by university on environment.

6. **New Build and Building Refurbishment:** The College will ensure that whenever new construction or refurbishment, work is planned and executed in a manner which reflects environmentally-responsible approaches defined by the National Building Code-2016.

7. **Green Travel Plan**: The University actively promotes the use of public transport, walking and cycling. The College owns vehicle and requires staff where possible to use public transport when on College assignments. This plan is regularly reviewed. The travel of students shall also be encouraged through public transport.

8. **Food Policy** : The College, will ensure that decisions pertaining to the purchase of food, together with the use and disposal of plastic crockery/cutlery, should at all times include environmental implications as well as such factors as cost and nutritional value.

9. **Environmental Rules and Guidelines**: The College commit to ensure compliance to extant pollution control and other applicable environmental guidelines.

10. **Water Use**: The University intends to promote optimization of water use by avoidance of wastage, treatment and re-use of black water for other possible uses.

11. **The college also commits for Plastic free environment in college premises**.

The policy shall be reviewed annually or as per requirement.

Description of Campus

There are following blocks constructed in campus

1. Administration Building
2. A-Block
3. B and C Block
4. D -Block
5. E-Block
6. Hostel Block
7. LT Panel Area

Pre Audit meeting

A pre-audit meeting provided an opportunity to reinforce the scope and objectives of the audit and discussions were held on the practicalities associated with the audit. This meeting is an important prerequisite for the green audit because it is the first opportunity to meet the University concerned personnel for audit and deal with any concerns.

Management's Commitment

The Management of the university has shown the commitment towards the green auditing during the pre-audit meeting. They were ready to encourage all green activities. It was decided to promote all activities that are environment friendly. Awareness programs on the environment are regularly conducted, the management of the University was willing to formulate policies based on green auditing report.

Scope and Goals of Green and Environment 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. Green Audit is the most efficient and ecological way to manage environmental problems. It is a kind of professional care which is the responsibility of each individual who are the part of economical, financial, social, environmental factor. It is necessary to conduct green audit in university campus because students become aware of the green audit, its advantages to save the planet and they become good citizens.

Benefits of the Green and Environment Auditing

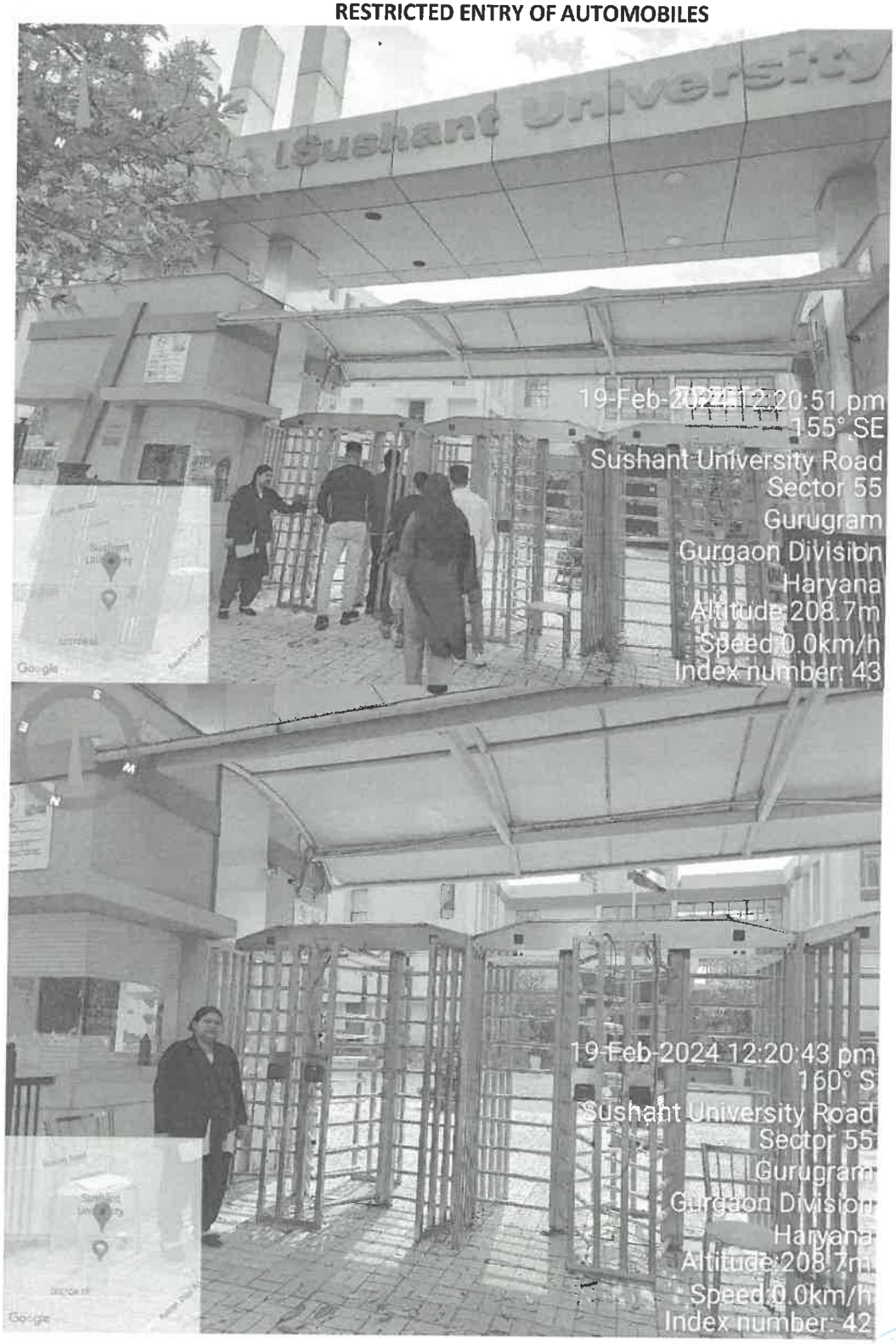
- More efficient resource management
- To provide basis for improved sustainability
- Financial savings through a reduction in resource use
- Enhance the alertness for environmental guidelines and duties
- Development of ownership, personal and social responsibility for the University and its environment
- Enhancement of university profile
- To create a green campus
- To enable waste management through reduction of waste generation, solid-waste and water recycling
- To create plastic free campus and evolve health consciousness among the stakeholders
- Recognize the cost saving methods through waste minimizing and managing and monitoring of environmental and sustainable development
- Developing an environmental ethic and value systems in youngsters.
- Point out the prevailing and forthcoming complications
- Authenticate conformity with the implemented laws
- Empower the organizations to frame a better environmental performance
- Impart environmental education through systematic environmental management approach and Improving environmental standards
- Benchmarking for environmental protection initiatives
- Green audit is a valuable tool in the management programs of the university.

Target Areas of Green and Environment Auditing

Green audit forms part of a resource management process. Although they are individual events, the real value of green audits is the fact that they are carried out, at defined intervals, and their results can illustrate improvement or changeover time. Eco-campus concept mainly focuses on the efficient use of energy and water; minimize waste generation or pollution and also economic efficiency.

All these indicators are assessed in process of "Green Auditing of educational institute". Eco-campus focuses on the reduction of contribution to emissions, procure a cost effective and secure supply of energy, encourage and enhance energy use conservation, promotes personal action, reduce the institute's energy and water consumption, reduce wastes to landfill, and integrate environmental considerations into all contracts and services considered to have significant environmental impacts. Target areas included in this green auditing are water, energy, waste, green campus and carbon footprint.

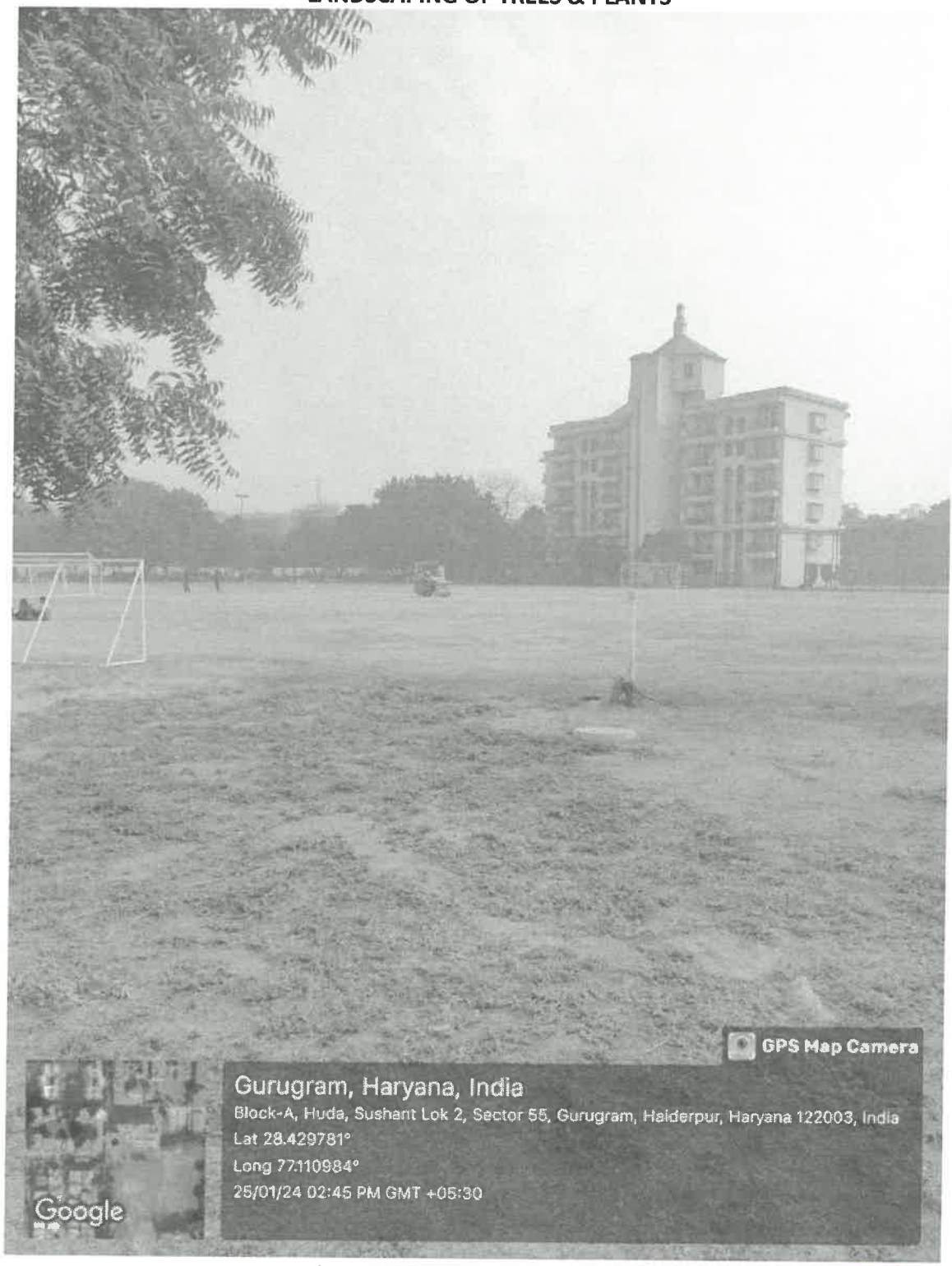
RESTRICTED ENTRY OF AUTOMOBILES



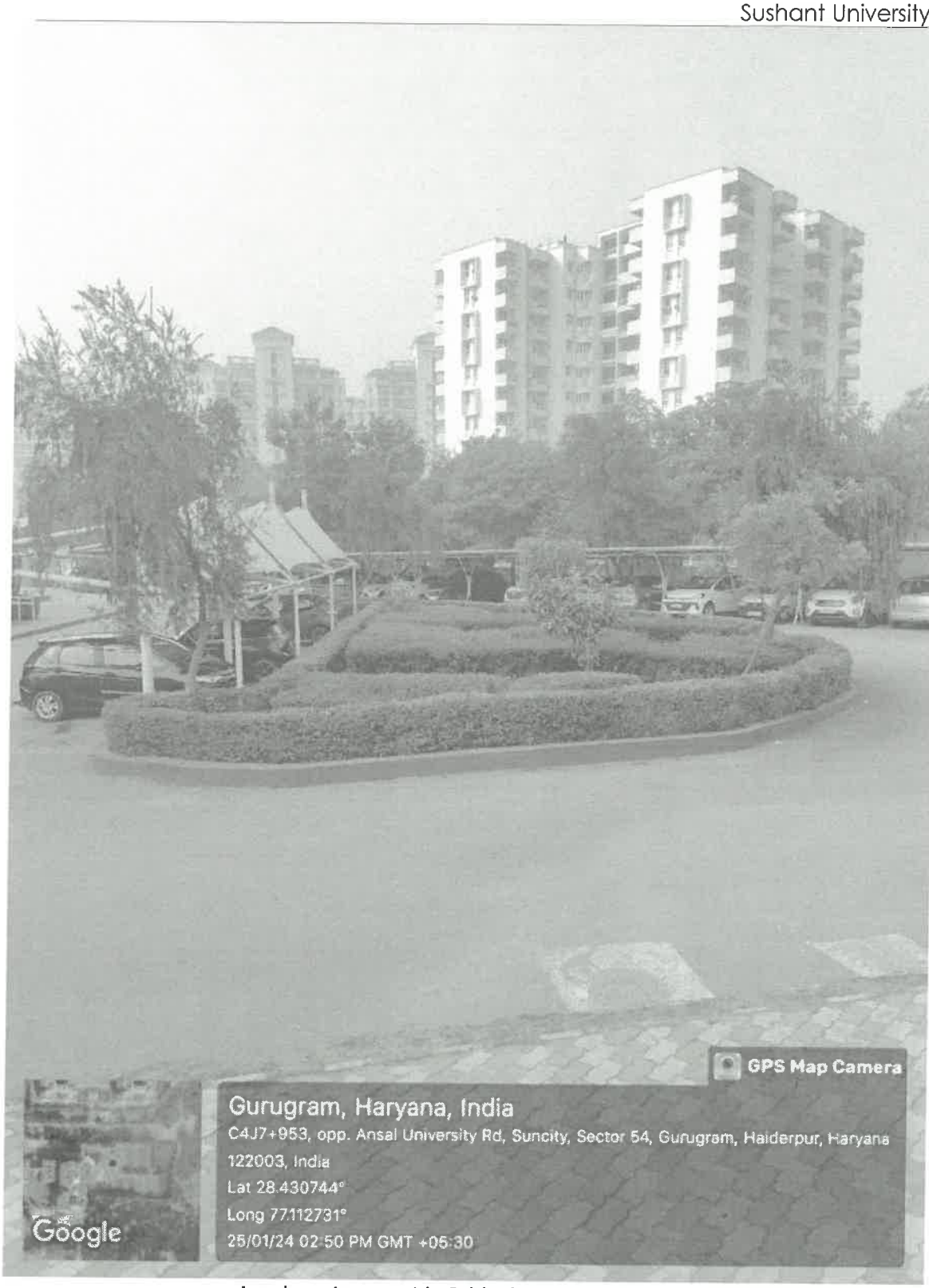
No entry for students automobiles at the main Sushant Universitygate

Restricted entry of automobiles at the main Sushant University gate

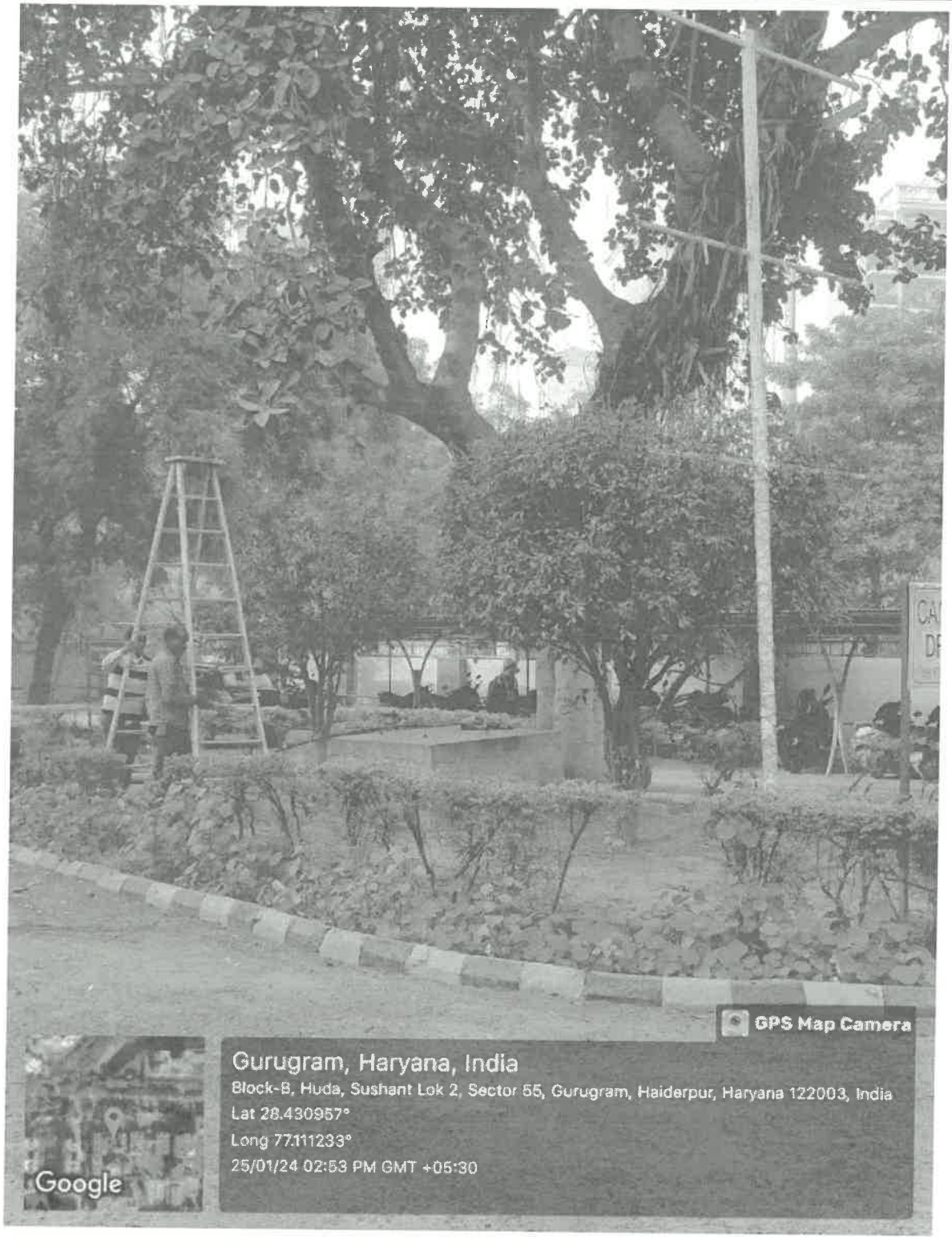
LANDSCAPING OF TREES & PLANTS



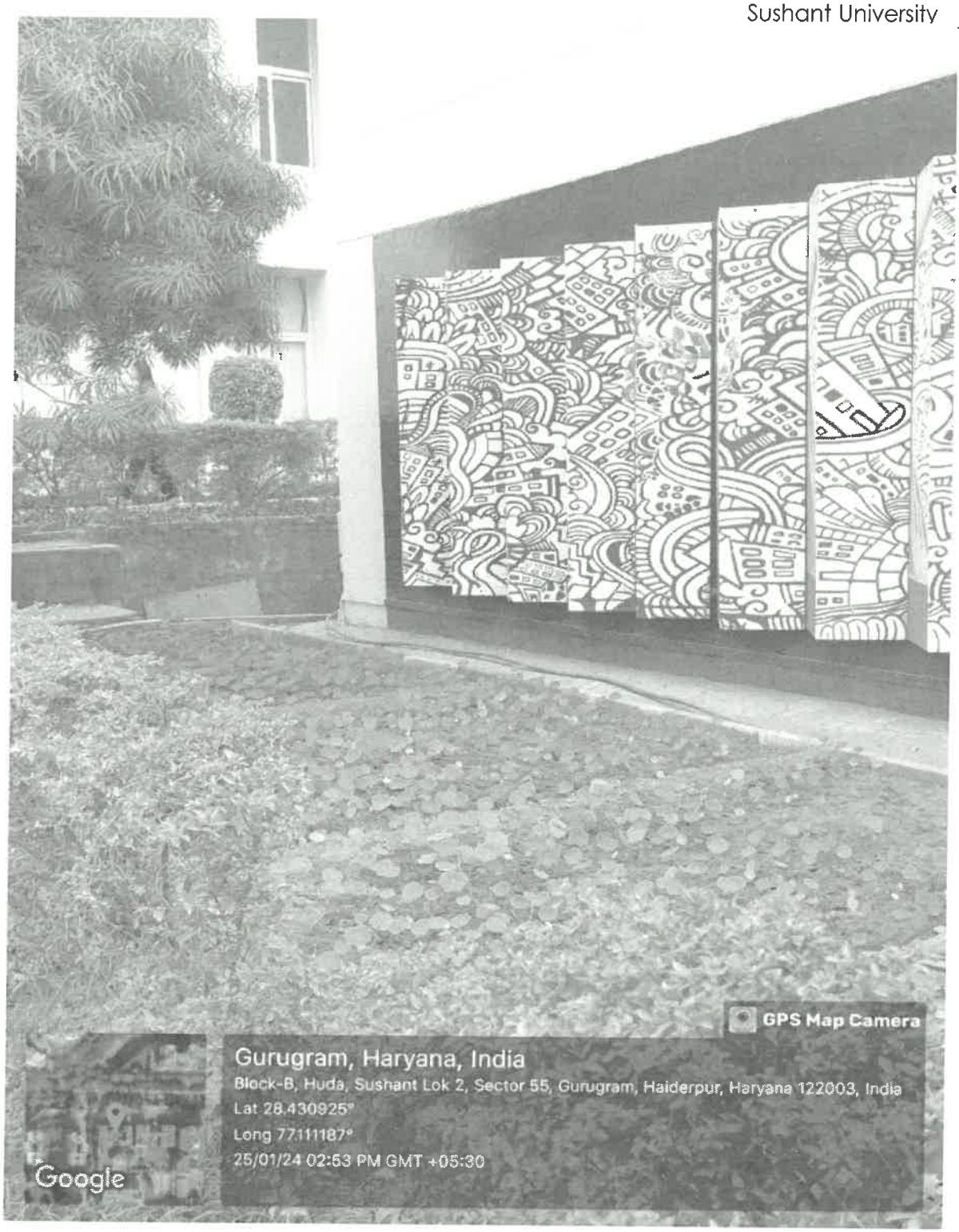
Landscaping at University Main Ground



Landscaping outside D block Entrance Area



Landscaping outside A block Entrance Area

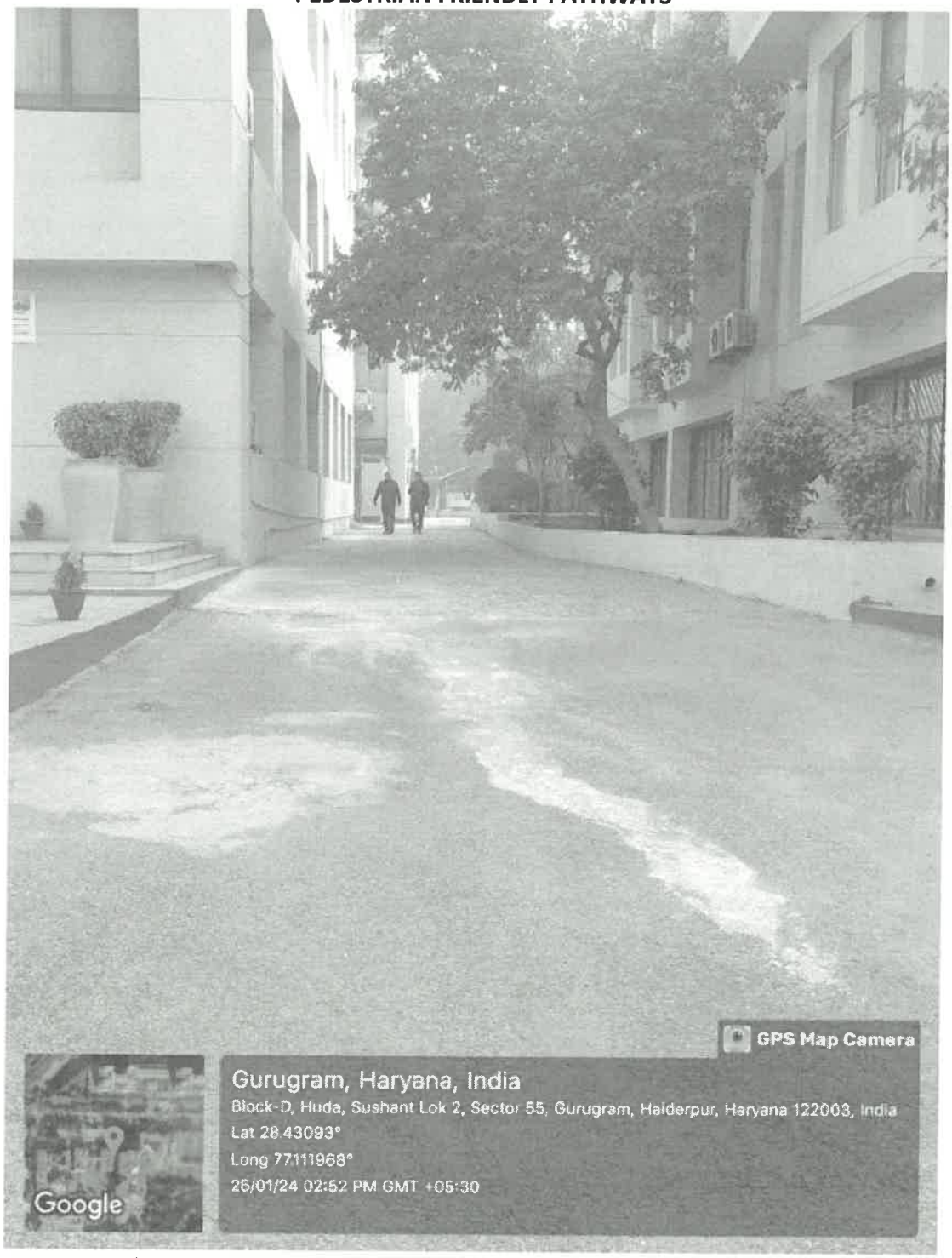


Landscaping outside A block Entrance Area

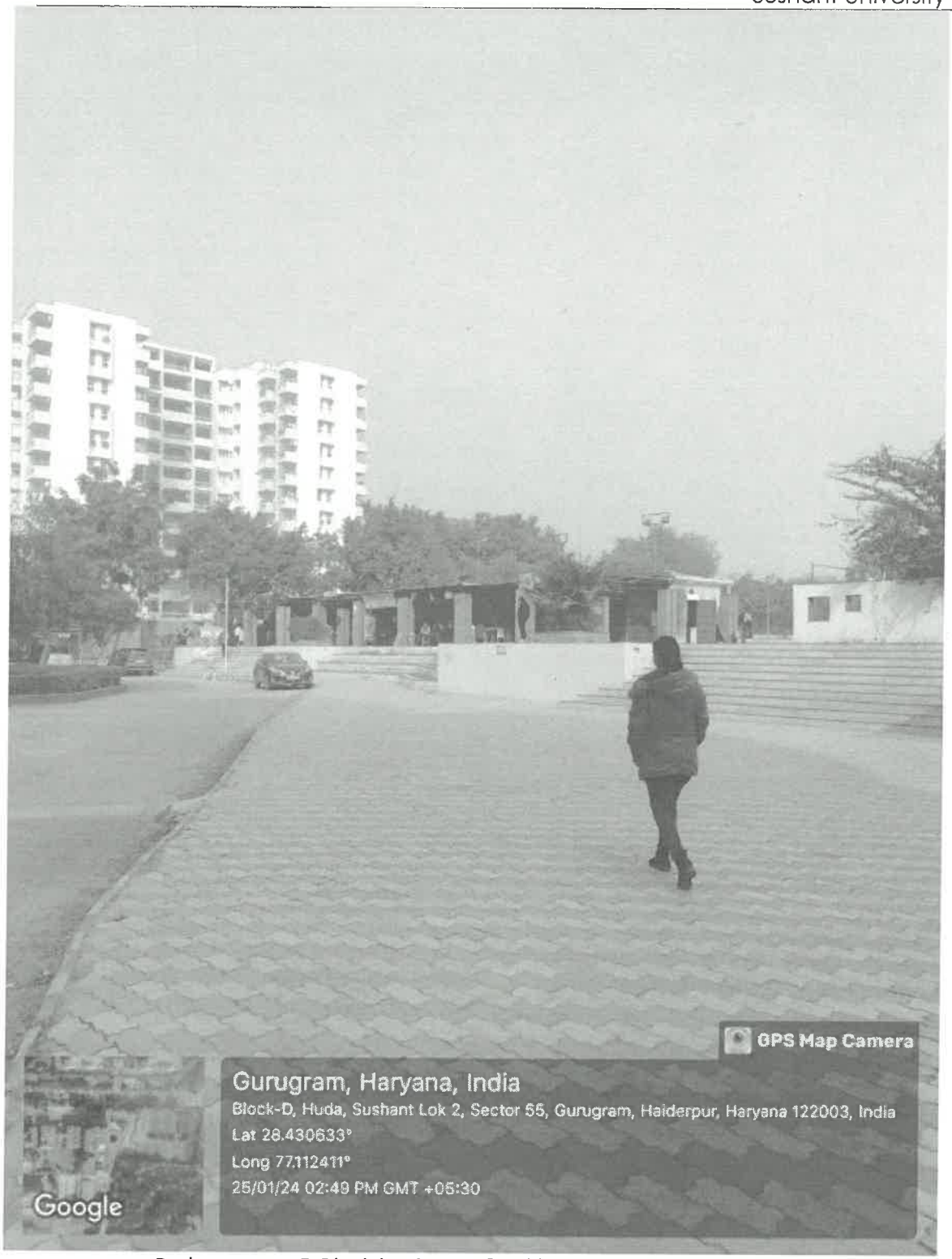
Landscaping near Tennis Court

SUSHANT UNIVERSITY SECTOR-55, GURUGRAM

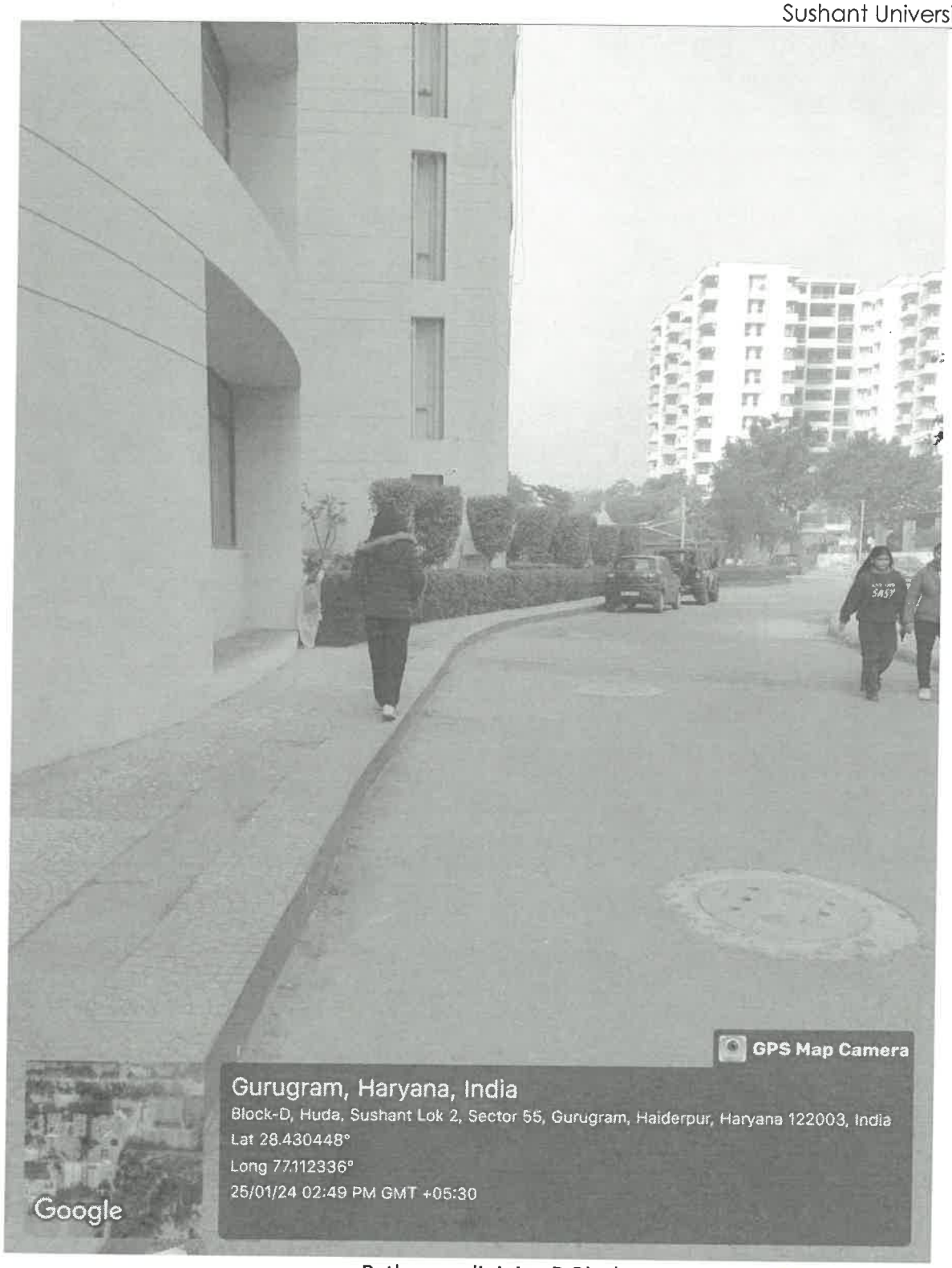
PEDESTRIAN FRIENDLY PATHWAYS



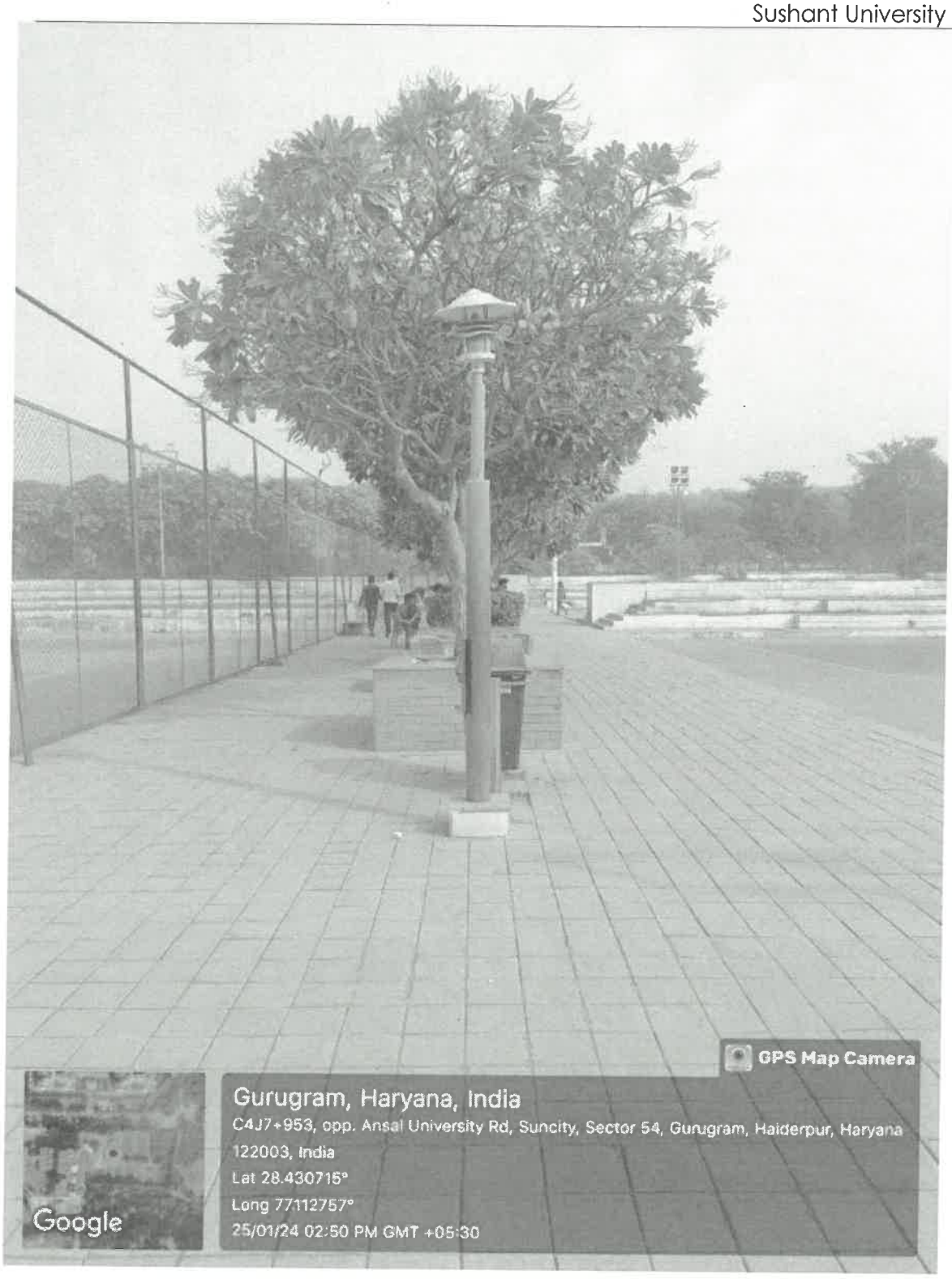
Pathway between B,C and D Block leading to the canteen and grounds



Pathway near D Block leading to food kiosks and Sports Arena



Pathway adjoining D Block



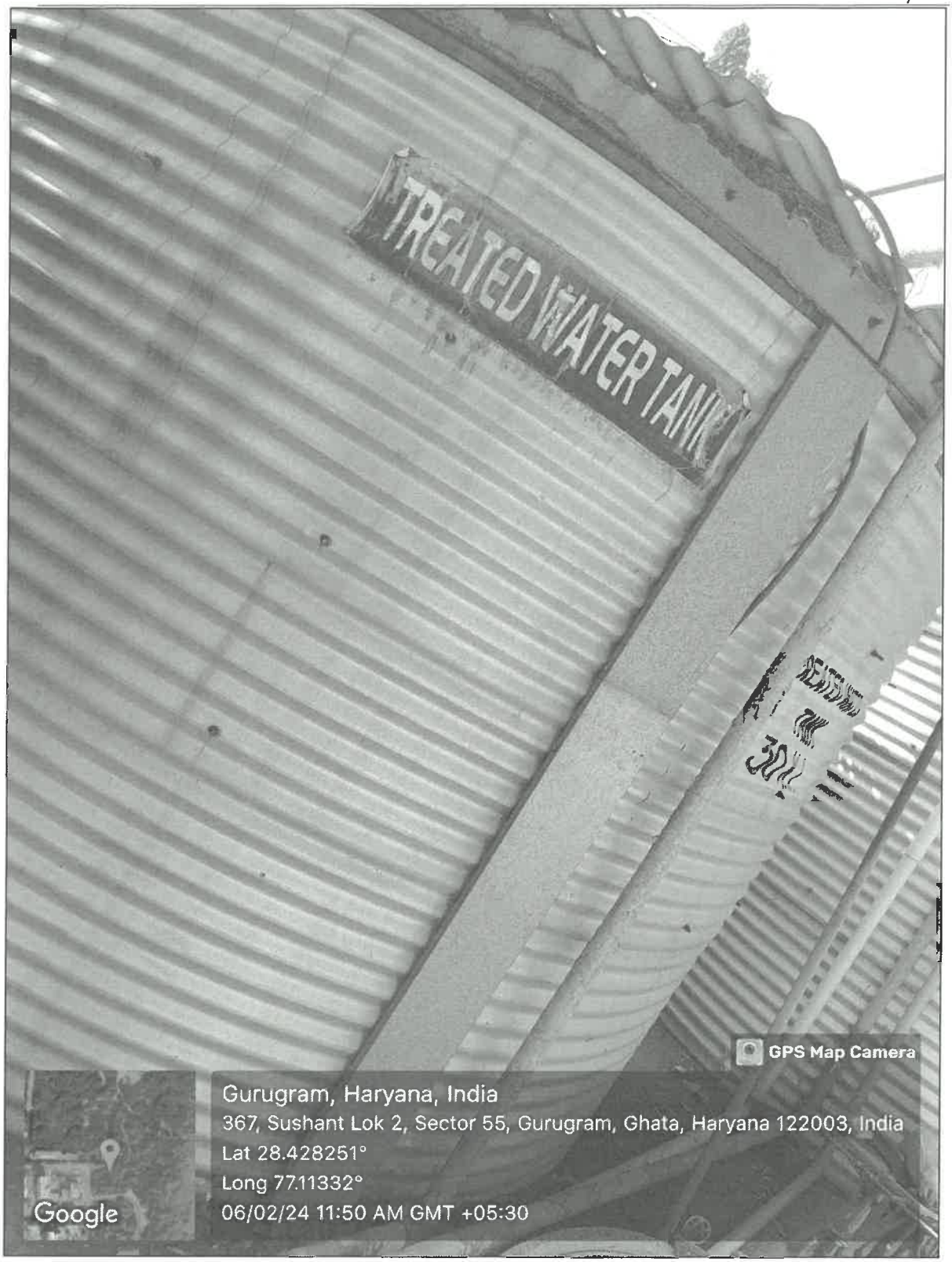
Pathway between Tennis courts in the Sports Arena

Liquid Waste Management

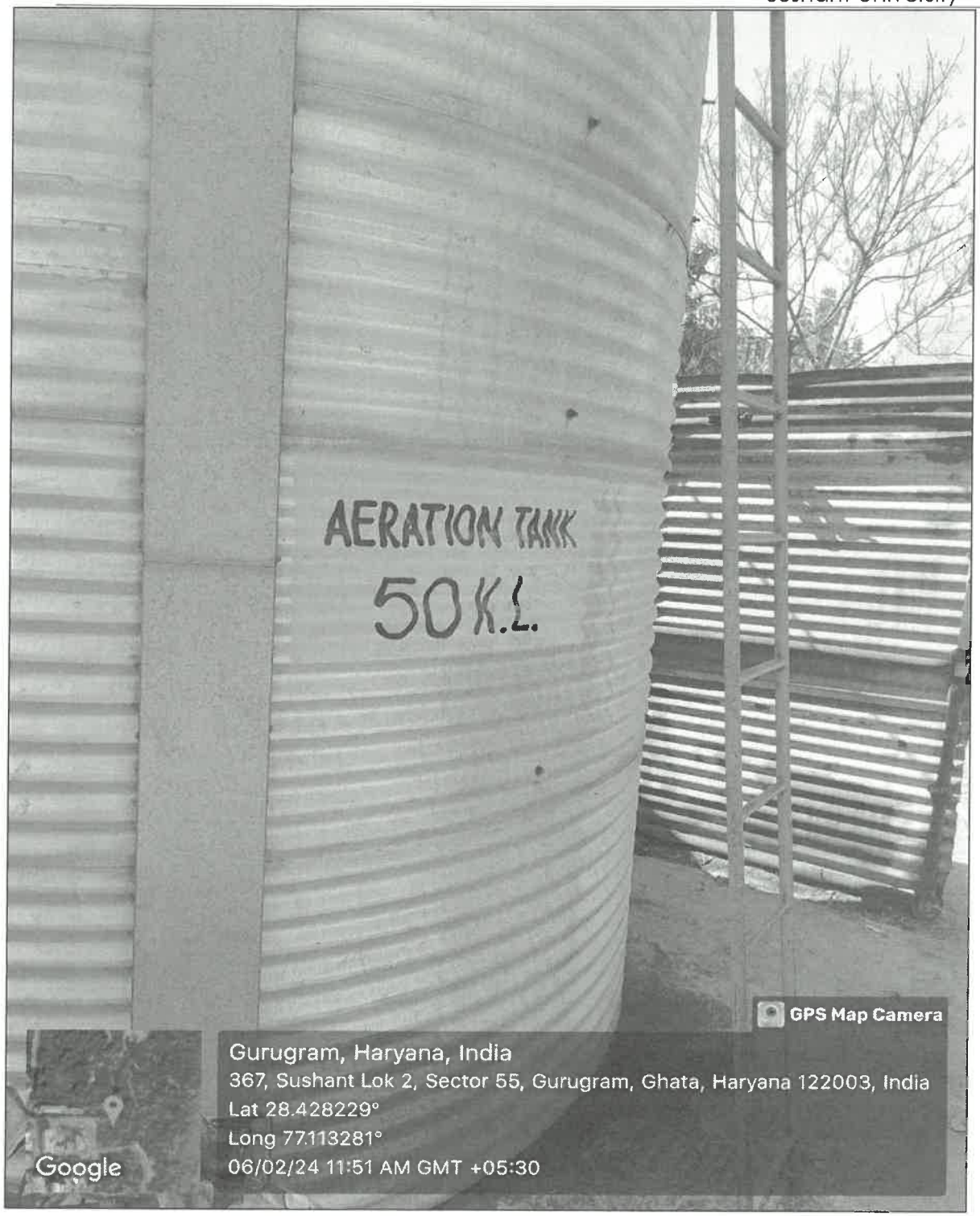
200KLD STP in Sushant University Campus

The university has a in-campus sewage treatment plant where the treated water is recycled for watering the garden. The campus following a 'Go green' policy, uses the treated waste water for fulfilling the irrigation requirements of the plants and trees.

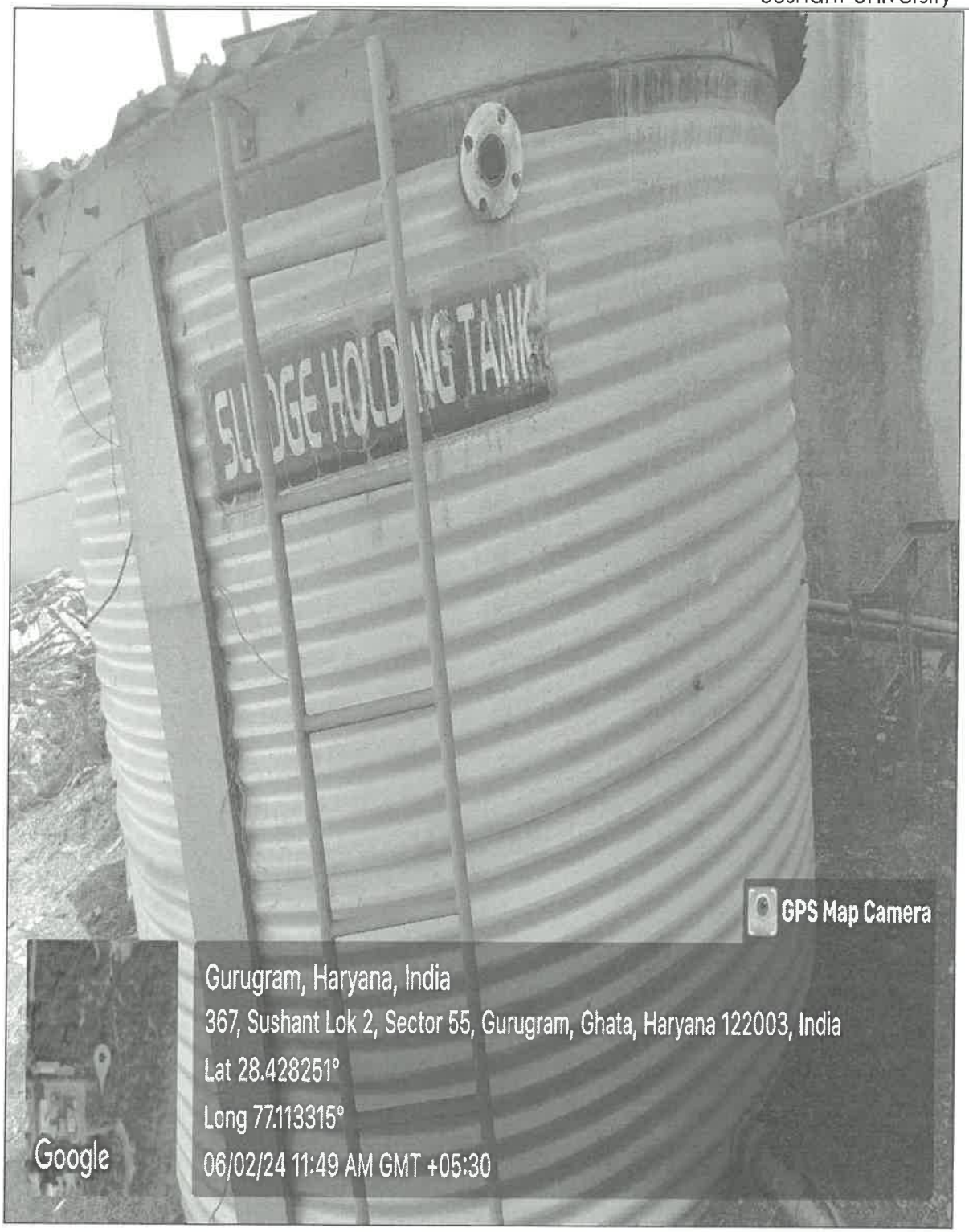
200KLD STP in Sushant University Campus



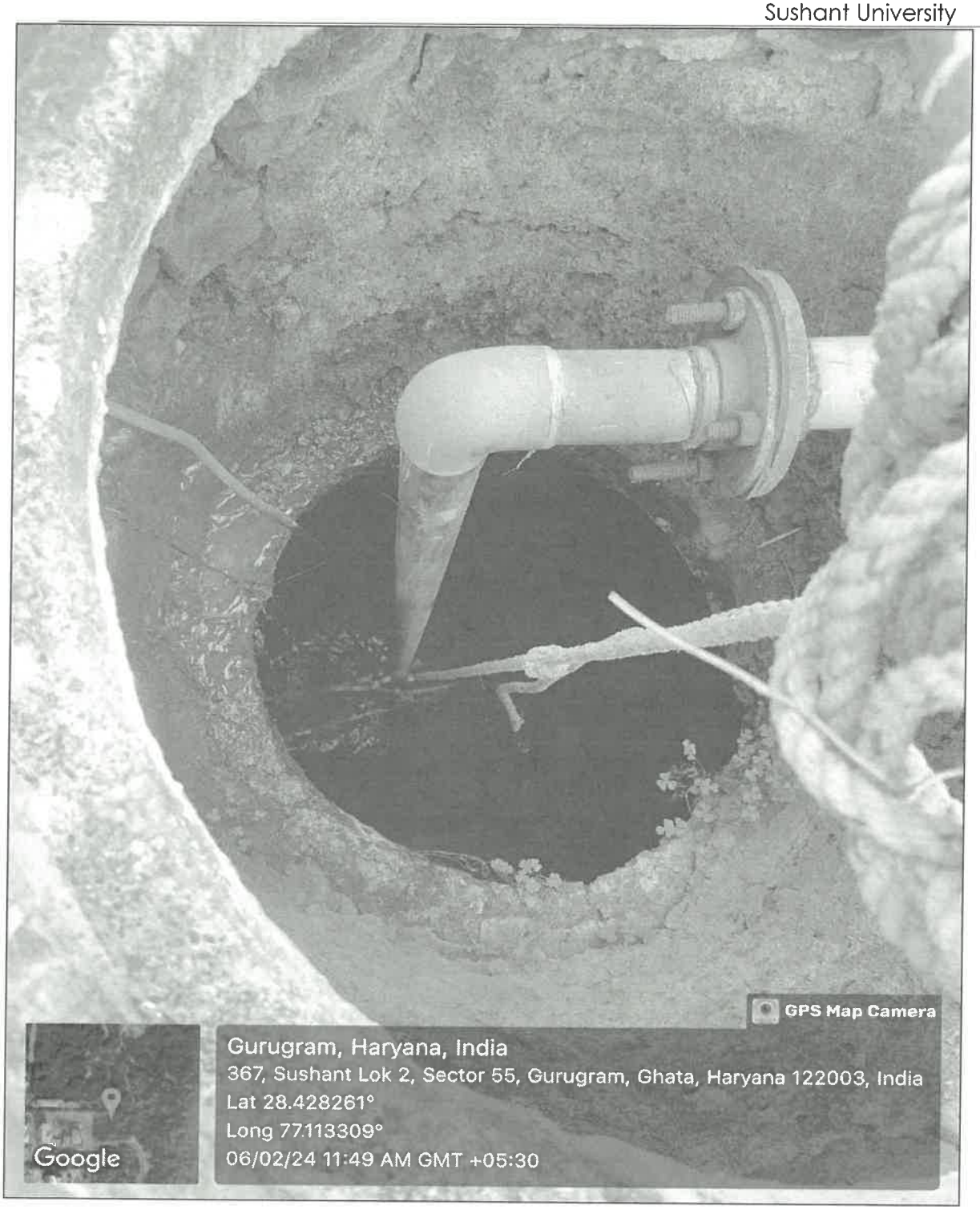
200KLD STP in Sushant University Campus



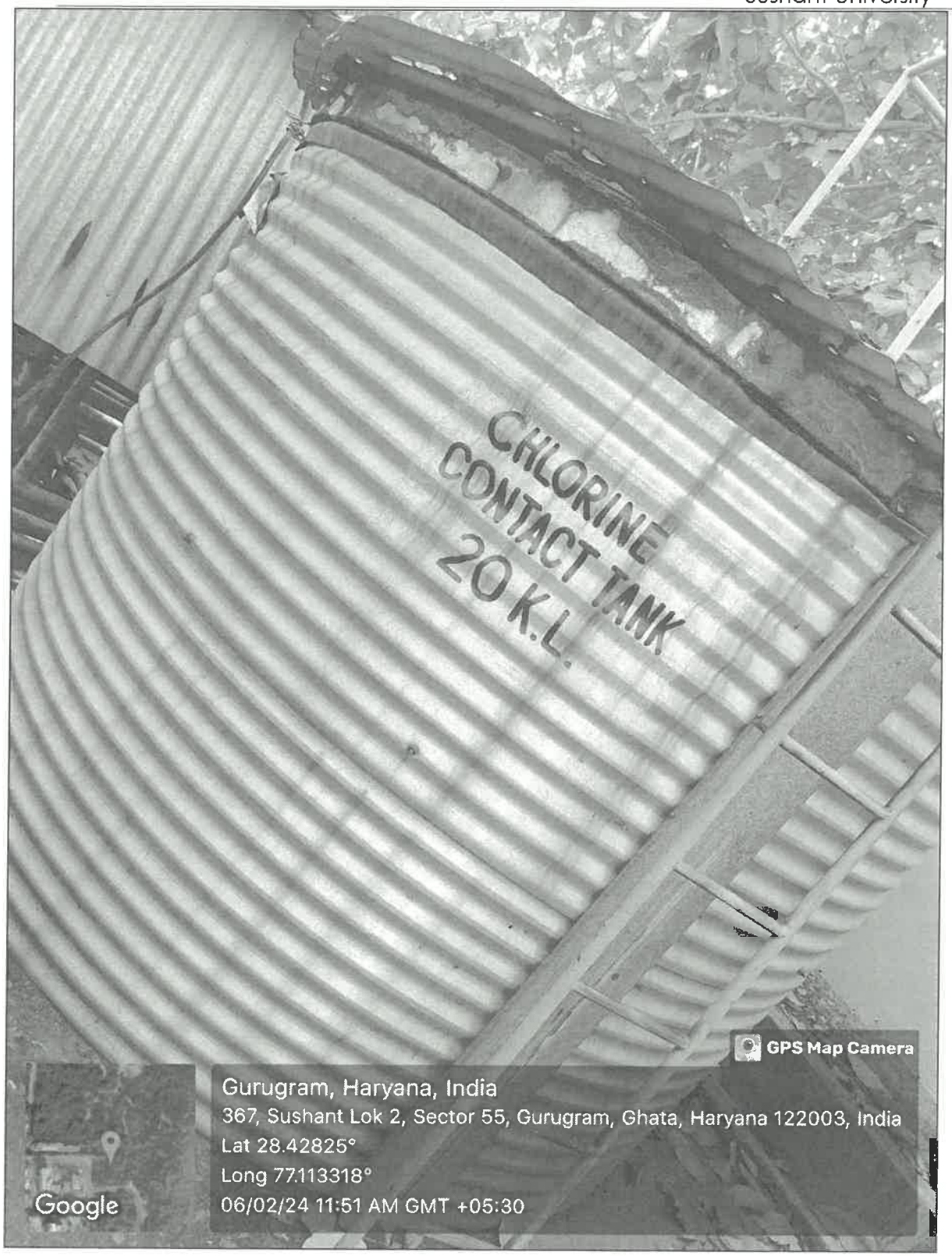
200KLD STP in Sushant University Campus



200KLD STP in Sushant University Campus



200KLD STP in Sushant University Campus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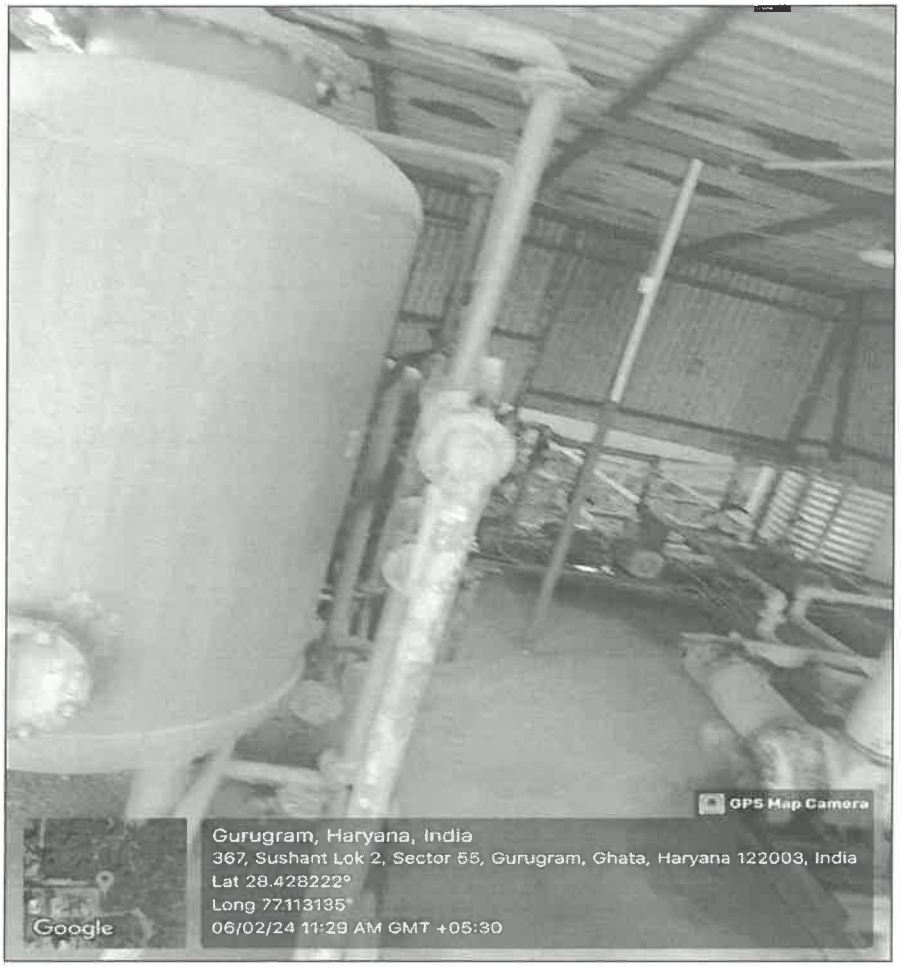
Google

RO Water Purifier in SU Campus

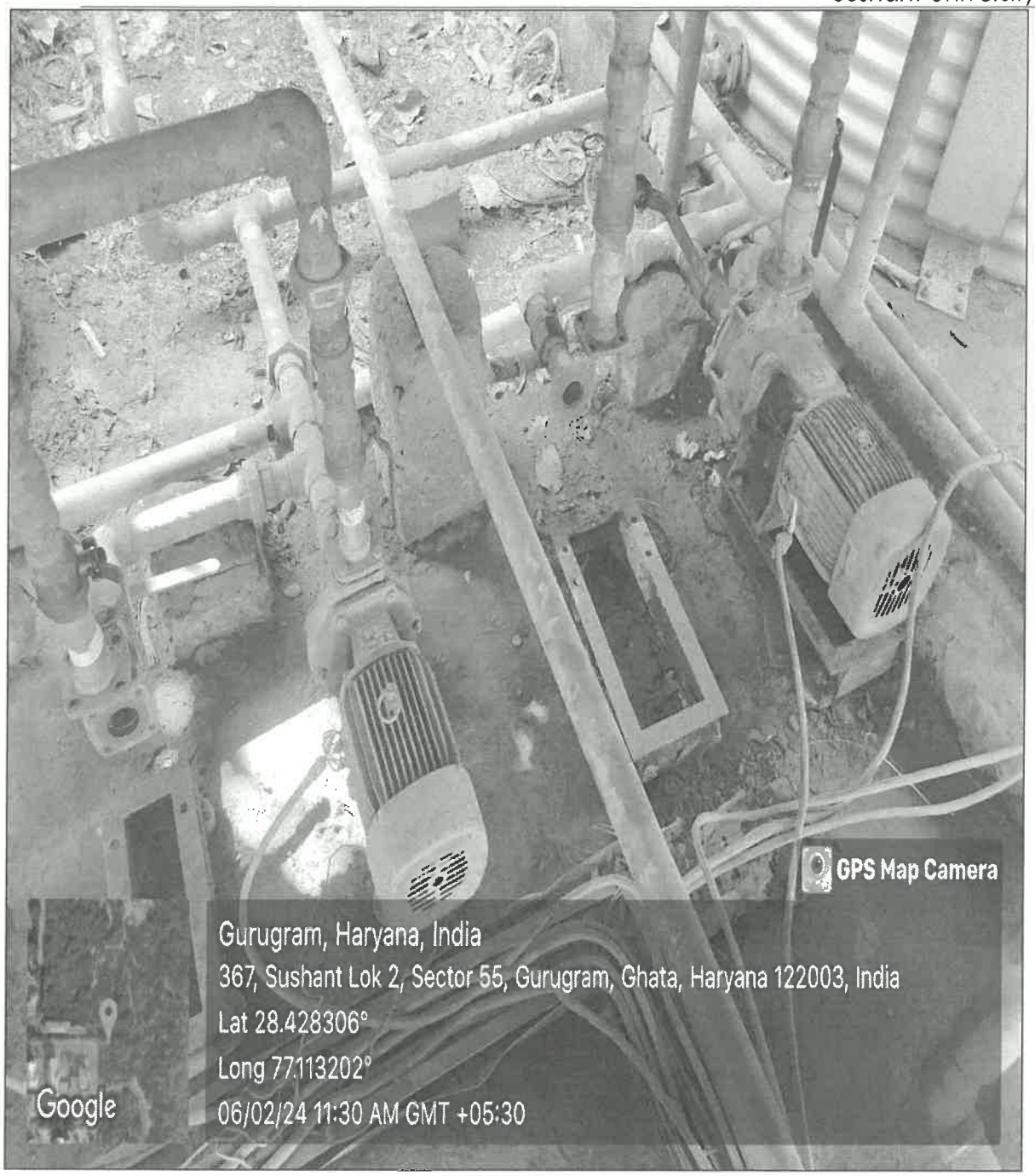
RO Water Purifier in D Block



RO Water Purifier in D Block

RO Water Purifier in D Block

RO Water Purifier in D Block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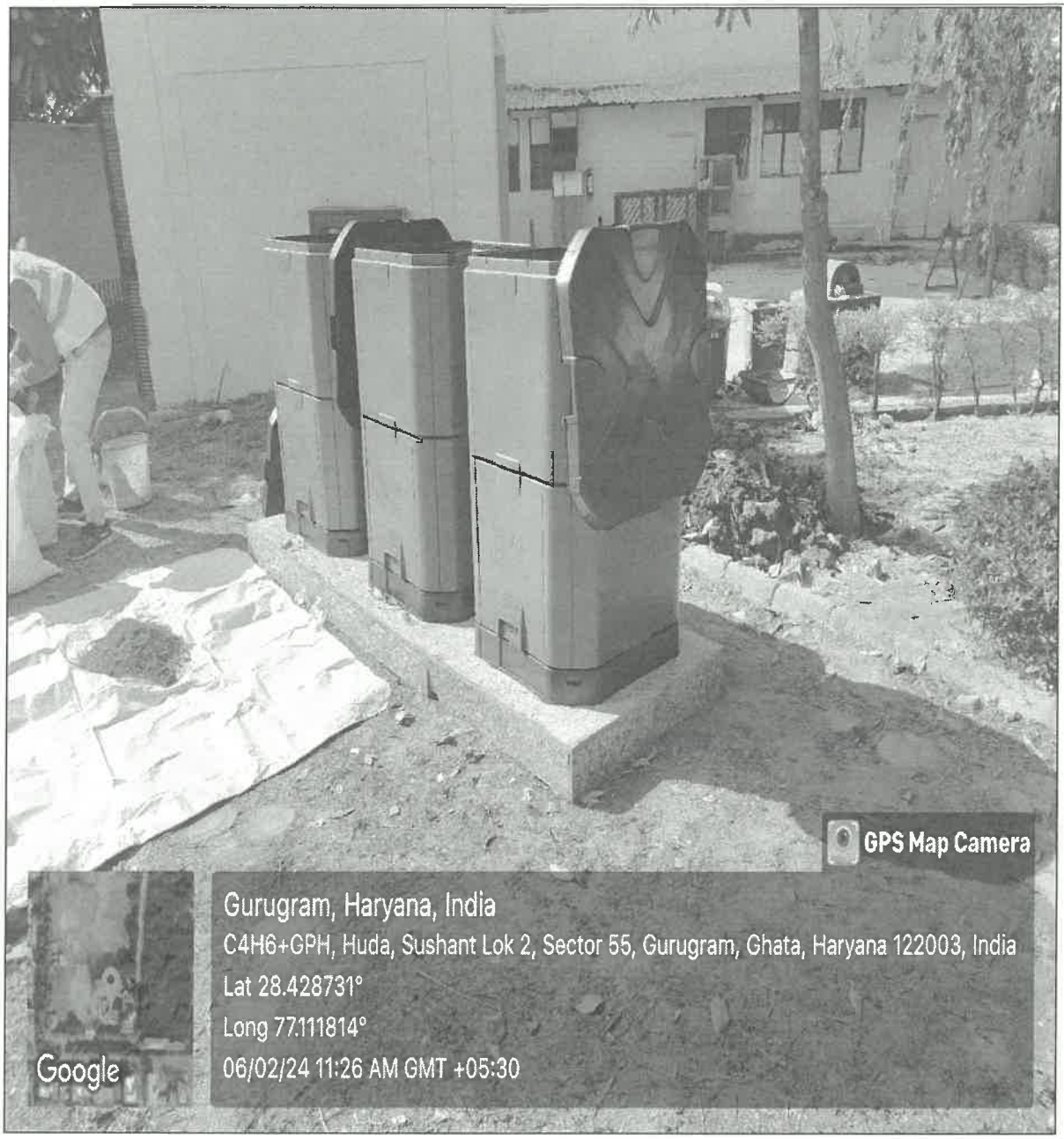
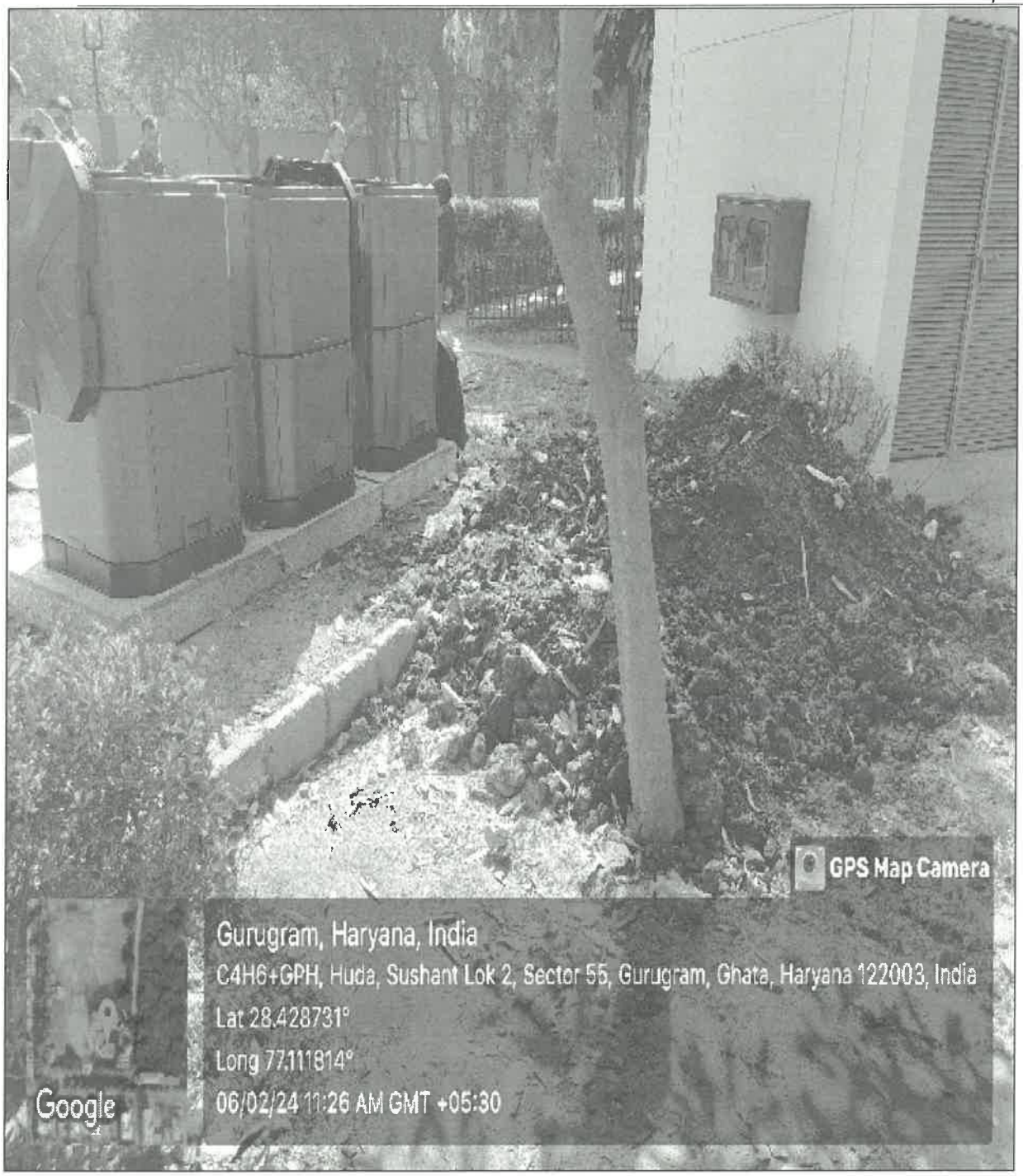
Google

Solid Waste Management in SU Campus



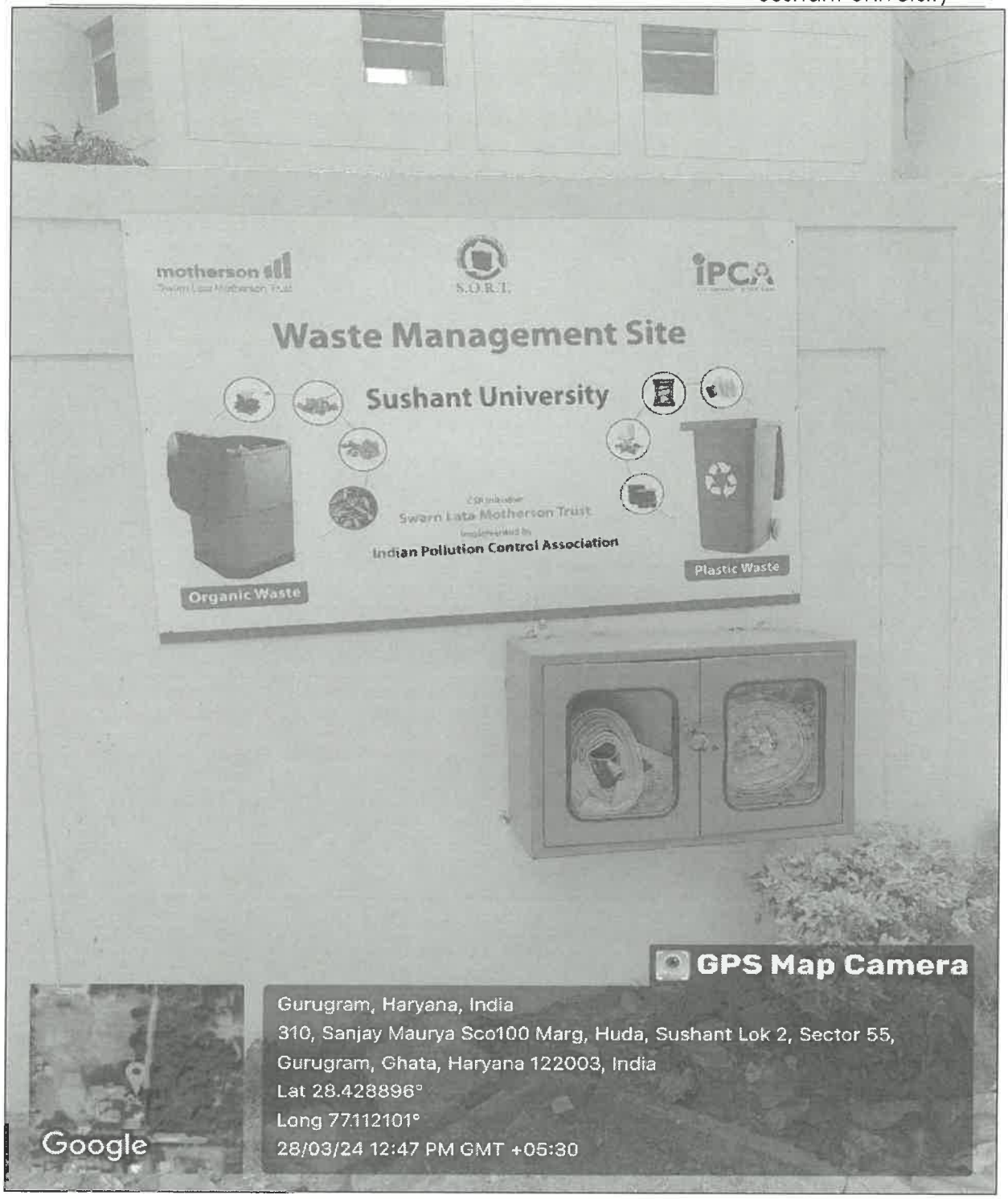
Sushant University Ground Area

Aerobin Compositing for Food & Yard waste in SU Campus

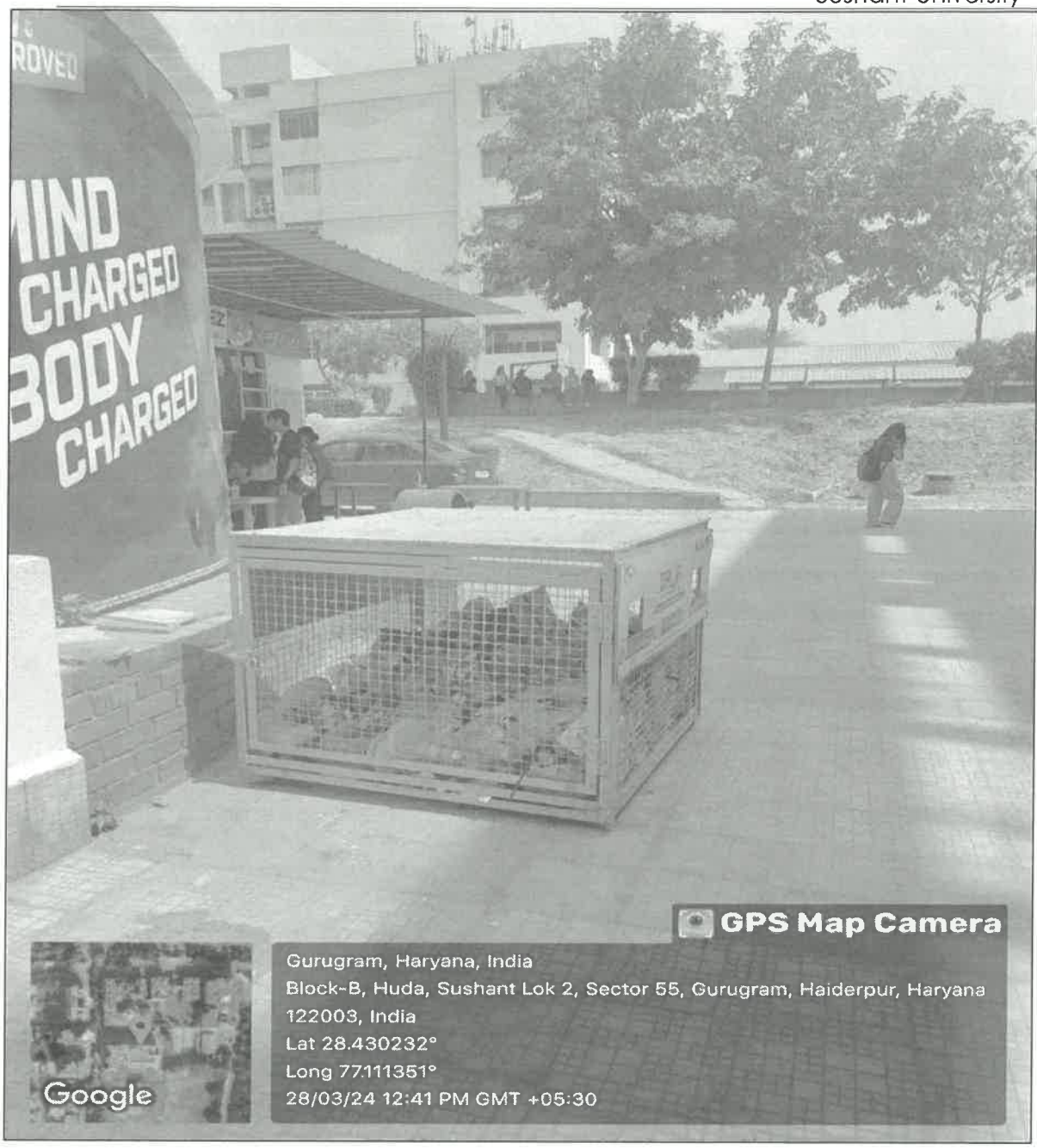


Sushant University Ground Area

Aerobin Compositing for Food & Yard waste

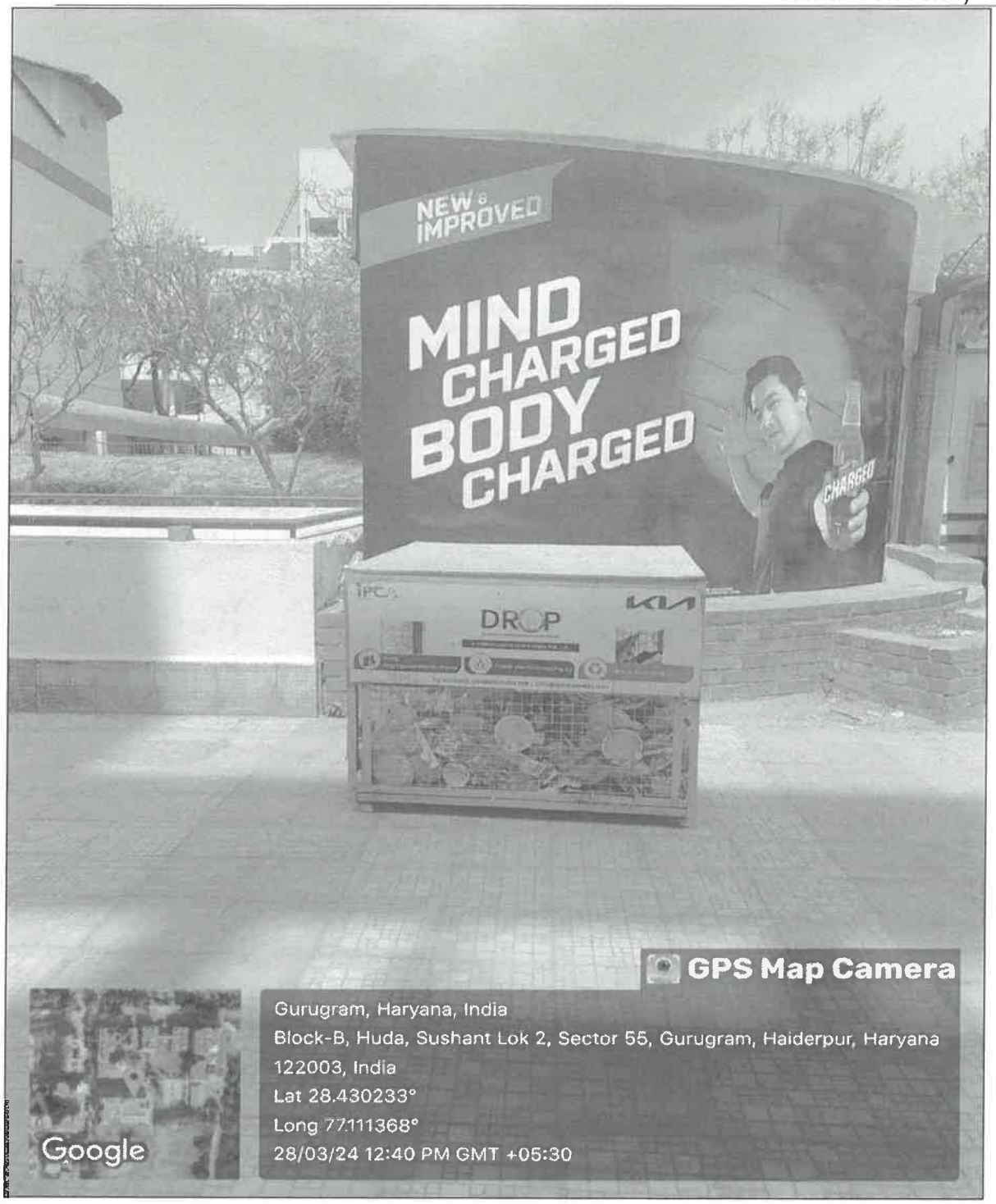


Sushant University Ground Area



E Block Canteen Area

Segregation of Waste in the SU Campus For Recycling & Effective Treatment Thereafter



E Block Canteen Area

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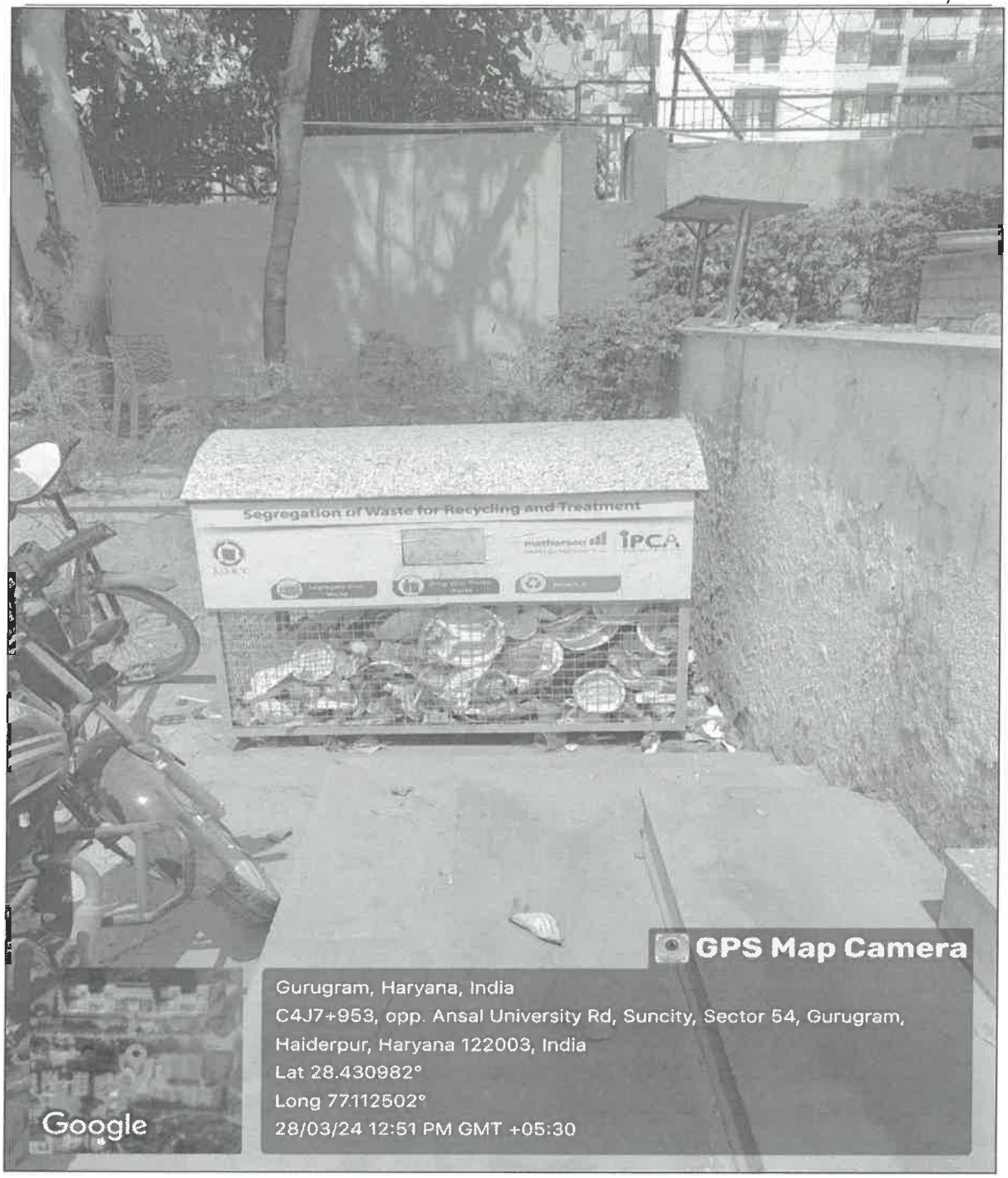
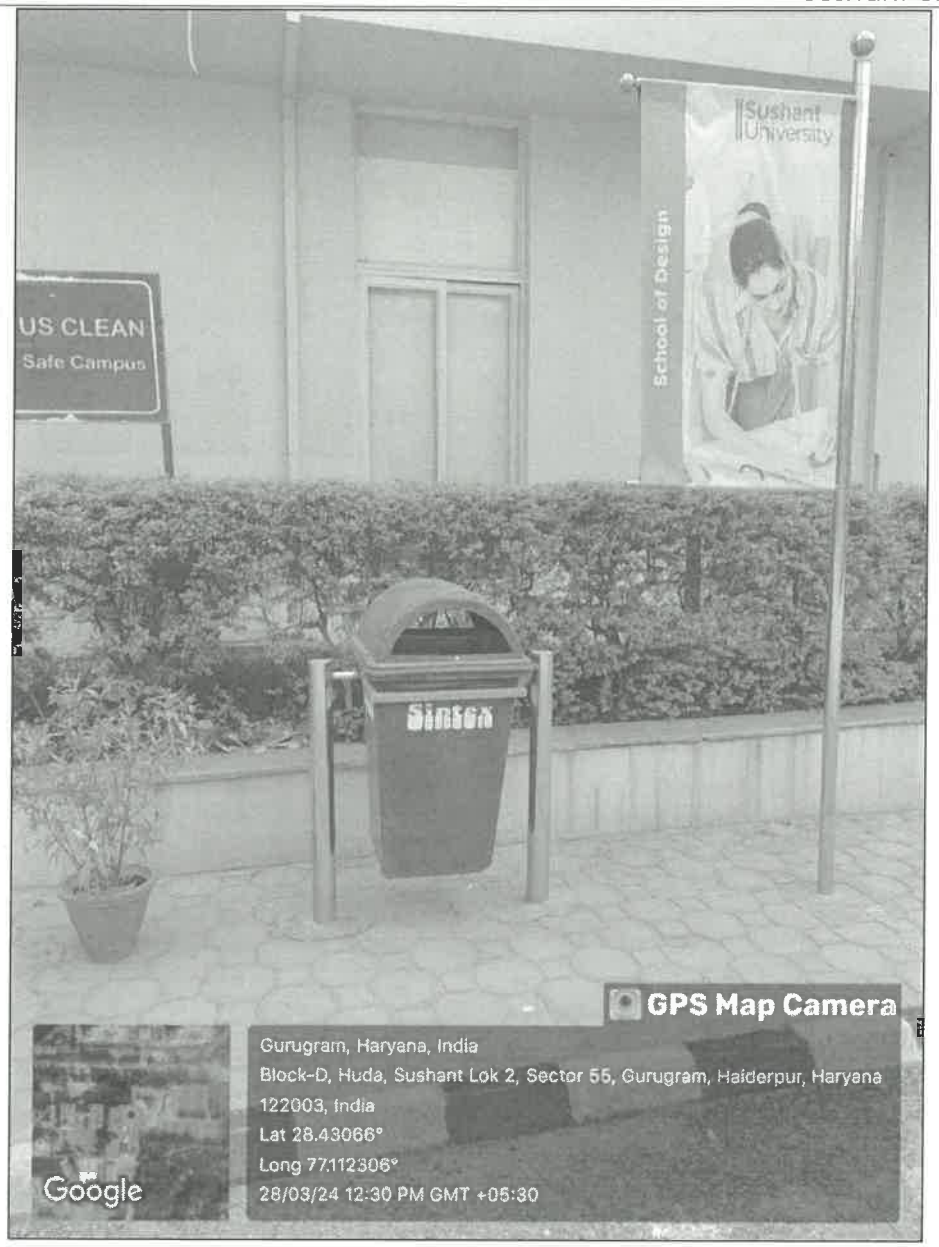


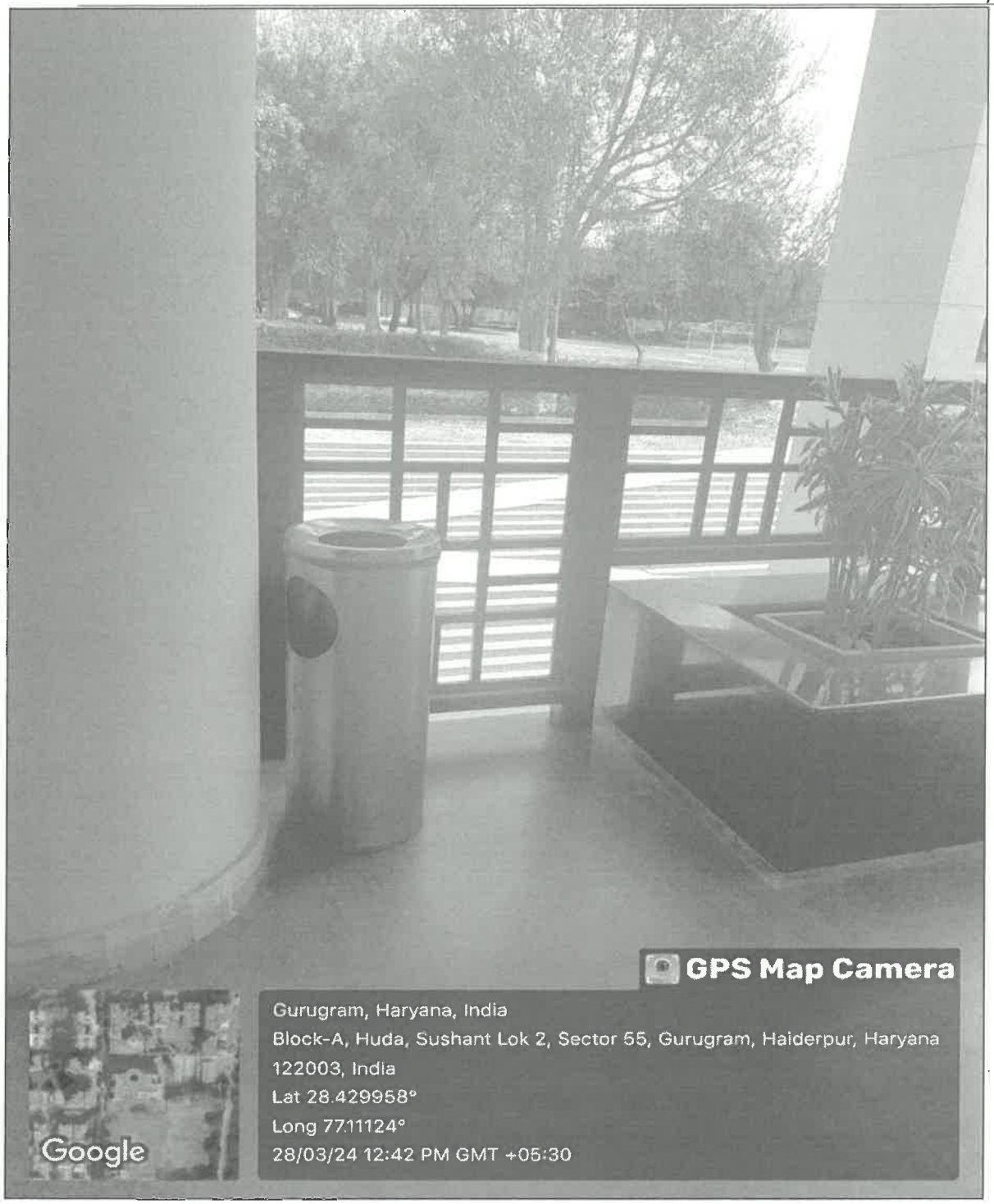
Staples Canteen Area

Waste Collection Points in Different blocks of SU Campus



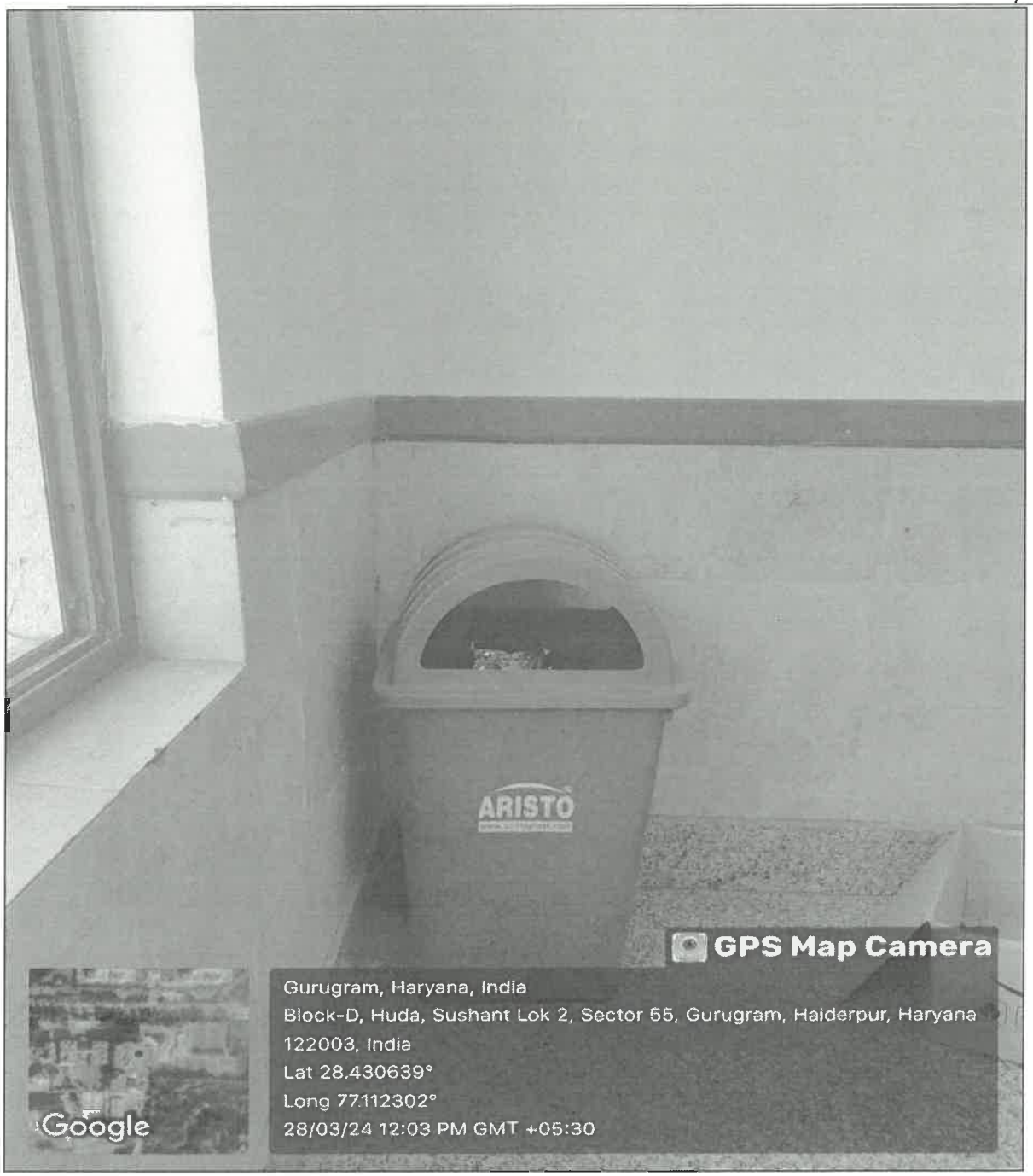
C Block Reception Area

Waste Collection Points in Different blocks of SU Campus



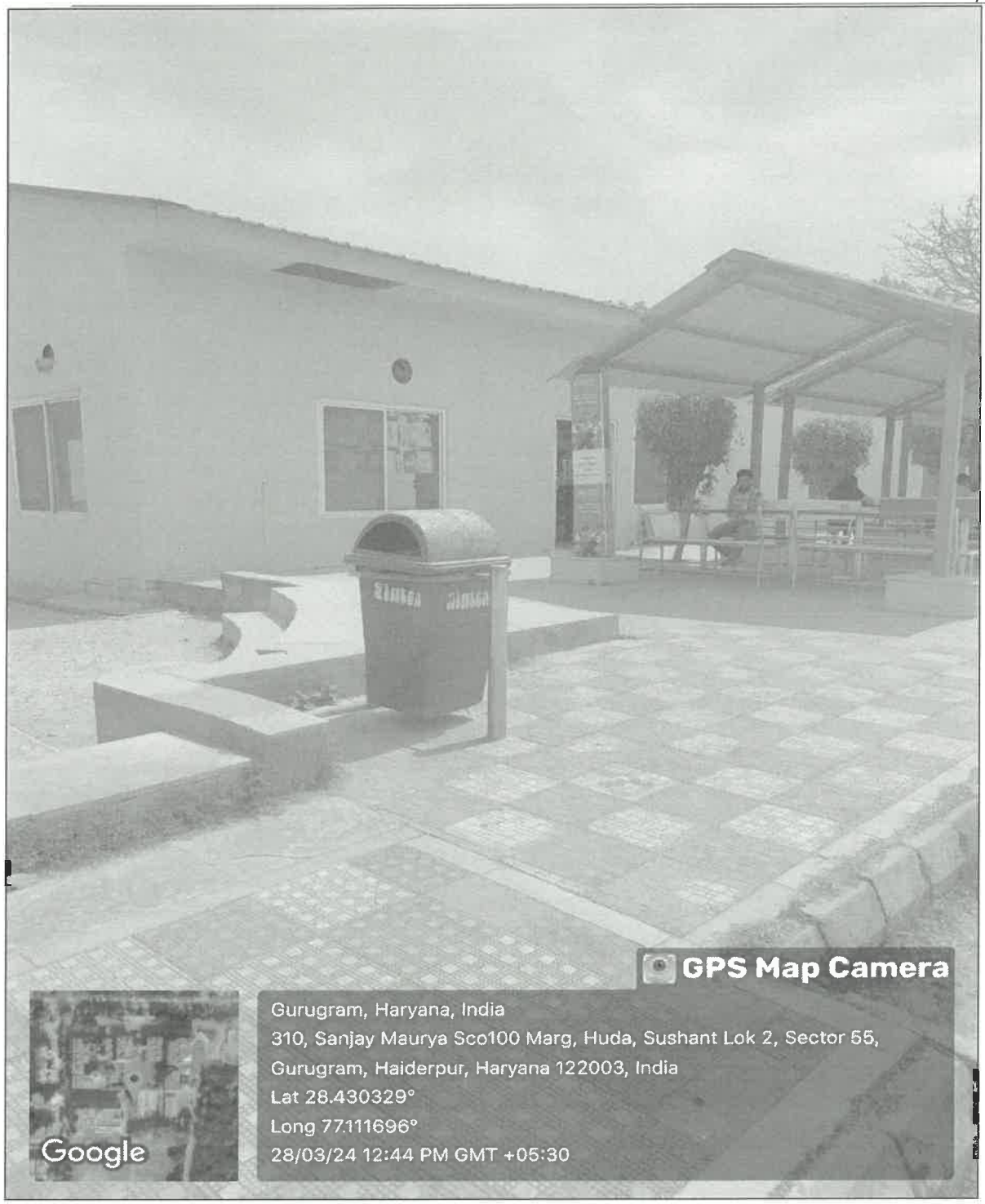
E Block, School of Art & Architecture

Waste Collection Points in Different blocks of SU Campus



D Block Sushant University

Waste Collection Points in Different blocks of SU Campus



Food Court Area

Waste Collection Points in Different blocks of SU Campus

Auditing for Energy Management

Energy cannot be seen, but we know it is there because we can see its effects in the forms of heat, light and power. This indicator addresses energy consumption, energy sources, energy monitoring, lighting, appliances, and vehicles. Energy use is clearly an important aspect of campus sustainability and thus requires no explanation for its inclusion in the assessment. An old incandescent bulb uses approximately 60W to 100W while an energy efficient light emitting diode (LED) uses only less than 10 W. Energy auditing deals with the conservation and methods to reduce its consumption related to environmental degradation. It is therefore essential that any environmentally responsible institution examine its energy use practices. **LED use also has a peculiar advantage towards environment that LED's are not using any mercury as the case of CFL's or Fluorescent tubes.**

There is an endeavour to check, manage and optimize energy use for mitigating the impact of university activities on Environment.

Also the university has taken a lead for producing green energy from Solar PV panels already installed

Auditing for Waste Management

The university has entered into a contract with agency for Solid waste management handling.

Pollution from waste is aesthetically unpleasing and results in large amounts of litter in our communities which can cause health problems. Plastic bags and discarded ropes and strings can be very dangerous to birds and other animals.

This indicator addresses waste production and disposal, plastic waste, paper waste, food waste, and recycling. Solid waste can be divided into two categories:

General waste and hazardous waste

General wastes include what is usually thrown away in homes and schools such as garbage, paper, tins and glass bottles. Hazardous waste is waste that is likely to be a threat to health or the environment like cleaning chemicals and petrol. Unscientific landfills may contain harmful contaminants that leach into soil and water supplies, and produce greenhouse gases contributing to global climate change.

Furthermore, solid waste often includes wasted material resources that could otherwise be channelled into better service through recycling, repair, and reuse. Thus the minimization of solid waste is essential to a sustainable campus. The auditor diagnoses the prevailing waste disposal policies and suggests the best way to combat the problems. It is therefore essential that any environmentally responsible institution examine its waste processing practices.

E-Waste: The old computers are sold back to vendor which is again put to beneficial use by repairing and it is good sustainable practice. Material not reusable is re cycled as per extant guidelines.

Presently authorised vendors who can handle E-waste are not engaged for management of E- waste

Key Boards and mouse which become un-serviceable are also disposed off. **It is required to be ensured that vendor dealing with E-waste is authorised to collect E-waste.**

Hazardous Waste: Lead Acid Cell Batteries are returned to Vendors for re-cycling of lead and other constituents.

Fluorescent tubes are handed over to Junk dealer who in turn should send them to Local re-cycling units. Storage of Fluorescent tubes in university should be as per recommended practice.

Auditing for Green Campus Management

Unfortunately, biodiversity is facing serious threats from habitat loss, pollution, over consumption and invasive species. Species are disappearing at an alarming rate and each loss affects nature's delicate balance and our quality of life. Without this variability in the living world, ecological systems and functions would break down, with detrimental consequences for all forms of life, including human beings. Newly planted and existing trees decrease the amount of carbon dioxide in the atmosphere. Trees play an important ecological role within the urban environment, as well as support improved public health and provide aesthetic benefits to cities. In one year, a single mature tree will absorb up to 48 pounds of carbon dioxide from the atmosphere, and release it as oxygen. The amount of oxygen that a singletree produces is enough to provide one day's supply of oxygen for people. So while you are busy studying and working on earning those good grades, all the trees on campus are also working hard to make the air cleaner for us. Trees on our campus impact our mental health as well; studies have shown that trees greatly reduce stress, which a huge deal is considering many students are under some amount of stress.

E-Waste disposal

The record of use and handling of E-waste is maintained .While disposing/Auction or sale of E-waste credential of purchaser should be documented to ensure that vendor is authorised for collection and ensuring re cycling of E-waste as per extant guidelines.

defined as those wastes which by reason of any of its physical, chemical, reactive, toxic,

flammable, explosive or corrosive characteristics causes danger or is likely to cause danger to health or environment, whether alone or when in contact with other wastes or substances, and shall include wastes as specified in Schedules of the Rules.

- Solid waste-yes-Extra waste removed through truck and disposed in municipal waste collection points
- Dry leaves-Yes-Used in university for making manure/compost
- Canteen waste-yes-Used for Compost in university
- Liquid waste-yes-Preserved and used in university
- Glass-Yes-sent for recycling.
- Unused equipment-yes-Returned to vendors through sale
- Plastic waste-Yes-Segregated and removed

Canteen Waste-Handling practice

There are no signs provided in Mess and Cafeteria for avoiding food wastage and take food as per requirement and there should not be any food wastage. These signage are required to be provided in all area where food is served or consumed.

1. All Hostel Mess
2. Canteen
3. Cafeteria

Food Procurement And Disposal

1. Food is prepared in Canteen/Mess and any food waste that is generated is now planned to be filled in compost pits for preparation of natural manure.
2. A good effort has been made to maintain all waste data for food. Record for all other types of wastes is also required to be maintained for better management.
3. Effort should be made for reduction of onsite wastages.

Consumer Level:

This is all operative in a highly unorganized sector. It has, also, been observed that, the used lamps are thrown in the garbage bins and finally into the municipal garbage dumpsites, contaminating air, water and soil. Most of the used lamps are broken either at transit solid waste bins (provided by local civic authority) or broken during the transport to the final disposal site.

A portion of the mercury, in vapor form, is released into the air; whereas rest of the mercury is released onto the soil with further possibility of getting into the surface and/or ground water bodies through the leachate from soil.

User Awareness:

All the consumers, individual domestic consumers and bulk consumers (offices, institutions, large residential complexes, etc.) should get fully aware about the potential health impact of mercury-bearing lamps, through audio-visual media and the product leaflets. The precautions, to be taken while cleaning up the broken FLs should, also, be known to the consumers. As a part of such awareness programs, the consumers, even at individual level, are expected to participate actively with constructive suggestions and provide the feedback, for the overall success of mercury management in fluorescent lamp

Collection: The collection of used lamps may be done mainly by two ways: (i) Collection of used lamp (FLs) from bulk consumers may either be arranged by the management of above set-up (institutions, etc.) for direct disposal to LRU or by the LRU which may arrange to pick up used lamps from such collection sites through an identified collection agency. (ii) Collection of used lamps (FLs) from individual domestic consumer may be arranged by the LRU, either through kabaris (individuals appointed for the purpose by LRU) or an identified collection agency for door to door pickup. Transportation: (i) The Handler (e.g. Kabari or representative of LRU) of used FLs in transit should take care of selection of proper vehicle and carriage so as to minimize breakage of used FLs.

(ii) There should not be any intermediate transfer of materials in the transit stage. The collected used FLs should be straight transported to the LRF for further processing. (iii) The Handler should be trained to take care of mercury spills, if any, that takes place en-route the journey to LRU.

Noise Pollution

1. **Sounds of Normal Conversations:**

   Sound Intensity: 40-60 dB

   Health Hazard: Sound less than 80 dB is safe for the ear.

2. **Sounds emanating from Tape recorders or an Orchestra:**

   Sound Intensity: 70 dB

   Health Hazard: It is safe for ear.

3. **Sounds of Heavy Traffic:**

   Sound Intensity: 90 dB

   Health Hazard: Constant exposure to sound greater than 80 dB causes temporary hearing loss and if they are not treated immediately, causes permanent impairment.

4. **Sounds of Pneumatic drills and other machines:**

   Sound Intensity: 100 dB

   Health Hazard: Constant exposure causes temporary hearing loss and if they are not treated immediately, causes permanent impairment.

5. **Sounds of Aircraft engine:**

   Sound Intensity: 100-200 dB

   Health Hazard: Higher noise level of 160 dB cause total deafness, rupturing eardrums, damaging inner ear. It also causes high blood pressure, ulcer in stomach, palpitation, nervous problems, irritation, anger, and affects pregnant women's embryo.

6. **Sounds of Rockets during Take off:**

   Sound Intensity: 200 dB

   Health Hazard: It is dangerously causing total deafness by rupturing the eardrums and damaging the inner ear. It also causes high blood pressure, ulcer in stomach, palpitation, nervous problems, irritation, anger, and affects pregnant women's embryo.

Decibels Measurement – Sushant University

Sr.No.	Location	Decibel level Measurement	Remarks
1	Administration office	48	Satisfactory
2	LT Panel Room	47	Satisfactory
3	Girls Hostel common room	48	Satisfactory
4	Outside VC office	49	Satisfactory
5	Lecture Theatre-D-113	46.5	Satisfactory
6	Block B and C 103	48	Satisfactory
7	A block Ground Floor	49.5	Satisfactory
8	E Block Room	52.7	Satisfactory
9	E-Block faculty room	51.3	Satisfactory
10	D-Block Chemistry Lab	51.0	Satisfactory
11	Near Main Gate	50.5	Satisfactory

Sound/Decibel level measured is satisfactory and there is no adverse impact of the same on occupants.

Custodial Chemical Use

Chemical for one year requirement are used in Labs and these are stored in a separate store. The store requires to be ventilated and hazard analysis should be got done through Material Specification Data Sheet and record should be maintained. Proper ventilation with hoods should be designed.

There is practice of burial of chemical waste in the soil in the university campus, This causes pollution of soil. The chemicals collected be disposed as per guidelines so that there is

Transportation Practices

Most of students are using shared transport , there is a university bus arranged to ferry students from nearest Metro station to university campus., which is sustainable. Students are using Buses, Shared auto. There is only one bus owned by the university. The consumption of HSD by buses is monitored for optimised consumption.

Teaching and Non Teaching faculty is also sensitized for using pooled transportation for working towards sustainability and reducing resource use and encouragement of resource conservation.

Procurement Practices To Be Followed

Presently there is no practice to consider impact of procurement of different items on the Environment.

Procurement team is required to be made aware regarding procurement of goods and services that are sustainable. The sensitization is required for all purchases in a way that optimized utilisation of natural resources is possible.

1. Paper with Recycle content
2. AC's using refrigerant with Zero ODP Refrigerant
3. Environmental friendly Housekeeping Chemicals
4. Paints, Adhesives, sealants with recommended percentage of volatile organic compound.

Paper Use and Printing Goals

1. There are efforts already directed through use of E-Books for reducing the use of paper.
2. Students are encouraged to make use of E- Library.
3. There are instructions to staff and student to resort to printing only if it is absolutely un-avoidable.
4. Papers should be purchased that have recycled content.

Recommended Paper use and Printing Goal to be followed. All concerned are required to be sensitized for adhering to these practices.

1. Distribute memos, reports, purchase orders and brochures electronically.
2. Encourage re-use of scrap paper for printing and note taking. Larger printers should have one dedicated tray for the reuse of scrap paper.
3. Print on letterhead paper only as needed; use electronic letterhead whenever possible
4. Network all printing to shared copiers/printers and eliminate stand-alone printers where possible
5. Discourage reckless printing and copying by requiring use of an account/password
6. Promote a 'Think before you Print' culture
7. Desktop drafting and editing of documents
8. Reduce default margin settings
9. Use toner-saving fonts (e.g. Eco Font) or smaller-sized fonts
10. Encourage increased use of Blackboard /Electronic Board as a paper-free resource
11. Training and Adherence - Distribute (an) email(s) with detailed instructions, including "screen shots" on how to change settings on computers, copiers, faxes, printers
12. Establish duplex (two-sided) copying and printing as standard
13. Phase out meeting handouts and distribute/project them electronically (this needs to be better defined).
14. Digitize forms and administrative and admission processes. Continue replacing paper based processes and administration.
15. Double-sided student assignments as standard (with electronic submission, grading & return)
16. Faxes: phase out fax machines, utilize computer faxing, end use of fax cover pages (research applicable technology/software: Win fax? E-fax?)
17. Increase electronic archiving and record keeping (this needs to be better defined and targets identified; work with Purchasing, Personnel, Academic Department and/or Student Records to be determined)

E-Library

E-books v/s Traditional books data and year wise history to moving from traditional to E-system.

There is constant endeavour to promote use of E-Books which is a very positive effort.

Despite fewer in numbers the e-books have advantage of being used by multiple students/ faculty simultaneously and thus creating better impact on sustainability in contrary to hard copy that can be read by only one person at a time.

The following recommendations are made

1. Use of E-books be promoted for students and faculty members specially in present Covid situation.
2. No. of E-books made available should be increased continuously.
3. Training on sustainability should be provided.
4. Adaption be promoted considering it to be a new normal.
5. Targets for increasing E-books should be fixed on continual basis.

Training and Awareness

The university is regularly conducting awareness program for students and faculty members.

Governance

Through enactment Waste Management and Green Initiative policy and its circulation to all stake holders, sustainability can be achieved. The results are regularly required to be verified at Periodical intervals. These can be managed through internal or external audits.

Plantation at Sushant University Gurugram

Plantation Inventory

Total Large tree counted on site are 122 Nos.

There is regular plantation program in vogue.

Air Quality

CPCB GUIDELINES

Exhausts of DG Sets are required to be raised as per CPCB requirement.

There is no record of air quality testing done earlier. Generally the dust level is found to higher than normal and is causing abnormal conditions.

As per WHO guidelines the following should be the limits for Air Quality

Particulate matter

Guidelines	
$PM_{2.5}$:	10 µg/m³ annual mean 25 µg/m³ 24-hour mean
PM_{10}:	20 µg/m³ annual mean 50 µg/m³ 24-hour mean

Air Quality Measurement

Sr. no	Location	PM-2.5	PM - 10	Particles	CO-2	HCHO	Remarks
1	Admin Office	60.1	88.3	6940	851	2.245	Higher HCHO-Formaldehyde-Higher PM
2	LT Panel Room Cabin	59.4	89.8	7092	1023	0.147	Higher PM
3	Out Side VC Room	54.5	82.7	6872	745	0.027	Higher PM
4	Lecture Theater D - 113	57.4	87.6	6417	752	0.021	Higher PM
5	Block - B & C Room C - 103	57.1	88.8	6245	761	0.001	Higher PM
6	A Block Room Ground Floor	55.5	82.3	6718	755	0.018	Higher PM
7	E Block Faculty Room	28	45.5	2828	666	0.02	Higher PM
8	D Block	22.9	38.2	2849	779	0.077	Higher PM
9	D Block Chemistry Lab	24.9	36.8	2953	780	0.45	Higher PM
10	Girls Hostel Common Room	70.2	102.3	7744	790	0.028	Higher PM
11	Canteen Area	60.3	90.7	7422	810	0.005	Higher PM

The values of PM-2.5 and PM-10 are y high and limits are dangerous for human beings. Values of CO2 and Formaldehyde are generally satisfactory except for Admn. area. There is not much that can be done by University for management of particulate matter. Only any loose soil or construction material inside premises should be sprinkled with water to mitigate to some extent.

Significance of Refrigerant for Environment

Table depicting properties of Refrigerants

Refrigerant	Global Warming Poetential	Ozone Depletion Potential
R 22	1810	Medium
R 410A	2088	Nil
R 32	675	Nil
R 134A	1430	Nil
R 290	3	Nil
R 600A	3	Nil

Refrigerant	Type	ODP	GWP	Atmospheric lifetime (years)
R12	CFC	0.9	8500	102
R22	HCFC	0.06	1700	13.3
R134a	HFC	0	1300	14
R407C	HFC blend	0	1610	36
R410A	HFC blend	0	1900	36
Ammonia (R717)	Natural compound	0	0	< 1
Propane (R290)	HC	0	3	< 1
R1234yf	HFC unsat.	0	6	Very low
R1234ze	HFC unsat.	0	6	Very low

Detail of Refrigerant used in installed Air Conditioners

Data of Refrigerants not maintained. It is recommended that in future all procurement for AC's, Water cooler etc. be made with consideration for Environment friendly refrigerants.

Recommendations

1. It is recommended that in future care should be taken to purchase Air conditioners with refrigerants for which GWP is low and ODP is nil.
2. Life cycle cost should be considered for making decision about purchase of Air Conditioners.
3. All AC's that were procured more than 8 years ago should be replaced with best in class energy efficient Air Conditioners after taking into consideration Life Cycle Cost. This will eliminate existing AC's impact on environment through low impact refrigerant and also with low consumption of Electricity thus reducing

ECO Friendly House Keeping Materials

Presently chemicals not complying to Green Pro certification are used. It is recommended that in future housekeeping chemicals with Green Pro standard certification be only used.

It is recommended that Eco Friendly material and Sustainable material as per NBC-2016 guidelines be procured and used.

CII
Confederation of Indian Industry

GreenPro

GreenPro Certification Standard for

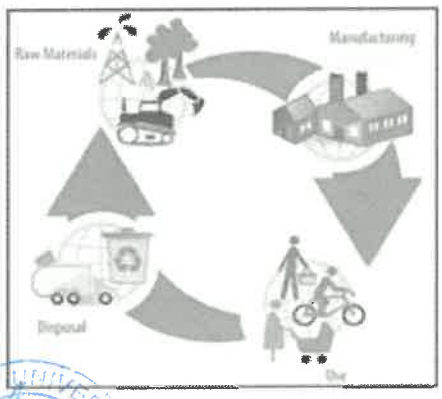
Cleaning Chemicals

Version 1.0

GreenPro Certification – Life Cycle Approach

The Green Products Rating adopts a holistic approach based on the 'Life Cycle' of the product. The rating system encourages the product manufacturers to implement measures that would result in environmental, health and wellbeing benefits at the following stages of the life cycle of the products.

1. Product Design
2. Raw materials
3. Manufacturing Process
4. Product Performance during use
5. Disposal / Recycling



For Users

Use of rated Green products leads to significant tangible and intangible benefits for the end users.

Some of the benefits for the users are highlighted as below:

1. Time and effort in carrying out due diligence in selecting a green product is saved
2. The user is assured of the performance of the product and equipment
3. Ensures Toxic and hazardous substances free products which in turn decrease "health and wellbeing" risks of the users
4. Improved product performance during use to reduce resource consumption and environmental impacts
5. Recognition and credits for achieving national and international Certification for the buildings

National Priorities addressed in Certification

GreenPro Certification addresses the following which are priorities of the Government at the National level:

Water:

Water is a major concern in most part of the country. Implementation of water efficiency measures and "zero Liquid Discharge" are being encouraged to address the water related issues.

Land:

Availability of land and increase in land pollution are major areas of concern. The Certification system demands for increased recycling of material after use which would result in reduction in landfills and hence reduction in land pollution.

Energy Efficiency:

The Certification system encourages the product manufacturers to adopt energy efficiency improvement measures and reduce their energy consumption which is in line with the National Mission on Enhanced Energy Efficiency. This also addresses

The key objective of the council is to facilitate Green product market transformation in India through 'Green Product Certification'.

The initial focus of the council will be on Green building products and related technologies. Over a period of time, the council will expand its focus to other areas such as Industrial products, consumer items, services etc.

Why GreenPro Certification?

The GreenPro Certification is a tool for facilitating Green Product market transformation in the country. The GreenPro Certification is expected to:

1. Enable green building projects in selecting the right product and equipment
2. Increase the market demand for the Green products
3. Put a system in place for a product to be called 'green'

Eliminate exposure to prohibited substances that can lead to long term health effects either through respiration / direct contact.

Mandatory Requirement Manufacturer to provide Material Safety Data Sheet (MSDS) for the products. The MSDS should have the following details:

1. Chemical Identify
2. Manufacturer's information
3. Hazardous ingredients / Identify information
4. Physical, Chemical characteristics
5. Fire and explosion hazard data
6. Reactivity data
7. Health hazard data
8. Precautions of safe handling and use
9. Control measures
10. Emergency and first aid procedures

General Purpose Cleaners

Presently there is no practice for procurement of Eco Friendly chemical.

Eco friendly housekeeping materials are recommended to be used for all cleaning application should be Green Pro or any similar Indian standard should be procured in future and records of such procurement b documented for future references.

The cleaning material may be required for following applications and also may be some other in addition to these.

1. Glass Cleaners
2. Bathroom Cleaners
3. Disinfectants and Sanitizers
4. Cleaner/Degreasers
5. Carpet and Upholstery Cleaners
6. Floor Cleaners
7. Liquid Hand Soap
8. Furniture Polish

Ventilation Assessment

There is no area which is not Air conditioned. Mechanical ventilation has since been provided.

Fire Safety:

No halon based fire extinguishers have been used, it is very good initiative. As a future guideline It is recommended that of fire suppression system is to be used for any fire extinguishing system, only clean agents with minimum environmental impact should be installed.

Sustainable Development Goals

Sustainable development should always be practiced in all activities of university.

Consideration for New Constructions

There are no construction presently going on and is also not mooted in near future.

There should be an effort to Encourage use of local materials

Always encourage use of locally available material. With this we will help local population and their Social Development Index will get a boost. Also low energy shall be expanded on transportation that will ultimately save fossil fuels and make decision of an organization more sustainable.

Low VOC (Volatile Organic Compound)%

The following material contains VOC

1. Paints
2. Adhesives
3. Sealants
4. Other materials

It should be ensured that while procurement or issuing PO's for work it should be ensured that only material with permitted percentage of VOC are procured or used in of works awarded. Special conditions in contract/specifications shall be incorporated.

Team responsible for PMC shall ensure that material brought to site and used in execution of work is in compliance to Green specifications.

Use of Low Impact material and Zero ODP material

Where ever relevant and applicable care should be taken to include in specifications use of low impact material and only zero ODP material shall be procured or used in execution of works by contractors/Vendors.

Guidelines for Environment Friendly and Green Initiatives

Annexure I

VOC limits of materials

Type of Material	VOC Limit (g/L less water)
Paints	
Non- Flat (Glossy) paint	150
Flat (Mat) paint	50
Anti- corrosive/ anti-rust paints	250
Varnish	350
Adhesives	
Glazing adhesives	100
Tiles adhesives	65
Wood adhesive	30
Wood flooring adhesive	100

Annexure II

Minimum Ventilation Rates in Various Functional Zones*

Occupancy Category	People Outdoor Air Rate	Area Outdoor Air Rate
	Cfm/person	Cfm/ sq.ft
Correctional Facilities		
Dayroom. Guard station	5	0.06
Booking/ waiting	7.5	0.06
Education Facilities		
Daycare (through age 4), daycare sickroom, Art Classroom, science laboratories. college laboratories. wood. metal shop	10	0.18
Classrooms (ages 5-8), (age 9+). computer lab. media centre	10	0.12
Lecture Room/ hall (fixed seating)	7.5	0.06
Music/ theater/ dance.	10	0.06
Multi use assembly	7.5	0.06
Food & Beverages Services		
Restaurant dining rooms/ cafeteria/ fast food dining/ Bars/ Cocktail Lounges	7.5	0.18
General		
Break Rooms. Coffee stations. conference/ meeting	5	0.06
Corridors	-	0.06
Storage Rooms	-	0.12
Hotels, Motels, Resorts, Dormitories		
Bedroom/ living room, barracks sleeping areas	5	0.06
laundry rooms	5	0.12
Lobbies/ prefunction	7.5	0.06
Multipurpose assembly	5	0.06

Occupancy Category	People Outdoor Air Rate	Area Outdoor Air Rate
	Cfm/person	Cfm/ sq.ft
Office Building		
Office Spaces, Reception Areas, Telephone, data entry, Main entry Lobbies	5	0.06
Electrical Equipment rooms	-	0.06
Elevator machine rooms	-	0.12
Pharmacy (prep area)	5	0.18
Photo Studios	5	0.12
Shipping/ receiving	-	0.12
Telephone closets	-	0.00
Transportation waiting	7.5	0.06
Warehouses	-	0.06
Public Assembly Spaces		
Auditorium seating area, Place of religious worship, Courtrooms, Legislative Chambers, Lobbies	5	0.06
Libraries	5	0.12
Museums (children's)	7.5	0.06
Museum/ galleries	7.5	0.06
Retail		
Sales	7.5	0.12
Mall common Areas	7.5	0.06
Barber Shop	7.5	0.06
Beauty & nail salons	20	0.12
Pet Shops (animal areas)	7.5	0.18
Super Market, Coin operated Laundries	7.5	0.06

Occupancy Category	People Outdoor Air Rate	Area Outdoor Air Rate
	Cfm/person	Cfm/ sq.ft
Sports & Entertainment		
Sports arena (Play Area), Gym, stadium (play area)	-	0.30
Spectator area	7.5	0.06
Swimming (pool & deck)	-	0.48
Disco/dance floor/ health club/ aerobics room/ weight rooms	20	0.06
Bowling alley (seating)	10	0.12
Gambling casinos/ game arcades	7.5	0.18
Stages, studios	10	0.06

** Total outdoor air flow in functional zone =*

$$\left\{\begin{array}{c}\text{Outdoor air flow rate required per person as per the above table}\\ \times\\ \text{Zone population}\end{array}\right\} + \left\{\begin{array}{c}\text{Outdoor air flow rate required per unit area as per the above table}\\ \times\\ \text{Net occupiable zone area}\end{array}\right\}$$

Landscape Water Demand Reduction

Plant factor for various species

Plant species	Plant factor
Lawns	1
Native grass	0.45
Existing native trees	0
Newly planted native shrubs	0.3
Newly planted exotic shrubs	0.9
Newly planted native trees	0.15
Newly planted exotic trees	1.65

Plant species	Plant factor
Vertical gardens	0.35
Newly planted native shrubs on podium	1.3
Newly planted exotic shrubs on podium	1.9
Newly planted native trees on podium	1.15
Newly planted exotic trees on podium	2.65
Note: For potted plants, calculate the water requirement as volume of pot and divide it by 4.	

Table 2 Irrigation system efficiency

Type of irrigation system	Efficiency (%)
Flood	65
Furrow	80
Sprinkler	85
Drip	90

ENERGY AUDIT
2023 - 2024

Sushant University

Sushant University

ENERGY AUDIT OF

SUSHANT UNIVERSITY CAMPUS

Energy Audit Team

AUDIT TEAM

Audit team for this assignment consisted of Energy Auditors, Engineers and Experts namely Dr. P.P. Mittal, Accredited Energy Auditor (AEA-0011), Sh. Pankaj Chauhan, Sr. Energy Consultant & Sh. Alok Tiwari, Sr. Engineer.

NOTE: It is intimated that this whole exercise is for Identifying Energy Saving Potential and for Quality of Power.

Place: DELHI Date: 26 April 2024

INTERNAL TEAM

Under guidance of following faculty members:

We are thankful and appreciative of the keen interest and commitment of Management and we convey our special thanks to

Name	Designation
Mr. Dheeraj Kuamar	Manager Facility
Mr. B. K. Jha Manager	Asst. Manager

We also thank to each & every official of Engineering Section for showing keen interest and co-operation during the course of our study.

Data collection for energy audit of the Sushant University Campus was carried out by the team members during 23th to 25th April 2024. This audit was conducted to seek opportunities to improve the energy efficiency of the campus. Reduction of energy consumption while maintaining or improving human comfort, health and safety were of primary concern. Beyond simply identifying the energy consumption pattern, this audit sought to identify the mostenergy efficient appliances. Moreover, some daily practices relating common appliances have been provided which may help reducing the energy consumption.

The report accounts for the energy consumption patterns of the block wise based on actual survey and detailed analysis during the audit. This report encompasses the area wise consumption traced using suitable equipments. The report is based on certain generalizations and approximations wherever necessary. The views expressed may not reflect the general opinion.

About the energy audit location

Sushant University is a private university situated in Gurgaon, National Capital Region (NCR), India. It was established in 2012 through the Haryana Private Universities Act (Amendment) 2012. It is located in the foothills of Aravalli Range on the Golf Course Road with facilities on a 12.85 acre campus

PARTICULARS	UNITS	DETAILS
Name of the establishment	-	Sushant University
Address	-	Sector-55, Gurugram–122003 (Haryana)
Contact Person	-	Sh. B.K.Jha, Manager
Daily Operating Hours	Days/Week	5
Operating Hours	Hours/Days	8
Source of Electricity	-	Dakshin Haryana Bijli Vitran Nigam (DHBVN)
Coordinates		28.431°N 77.111°E

1. Introduction

Sushant University is strategically located in Gurugram, a rapidly growing city in the National Capital Region (NCR). The university's campus is designed to provide a conducive learning environment, with modern classrooms, well-equipped laboratories, and ample recreational facilities. Students can enjoy a vibrant campus life, participating in various extracurricular activities, sports, and cultural events.

The university's proximity to Delhi and other major cities offers students numerous opportunities for internships, placements, and research collaborations. The university also has strong partnerships with industry leaders, enabling students to gain valuable practical experience and network with professionals.

1.1 Objective of Energy Audit Practice

The basic objective of energy audit report is to promote the general awareness of Energy conservation in the Sushant University campus. The purpose of the energy audit is to measure all feasible connected loads, its power ratings, quantity, descriptions and prioritize energy cost measures relating to energy use in the blocks.

- Identification of Blocks of energy consumption and estimation of energy saving potential in four blocks and basic amenities.

1.2 Analysis of Block wise of Use

Identifying where energy is used is useful because it identifies which areas the audit should focus on and raises awareness of energy use and cost. The results of the analysis can be used in the review of management structures and procedures for controlling energy use. Analysis of energy use can be done by taking meters readings in different blocks locations to pinpoint actual energy usage per block. This is a good source data for allocating energy use. The electricity in-charge can also list all equipment used and the corresponding operating hours. With this information, spreadsheet can be created and charts useful for analysis may be generated.

1. Energy Audit Methodology:

The methodology adopted for this audit was a three step process comprising of:

1. Data Collection: In preliminary data collection phase, exhaustive data collection was performed using different tools such as observation, interviewing key persons, and measurements.
2. Data Analysis: Detailed analysis of data collected was done using excel sheet.

Recommendation: On the basis of results of data analysis and observations, some steps for reducing power consumption without affecting the comfort and satisfaction were recommended along with their cost analysis.

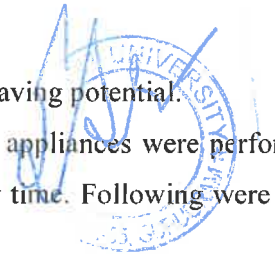
Data Collection: For suggesting any corrective measures to reduce power consumption, it is first necessary to know the power consumption pattern in detail. For this, the exhaustive data collection exercise was performed at all the blocks. Following steps were taken for data collection:

- The team went to each blocks, etc.
- Information about the general electrical appliances was collected by observation and interviewing.
- The power consumption of appliances was measured based on rated power was used (CFL and Fan etc.).
- The details of usage of the appliances were collected by interviewing key persons.
- In case of Air Conditioning, insulation was checked by visual inspection.
- Approximations and generalizations were done at places with lack of information.

Data Analysis: In data analysis, the data collected is processed to draw significant conclusions to pinpoint loopholes and identify the areas to focus upon. Analysis of the power consumption observations obtained was used to obtain the power consumption pattern and also to get the information about the points where electric power is wasted.

The team analyzed the data in following way:

- The database prepared in sheets and electricity bill sheet was further studied and the results have been graphically represented.



- This helped to identify the areas with maximum energy saving potential.

Recommendation: Energy as well as cost analysis of different appliances were performed and recommendations were made based on the capital cost recovery time. Following were the steps involved in this process:

- The capital cost involved in replacing an appliance and/or process was estimated.
- The energy saving by the move was calculated in terms of price of energy per year.

The Sushant University has 07 schools, A,B,C,D and E blocks. D block is the single largest power consuming unit.

Sr. No.	Month	Grid	DG	Solar	TOTAL
1	September 2023	46262	822	14039	61123
2	October 2023	51400	548	15642	67590
3	November 2023	39685.6	903	15011	55599.6
4	December 2023	46382.2	104	11962	58448.2
5	January 2024	29824	767	9688	40279
6	February 2024	43893.8	765	10108	54766.8
7	March 2024	49628	1120	12495	63243
8	Total	495938.2	16295	157045	669278.2

ANALYSIS OF POWER CONSUMPTION

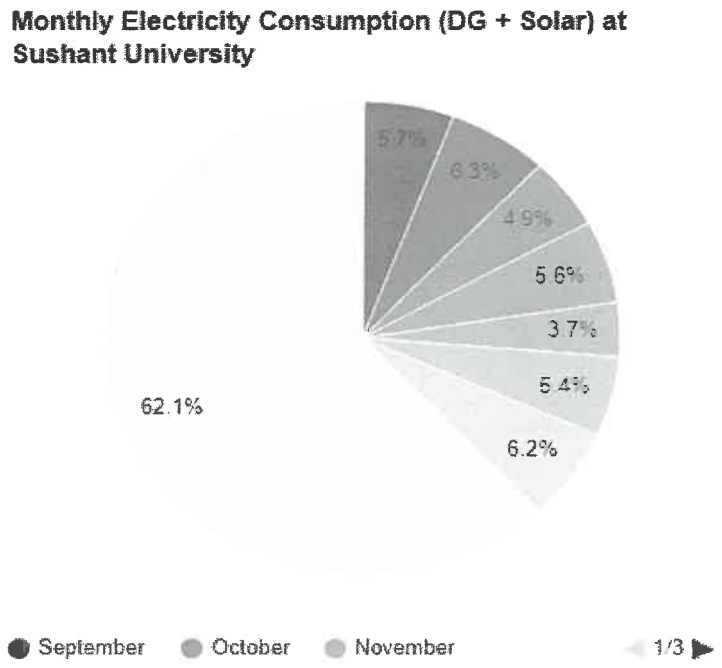


Fig.1. Total connected Loads in KW

Sr. No.	Month	Unit Generated (kWh)	Diesel Consumption Ltr
1	August 2023	3326	1635
2	September 2023	5346	2430
3	October 2023	1120	440
4	November 2023	765	525
5	December 2023	1369	725
6	January 2024	767	334
7	February 2024	104	91
8	March 2024	903	340
Total		14666	7320

Table. 2: Details of Electrical Energy from Solar PV

Srl.	Month	Unit Generated (kWh)
1	Aug 2023.	16500
2	Sept2023.	14000
3	Oct2023.	13600
4	Nov.2023	11000
5	Dec.2023	13500
6	Jan. 2024	12500
7	Feb. 2024	12200
8	Mar. 2024	15500
	Total	168700

Table. 3: Details of Electrical Energy from DG

A point to note in the above chart is the higher consumption of block D due to its large area as well as installed different laboratories.

he connected equipment wise distribution of power consumption in the Sushant University campus has been shown in the following chart. As the chart suggests, major power consuming areas are ACs during summer (21%), UPS (21%), Lightening (33%), Lift (6%), RO (7%), STP (3%), Food Court (3%) and others (7%).In case of computer labs, wise use of computers and ACs is required to reduce the consumption. In other labs also, wise use of lighting and other appliances can largely reduce the consumption. It is advised that T5 lamps or CFL should be used for lighting and star rated fans should be used. Corridors, toilets and faculty cabins are the areas where automation can be used to reduce the consumption largely.

Fig. 2 Equipment wise connected loads in KW

Power saving Sample Calculation

November 2023 bill for non industrial load

Particulars	Amount	Remarks
Demand Charges Rs.	2,20,931.51	fixed charged for 600 KVA for billing period of 28 days as per bill *Calculation of demand charge :per day rate (400X12)/365 days : 1 day demand charge is rs:13.16,* *Now the billable demand is 600 for 28 days billing,* *hence amount will be =600 X13.16 X 28* = 2,20,931.51
Energy Charges Rs.	11,21,595.95	Total Energy Charges (i.e Unit consumed as per slab for billing period/days)
Electricity Duty @ 7.5% on demand charged + Energy charges Rs.	1,00,689.56	

Regulatory Surcharge @6% on Demand charges + Energy charges	80,551.65	
Rounding amount Rs.	0.2	
Total Amount Rs.	1,523,768.00	

Rate category = HV 1(NON INDUSTRIAL HV)

Contractual load = 800 KVA

Billable demand = 600 KVA (75% of contractual demand or max. demand recorded in month

March 2024 bill after solar PV power system for non industrial load

Particulars	Amount	Remarks
Demand Charges Rs.	**2,20,931.51**	**fixed charged for 600 KVA for billing period of 28 days as per bill** *Calculation of demand charge :per day rate (400X12)/365 days : 1 day demand charge is rs:13.16, Now the billable demand is 600 for 28 days billing, hence amount will be = 600 X13.16 X 28* **= 2,20,931.51**
Energy Charges Rs.	**1,018,260.43**	**Total Energy Charges (i.e Unit consumed as per slab for billing period/days)**
Electricity Duty @ 7.5% on demand charged + Energy charges Rs.	**92,939.39**	
Regulatory Surcharge @6% on Demand charges + Energy charges	**74,351.51**	
Rounding amount Rs.	**0.45**	
Total Amount Rs.	**1,406,482.00**	

Difference/saving = 117,286.00

Solar PV system details

- **Total PV module = 100KW solar photovoltaic system**
- **Power generates = 12000 units or watts per month**
- **no. of nodes = 400 nos.**
- **Solar PCU (inverter) = 100KW**
- **Space required = 600-1000 sq. metre**

Suggestions for Optimal Consumption

1. **Green campus** : Installation of renewable energy sources like solar and wind farms.
2. Uses of **5 star rating** equipments.
3. **IOT connected/Sensor** based opening and closing of electricity.
4. Requirement of **sub meters** in each block and based on floor.
5. **Individual switch** for individual fan or light so that students can switch on as per their requirement.
6. CFL can be replaced by **LED lights**.
7. Many ACs of lower ratings can be replaced by **single AC with higher rating.**
8. **Regular maintenance** and advanced power factor correction panel is required.
9. **Regular service of equipments** (ACs, STP, Machines etc) is required.
10. **Halogen lighting** can be replaced by LED lights.
11. **Maintenance for fan regulators** is needed.
12. Replacement of LCD based systems by **LED screen systems** in laboratories.
13. **Water pumping** can be operate in **off peak hours**
14. **Continuous monitoring of energy consumption pattern** for immediate necessary action.
15. **Regular replacement of fan capacitors**
16. **Proper earthing** can be provided
17. **Regular measurement of earth resistance** for maintenance
18. **Surveillance of electricity consumption** (heaters, kettles, immersion rods, iron,. etc.) in hostels and university blocks.
19. **Optimal working hours/ days** for the university.
20. **Replacement of old ACs** is required.
21. **Advertisement of energy saving / consumption** can be posted throughout the university campus for awareness.
22. **Proper instructions** can be given to faculties and staff for **optimal** use of electricity.

CERTIFICATE ON

GREEN AUDIT/ENERGY AUDIT/ENVIRONMENT AUDIT/WATER AUDIT & THERMAL IMAGING

National Award Winner
(2013)

एक कदम स्वच्छता की ओर

IGBC AP
Save Energy Save Earth

A-Z ENERGY ENGINEERS PVT. LTD.

(An ISO 9001:2015 Certified Company)

Winner

- Best Entrepreneur Award By Hon'ble Prime Minister of India
- Awards by AEE Atlanta, USA in 2016, 2018, 2020 & 2021
- National Energy Conservation Award – 2016, 2015 & 2013
- Haryana State Energy Conservation Award – 2012, 2017 & 2018

Corporate Identity Number : U40300DL2012PTC236342

Certificate

It is certified that our company A-Z Energy Engineers Pvt. Ltd. has carried out following Studies / Audits in the premises of Sushant University (Esrt. Ansal University), Sector-55, Gurugram, in the month of July 2021;

1. Detailed Energy Audit
2. Electrical Safety Audit
3. Water Audit
4. Green and Environment Study
5. Thermal Imaging

The audit team was headed by Dr. P.P. Mittal, Accredited Energy Auditor, Director, A-Z Energy Engineers Pvt. Ltd. and Sh. S.S.Maan, Accredited Energy Auditor, It is further intimated that the data collection had been carried out diligently and truthfully. All reasonable professional skill, case and diligence had been taken in preparing the Reports and the contents thereof are a true representation of the facts;

For A-Z Energy Engineers Private Limited

Director

19th July 2021

Dr. P. P. MITTAL
Director

HEAD OFFICE: 4860-62, Harbans Singh Street Plot No. 12, Kothi No.24, Ward No.II, Darya Ganj, Delhi – 110002
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pp_mittal@yahoo.com, info@energyengineers.co.in, www.energyengineers.co.in

(2015)

एक कदम स्वच्छता की ओर

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Corporate Identity Number : U40300DL2012PTC236342

ACCREDITED BY BEE No.: 0011 EMPANELMENT NO. EmAEA-0024 ESCO BY BEE : 980/20AUG2020

Certificate

This is to certify that Team of A-Z Energy Engineers Pvt. Ltd. Delhi, Headed by Dr. P.P. Mittal, Accredited Energy Auditor and his team had carried out **Green, Energy and Environment Study** of **Sushant University**, Sector 55, off Golfcourse road, Near AIT Chowk, Gurugram (Haryana)-122003,in the month of April 2024.

It is further intimated that the data collection had been carried out diligently and truthfully. All reasonable professional skill, case and diligence had been taken in preparing the reports and the contents thereof are a true representation of the facts.

26th April 2024

Dr. P. P. MITTAL
Director

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