7.1.6 Quality audits on environment and energy regularly undertaken by the Institution and any awards received for such green campus initiatives:

1. **Green audit**
2. **Energy audit**
3. **Environment audit**
4. **Clean and green campus recognitions**
5. **Beyond the campus environmental promotion activities**

A. Any 4 or all of the above

B. Any 3 of the above

C. Any 2 of the above

D. Any 1of the above

E. None of the above

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Green Audit Report

of

THADOMAL SHAHANI ENGINEERING COLLEGE, BANDRA WEST, MUMBAI

Prepared

By

Endutech Consultancy Services
Navi Mumbai

2022-2023

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ENDUTECH CONSULTANCY SERVICES PVT LTD

ACCREDITED
ISO 9001: 2015
QMS Certification CAB # 118005

ECS/2023/1 Date- 31/01/2023

GREEN AUDIT COMPLETION CERTIFICATE

AY (2022-23)

This is to certify that Green Audit has been carried out in the campus and buildings of Thadomal Shahani Engineering College, Bandra West, Mumbai- 400050, Maharashtra in the month of January 2023.

Name of the Installation	Thadomal Shahani Engineering College, Bandra West, Mumbai- 400050
Details of Facilities Audited	Laboratories, Classrooms, Library, Seminar halls, Campus (New and Old Building)
Duration of Audit	27/01/2023 to 28/01/2023
Name of Government Registered Agency	ENDUTECH CONSULTANCY SERVICES PVT LTD, Navi Mumbai
Name of Certified Energy Auditor	Dr. S D Dalvi
BEE Certification Number	CEA- 12141

For,
Endutech Consultancy Services

Dr. S D Dalvi (Lead Auditor-CEA 12141)

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Contents

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Chapter-I

Green Audit

1.1 Background of the study:

According to National Assessment and Accreditation Council (NAAC), the Green Audit is defined as the process of assessing the environmental impact of an organization, process, project, product, etc.

Green audit was originated with the beginning of 1960's with the purpose of examining the work conducted within the establishments whose activities can cause risk to the health of inhabitants and the environment.

It exposes the authenticity of the proclamations made by multinational industries and governments with the concern of health issues as the consequences of environmental pollution. Each organization should carry out the Green Audit of ongoing processes for various reasons such as; to make sure whether they are performing in accordance with relevant rules and regulations, to improve the procedures and ability of materials, to analyze the potential duties and to determine a way which can lower the cost and add to the revenue. Through Green Audit, the organization gets a direction as how to improve the condition of environment and there are various factors that have determined the growth of carrying out Green Audit.

Green Audit is assigned to the Criteria **VII** of NAAC, which is a self-governing organization of India that declares the institutions as Grade A, Grade B or Grade C according to the scores assigned at the time of accreditation.

The aim of organizing Green Audit is to upgrade the environment condition in and around the institutes, colleges, industries and other organizations. It is carried out with the aid of performing tasks like waste management, energy saving and others to turn into a better environmentally friendly institute.

This green audit report presents the analysis of the data collected, observations made at the facility and is governed by the objectives, scope of work, methodology etc. discussed in the ensuing paragraphs.

Objectives:

The basic objectives of the Energy Audit Study are to,

- assess the environmental impact of an organization (educational institute)
- assess the environmental impact of an educational system/process
- assess the environmental impact of projects requiring machine, material etc.
- assess the environmental impact of education system products.
- make sure that rules and regulations are taken care of
- avoid the interruptions in environment that are more difficult to handle and their correction requires high cost.
- suggest the best protocols for adding to sustainable development
- to secure the environment and cut down the threats posed to human health.

Methodology:

Following methodology is adopted to conduct the green audit at TSEC.

1. Prior to start of the Audit session, list of data required along with the execution plan is submitted to the TSEC.
2. The team of Project Engineers for this task is deputed.
3. The visit was undertaken in the First week of January 2023.
4. The field training was given to the engineers about data collection.
5. The data about trees types, tree height, number of trees is recorded with photographs.

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6. The data about infrastructure like draining system, seepage in the building and parking area is collected.
7. The data of elevators, staircases, fire fighting system is noted down.
8. The data about green culture of TSEC is noted down.

Team:

The team members of the audit study.

1. Dr S D Dalvi, Certified Energy Auditor (CEA-12141)

2. Mr Harshal Shirsath, Project Engineer

3. Mr Pratik Ghade, Project Engineer

Acknowledgment:

Endutech consultancy services wish to record their gratitude to the management of TSEC for awarding this assignment.

We extend our thanks to the Principal, **Dr. G T Thampi** for initiating the work.

We are also thankful to **Prof. Monika G Tolani**, Assistant Professor, Training & Placement Officer, TSEC, and the maintenance team including Mr. Gomes, Mr. Manish and Mr. Sunil for extending all possible help and co-operation from their side.

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Chapter-II

Trees & Plantation

2.1 Brief Description:

Many trees are planted in the campus of TSEC. Trees and plants covers all directions of the college. Potted trees, landed trees are seen in the campus. The trees and plants are taken care by maintenance team of the institute.

Figure below shows the flora and fauna of TSEC.

Trees/Plants towards East Side of New Building

Trees/Plants towards East Side of New Building

Trees/Plants towards South Side of Old Building

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Trees/Plants towards South Side of Old Building

2.2 Trees and Plants Details:

The trees details and botanical identifications are given in the table below.

Plant/Tree Botanical name	Location	Direction	Height (ft)	Quantity
Dypsis lutescens	New building	North	5	12
Dypsis lutescens	New building	East	6	4
Pandanus_tectorius	New building	North	6	1
Syngonium_podophyllum	New building	East	4	1
Euphorbia_tithymaloides	New building	North	6	1
Manilkara_zapota	New building	East	6	1
Cordyline_fruticosa	New building	East	6	1
Saraca Asoca	New building	East	25	1
Saraca Asoca	Old building	South	15-30	5
Lemon	New building	East	5	1
Vanilla_planifolia	New building	East	6	1
Firmiana_simplex	New building	East	6	1
Dracaena_sanderiana	New building	East	6	2
Papaya	Old building	South	7	1
Solanum_diphyllum	Old building	South	5	1
Ficus_microcarpa	Old building	South	5	1
Dracaena_fragrans	Old building	South	5	1
Monoon_longifolium	Old building	South	4	1
Rhapis_excelsa	Old building	South	4	1
Mangifera_indica	Old building	South	15	1
Tabernaemontana_divaricata	Old building	South	4	1

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Bougainvillea_glabra	Old building	South	5	1
Hibiscus_rosa-sinensis	Old building	South	5	1
Heptapleurum_arboricola	Old building	South	5	1
Dieffenbachia	Old building	South	5	1
Codiaeum_variegatum	Old building	South	4	1
Elaeis_guineensis	Old building	South	7	1
Elaeis_guineensis	Old building	South	10	1
Elaeis_guineensis	Old building	South	35	1
Terminalia_catappa	Old building	East	15	2
Peepal (Ficus Religiosa)	Old building	East	25	1

2.2 Observation/Suggestions:

The broken pots of the potted plants to be replaced towards North side of New building.

Broken potted plants pots

The trees may be provided with QR codes showing technical/botanical information.

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Chapter-III

Infrastructure

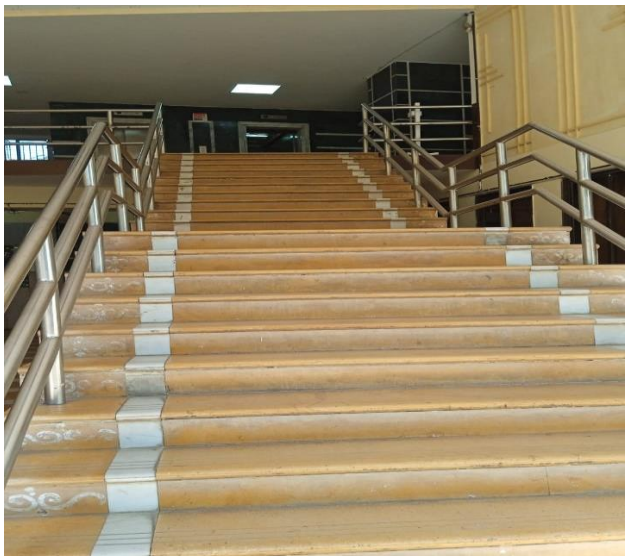
3.1 Introduction:

Thadomal Shahani Engineering College (TSEC) is a private engineering college in Mumbai, India. Founded in 1983, it is the first and the oldest private engineering institute affiliated with the University of Mumbai.

TSEC was founded by the Hyderabad (Sind) National Collegiate Board (HSNC Board) in the year 1983. It is named after one of Mumbai's most respected philanthropists, Dada Kishinchand T. Shahani's father, Thadomal Shahani.

3.2 Movements and Parking Facility:

TSEC campus is provided with multiple staircases as well as elevators with necessary entrances to ensure quick and effective movement in normal as well as emergency conditions.



New building Ese of Movements

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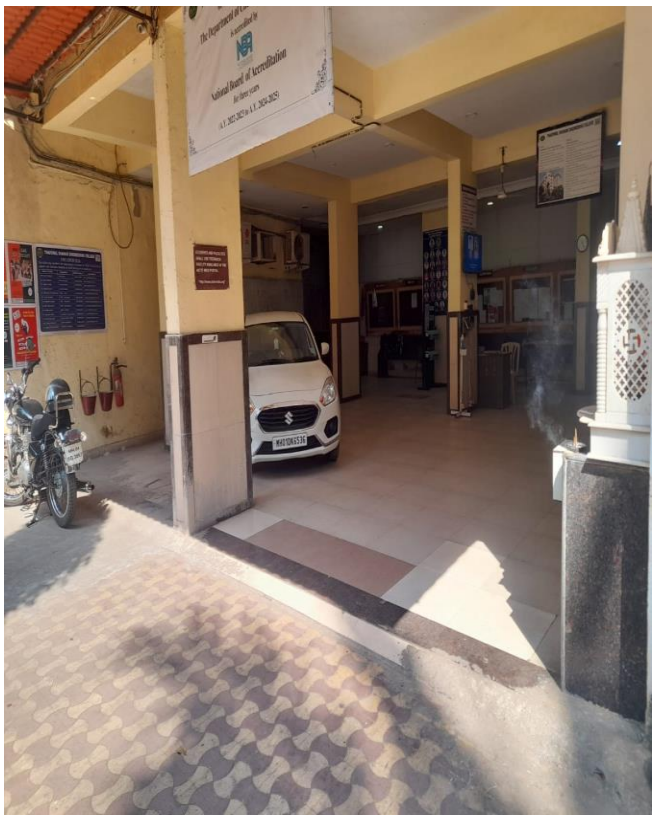
Old building Ese of Movements

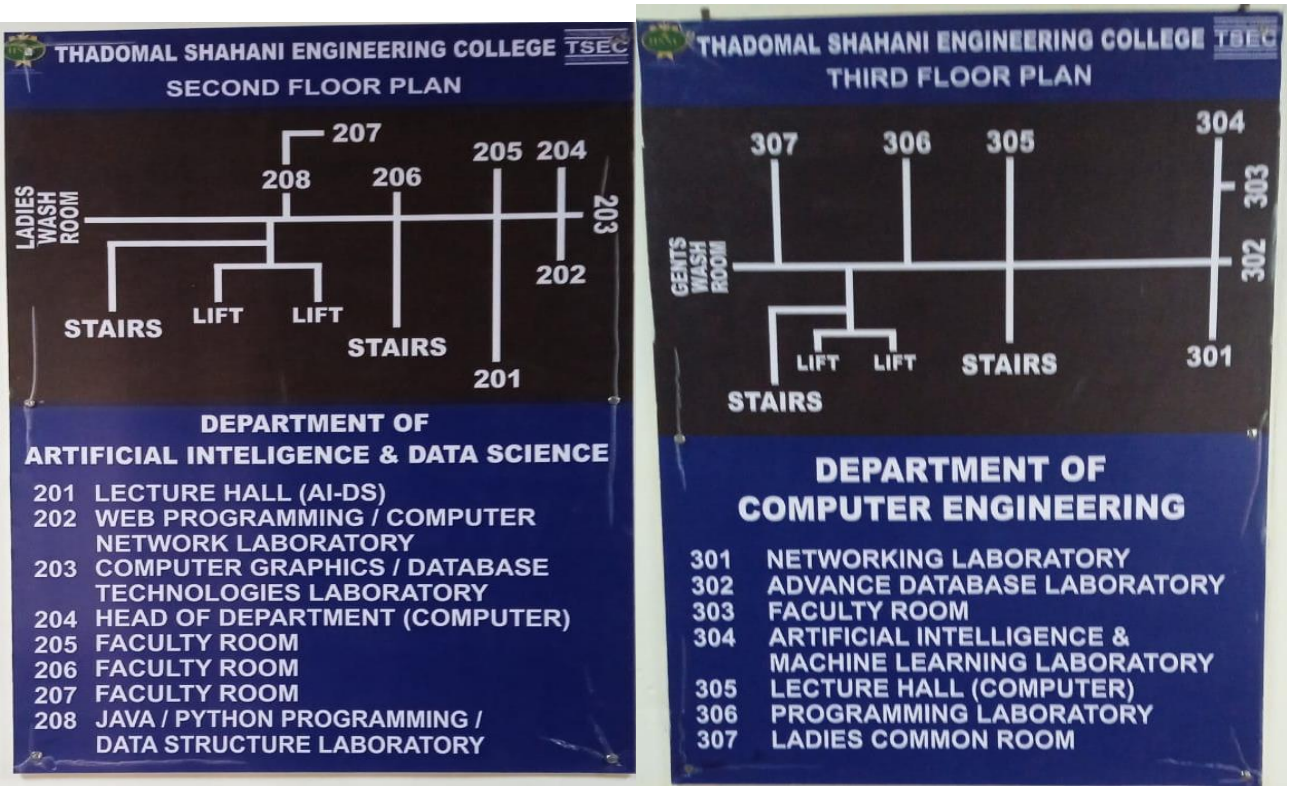
The movement of vehicle inside the campus is restricted and separate parking areas are provided in the campus.



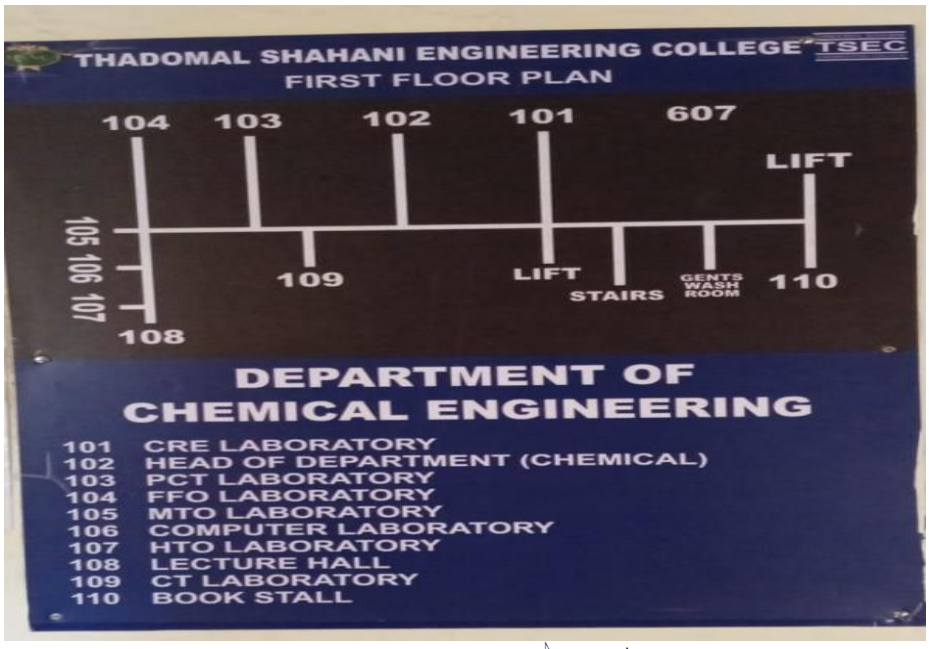
Parking Facility in Old & New building

The students and many of the faculty members avail public transport system which is very convenient due to proximity to Bandra and Khar road railway stations and bus services.

Floor plans are disseminated at all locations in the new building and old building.



New building sample floor plans



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Old building sample floor plans

Draining system:

The drains from the washrooms are connected to the municipal drainage, which is a common practice in the colleges in the BMC region.

Seepage in the building:

The organization is inspected for seepages.

No seepages are observed in any of the places of the new building. But at few places in the old building the seepages are observed.

Old building seepage (First Floor)

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Chapter-IV

Safety

4.1 Introduction:

Healthy and safety environments are inevitable to conduct all Educational, Research, Service and campus activities in any institutions.

In any organization, human resource is the most important one, especially in the educational institute. Safety practices are aimed at preventing accidents which cause injury to the persons and damage to the properties.

Accidents invariably cause some kind of damage – injury to the personnel and/or damage to property. However, accidents are preventable, if proper care is taken in the safety guidelines for any kind of activity. Unsafe conditions and unsafe acts during a particular work cause accident. These can be avoided by ensuring:

- Safe working conditions in workshop/machine shop.
- Proper maintenance of tools and equipment.
- Availability of first-aid.
- Training of safety to the students and faculty members

4.2 Fire-fighting system:

There are sufficient fire extinguishers/fire sand buckets/fire hydrants in the new building; which are checked / refilled as per the stipulated frequency. In the old building the adequate number of fire extinguishers are required.

The details of the fire extinguishers are given in the table.

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Location	Fire Extinguisher (ABC Class)	Sand Bucket	Fire Hydrant
New Building Gr floor	2	2	Yes
New Building 1st floor	2	2	Yes
New Building 2nd floor	2	2	Yes
New Building 3rd floor	2	2	Yes
New Building 4th floor	2	2	Yes
New Building 5th floor	2	2	Yes
New Building 6th floor	2	2	Yes
New Building 7th floor	2	2	Yes
New Building 8th floor	2	2	Yes
New Building 9th floor	2	2	Yes
New Building 10th floor	2	2	Yes
New Building 11th floor	2	2	Yes

Fire Extinguishers & Sand Buckets at TSEC

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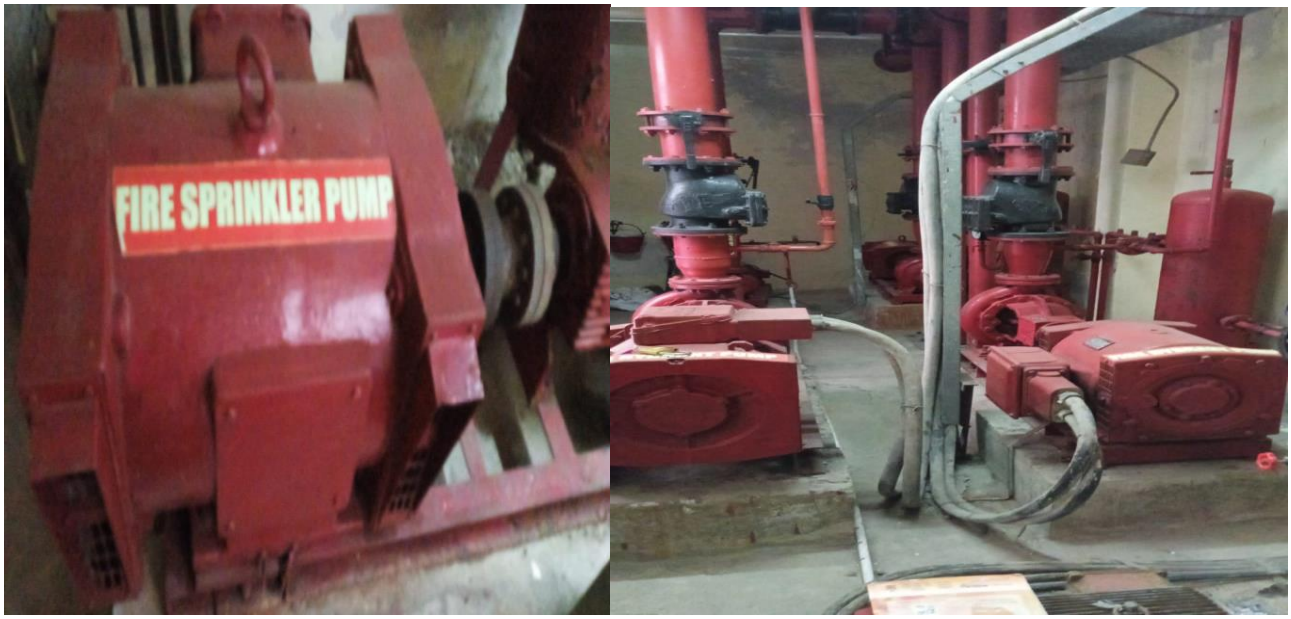
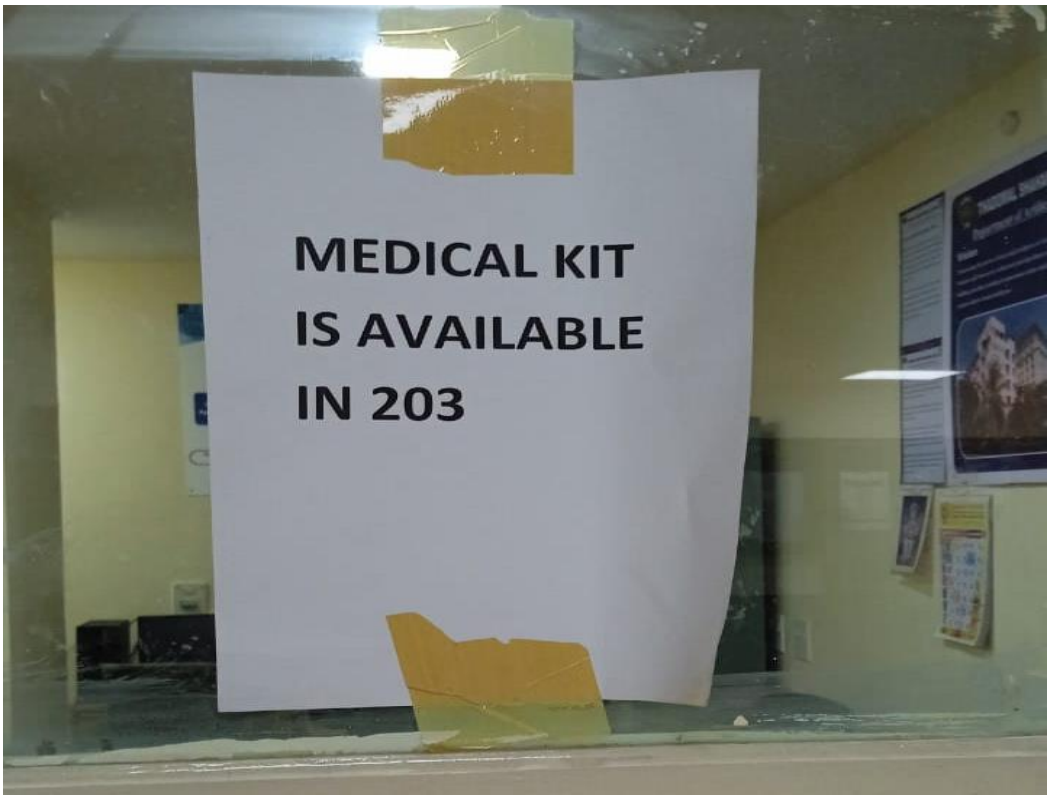


Fire Hydrant and Pumps (NB Ground Floor) at TSEC

4.3 First Aid:

In the TSEC, the medical kits are kept at various places to ensure the injured person will get the first aid immediately.



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Chapter-V

Green Culture

5.1 Description:

Green culture is a collective belief toward an ecological, environment-friendly working procedures followed by institutions. TSEC has an NSS wing to inculcate a sense of social sensibilities among students. NSS unit organizes the green activities like Cleaning Of Village Areas, Cleaning Of Common Water Bodies at Adopted villages, Juhu Beach Cleaning after Ganapati festival etc.
Under the Green Army project of Govt of India, TSEC students and teachers regularly participate in plantation in nearby area.

TSEC has procured the star rated, energy efficient devices like

1. Air-conditioners
2. LED/LCD displays
3. Projectors

The following steps may be initiated to further enhance efficiency of the systems.

1. An efficient power management system may be incorporated to

a. Switch off the display if not in use.

b. Put the computer in Sleep mode / switching off the machines, if not used for prolonged period.

2. Optimize brightness of the screen.

3. Discourage use of screen savers, which has similar power consumption.

Digital communication:

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The internal communication is through electronic medium. Digital library, Digital diary of TSEC are the few examples of digital communication at TSEC.

Paperless Submission:

The institute is adopting the method of paperless submission of subject journals for students.

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Energy Audit Report

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THADOMAL SHAHANI ENGINEERING COLLEGE, BANDRA WEST, MUMBAI

Prepared

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QMS Certification CAB # 118005

ECS/2023/1 Date- 31/01/2023

ENERGY AUDIT COMPLETION CERTIFICATE

AY (2022-23)

This is to certify that Energy Audit has been carried out in the campus and buildings of Thadomal Shahani Engineering College, Bandra West, Mumbai- 400050, Maharashtra, as per guidelines laid down in The Energy Conservation Act, 2001, in the month of January 2023.

Name of the Installation	Thadomal Shahani Engineering College, Bandra West, Mumbai- 400050
Details of Facilities Audited	Laboratories, Classrooms, Library, Seminar halls, Campus (New and Old Building)
Duration of Audit	27/01/2023 to 28/01/2023
Name of Government Registered Agency	ENDUTECH CONSULTANCY SERVICES PVT LTD, Navi Mumbai
Name of Certified Energy Auditor	Dr. S D Dalvi
BEE Certification Number	CEA- 12141

For,
Endutech Consultancy Services

Dr. S D Dalvi (Lead Auditor-CEA 12141)

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Executive Summary-Energy Audit

Energy Saving Potential

Sr No	Area & Proposed Action for Energy Efficiency Improvement	Savings Potential	Investment	Payback Period
		Rs/month	Rs	Months
1	Maintaining Power factor to unity and other incentives/discounts	6723	Minimum	Immediate
2	Replacing magnetic ballast with electronic ballasts for tube lights and lamps	3276.58	1,13,800	35
3	Improving & maintaining performance of air conditioners at optimal levels (Sampled)	362	Negligible	Immediate
4	Replacing tube lights (TL) by LED lamps	10000	1,60,000	16
5	Replacing ordinary ceiling fans by energy efficient Fans	8917	17,53,500	17 years

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Chapter-I

Introduction

1.1 Background of the study:

The fundamental purpose of the energy audit is not only to identify the potential saving areas but also to establish energy monitoring and control system to reap the gains on sustainable basis. It is with this purpose that Thadomal Shahani Engineering College (TSEC), Bandra (West), Mumbai, Maharashtra, assigned Endutech Consultancy Services, Navi Mumbai to carry out Energy Audit.

This energy audit report presents the analysis of the data collected, observations made at the facility and is governed by the objectives, scope of work, methodology etc. discussed in the ensuing paragraphs.

Objective:

The basic objectives of the Energy Audit Study are to,

- Identify key result areas for energy saving along with their broad Cost Benefit Analysis.
- Suggest energy monitoring and control mechanism to realize the savings on the sustainable basis.

Methodology:

Prior to start of the Audit session, submitted a list of data required along with the execution plan.

Then deputed a team of Project Engineers for this task. The visit was undertaken in the First week of January 2023. The field training was given to the engineers about data collection. The team was trained about operation and handling of the instruments used in the energy auditing.

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The prime objectives of these visits were:

- To hold discussions with Principal, to understand Energy consumption pattern, to get acquainted with the efforts already put in for energy conservation
- To collect historic data regarding energy consumption and maintenance practices.
- To undertake requisite field trials and to make observation.

Team:

The team members of the audit study.

1. Dr S D Dalvi, Certified Energy Auditor (CEA-12141)

2. Mr Harshal Shirsath, Project Engineer

3. Mr Pratik Ghade, Project Engineer

Instruments

The following instruments were utilized for measurement during the energy audit study.

1. Power meter
2. Hygro-temperature meter
3. Anemometers
4. AC power meter
5. Lux meter

Acknowledgment:

Endutech Consultancy Services wish to record their gratitude to the management of TSEC for awarding this assignment.

We extend our thanks to the Principal, **Dr. G T Thampi** for initiating the work.

We are also thankful to **Prof. Monika G Tolani**, Assistant Professor, Training & Placement Officer, TSEC, and the maintenance team including Mr. Gomes, Mr. Manish and Mr. Sunil for extending all possible help and co-operation from their side.

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Chapter-II

Consumption Pattern

2.1 Brief Description & Consumption data:

Present Scenario:

- The total average monthly consumption is around 24,800 kWh out of which 15800 units is for new building and 9000 units is for old building.
- The total payment made towards electricity consumption for January 2023 is Rs. 3,62,630 out of which Rs. 2,36,420 is for new building and Rs. 1,26,210 is for old building.
- The calculated cost of power is Rs 10.47/- per kWh in AY 22-23.

As can be seen the major consumption is of

- Air conditioners
- Ceiling fans
- Computers
- Illumination
- Elevators

The other unaccounted consumptions are of elevators, centrifugal pumps,

printers, scanners, ups etc.

2.2 Electricity Bills:

The electricity is supplied through LT connection; TSEC has installed Seven LT I (B) electricity meters. TSEC has installed five LT II (C) electricity meters. This tariff category is applicable for electricity used at Low/Medium voltage in non-

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residential, non-industrial and/or commercial premises for commercial consumption meant for operating various appliances used for purposes such as lighting, heating, cooling, cooking, washing/cleaning, entertainment/ leisure and water pumping in.

The statistics of electricity consumption for month of January 2023 is tabulated.

The analysis of LT II (C) electricity meters is shown in table.

Location		**NB 5/6th Floor**	**NB 9/10th Floor**	**NB Accounts**	**NB Lift Room**	**OB pump, lift room**
Meter No		L1003438	L1003439	L1003440	L1004492	L1004495
Account No		150157256	150154523	150157252	151251739	102698704
Tariff		LT II (C)	LT II (C)	LT II (C)	LT II (C)	LT II (C)
MF		20	40	80	40	20
Consumption	KWH	1543	2358	5239	972	8526
Month and Year		Jan-23	Jan-23	Jan-23	Jan-23	Jan-23
Power factor		L19.80	L99.10	L89.30	L99.3	L90.80
PF Penalty/Incentives	Rs	6723.87Dr	778.45Cr	1546.55	373.49Cr	0.00
Bill Amount	Rs	30130	37730	82790	18000	120770

The analysis of LT I (B) electricity meters are shown in table.

Location		**OB**	**NB**	**NB pump room**	**NB 1/2nd Floor**
Meter No		7780668	7735461	7735462	7602803
Account No		102174897	150157262	150157261	102196435
Tariff		LT I (B)	LT I (B)	LT I (B)	LT I (B)
Consumption	KWH	540	94	128	1135
Month and Year		Jan-23	Jan-23	Jan-23	Jan-23
Bill Amount	Rs	5440	1100	1060	13150

Location		**NB 7/8th Floor**	**NB 3/4th Floor**	**NB Basement**
Meter No		7882202	7541328	7881869
Account No		150157255	102196445	150157258
Tariff		LT I (B)	LT I (B)	LT I (B)
Consumption	KWH	817	1342	2140
Month and Year		Jan-23	Jan-23	Jan-23
Bill Amount	Rs	9770	15850	26840

2.3 Energy Saving Analysis:

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The observations are as below.

1. Power factor penalty of Rs. 6723 is observed for new building meters of 5th and 6th floor, which can be saved and converted into incentives by maintaining power factor near to unity.
The improvement in power factor also reduces maximum demand and proportionally saves on demand charges. The power factor has been maintained at unity.
2. Delayed payment charges per month may be saved.
3. TOD charges may be saved.
4. The prompt payment discount and digital payment discount may be availed.

2.4 Important Information from Electricity Distributor:

The electricity distributor of TSEC is Adani Electricity Mumbai Limited.
Whenever the average Power Factor is more than 0.95 (lag or lead) and upto 1, an incentive shall be given at the rate of the following percentages of the amount of the monthly electricity bill. The details are shown in the table.

Sl.	Range of Power Factor	Power Factor Level	Incentive
1	0.951 to 0.954	0.95	0.0%
2	0.955 to 0.964	0.96	0.5%
3	0.965 to 0.974	0.97	1.0%
4	0.975 to 0.984	0.98	1.5%
5	0.985 to 0.994	0.99	2.5%
6	0.995 to 1.000	1.00	3.5%

Whenever the average PF is less than 0.9 (lag or lead), penal charges shall be levied at the rate of the following percentages of the amount of the monthly electricity bill. The details are shown in the table.

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Sl.	Range of Power Factor	Power Factor Level	Penalty
1	0.895 to 0.900	0.90	0.0%
2	0.885 to 0.894	0.89	1.0%
3	0.875 to 0.884	0.88	1.5%
4	0.865 to 0.874	0.87	2.0%
5	0.855 to 0.864	0.86	2.5%
6	0.845 to 0.854	0.85	3.0%
7	0.835 to 0.844	0.84	3.5%
8	0.825 to 0.834	0.83	4.0%
9	0.815 to 0.824	0.82	4.5%
10	0.805 to 0.814	0.81	5.0%
...	...	...	...

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Bandra (W), Mumbai - 400 050.

Chapter-III

Computers

3.1 Brief Description:

In new building there are 1071 LCD/LED computers and in old building 167 LCD/LED computers counted as observed. There were printers and scanners in both the buidings.

General Suggestions:

1. An efficient power management system may be incorporated to

a. Switch off the display if not in use.

b. Put the computer in Sleep mode / switching off the machines, if not used for prolonged period.

2. Optimize brightness of the screen.

3. Discourage use of screen savers, which has similar power consumption

4.2.1 New Building

S N	Location	DISPLAY
1	LH 1101 (IT)	0
2	LH 1102 (IT)	0
3	LH 1103 (IT)	0
4	LH 1104 (IT)	0
5	Seminar hall 1105 (IT)	0
6	11th Floor Lobby	0
7	LH 1001 (IT)	0
8	LH 1002 (IT)	45
9	LH 1003 (IT)	42
10	CL 1004 (IT)	49
11	CL 1005 (IT)	27

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12	CL 1006	22
12	10th FLOOR LOBBY	22
13	LH 901 (IT)	0
14	LH 902 (IT)	42
15	LH 903	2
16	LH 904	3
17	LH 905	5
18	CL 906 (IT)	0
19	LH 907 (IT)	0
20	9th FLOOR LOBBY	0
21	LH 801 (I)	0
22	LH 802 (IT)	0
23	LH 803 (IT)	6
24	LH 804 (IT)	28
25	LH 805 (IT)	28
26	LH 806 (IT)	0
27	8th Floor Lobby	0
28	LH 701	67
29	LH 702	0
30	COM 703	21
31	COM 704	19
32	COM 705	7
33	COM 706	8
34	7th Floor Lobby	0
35	LH 601	0
36	LH 602	26
37	LH 603	7
38	LH 604	0
39	LH 605	23
40	LH 609	26
41	6th Floor Lobby	1 TV
42	LH 503	30
43	LH 504	0
44	LH 505	0
45	LH 509	0
46	5th Floor Lobby	0
47	CL 401 + 402	114
48	CL 403	40
49	CL 404	0
50	CL 405	36
51	4th Floor Lobby	0
52	CL 301	40
53	CL 302	44
54	CL 303 + 304	44
55	LH 305	0

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56	CL 306	46
57	LH 307	0
58	3rd Floor Lobby	1 TV
59	LH 201	0
60	CL 202	30
61	CL 203	23
62	LH 204	1
63	LH 205	1
64	LH 206	-
65	CL 207 + 208	52
66	2nd Floor Lobby	0
67	101 + 102	13
68	OF 103	9
69	OF 104	23
70	OF 105	4 (1 TV)
71	1st Floor Lobby	0
72	Ground Floor	0
73	Reading Room (GF)	1 TV
74	GYM	0

4.2.2 Old Building

S N	Location	DISPLAY
1	LH 601	1
2	LH 602	8
3	LH 603	0
4	LH 604	0
5	LH 605	25
6	LH 606	0
7	LH 607	0
8	LH 609	0
9	6th Floor Lobby	0
10	OFFICE 502	3
11	LH 503	0
12	LH 504	0
13	LH 505	1
14	LH 506	1
15	LH 507	0
16	LH 508	1
17	5th Floor Lobby	0
18	OF 401	3
19	OF 402	1
20	Library	5
21	408 (work)	0
22	OF 409	0

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23	4th Floor Lobby	0
24	LH 301	0
25	LH 302	1
26	LH 303	2
27	LH 304	0
28	LH 305	0
29	CL 306	23
30	CL 307	19
31	CL 308	1
32	NSS 308	1
33	OF 309	0
34	3rd Floor Lobby	0
35	LH 202	3
36	LH 203 (A&B)	0
37	LH 204	1
38	LH 205	1
39	LH 206	0
40	LH 207	1
41	LH 208	0
42	OF 209	0
43	PRINCIPLE RESIDANCY	1 (2 TV)
44	2nd Floor Lobby	0
45	OF 102	2
46	LI 103	0
47	LI 104	0
48	LI 105	0
49	LI 106	60
50	LI 107	1
51	LI 108	1
52	OF 109	1
53	Book Stall	0
54	1St Floor Lobby	0
55	Ground Floor	1 TV

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Chapter-IV

Air Conditioning System

4.1 Brief Description:

Air conditioning system is basically provided to maintain comfortable ambience inside the premises by maintaining the temperature (and relative humidity, at times) at appropriate levels. The performance of human being is optimal at the temperature of 24 ± 2 °C and at relative humidity (RH) of 60 ± 5%.

The warmer and humid air from the premises is drawn and fed to the Air Conditioning System by a circulating fan. This air is chilled in an evaporator by vaporizing the refrigerant and is distributed throughout the conditioned area. The refrigerant is pressurized by a compressor and subsequently s cooled and condensed by an air-cooled condenser. The compressor and condenser are placed in an outdoor unit, located on the external side of the premise. While the circulating fan and evaporator is placed in an indoor unit located inside the premises.

4.2 Air conditioner (A/c) Survey:

The survey of air conditioners was carried out for inspection of type of A/c, STAR rating, outdoor unit, indoor unit and tubes insulation condition.

The details are as below.

4.2.1 New Building

S N	Location	SPLIT	WNDOW	* Rating	TR
1	LH 1101 (IT)	2	0	3	2
2	LH 1102 (IT)	2	0	3	2
3	LH 1103 (IT)	2	0	3	2
4	LH 1104 (IT)	2	0	3	2
5	Seminar hall 1105 (IT)	6	0	3	2

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6	11th Floor Lobby	0	0	0	0
7	LH 1001 (IT)	2	0	3	2
8	LH 1002 (IT)	2	0	3	2
9	LH 1003 (IT)	2	0	3	2
10	CL 1004 (IT)	3	0	3	2
11	CL 1005 (IT)	3	0	3	2
12	CL 1006	4	0	3	2
12	10th FLOOR LOBBY	0	0	0	0
13	LH 901 (IT)	2	0	3	2
14	LH 902 (IT)	2	0	3	2
15	LH 903	2	0	3	2
16	LH 904	1	0	3	1.5
17	LH 905	1	0	3	1.5
18	CL 906 (IT)	3	0	3	2
19	LH 907 (IT)	2	0	3	2
20	9th FLOOR LOBBY	0	0	0	0
21	LH 801 (I)	2	0	3	2
22	LH 802 (IT)	2	0	3	2
23	LH 803 (IT)	2	0	3	2
24	LH 804 (IT)	2	0	3	2
25	LH 805 (IT)	2	0	3	2
26	LH 806 (IT)	2	0	3	0
27	8th Floor Lobby	0	0	3	2
28	LH 701	3	0	3	2
29	LH 702	1	0	3	2
30	COM 703	2	0	3	2
31	COM 704	1	0	3	2
32	COM 705	2	0	3	1.5
33	COM 706	3	0	3	2
34	7th Floor Lobby	0	0	3	2
35	LH 601	2	0	3	2
36	LH 602	2	0	3	2
37	LH 603	2	0	3	2
38	LH 604	2	0	3	2
39	LH 605	2	0	3	2
40	LH 609	1	2	3	1.5
41	6th Floor Lobby	0	0	0	2
42	LH 503	2	0	3	2
43	LH 504	2	0	3	2
44	LH 505	2	0	3	2
45	LH 509	2	0	3	2
46	5th Floor Lobby	0	0	3	2
47	CL 401 + 402	6	2	3	1.5
48	CL 403	2	0	3	2
49	CL 404	2	0	3	2

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50	CL 405	2	2	3	1.5
51	4th Floor Lobby	0	0		
52	CL 301	2	0	3	1.5
53	CL 302	2	0	3	2
54	CL 303 + 304	3	0	3	1.5
55	LH 305	2	0	3	1.5
56	CL 306	4	0	3	1.5
57	LH 307	0	0	0	0
58	3rd Floor Lobby	0	0	0	0
59	LH 201	2	0	3	2
60	CL 202	2	0	3	2
61	CL 203	2	0	3	2
62	LH 204	1	0	3	1.5
63	LH 205	1	0	3	2
64	LH 206	2	0	2	1.5
65	CL 207 + 208	4	0	2	2
66	2nd Floor Lobby	0	0	2	0
67	101 + 102	2	0	3	2
68	OF 103	1	0	3	2
69	OF 104	3	0	3	2
70	OF 105	3	0	3	2
71	1st Floor Lobby	0	0	0	0
72	Ground Floor	0	0	0	0
73	Reading Room (GF)	0	0	0	0
74	GYM	0	0	0	0

4.2.2 Old Building

S N	location	SPLIT	WNDOW	* Rating	TR
1	LH 601	1	0	3	2
2	LH 602	1	0	3	2
3	LH 603	2	0	2	1.5
4	LH 604	3	0	3	2
5	LH 605	2	0	3	2
6	LH 606	2	0	3	2
7	LH 607	2	0	3	1.5
8	LH 609	1	0	3	1.5
9	6th Floor Lobby	0	0	0	0
10	OFFICE 502	1		3	2
11	LH 503	2	0	3	2
12	LH 504	4	0	2	2
13	LH 505	2	0	3	2
14	LH 506	2	0	3	2
15	LH 507	2	0	3	2
16	LH 508	1	0	3	1.5

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17	5th Floor Lobby	0	0	0	0
18	OF 401	1	0	3	2
19	OF 402	1	0	3	1.5
20	Library	3	0	3	2
21	408 (work)	2	0	3	2
22	OF 409	1	0	3	1.5
23	4th Floor Lobby	0	0	0	0
24	LH 301	0	1	3	1.5
25	LH 302	0	1	3	1.5
26	LH 303	0	1	3	1.5
27	LH 304	2	0	3	2
28	LH 305	2	0	3	2
29	CL 306	3	0	3	2
30	CL 307	3	0	3	1.5
31	CL 308	2	0	3	1.5
32	NSS 308	2	0	3	1.5
33	OF 309	1	0	3	1.5
34	3rd Floor Lobby	0	0	0	0
35	LH 202	0	1	3	1.5
36	LH 203 (A&B)	0	0	0	0
37	LH 204	0	2	3	1.5
38	LH 205	0	0	0	0
39	LH 206	0	2	3	1.5
40	LH 207	1	1	3	1.5
41	LH 208	0	2	3	1.5
42	OF 209	1	0	3	1.5
43	PRINCIPLE RESIDANCY	4	0	3	2
44	2nd Floor Lobby	0	0	0	0
45	OF 102	1	0	3	2
46	LI 103	0	0	0	0
47	LI 104	0	0	0	0
48	LI 105	0	0	0	0
49	LI 106	1	0	3	2
50	LI 107	0	1	3	1.5
51	LI 108	2	0	3	1.5
52	OF 109	0	0	0	0
53	Book Stall	0	0	0	0
54	1St Floor Lobby	0	0	0	0
55	Ground Floor	0	0	0	0

4.2.3 Observation:

Total 134 and 61 split air-conditioners are fitted in the new and old building respectively. 18 window A/c's to be replaced by split A/c's.

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4.3 Performance Evaluation:

The Air Conditioning effect (TR) and specific power consumption can be computed as under

AC Effect (TR) = Air flow rate x Specific gravity of air x (Enthalpy of supply air - Enthalpy of return air) / 3000

Specific Power (kWh/TR) = Power Consumption / AC Effect

The performance as well as chilling (or Air Conditioning) effect delivered by the air conditioner (represented as TR - Ton of Refrigeration) is computed by measuring

- Air Velocity along with the cross-sectional area of flow to determine flow rate and subsequently mass flow rate.
- Temperature and relative humidity of the air at the inlet of the evaporator coil to determine enthalpy of the air.
- Temperature and relative humidity of the air at the outlet of the evaporator coil to determine enthalpy of the air.
- Power drawn by the air conditioning unit

The chilling effect can be computed as under,

1. Flow Rate of Air (kg/hr)

= Average Air velocity (M/s) x Cross sectional area of the air flow (Sq M) X Specific gravity of air

2. Chilling or Air Conditioning Effect (TR)

= Air flow rate (kg/hr) x Enthalpy difference between the air at inlet and outlet of the evaporator coil (kJ/kg) / (4.18 x 3024)

3. Chilling or Air Conditioning Effect (kW)

= Air flow rate (kg/hr) x Enthalpy difference between the air at inlet and outlet of the evaporator coil (kJ/kg) / 3600

= 3.5112 x Chilling Effect (TR)

4. Specific Power Consumption (kWh/TR) =

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Power consumption (kW) / Air Chilling Effect (TR)

Energy Efficiency Ratio - EER (W of cooling / W of input power)

= Power consumption (kW) / Air Chilling Effect (kW)

= 3.5112 / Specific Power consumption (kW/TR)

The data collected only at the sampled and accessible air conditioners, based on structural observations like filter condition, insulation damage etc. and analyzed is tabulated below.

Assuming,

daily operation hours= 5

No of functioning days per year= 200

No of functioning days per month= 22

Average cost of electricity = Rs. 5/kWh

Sr No	**LOCATION**	**Make**	**TYPE OF A/C Split/window**	**CAPACITY**	**POWER**	**Average Velocity**	**FLOW**
				TR	**kW**	**MPS**	**M^3/hr**
TSEC OLD BUILDING							
1	202	Voltas	Window	1.5	1.71	1.9	465.1
2	203	Blue star	Window	1.5	1.83	1.8	440.6
3	503	Voltas	Split	2	1.88	3.3	950.4
TSEC NEW BUILDING							
4	702	Voltas (2)	Split	2	1.88	1.6	460.8
5	704	Voltas	Split	2	2.85	2.8	806.4
6	802	Voltas	Split	2	2.89	2.6	748.8
7	804	Voltas (2)	Split	2	1.67	1.6	460.8

Sr No	AHU Inlet			AHU Outlet			AC Load	SPC	Savings	
	Temp	RH	Enthalpy	Temp	RH	Enthalpy				
	°C	%	KJ/Kg	°C	%	KJ/Kg	TR	kW/TR	kwh	Rs

TSEC OLD BUILDING										
1	30.5	70.5	80.72	20.6	72.6	50.65	1.34	1.27	0.4	366
2	29.4	72.2	80.7	20	78	49.04	1.34	1.37	0.8	830
3	28.7	80.5	80.16	24.9	77.7	64.24	1.45	1.29	0.5	469
TSEC NEW BUILDING										
4	29.2	69.3	74.67	27.2	68.4	78.96	1.50	1.25	0.3	267
5	26.4	75.3	75.48	18.2	70.9	48.41	2.10	1.36	0.8	798
6	26.5	75.4	75.48	18.2	70.9	48.4	1.95	1.48	1.4	1421
7	27	70.2	67.34	23.5	78.6	59.99	1.35	1.24	0.2	185

Opportunity for Conservation of energy:

Performance improvement:

The specific power consumption of sampled air conditioning units is higher than the general norm of 1.2 KWH/TR or EER of around 3.0.

The saving potential works out to about 4-6% in the overall consumption of the air conditioners as can be seen from the table above.

The performance of air condition can deteriorate due to

- Lower suction pressure and consequently temperature due to constrains on the evaporator. Generally, 1 °C drop in condensing temperature increases the specific power consumption by 4 to 5%. The constraints on the evaporator include

o Clogging of the filters

o Choking of fins o Damages to the fins

o Deposition of dust on the external surface of the coil

o Scaling on the internal or external surface of the coil

o Depositions inside the coil o Inadequate surface areas due to improper design

- Higher discharge pressure and consequently temperature due to constrains on the condenser. Generally, 1 °C rise in condensing temperature increases the specific power consumption by 3 to 4%. The constraints on the condenser include

o Clogging of the fins o Damages to the fins

o Deposition of dust on the external surface of the coil

o Scaling on the internal or external surface of the coil

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o Depositions inside the coil o Inadequate surface areas due to improper design

- Deteriorations in the fan (for the indoor as well outdoor unit) performance

o Damages to the fan blade o Deposition of dust on the fan surface o Damages to bearings, shaft, etc.

o Inadequate capacity due to improper design

- Improper location of the outdoor unit

o Direct exposure to sunlight o Inaccessible to maintenance / servicing o Restriction on cooling air circulation

- Improper quantity of refrigerant.
- Mechanical constrains on the refrigeration compressor

O Damages to bearings, shaft, etc.

O Increases in internal clearances

o Drop in volumetric efficiency

The saving potential can be worked out based on specific power consumption of 1.2 kWh/TR (Energy Efficiency Ratio - EER of 2.93); as detailed above.

The expected saving is about 4.4 kWh, considering an operating period of 5 hours a day for 22 days per month.

The savings work out to Rs 4,336/- per year for sampled air conditioners.

There are no capital investment and the payback period shall be attractive.

Chapter-V

Illumination

5.1 Brief Description:

Energy efficient tube-lights are fitted in new building.

The fittings in the old buildings are fitted with magnetic ballast, except few locations, are provided with electronic ballast.

The detail list of light fitting is as under.

5.1.1 New Building

S N	location	LED	LED	LED	T5	LED	TUBELIGHT
		36W	22W	15W		15W	36W
1	LH 1101 (IT)	0	0	14	0	0	0
2	LH 1102 (IT)	0	0	12	0	0	0
3	LH 1103 (IT)	0	0	12	0	0	0
4	LH 1104 (IT)	0	0	16	0	0	0
5	Seminar hall 1105 (IT)	0	27	0	0	0	0
6	11th Floor Lobby	0	3	0	0	0	6
7	LH 1001 (IT)	0	16	0	0	0	0
8	LH 1002 (IT)	0	0	0	0	0	9
9	LH 1003 (IT)	0	0	0	0	0	7
10	CL 1004 (IT)	0	0	0	0	0	18
11	CL 1005 (IT)	0	0	0	0	0	10
12	CL 1006	0	0	0	0	0	10
12	10th FLOOR LOBBY	0	0	0	0	0	4
13	LH 901 (IT)	0	16	0	0	0	0
14	LH 902 (IT)	0	0	0	0	0	7
15	LH 903	0	6	0	0	0	1
16	LH 904	0	0	0	0	0	3
17	LH 905	0	0	0	0	0	3
18	CL 906 (IT)	0	0	0	0	0	6
19	LH 907 (IT)	0	15	0	0	0	0
20	9th FLOOR LOBBY	0	0	0	0	0	3
21	LH 801 (I)	0	16	0	0	0	0
22	LH 802 (IT)	0	15	0	0	0	0
23	LH 803 (IT)	0	0	0	0	0	18
24	LH 804 (IT)	0	0	0	0	0	0
25	LH 805 (IT)	0	0	0	0	0	12

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26	LH 806 (IT)	0	16	0	0	0	0
27	8th Floor Lobby	0	0	0	0	0	2
28	LH 701	0	0	0	0	0	12
29	LH 702	0	15	0	0	0	0
30	COM 703	0	0	0	0	0	10
31	COM 704	0	0	0	0	0	8
32	COM 705	0	0	0	0	0	8
33	COM 706	0	0	0	0	0	10
34	7th Floor Lobby	0	0	0	0	0	2
35	LH 601	0	0	0	0	0	8
36	LH 602	0		0	0	0	12
37	LH 603	0	0	0	0	0	8
38	LH 604	0		0	0	0	10
39	LH 605	0	0	0	0	0	9
40	LH 609	0	0	0	0	0	10
41	6th Floor Lobby	0	0	0	0	0	3
42	LH 503	0	8	10	0	0	0
43	LH 504	0	15	0	0	0	0
44	LH 505	0	16	0	0	0	0
45	LH 509	0	0	0	0	0	7
46	5th Floor Lobby	0	0	0	0	0	3
47	CL 401 + 402	0	64	0	0	0	0
48	CL 403	0	0	0	0	0	9
49	CL 404	0	15	0	0	0	0
50	CL 405	0	0	0	0	0	9
51	4th Floor Lobby	0	0	0	0	0	3
52	CL 301	0	0	0	0	0	9
53	CL 302	0	0	0	0	0	6
54	CL 303 + 304	0	0	0	0	0	9
55	LH 305	0	15	0	0	0	0
56	CL 306	0	0	0	0	0	9
57	LH 307	0	0	0	0	0	4
58	3rd Floor Lobby	0	0	0	0	0	8
59	LH 201	0	20	0	0	0	0
60	CL 202	0	16	0	0	0	0
61	CL 203	0	21	0	0	0	0
62	LH 204	0	0	0	0	0	7
63	LH 205	0	0	0	0	0	2
64	LH 206	0	0	0	0	0	6
65	CL 207 + 208	0	25	0	0	0	0
66	2nd Floor Lobby	8	0	0	0	0	0
67	101 + 102	0	27	0	0	0	0
68	OF 103	0	9	0	0	0	0
69	OF 104	0	29	0	0	0	0
70	OF 105	8	0	4	4	2	4

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71	1st Floor Lobby	6	4	0	0	0	0
72	Ground Floor	0	0	0	0	0	12
73	Reading Room (GF)	24	0	0	0	0	0
74	GYM	0	0	0	0	0	6

5.1.2 Old Building

S N	Location	LED	LED	LED	T5	LED	TUBELIGHT
		36W	22W	15W		15W	36W
1	LH 601	0	0	0	0	0	2
2	LH 602	0	0	0	0	0	6
3	LH 603	0	0	0	0	0	6
4	LH 604	0	0	0	0	0	10
5	LH 605	0	0	0	0	0	9
6	LH 606	0	0	0	0	0	6
7	LH 607	0	0	0	0	0	7
8	LH 609	0	0	0	0	0	1
9	6th Floor Lobby	0	0	0	0	0	5
10	OFFICE 502	0	0	0	0	0	2
11	LH 503	0	0	0	0	0	5
12	LH 504	0	0	0	12	0	0
13	LH 505	0	0	0	4	0	0
14	LH 506	0	0	0	5	0	2
15	LH 507	0	0	0	1	0	5
16	LH 508	0	0	0	0	0	1
17	5th Floor Lobby	0	0	0	4	0	0
18	OF 401	0	0	0	0	0	3
19	OF 402	0	0	0	0	0	3
20	Library	0	0	0	0	0	48
21	408 (work)	0	12 (30V)	0	0	0	0
22	OF 409	0	0	0	0	0	1
23	4th Floor Lobby	0	0	0	0	0	5
24	LH 301	0	0	0	0	0	3
25	LH 302	0	0	0	0	0	2
26	LH 303	0	0	0	0	0	4
27	LH 304	0	0	0	4	0	5
28	LH 305	0	0	0	3	0	10
29	CL 306	0	0	0	7	0	1
30	CL 307	0	0	0	3	0	4
31	CL 308	0	0	0	0	0	5
32	NSS 308	0	0	0	0	0	5
33	OF 309	0	0	0	0	0	1
34	3rd Floor Lobby	0	0	0	0	0	6
35	LH 202	0	0	0	2	0	1

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36	LH 203 (A&B)	0	0	0	0	0	6
37	LH 204	0	0	0	0	0	6
38	LH 205	0	0	0	0	0	7
39	LH 206	0	0	0	6	0	0
40	LH 207	0	0	0	4	0	1
41	LH 208	0	0	0	0	0	5
42	OF 209	0	0	0	0	0	1
43	PRINCIPLE RESIDANCY	0	12	0	0	0	1
44	2nd Floor Lobby	0	0	0	4	0	0
45	OF 102	0	0	0	3	0	0
46	LI 103	0	0	0	0	0	4
47	LI 104	0	0	0	0	0	4
48	LI 105	0	0	0	0	0	5
49	LI 106	0	0	0	7	0	0
50	LI 107	0	0	0	4	0	2
51	LI 108	0	0	0	3	0	3
52	OF 109	0	0	0	4	0	1
53	Book Stall	0	0	1 (40W)	0	0	0
54	1St Floor Lobby	0	0	0	4	0	6
55	Ground Floor	0	0	21	3	0	1

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Opportunity for Conservation of energy:

Electronic Ballast:

The conventional ballast may be replaced with electronic ballast. The magnetic ballast generally consumes 15 W of power; while the electronic ballast consumes just about 3 W and delivers 10% more light output. However, these ballasts are usually tuned to save about 15 W of power while providing slightly lower light output (about 5%).

Thus energy saving of over 30% can be realized by replacing conventional ballast by electronic ballast. The expected annual savings shall be around Rs 500/- per tube light; while the cost of installing a ballast shall be Rs 250/-

The saving potential can be computed as under.

Description	Unit	Value
Present Condition: Conventional Ballast		
Number of points	No	569
Rating of the point light	Watt	36
Rating of the switchgear	Watt	15
Power consumption of the lamp	Watt	51
Desirable Condition: Electronic Ballast		
Rating of the lamp	Watt	36
Rating of the switchgear	Watt	2
Power consumption of the lamp	Watt	32
Controllable Loss		
Loss	Watt	10
	%	20.3%
Saving Potential		
Cost of power	Rs/kWh	10.47
Operating period	Hr/Month	110
Diversity Factor	%	50%
Energy Saving	kWh/Month	312.95
	Rs/Month	3276.58

The magnetic ballast can be replaced by electronic ballast; saving around Rs 3276.58/- per month. The actual saving shall vary depending on the switching period of the luminaire. (Rs. 200/ballast cost)

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The investment shall be Rs 1,13800/-; giving a payback period of 35 months.

LED Lamps:

A 15 W LED lamp can provide similar illumination level to that of 36 W TFL. It is thus possible to save about 15 W of power by replacing a 36 W TFL (with conventional ballast). Thus, energy saving of over 40% can be realized by replacing TFL with LED lamp.

The expected monthly savings shall be around Rs 3921.53/- for old building and Rs. 5908.22/- for new building.

The payback for the individual lamp shall be around 16 months.

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Chapter-VI

Ceiling Fans

6.1 Brief Description:

Total 174 ceiling fans are counted in the available locations of old building and total 327 ceiling fans are counted in the available locations of new building. The average rating is around 60W for old fans in the old building. For comparison purpose 45W rating is considered for both old and new buildings.

6.2 Details:

The details are as below.

Sr No	Location or Room No	Operation		Ceiling Fan Details		Energy Eff Fan	Saving		
				48'		28W@speed 5	Rs 10.47/kWh		
		hr/d	d/m	Fitted	Rating	Rating	W	kWh/Month	Rs. /Month
1	LH 1101 (IT)	5	20	9	45	28	17	15.3	160.19
2	LH 1102 (IT)	5	20	6	45	28	17	10.2	106.79
3	LH 1103 (IT)	5	20	6	45	28	17	10.2	106.79
4	LH 1104 (IT)	5	20	9	45	28	17	15.3	160.19
5	Seminar hall 1105 (IT)	5	20	15	45	28	17	25.5	266.99
6	11th Floor Lobby	5	20	1	45	28	17	1.7	17.80
7	LH 1001 (IT)	5	20	4	45	28	17	6.8	71.20
8	LH 1002 (IT)	5	20	5	45	28	17	8.5	89.00
9	LH 1003 (IT)	5	20	5	45	28	17	8.5	89.00
10	CL 1004 (IT)	5	20	4	45	28	17	6.8	71.20
11	CL 1005 (IT)	5	20	2	45	28	17	3.4	35.60
12	CL 1006	5	20	3	45	28	17	5.1	53.40
13	LH 901 (IT)	5	20	3	45	28	17	5.1	53.40
14	LH 902 (IT)	5	20	4	45	28	17	6.8	71.20
15	LH 903	5	20	1	45	28	17	1.7	17.80
16	LH 904	5	20	2	45	28	17	3.4	35.60

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17	LH 905	5	20	2	45	28	17	3.4	35.60
18	CL 906 (IT)	5	20	4	45	28	17	6.8	71.20
19	LH 907 (IT)	5	20	4	45	28	17	6.8	71.20
20	LH 801 (I)	5	20	4	45	28	17	6.8	71.20
21	LH 802 (IT)	5	20	4	45	28	17	6.8	71.20
22	LH 803 (IT)	5	20	14	45	28	17	23.8	249.19
23	LH 804 (IT)	5	20	14	45	28	17	23.8	249.19
24	LH 805 (IT)	5	20	6	45	28	17	10.2	106.79
25	LH 806 (IT)	5	20	4	45	28	17	6.8	71.20
26	LH 701	5	20	9	45	28	17	15.3	160.19
27	LH 702	5	20	4	45	28	17	6.8	71.20
28	COM 703	5	20	9	45	28	17	15.3	160.19
29	COM 704	5	20	6	45	28	17	10.2	106.79
30	COM 705	5	20	5	45	28	17	8.5	89.00
31	COM 706	5	20	7	45	28	17	11.9	124.59
32	LH 601	5	20	8	45	28	17	13.6	142.39
33	LH 602	5	20	8	45	28	17	13.6	142.39
34	LH 603	5	20	5	45	28	17	8.5	89.00
35	LH 604	5	20	7	45	28	17	11.9	124.59
36	LH 605	5	20	7	45	28	17	11.9	124.59
37	LH 609	5	20	7	45	28	17	11.9	124.59
38	LH 503	5	20	5	45	28	17	8.5	89.00
39	LH 504	5	20	4	45	28	17	6.8	71.20
40	LH 505	5	20	4	45	28	17	6.8	71.20
41	LH 509	5	20	4	45	28	17	6.8	71.20
42	CL 401 + 402	5	20	0	45	28	17	0	0.00
43	CL 403	5	20	4	45	28	17	6.8	71.20
44	CL 404	5	20	4	45	28	17	6.8	71.20
45	CL 405	5	20	1	45	28	17	1.7	17.80
46	CL 301	5	20	5	45	28	17	8.5	89.00
47	CL 302	5	20	2	45	28	17	3.4	35.60
48	CL 303 + 304	5	20	2	45	28	17	3.4	35.60
49	LH 305	5	20	4	45	28	17	6.8	71.20
50	CL 306	5	20	7	45	28	17	11.9	124.59
51	LH 307	5	20	3	45	28	17	5.1	53.40
52	LH 201	5	20	4	45	28	17	6.8	71.20
53	LH 204	5	20	2	45	28	17	3.4	35.60
54	LH 205	5	20	1	45	28	17	1.7	17.80
55	LH 206	5	20	4	45	28	17	6.8	71.20
56	CL 207 + 208	5	20	4	45	28	17	6.8	71.20
57	101 + 102	5	20	14	45	28	17	23.8	249.19
58	OF 103	5	20	4	45	28	17	6.8	71.20
59	OF 104	5	20	6	45	28	17	10.2	106.79
60	OF 105	5	20	4	45	28	17	6.8	71.20
61	Reading Room	5	20	13	45	28	17	22.1	231.39
62	GYM	5	20	5	45	28	17	8.5	89.00

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Sr No	Location or Room No	Operation		Ceiling Fan Details		Energy Eff Fan	Saving		
				48'		28W@speed 5	Rs 10.47/kWh		
		hr/d	d/m	Fitted	Rating	Rating	W	kWh/Month	Rs. /Month
1	LH 601	5	20	1	45	28	17	1.7	17.80
2	LH 602	5	20	5	45	28	17	8.5	89.00
3	LH 603	5	20	4	45	28	17	6.8	71.20
4	LH 604	5	20	4	45	28	17	6.8	71.20
5	LH 605	5	20	6	45	28	17	10.2	106.79
6	LH 606	5	20	4	45	28	17	6.8	71.20
7	LH 607	5	20	4	45	28	17	6.8	71.20
8	LH 609	5	20	1	45	28	17	1.7	17.80
9	OFFICE 502	5	20	1	45	28	17	1.7	17.80
10	LH 503	5	20	5	45	28	17	8.5	89.00
11	LH 505	5	20	5	45	28	17	8.5	89.00
12	LH 506	5	20	4	45	28	17	6.8	71.20
13	LH 507	5	20	4	45	28	17	6.8	71.20
14	LH 508	5	20	1	45	28	17	1.7	17.80
15	OF 401	5	20	3	45	28	17	5.1	53.40
16	OF 402	5	20	1	45	28	17	1.7	17.80
17	Library	5	20	24	45	28	17	40.8	427.18
18	OF 409	5	20	1	45	28	17	1.7	17.80
19	LH 301	5	20	2	45	28	17	3.4	35.60
20	LH 302	5	20	1	45	28	17	1.7	17.80
21	LH 303	5	20	4	45	28	17	6.8	71.20
22	LH 304	5	20	5	45	28	17	8.5	89.00
23	LH 305	5	20	4	45	28	17	6.8	71.20
24	CL 306	5	20	5	45	28	17	8.5	89.00
25	CL 307	5	20	3	45	28	17	5.1	53.40
26	CL 308	5	20	1	45	28	17	1.7	17.80
27	NSS 308	5	20	4	45	28	17	6.8	71.20
28	OF 309	5	20	1	45	28	17	1.7	17.80
29	LH 202	5	20	1	45	28	17	1.7	17.80
30	LH 203 (A&B)	5	20	4	45	28	17	6.8	71.20
31	LH 204	5	20	4	45	28	17	6.8	71.20
32	LH 205	5	20	3	45	28	17	5.1	53.40
33	LH 206	5	20	4	45	28	17	6.8	71.20
34	LH 207	5	20	4	45	28	17	6.8	71.20
35	LH 208	5	20	3	45	28	17	5.1	53.40
36	OF 209	5	20	1	45	28	17	1.7	17.80
37	PRINCIPLE RESIDANCY	5	20	3	45	28	17	5.1	53.40

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38	OF 102	5	20	2	45	28	17	3.4	35.60
39	LI 103	5	20	4	45	28	17	6.8	71.20
40	LI 104	5	20	4	45	28	17	6.8	71.20
41	LI 105	5	20	4	45	28	17	6.8	71.20
42	LI 106	5	20	6	45	28	17	10.2	106.79
43	LI 107	5	20	6	45	28	17	10.2	106.79
44	LI 108	5	20	3	45	28	17	5.1	53.40
45	OF 109	5	20	4	45	28	17	6.8	71.20
46	Book Stall	5	20	1	45	28	17	1.7	17.80
47	Ground Floor	5	20	5	45	28	17	8.5	89.00

6.3 Economics:

Replacing old fans with new energy efficient fans can be considered. These fans save energy while delivering similar air flows.

The cost of replacement of 501 ceiling fans (excluding non-working, wall and exhaust fans) shall be around Rs 17,53,500/- giving a payback period of around 16.38 years. It is calculated by considering 45W consumption on average operation basis.

The expected saving potential is around Rs 8917/- per month.

Thus, the investment is high and the payback period is not much attractive.

Chapter-VII

Miscellaneous Consumers

7.1 Brief Description:

The other consumers include elevators, street lighting, passage lighting, water pumps, fire pumps, machine tools in the work shop, xerox machines, printers and computers.

The consumption of above equipment was not possible due to unavoidable circumstances.

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Chapter-VIII

Renewable Energy

8.1 Brief Description:

The institute should prefer the installation of solar system for both the old and new buildings.

It is possible to cut down the cost of electricity to great extent.

Also, solar water pumping must be considered which will save significant electricity as presently consumed by conventionally operated centrifugal pumps.

Environment Audit Report

of

THADOMAL SHAHANI ENGINEERING COLLEGE, BANDRA WEST, MUMBAI

Prepared

By

Endutech Consultancy Services Pvt Ltd
Navi Mumbai

2022-2023

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ENDUTECH CONSULTANCY SERVICES PVT LTD

ACCREDITED
ISO 9001: 2015
QMS Certification CAB # 118005

ECS/2023/1 **Date- 31/01/2023**

ENVIRONMENT AUDIT COMPLETION CERTIFICATE

AY (2022-23)

This is to certify that Environment Audit has been carried out in the campus and buildings of Thadomal Shahani Engineering College, Bandra West, Mumbai- 400050, Maharashtra in the month of January 2023.

Name of the Installation	**Thadomal Shahani Engineering College, Bandra West, Mumbai- 400050**
Details of Facilities Audited	**Laboratories, Classrooms, Library, Seminar halls, Campus (New and Old Building)**
Duration of Audit	**27/01/2023 to 28/01/2023**
Name of Government Registered Agency	**ENDUTECH CONSULTANCY SERVICES PVT LTD, Navi Mumbai**
Name of Certified Energy Auditor	**Dr. S D Dalvi**
BEE Certification Number	**CEA- 12141**

For,
Endutech Consultancy Services

Dr. S D Dalvi (Lead Auditor-CEA 12141)

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Contents

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Chapter-I

Environment Audit

1.1 Introduction:

An environmental audit evaluates and quantifies the environmental performance.

Environmental Auditing is an independent assessment performed by different organizations to ensure that they are complying with the Environmental Policies.

It examines the amount of risk or injury or actual harm caused by operational procedures and determines the types of Pollution produced by assessing the range of locations, procedures and activities.

Objectives:

The basic objectives of the Environment Audit Study are to,

- Evaluate waste management practices of an organization.
- Determine pollution level in the organization.
- Assess energy conservation practices
- Assess water conservation practices

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Methodology:

The environment audit methodology is given below.

1. Reviewing the Institutes Environmental Protection Policy along with the applicable regulations

2. Structuring a plan for the audit for the applicable activities

3. Gathering of information and all relevant data

4. Evaluating the overall performance of the institution

5. Identifying the zones that require being focused on improvement

6. Submitting the Report of the Audit conducted to the management.

Team:

The team members of the audit study.

1. Dr S D Dalvi, Certified Energy Auditor (CEA-12141)

2. Mr Harshal Shirsath, Project Engineer

3. Mr Pratik Ghade, Project Engineer

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Instruments

The following instruments were utilized for measurement during the energy audit study.

1. Power meter
2. Hygro-temperature meter
3. Lux meter
4. Air Quality meter

Acknowledgment:

Endutech consultancy services wish to record their gratitude to the management of TSEC for awarding this assignment.

We extend our thanks to the Principal, **Dr. G T Thampi** for initiating the work.

We are also thankful to **Prof. Monika G Tolani**, Assistant Professor, Training & Placement Officer, TSEC, and the maintenance team including Mr. Gomes, Mr. Manish and Mr. Sunil for extending all possible help and co-operation from their side.

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Chapter-II

Water Management

2.1 Introduction to water management:

Water conservation and management include the policies, framework, and strategies to manage water effectively and efficiently.

The different methods of water conservation are as follows.

1. Rainwater Harvesting- It is the process of collection and storage of rainwater, rather than allowing it to run off. Rainwater is collected from the roof and is redirected to a tank, reservoir, cistern, or natural tanks, etc.
2. Groundwater Harvesting- It is a method for saving water placed under the ground to control the groundwater flow in an aquifer and to raise the water table.
3. Water-wise Habits- There are various good habits to conserve water for a long time. Some of them are Fixing leaky taps, Keeping the tap closed while brushing, taking a shower of 5 mins instead of long baths are a few examples of saving water.
4. Sensor based water conservation- Using IoT (Internet of Things) is a flexible solution designed for the water utility industry, allowing for smarter decisions while optimizing the use of existing city resources and investments.

2.2 Water Consumption:

The water is supplied by BMC to TSEC and the frequency of billing is 90 days. The water meter of 40 mm size, number is 8911190 supplied by AMR Arad company. The monthly consumption of water is 300 KL on an average basis. The connection type is MN00 which means main connection.

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Water Meter 8911190, size 40mm

Water Pumping System

The basic uses of water at TSEC are as below.

1. Drinking
2. Gardening
3. Kitchen and Toilets
4. Others

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Water Purifier and Cooler System

2.3 Observations and Suggestions:

- Rainwater harvesting system is not present in the institute but the rainwater is at single point at ground level. It may be discharged into ground water tank and used for gardening, cleaning purpose.
- The distribution network and piping are more or less satisfactory and adequate.

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Sensor based water usage (Old Building)

- In the old building, the wash basin is provided with sensor in order to conserve the water.

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Chapter-III

Solid Waste Management

3.1 Introduction:

Solid waste management mainly refers to the complete process of collecting, treating and disposing of solid wastes.

It addresses waste production and disposal of different wastes like paper, food, plastic, biodegradable, construction, glass, dust etc. and recycling.

Furthermore, solid waste often includes wasted material resources that could otherwise be channelled into better service through recycling, repair, and reuse.

Unscientific handling of solid waste can create threats to everyone. The survey focused on volume, type and current management practice of solid waste generated in the campus.

One of the ways solid management is through the 3 R's — Reduce, Reuse, Recycle.

- Reduce means to cut back on the amount of trash we generate.
- Reuse means to find new ways to use things that otherwise would have been thrown out.
- Recycle means to turn something old and useless (like plastic milk jugs) into something new and useful (like picnic benches, playground equipment and recycling bins).

Bins for waste collection at TSEC

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3.2 Observations and Suggestions:

- TSEC is handling the environmental issues very carefully and taking all possible steps towards sustainability.

- The waste is segregated in the separate green, red and blue dustbins after collecting in the dustbin bags.

- The canteen kitchen waste and dry waste is disposed by BMC.

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Chapter-IV

Liquid Waste Management

4.1 Introduction:

Liquid waste is a major problem in the world, due to approximately 71% of the Earth's surface being covered in water.
According to the Environmental Protection Agency (EPA), liquid waste is defined as any waste material that passes the definition of a "liquid." This means that the material must, "pass through a 0.45 micron filter at a pressure differential of 75 psi," according to the EPA's provided definition of a liquid (1). The main producers of liquid waste are animals and human beings as natural excretion of waste is flushed into sewage and waste lines.

Liquid waste is such an important category of waste management because it is so difficult to deal with. Unlike solid wastes, liquid wastes cannot be easily picked up and removed from an environment. Liquid wastes spread out, and easily pollute other sources of liquid if brought into contact. This type of waste can also soak into objects such as soil and groundwater. This pollution then carries over to pollute the plants we eat, the animals in the ecosystem, as well as the humans within the area of the pollution.

At the TSEC, no hazardous liquid waste is generated in the institute.

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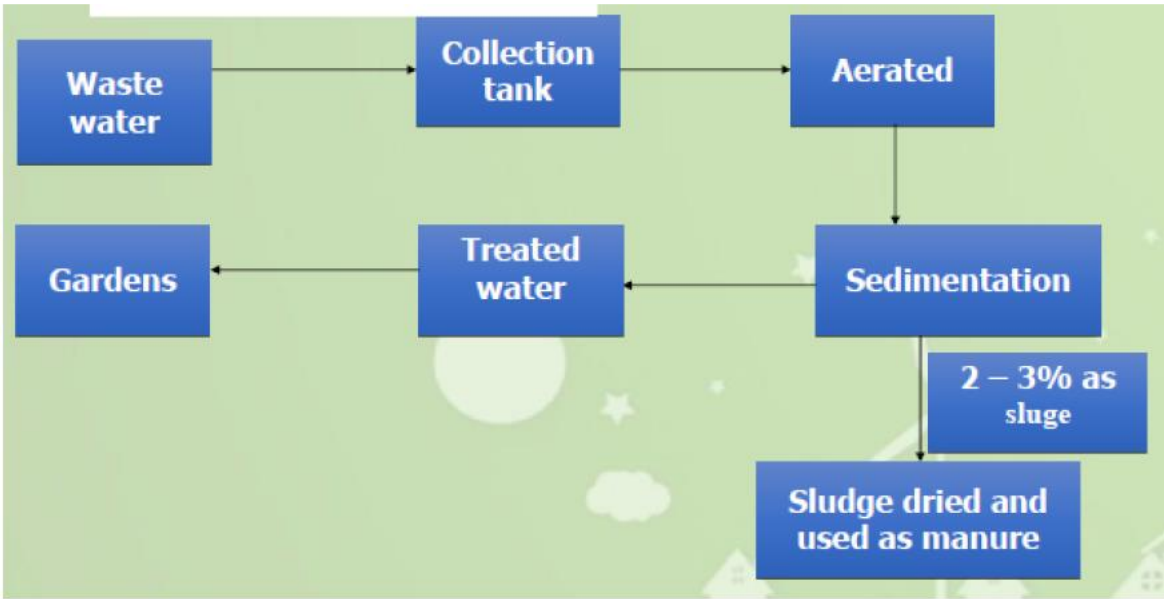
4.2 Observations and Suggestions:

- 70% amount of water charges are deducted as sewerage charges by BMC as observed from the water bill.
- TSEC may have their own sewerage treatment plant as shown below for treatment of waste water.



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Chapter-V

E- Waste Management

5.1 Brief Description:

E-waste can be described as consumer and business electronic equipment that is near or at the end of its useful life.

This makes up about 5% of all municipal solid waste worldwide but is much more hazardous than other waste because electronic components contain cadmium, lead, mercury, and Polychlorinated biphenyls (PCBs) that can damage human health and the environment.

5.2 Observations and Suggestions:

- E-waste generated in the TSEC campus is very less in quantity.
- TSEC Administration conducts the awareness programs regarding E-waste Management with the help of various departments.
- The E-waste and defective items from computer laboratories are being stored properly and collected in the E-waste bin kept at the ground floor in the new building.
- TSEC has decided to contact approved E-waste management and disposal facility in order to dispose E-waste in scientific manner.

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Bins for E-waste collection at TSEC

Figure shows Bins kept at the ground floor of ground floor of new building, for E-waste collection at TSEC.

Few other recommendations are as below.

- Recycle or safely dispose of white goods, computers and electrical appliances.
- Use reusable resources and containers and avoid unnecessary packaging where possible.
- Always purchase recycled resources where these are both suitable and available.

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Chapter-VI

Air Quality Analysis

6.1 Brief Description:

The air quality was checked by measuring the Carbon Dioxide and VOC contents at various locations in the college classrooms and the administrative areas.

6.2 Observations

The Carbon dioxide and VOC levels are within the limits at all the places.

The average value of 491 ppm and 424 ppm is observed in the new building and new building.

The standard norm is to maintain the Carbon dioxide level below 1000 ppm and VOC level below 400 ppm.

S N	Location	CO2	TVOC	HCHO
1	LH 1101 (IT)	385	0.019	0
2	LH 1102 (IT)	387	0.015	0
3	LH 1103 (IT)	417	0.02	0.0004
4	LH 1104 (IT)	385	0.02	0
5	Seminar hall 1105 (IT)	594	0.208	0.037
6	11th Floor Lobby	402	0.023	0.003
7	LH 1001 (IT)	490	0.106	0.019
8	LH 1002 (IT)	512	0.127	0.023
9	LH 1003 (IT)	592	0.159	0.028
10	CL 1004 (IT)	489	0.1	0.017
11	CL 1005 (IT)	506	0.12	0.02
12	CL 1006	386	0.015	0.006
12	10th FLOOR LOBBY	386	0.015	0.006
13	LH 901 (IT)	400	0.014	0.003
14	LH 902 (IT)	576	0.197	0.036
15	LH 903	386	0.018	0

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16	LH 904	524	0.139	0.025
17	LH 905	558	0.0173	0.031
18	CL 906 (IT)	3856	0.021	0
19	LH 907 (IT)	491	0.111	0.02
20	9th FLOOR LOBBY	406	0.023	0.003
21	LH 801 (I)	435	0.052	0.009
22	LH 802 (IT)	489	0.103	0.018
23	LH 803 (IT)	390	0.013	0.002
24	LH 804 (IT)	403	0.016	0.003
25	LH 805 (IT)	483	0.096	0.016
26	LH 806 (IT)	415	0.015	0.011
27	8th Floor Lobby	414	0.012	0.003
28	LH 701	499	0.116	0.02
29	LH 702	531	0.149	0.026
30	COM 703	469	0.085	0.015
31	COM 704	471	0.084	0.015
32	COM 705	385	0.014	0
33	COM 706	434	0.013	0.08
34	7th Floor Lobby	407	0.017	0.002
35	LH 601	426	0.01	0.009
36	LH 602	474	0.089	0.016
37	LH 603	385	0.001	0
38	LH 604	403	0.015	0.003
39	LH 605	390	0.017	0.001
40	LH 609	388	0.022	0
41	6th Floor Lobby	402	0.019	0.004
42	LH 503	544	0.16	0.029
43	LH 504	527	0.136	0.024
44	LH 505	459	0.057	0.008
45	LH 509	399	0.023	0.003
46	5th Floor Lobby	425	0.017	0.007
47	CL 401 + 402	505	0.254	0.045
48	CL 403	389	0.057	0.09
49	CL 404	506	0.126	0.023
50	CL 405	385	0.015	0
51	4th Floor Lobby	385	0.018	0
52	CL 301	454	0.0075	0.014
53	CL 302	387	0.012	0
54	CL 303 + 304	391	0.023	0.006
55	LH 305	389	0.018	0.009
56	CL 306	407	0.016	0.003
57	LH 307	483	0.096	0.016
58	3rd Floor Lobby	385	0.024	0
59	LH 201	416	0.02	0.009
60	CL 202	607	0.225	0.04

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61	CL 203	385	0.018	0
62	LH 204	599	0.213	0.03
63	LH 205	482	0.1	0.018
64	LH 206	438	0.056	0.01
65	CL 207 + 208	386	0.007	0
66	2nd Floor Lobby	388	0.016	0
67	101 + 102	470	0.08	0.016
68	OF 103	554	0.166	0.0309
69	OF 104	596	0.0211	0.038
70	OF 105	218	0.133	0.023
71	1st Floor Lobby	388	0.012	0.002
72	Ground Floor	422	0.016	0.006
73	Reading Room (GF)	409	0.016	0.004
74	GYM	451	0.667	0.01

4.2.2 Old Building

S N	Location	CO2	TVOC	HCHO
1	LH 601	385	0.012	0.003
2	LH 602	445	0.059	0.01
3	LH 603	413	0.013	0.003
4	LH 604	386	0.016	0
5	LH 605	466	0.08	0.018
6	LH 606	422	0.024	0.009
7	LH 607	393	0.02	0.002
8	LH 609	413	0.023	0.009
9	6th Floor Lobby	386	0.026	0.002
10	OFFICE 502	413	0.02	0.005
11	LH 503	385	0.001	0.001
12	LH 504	482	0.078	0.078
13	LH 505	435	0.07	0.008
14	LH 506	420	0.012	0.007
15	LH 507	432	0.0021	0.025
16	LH 508	386	0.001	0
17	5th Floor Lobby	403	0.013	0.004
18	OF 401	385	0.023	0
19	OF 402	389	0.023	0.001
20	Library	413	0.011	0.005
21	408 (work)	385	0.023	0
22	OF 409	432	0.01	0.025
23	4th Floor Lobby	431	0.0017	0.007
24	LH 301	395	0.016	0.003
25	LH 302	443	0.05	0.07
26	LH 303	408	0.011	0.003
27	LH 304	425	0.02	0.007

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28	LH 305	435	0.05	0.009
29	CL 306	520	0.138	0.024
30	CL 307	428	0.022	0.006
31	CL 308	405	0.012	0.004
32	NSS 308	418	0.02	0.006
33	OF 309	385	0.001	0
34	3rd Floor Lobby	435	0.069	0.013
35	LH 202	417	0.016	0.005
36	LH 203 (A&B)	409	0.013	0.004
37	LH 204	386	0.072	0
38	LH 205	388	0.018	0
39	LH 206	386	0.014	0.001
40	LH 207	444	0.0061	0.011
41	LH 208	551	0.178	0.032
42	OF 209	385	0.001	0
43	PRINCIPLE RESIDANCY	389	0.019	0
44	2nd Floor Lobby	394	0.022	0.05
45	OF 102	385	0.015	0
46	LI 103	593	0.205	0.036
47	LI 104	497	0.12	0.021
48	LI 105	385	0.017	0
49	LI 106	385	0.023	0
50	LI 107	404	0.012	0.003
51	LI 108	482	0.1	0.018
52	OF 109	547	0.0161	0.029
53	Book Stall	406	0.018	0.003
54	1St Floor Lobby	464	0.078	0.014
55	Ground Floor	427	0.014	0.008

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GREEN ENVIRONMENT INITIATIVES

TREE PLANTATION DRIVE:

TSEC with the help of Municipal Corporation of Greater Mumbai (MCGM) organized a Tree Plantation Drive on July 22nd, 2019 at Pali Hill Railway Colony, Carter Road, Bandra West. This event was glorified by the presence of Cabinet Minister Mr. Ashish Shellar, Corporator Ms. Swapna Mhatre, Asst. Commissioner H West MCGM Mr. Sharad Ughade, Principal of Thadomal Shahani Engineering College Dr. G. T. Thampi. Students, from different branches participated in the plantation drive. Also, the TSEC Drama Team performed a street play creating awareness about the adverse effects of deforestation and the need to grow more trees.

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CAUVERY CALLING:

Isha Foundation collaborated with NSS - TSEC on the 4th of September 2019 to conduct a River awareness programme "CAUVERY CALLING" on the streets of Bandra where the NSS Volunteers willingly participated even in heavy rains and made the locals aware about how the deforestation has led to making our rivers dead and that their little contribution might be of great help in saving Cauvery.

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RAILWAY WALL PAINTING

The walls and boards at Bandra station were given a facelift by the students of TSEC on the 26th of September. Students and teachers actively took part in creating awareness towards a clean and healthy environment through their paintings. The paintings were themed on topics of Swachh Bharat and Plastic ban.

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