GREEN AUDIT REPORT

For

LOYOLA COLLEGE

Nungambakkam, Chennai

By

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Delivering Performance

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ACKNOWLEDGEMENT

Conserve Consultants Pvt limited wishes to thank all the staff and Management & Technical Team of **Loyola College, Chennai** for the kind cooperation and assistance extended to our Auditors during the course of the Green audits.

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1. Executive Summary

Green Audit of Loyola College, Chennai was carried out by Conserve Consultants during October 2019.

The approach taken in this facility included different tools such as preparation of questionnaire, physical inspection of the campus, observation and review of the documentation, interviewing key persons and associated systems & equipment, including the electrical, lighting & AC systems, and operational & maintenance procedures. Sample measurements were taken using various instruments like ALM Power Analyzer, clamp meter, Infrared Thermometer, Lux meter, Humidity meter, CO_2 meter, etc. Operational Data were also collected from the past records. The study covered the following areas to summarize the present status of environment management in the campus:

- Water management
- Energy Conservation
- Waste management
- Green area management

The report accounts for the energy consumption patterns of the Loyola College based on actual assessment. The report compiles a list of possible actions to conserve and efficiently access the available scarce resources and their saving potential was also identified.

The overall annual energy and water consumption is 22, 19,530 kWh/annum. The annual greenhouse gas emissions equivalent for electricity is **1866 tons of CO_2** (0.85kg of CO_2 emits /kWh of unit generation).

Overall the Loyola campus has green initiatives to meet the sustainable environment and giving green education to students to need of environment protection.

Overall 12% **i.e. 257, 353 kWh** unit savings has been identified on above mentioned categories with an average payback of **3 year** and reduced annual greenhouse gas emissions equivalent (GHG_e) to **777 tons of CO_2.**

At present **160 kW of Solar PV** has been installed with energy generation of **17,913 kWh** in the past two months. Its overall contribution is around **1% of the total energy**. Renewable and grid energy contribution is **1% and 99%** respectively. It is recommended to increase Solar PV on rooftop to reduce **CO_2 emission** & and the same is highlighted <u>in ECM-1.</u>

On an overall note, there is no water meter in the site to monitor the water consumption, it is recommended to install the water meter on each block and also at source of water supply.

In Loyola campus all the degradable waste is converted fed for composting & Biogas production. Garden wastes are sent for composting & Food wastes are being sent to gasification for production of biogas. On an overall waste collection **68% of food waste** is converted into biogas i.e., **190,310 kgs** which converted into biogas of **51,540 cu.m** and **garden waste of 21%** is **51,540 kgs** which converted into compost by **18,500 kgs. In addition 10%** of non-degradable waste is sent to the municipal segregation for landfills.

In Loyola campus overall Landscape is good. In landscape turf is with non-native species and it consumes water, it is requested to replace turf to 'energy plantation' as it acts as a rich producer of oxygen and absorber of carbon dioxide. **Beema Bamboo** can produce 62 tonnes of oxygen and absorbs 88 tonnes of carbon dioxide per acre per year.

For continuous improvement, every identified Performance Improvement Measure, a detailed M&V Plan shall be established for continuous monitoring & evaluation of the effect of the system over which PIM will be implemented.

2. List of Performance Improvement Measures at Loyola College, Chennai

S.No	ECM Description	Annual Energy savings kWh	Annual savings, Lacs.	Cost of Measure, Lac.	Payback Months
1	Install Solar PV in roof top to reduce overall power consumption	657,000	53.9	200.0	45
2	Water saving through the efficient water faucets	-	1.1	2.0	22
3	Replace Split units with efficient VRF system	27,000	2.2	10.0	54
4	Replace exterior Halogen lamps with LED	8,400	0.7	2.3	39
5	Measurement & Verification (M&V) as per IPMVP	221,953	18.2	20.0	13
	Total	**914,353**	**76.1**	**234.3**	**37**

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3. Project Background

Loyola College, a Catholic Minority Institution, was founded by the Society of Jesus (Jesuits) in 1925, with the primary objective of providing University Education in a Christian atmosphere for deserving students irrespective of caste and creed. It started functioning in July 1925 with just 75 students on the rolls in three undergraduate courses of Mathematics, History and Economics. Overall college built-up area is 98,079 sq. m.

Loyola College, though affiliated to University of Madras, became autonomous in July 1978. It is autonomous, in the sense that it is empowered to frame its own course of studies and adopt innovative methods of teaching and evaluation. The University degrees will be conferred on the students passing the examinations conducted by the college.

UGC conferred the status of "College with potential for Excellence" on Loyola College in 2004 and confirmed the same in 2010. NAAC's re-accreditation score in 2012 (Third Cycle) is 3.70 out of 4.00 CGPA. UGC has elevated Loyola College to the status of "College of Excellence" for the period from April 1, 2014 till March 31, 2019.

Today, there are 19 P.G courses and 19 U.G courses (Arts, Sciences and Commerce) and 12 special Institutes offering various programs to 12,107 students. 11 departments are offering M.Phil. Programs and 12 departments offer Ph.D. programs. At present, 117 teaching staff members out of 286 hold doctoral degree. There are 182 non-teaching staff in service.

Loyola college major facilities:-

- The central library has a collection of more than 1, 02,000 books, 225 journals, 8,087 e-journals and 48,146 e-books.
- Loyola Men's Hostel and Loyola Women's Hostel together have 836 rooms and can accommodate 1650 students.
- Prayer Room
- Loyola Health Centre
- Food Court
- Recreational Center
- Sports Pavilion and Gymnasium

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4. GREEN AUDIT

The main objective of the green audit is to promote the Environment Management and Conservation in the College Campus. The purpose of the audit is to identify, quantify, describe and prioritize framework of Environment Sustainability in compliance with the applicable regulations, policies and standards.

The main objectives of carrying out Green Audit are:

- To introduce and aware students to real concerns of environment and its sustainability
- To secure the environment and cut down the threats posed to human health by analyzing the pattern and extent of resource use on the campus.
- To establish a baseline data to assess future sustainability by avoiding the interruptions in environment that are more difficult to handle and their corrections requires high cost.

Green Audit also includes the preliminary analysis and more detailed energy calculations-financial analysis of proposed Performance Improvement Measures (PIM). The financial analysis provides the facility team the understanding of the financial benefits in implementing specific Performance Improvement Measures. Utility bills were collected for three months period to allow the auditor to evaluate the facility's energy/demand rate structures and energy usage profiles. A detailed financial analysis is performed for each measure based on implementation cost estimates; site-specific operating cost savings, and the customer's investment criteria. Sufficient detail is provided to justify project implementation.

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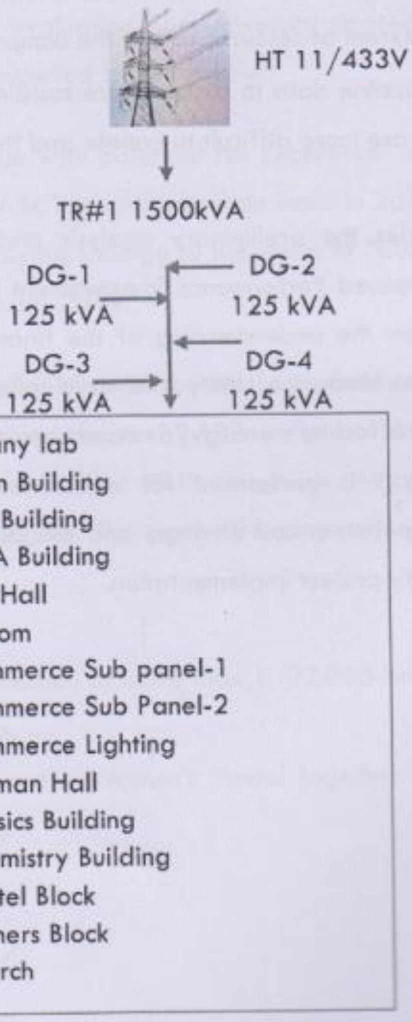
5. Electrical System

The electrical power is availed from Southern Power Distribution Company of TamilNadu Electricity Board. The power is distributed through LT panel located in the Facility Area. The power is distributed to the industry through transformer of loading position 11KV/433V distribution transformer.

There is 1 No. of 1500 kVA & 2 Nos. of 500 kVA DG set for the backup to handle any grid power interruption.



5.1 ELECTRICAL BILL ANALYSIS

The Energy bill data were analyzed from October'16 to Sep'19, the total electricity bill for the year 2018-19 is Rs.181 Lakhs and unit consumption is 8.2 lakhs kWh.

Month	Energy Consumption kWh	Energy Cost Rs	Maximum Demand kVA	Demand Cost Rs	Total Energy bill Charges RS	Power Factor	Unit Cost Rs/kWh
Oct-16	212280	1347978	837	318325	1750340.7	0.98	8.2
Nov-16	139950	888683	720	252000	1195280.4	0.98	8.5
Dec-16	121650	772478	720	252000	1073892.5	0.98	8.8
Jan-17	122490	777812	720	252000	1080193.5	0.98	8.8
Feb-17	183310	1164019	720	252000	1487825.4	0.98	8.1
Mar-17	209990	1333437	799	279755	1734883.1	0.98	8.3
Apr-17	180010	1143064	720	252000	1466459.7	0.98	8.1
May-17	146050	927418	720	252000	1236214.6	0.98	8.5
Jun-17	153390	974027	720	252000	1288255.1	0.98	8.4
Jul-17	238560	1514856	828	309400	1916488.8	0.98	8.0
Aug-17	193750	1230313	770	269465	1576766.4	0.98	8.1
Sep-17	239120	1518412	821	302155	1912856.9	0.98	8.0
Total	**2140550**	**1E+07**	**9095**	**3243100**	**17719457.1**	**0.98**	**8.3**

Table: Energy Bill Analysis Oct'16 to Sep'17

Month	Energy Consumption kWh	Energy Cost Rs	Maximum Demand kVA	Demand Cost Rs	Total Energy bill Charges RS	PF	Unit Cost Rs/kWh
Oct-17	201190	1277557	754	263760	1620382	0.98	8.1
Nov-17	161490	1025462	720	252000	1342059	0.99	8.3
Dec-17	178710	1134809	720	252000	1456679	0.98	8.2
Jan-18	137320	871982	720	252000	1179512	0.98	8.6
Feb-18	184840	1173734	720	252000	1497276	0.98	8.1
Mar-18	215900	1370965	767	268520	1723459	0.98	8.0
Apr-18	205340	1303909	773	270655	1655292	0.98	8.1
May-18	155380	986663	720	252000	1299847	0.98	8.4
Jun-18	151020	958977	720	252000	1272246	0.97	8.4
Jul-18	219640	1394714	859	341950	1823792	0.97	8.3
Aug-18	242710	1541209	846	328720	1963601	0.98	8.1
Sep-18	246470	1565085	826	306985	1967134	0.98	8.0
Total	**2300010**	**1E+07**	**9145**	**3292590**	**18801279**	**0.979**	**8.2**

Table: Energy Bill Analysis Oct'17 to Sep'18

Month	Energy Consumption kWh	Energy Cost Rs	Maximum Demand kVA	Demand Cost Rs	Total Energy bill Charges RS	PF	Unit Cost Rs/kWh
Oct-18	204870	1300925	834	315805	1698733	0.980	8.3
Nov-18	164440	1044194	720	252000	1361692	0.980	8.3
Dec-18	175470	1114235	720	252000	1435348	0.980	8.2
Jan-19	121280	770128	720	252000	1071984	0.980	8.8
Feb-19	207370	1316800	720	252000	1649248	0.980	8.0
Mar-19	217460	1380871	802	281890	1748196	0.980	8.0
Apr-19	199530	1267016	757	265090	1611071	0.980	8.1
May-19	139810	887794	720	252000	1194856	0.980	8.5
Jun-19	146330	929196	730	255640	1246437	0.970	8.5
Jul-19	215480	1368298	759	265650	1657071	0.980	7.7
Aug-19	203060	1289431	755	264145	1633614	0.980	8.0
Sep-19	224430	1425131	975	341103	1853167	0.980	8.3
Total	**2219530**	**1E+07**	**9212**	**3249323**	**18161417**	**0.979**	**8.2**

Table: Energy Bill Analysis Oct'18 to Sep'19

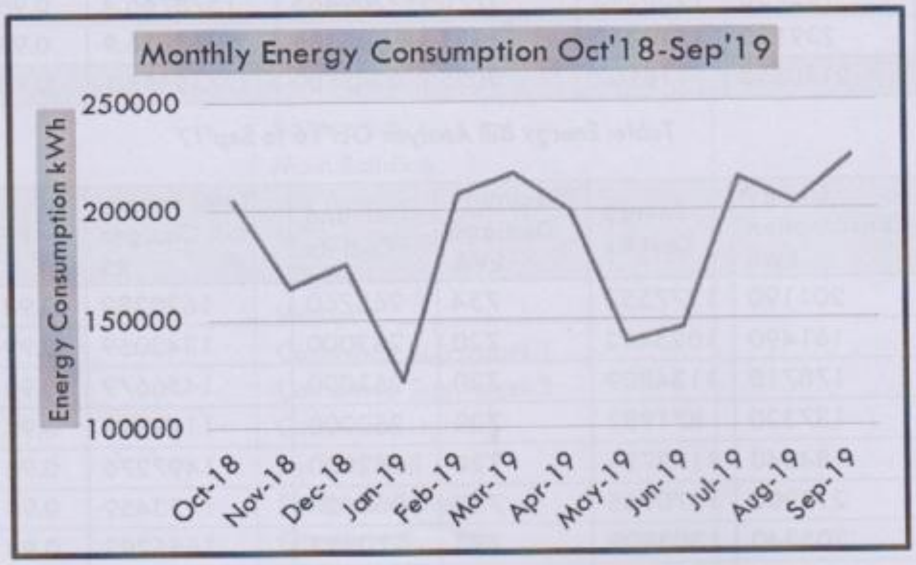


Chart: kWh Consumption analysis – During Sep 2019 energy consumption is high

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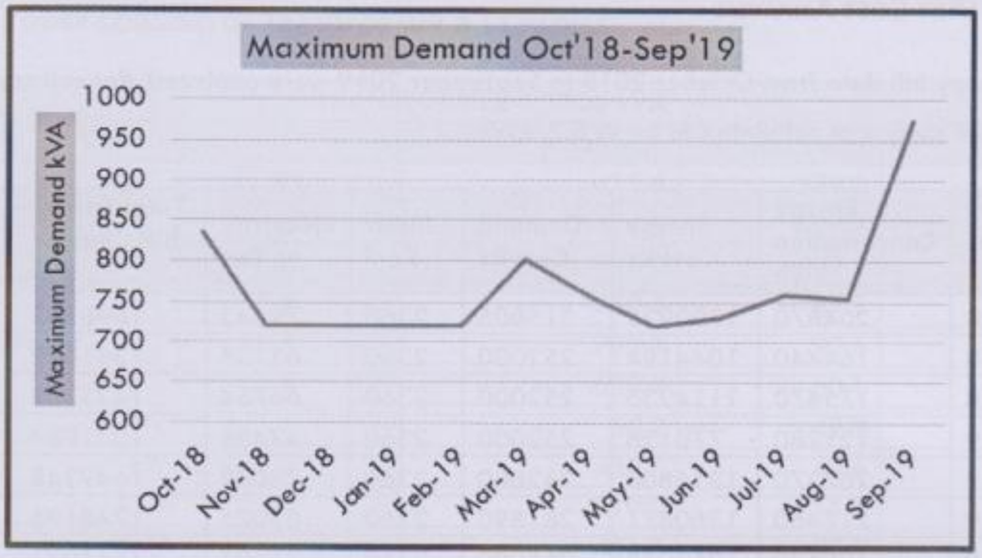

Chart: Maximum Demand analysis – During Sep 2019 Maximum Demand is high.

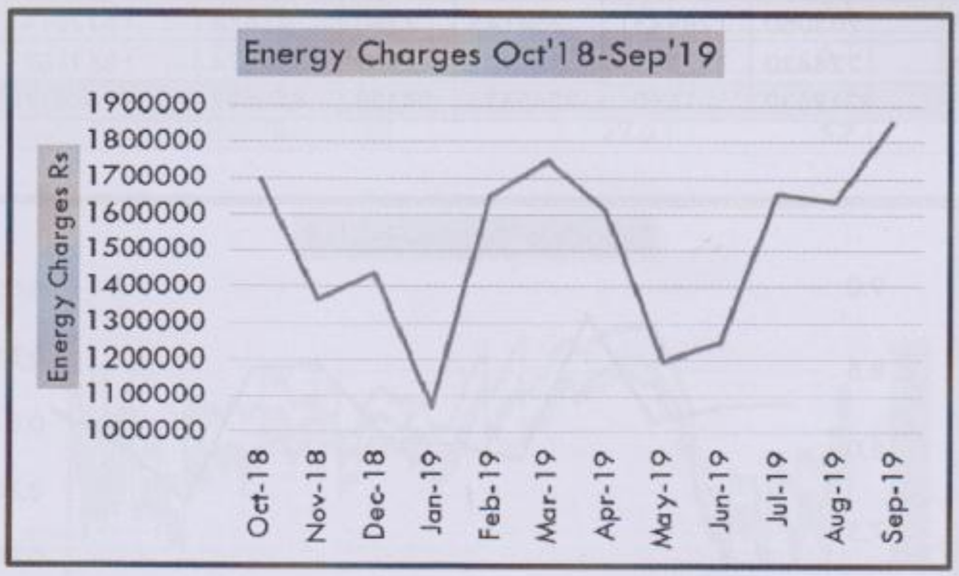

Chart: Monthly Unit Consumption Charges – During Sep 2019 energy bill is high

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6.1 UNIT COST ANALYSIS

The Energy bill data from October 2018 to September 2019 were analyzed. Per unit cost for the period of study was calculated to be Rs 8.2/kWh.

Month	Energy Consumption kWh	Energy Cost Rs	Demand Cost Rs	Meter Rent	Electricity Tax	Total Energy bill Charges Rs	Unit Cost Rs/kWh
Oct-18	204870	1300925	315805	2360	79643	1698733	8.3
Nov-18	164440	1044194	252000	2360	63138	1361692	8.3
Dec-18	175470	1114235	252000	2360	66754	1435349	8.2
Jan-19	121280	770128	252000	2360	47496	1071984	8.8
Feb-19	207370	1316800	252000	2360	78088	1649248	8.0
Mar-19	217460	1380871	281890	2360	83075	1748196	8.0
Apr-19	199530	1267016	265090	2360	76605	1611071	8.1
May-19	139810	887794	252000	2360	52702	1194856	8.5
Jun-19	146330	929196	255640	2360	59242	1246437	8.5
Jul-19	215480	1368298	265650	2360	81697	1657071	7.7
Aug-19	203060	1289431	264145	2360	77678	1633614	8.0
Sep-19	224430	1425131	341103	2360	84574	1853167	8.3
Total	**2219530**	**1E+07**	**3249323**	**28320**	**850692**	**18161417**	**8.2**

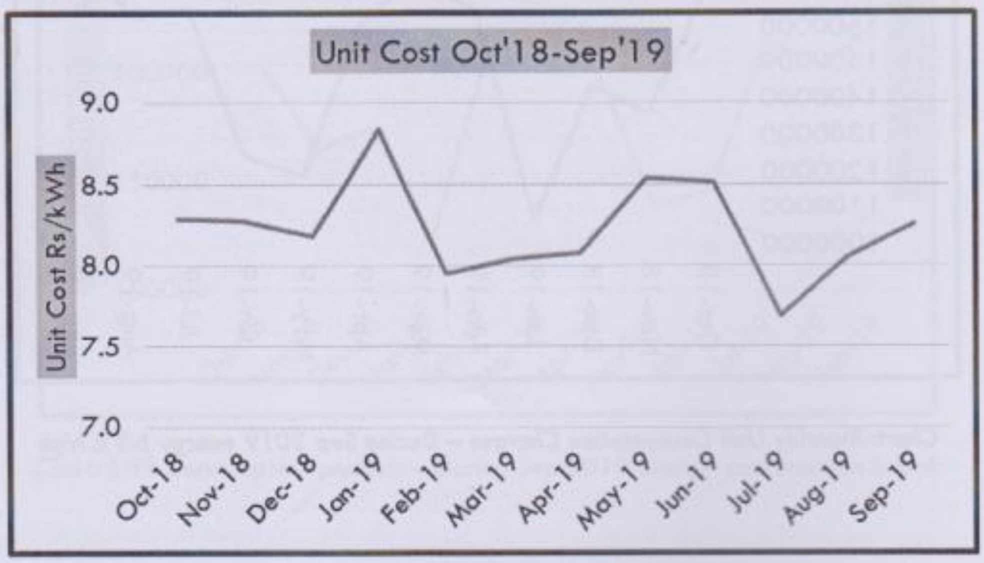

Chart: Monthly Unit Cosy – During March Jan 2019 Unit Cost Rare is high.

5.2 Power Logging of Transformer & LT panels

TRANSFORMER-1 1500 kVA				
Description		Maximum	Minimum	Average
Voltage	RY	415.6	399.9	408.6
	YB	414.1	399.4	407.5
	BR	418.0	402.1	411.3
Current	R	760.1	87.3	330.5
	Y	722.3	90.6	311.2
	B	620.2	60.1	249.6
Hz		50.2	49.9	50.0
kW		432.7	49.6	186.6
kVAr		210.0	15.7	68.3
kVA		456.7	57.1	200.8
Power Factor PF		0.991	0.845	0.935
Voltage THD %	R	2.0	1.1	1.4
	Y	2.1	1.2	1.6
	B	2.0	1.1	1.5
Current THD %	R	19.8	6.1	11.1
	Y	25.0	7.0	14.4
	B	22.6	5.7	12.0

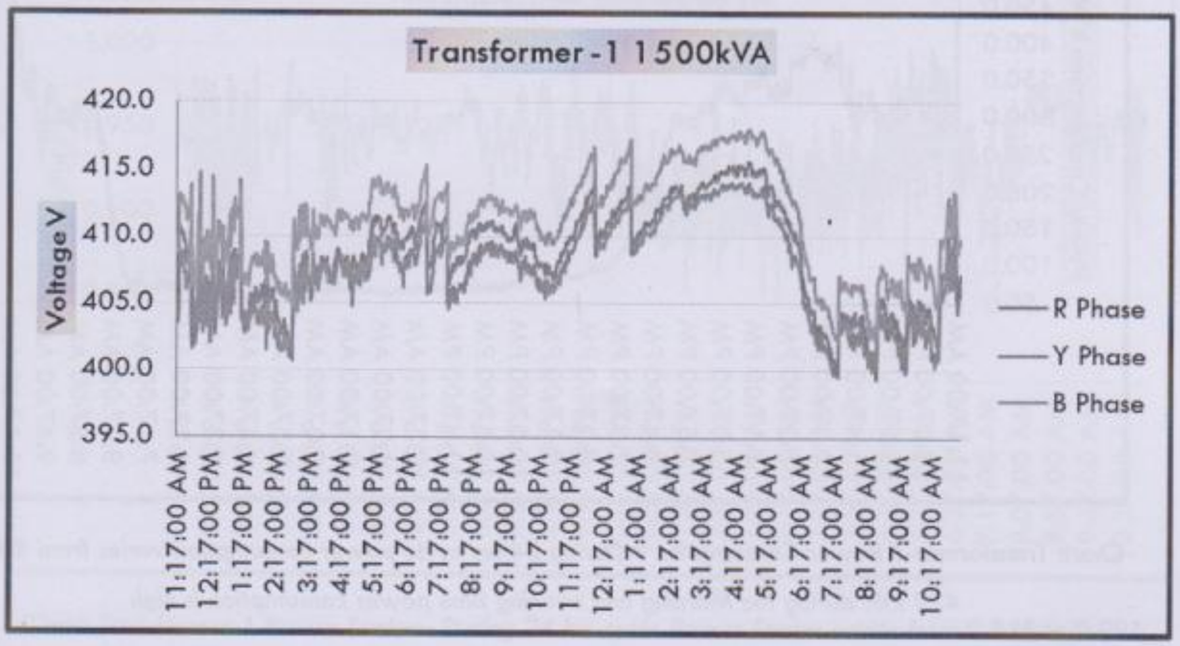

Chart: Transformer-1 Voltage – During 24 hrs cycle voltage varies from 399 to 415 V.

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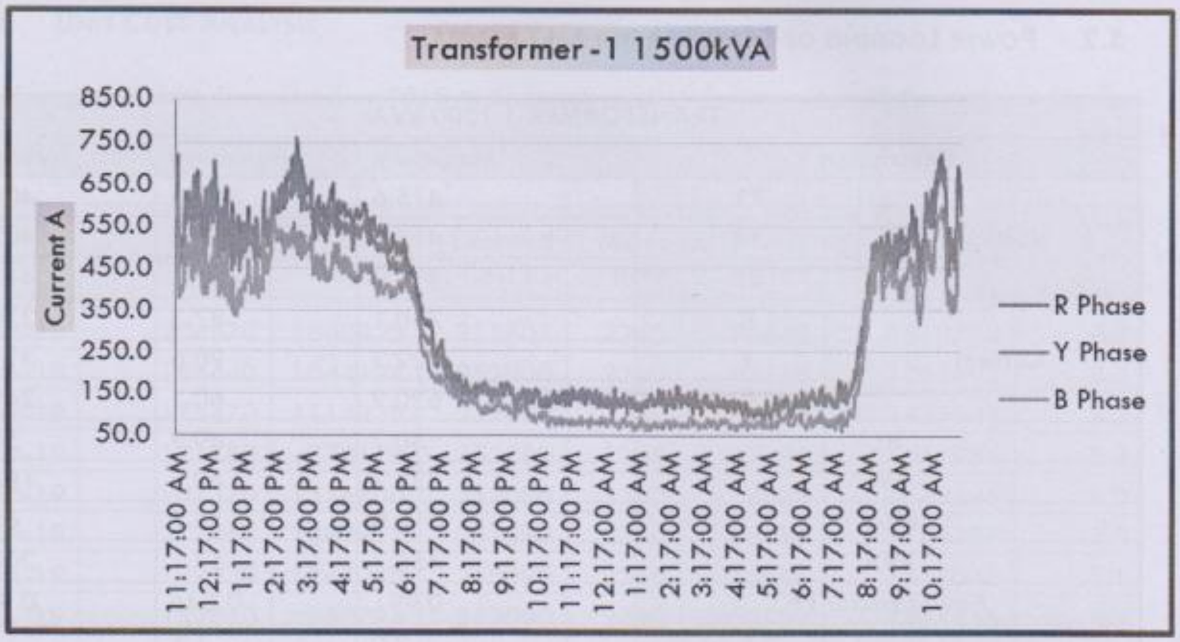

Chart: Transformer-1 Current – During 24 hrs cycle current varies from 60 to 760 A.

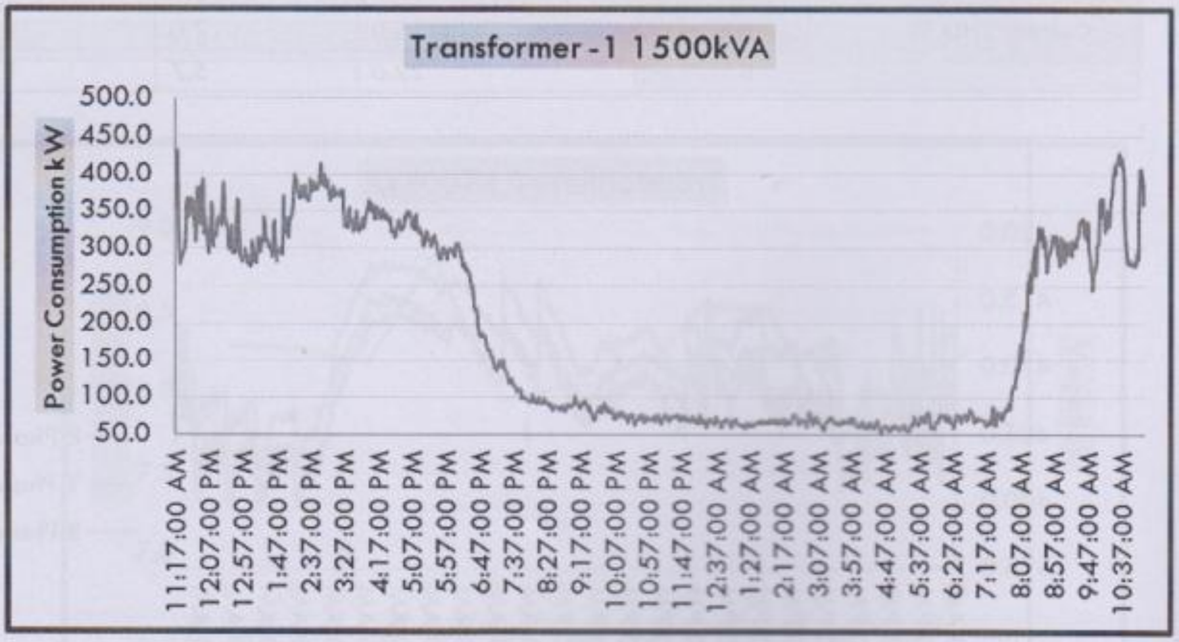

Chart: Transformer-1 Power Consumption – During 24 hrs cycle power consumption varies from 50 to 432 kW, during the Morning and evening time power consumption is high

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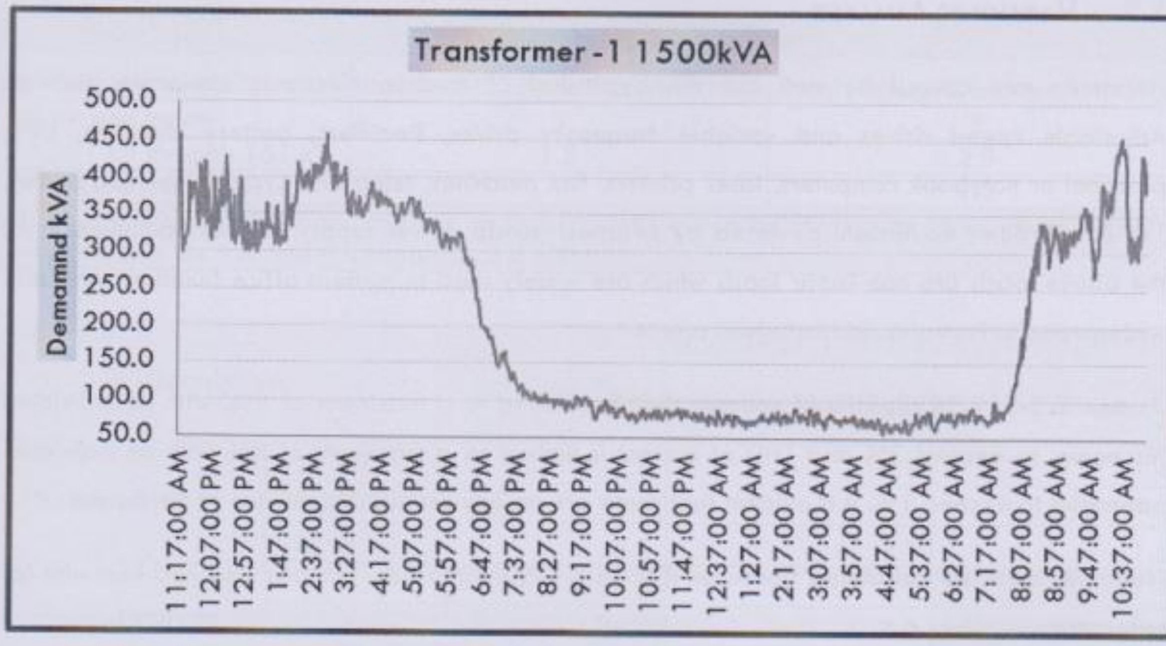

Chart: Transformer-1 Maximum Demand – During 24 hrs cycle Maximum Demand varies from 57 to 456 kVA, during the Morning and evening time maximum demand is high

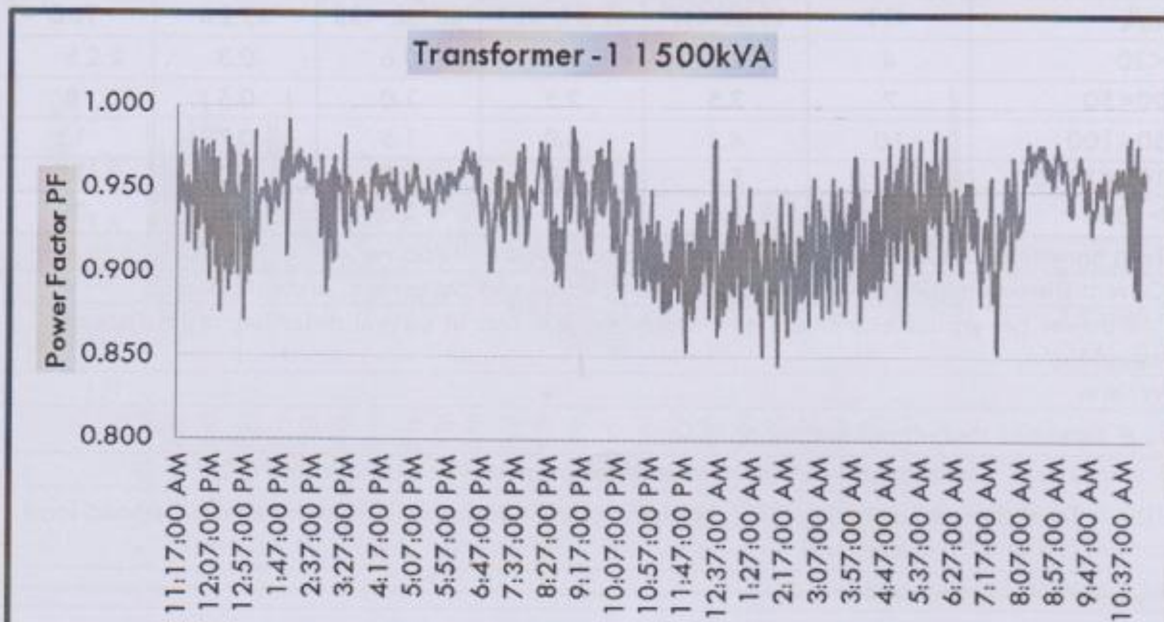

Chart: Transformer-1 Power Factor– During 24 hrs cycle Power Factor varies from 0.845 to 0.991, during the Morning and evening time power factor nearing unity.

5.3 Harmonic Analysis

Harmonics are caused by and are the byproduct of modern electronic equipment such as Adjustable speed drives and variable frequency drives, Rectifiers, battery chargers, UPS, personal or notebook computers, laser printers, fax machines, telephone systems, stereos, radios, TVs & any other equipment powered by switched- mode power supply (SMPS) equipment's. All the above loads are non-linear loads which are widely used in modern office buildings and also widespread in factories and industrial plants.

As per IEEE-519 1992, THD of voltage shall be limited to a maximum of 5%, with no individual harmonics to exceed 3% and THD of current is limited to a maximum of 4% with no individual harmonics to exceed 1%. It is evident that there are no any serious magnitudes of harmonics.

Harmonic limits are calculated based on IEEE 519-1992 standards. Same is attached herewith for reference

Harmonic Limits						
Current Distortion Limits for General Distribution Systems (120 through 69000 V)						
Maximum harmonic Current Distortion in Percent of I_L						
Individual harmonic Order (Odd harmonics)						
I_{sc}/I_L	<11	$11 \leq h < 17$	$17 \leq h < 23$	$23 \leq h < 35$	$35 \leq h$	TDD
<20	4	2.0	1.5	0.6	0.3	5
20<50	7	3.5	2.5	1.0	0.5	8
50<100	10	4.5	4.0	1.5	0.7	12
100<1000	12	5.5	5.0	2.0	1.0	15
>1000	15	7.0	6.0	2.5	1.4	20
Even harmonics are limited to 25% of the odd harmonic limits above.						
Current Distortion that result in a DC offset, e.g. half-wave converters, are not allowed						
*All power generation equipment is limited to these values of current distortion, regardless of actual I_{sc} / I_L						
Where:						
I_{sc} = maximum short-circuit current at PCC						
I_L = maximum demand load current (fundamental frequency component) at PCC						
TDD = Total demand distortion (RSS), harmonic current distortion in % of maximum demand load current (15 or 30 min demand)						
PCC = Point of common coupling						

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Voltage distortion limits		
Bus Voltage at PCC	Individual Voltage Distortion (%)	Total Voltage Distortion THD (%)
69 kV and below	3	5
69.001 kV through 161 kV	1.5	2.5
161.001 kV and above	1	1.5
NOTE: High-voltage systems can have up to 2.0% THD where the cause is an HVDC terminal that will attenuate by the time it is tapped for a user		

Description		Transformer -1 1500 kVA		
		Average	Maximum	Minimum
Voltage THD %	R	2.0	1.1	1.4
	Y	2.1	1.2	1.6
	B	2.1	1.1	1.5
Current THD %	R	19.8	6.1	11.1
	Y	25.0	7.0	14.4
	B	22.6	5.7	12.0

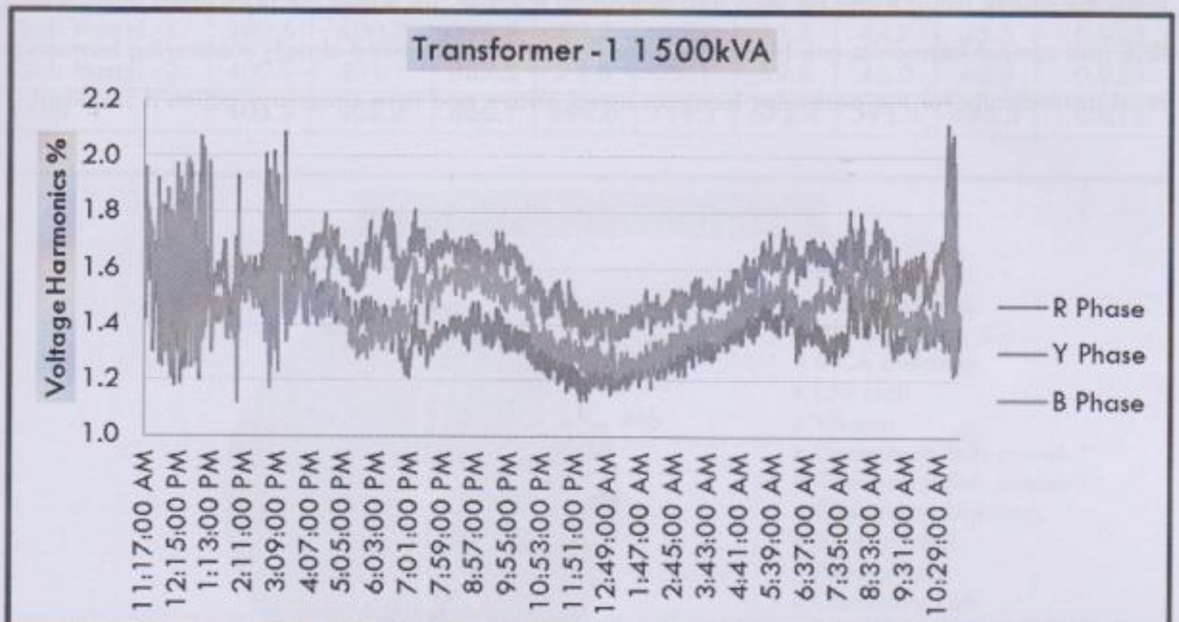

Chart: Transformer-1 Voltage THD – During 24 hrs cycle voltage harmonics varies from 1.1 to 2.1%.

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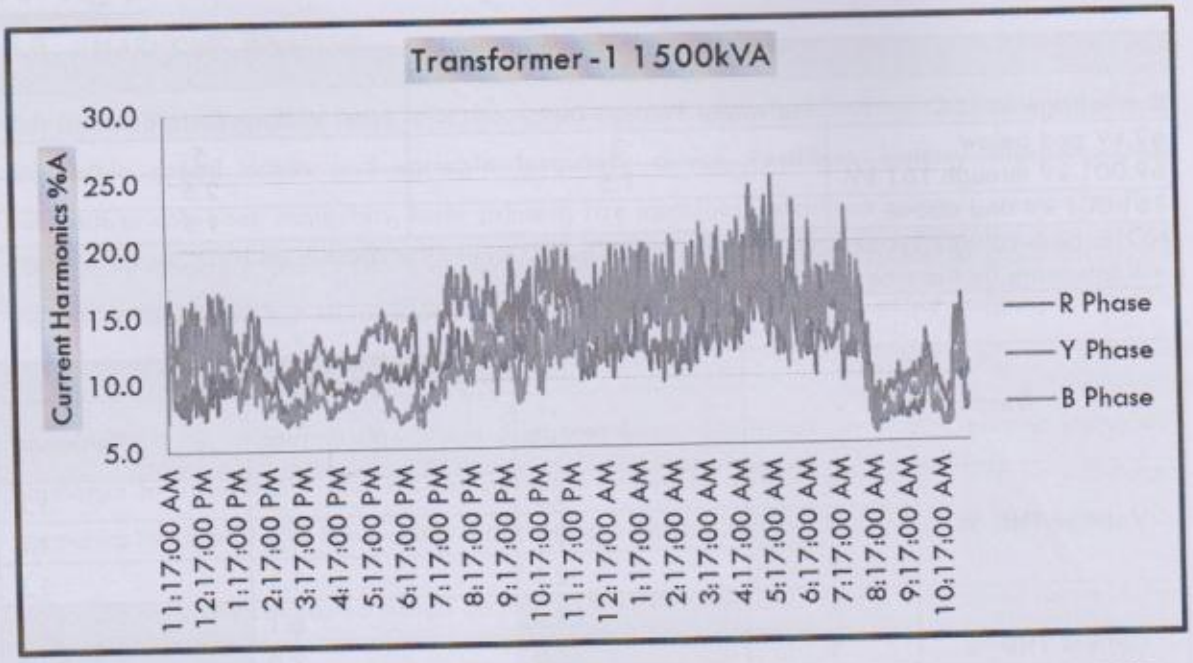

Chart: Transformer-1 Current THD – During 24 hrs cycle current harmonics varies from 5.7 to 25%.

Comments:

From the above table it can be seen that individual voltage are within the prescribed limits set by IEEE and current harmonics are higher than the limit. We recommend closely monitoring harmonics level periodically for the particular locations listed above and take necessary action if required.

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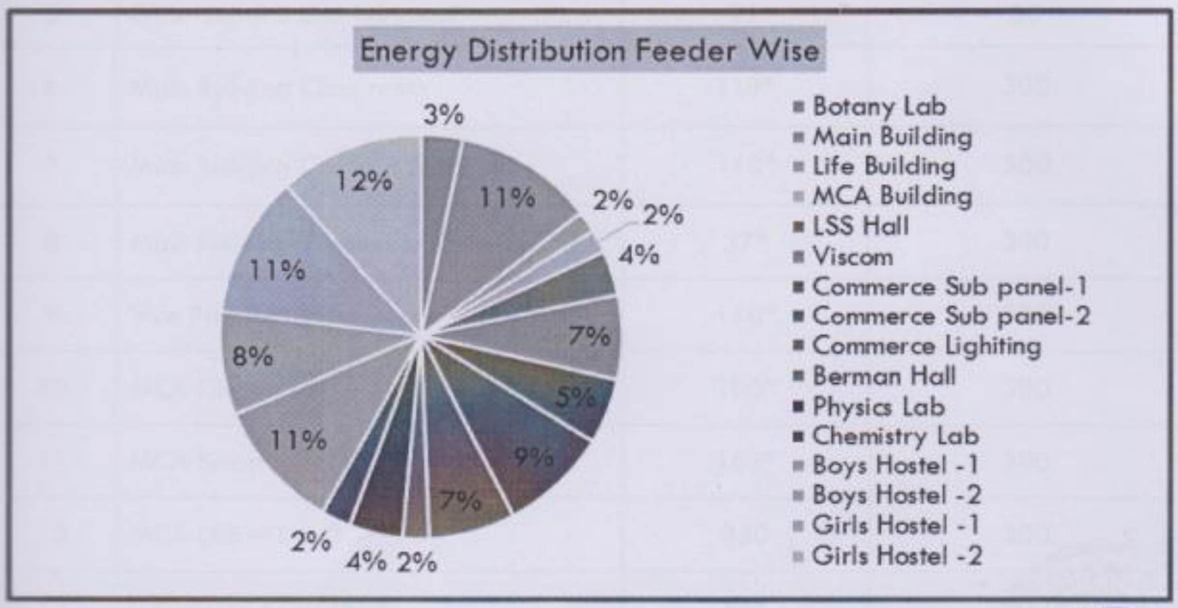
5.4 Energy Distribution

Area	Voltage			Current			kW	kVA	Power Factor
	RY	YB	BR	R	Y	B			
Botany Lab	406.9	405.9	409.1	28.6	29.1	28.5	13.2	20.7	0.648
Main Building	410.4	406.5	406.8	55.1	65.1	83.4	44.2	45.2	0.689
Life Building	407.7	406.2	401.2	14.8	24.2	18.7	6.7	9.4	0.691
MCA Building	407.6	407.0	411.2	19.4	18.3	5.3	7.2	10.1	0.742
LSS Hall	406.8	405.5	410.0	56.6	64.7	60.1	14.1	44.3	0.371
Viscom	408.1	406.4	410.4	59.8	53.8	26.8	26.7	33.1	0.842
Commerce Sub panel-1	406.7	406.0	409.1	11.7	39.3	44.7	20.4	25.3	0.902
Commerce Sub panel-2	407.3	407.6	409.9	71.0	61.6	48.2	34.4	39.4	0.872
Commerce Lighting	408.1	407.9	410.4	42.0	40.7	34.9	27.2	27.7	0.980
Berman Hall	408.5	408.1	410.4	37.5	25.0	14.2	8.3	15.2	0.548
Physics Lab	406.0	406.7	401.0	44.1	33.9	33.2	16.9	18.8	0.895
Chemistry Lab	401.0	407.6	411.0	17.6	15.4	16.3	9.3	9.4	0.935
Boys Hostel -1	394.5	397.6	395.5	61.7	50.0	79.1	41.7	43.6	0.957
Boys Hostel -2	412.5	411.9	415.5	42.1	47.8	47.5	32.4	32.8	0.987
Girls Hostel -1	399.5	400.7	398.7	59.2	65.2	71.8	44.7	45.3	0.988
Girls Hostel -2	400.9	401.1	387.2	72.8	77.1	59.8	46.0	48.0	0.958
Total	**405.8**	**405.8**	**406.1**	**694.0**	**711.1**	**672.4**	**393.3**	**468.3**	**0.813**



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Area	Power Consumption kW	% Sharing
Botany Lab	13.2	3.4
Main Building	44.2	11.2
Life Building	6.7	1.7
MCA Building	7.2	1.8
LSS Hall	14.1	3.6
Viscom	26.7	6.8
Commerce Sub panel-1	20.4	5.2
Commerce Sub panel-2	34.4	8.7
Commerce Lighting	27.2	6.9
Berman Hall	8.3	2.1
Physics Lab	16.9	4.3
Chemistry Lab	9.3	2.4
Boys Hostel -1	41.7	10.6
Boys Hostel -2	32.4	8.2
Girls Hostel -1	44.7	11.4
Girls Hostel -2	46.0	11.7
Total	**393.3**	**100.0**

Table: Feeder Sharing – Main Building, Hostels sahring 11%% of energy consumption in a year and for the miscellaneous power further more meters to added for individual area to be monitered.

5.5 Lighting Analysis

Good lighting is necessary to enable work to be done well and in comfort. A facility with bad lighting is an inefficient one, though it may look attractive. Poor lighting can be combated by good eyesight and by keenness on work but at the eventual expenses of efficiency, wellbeing and comfort. Hence, the designer of the building should pay sufficient attention to the need for good lighting.

The lighting details of the facility were studied. The various type of light fitting used are 7W, 20W, 100W, 120W, LED lamps & 32W PL lamps and 1000W, 2000W Halogen lamp.

5.6 Day Light Analysis

S.No	Area	LUX Level	Baseline Lux Level as per NBC
1.	Boys Hostel - room	85*	50
2.	Girls Hostel 6 Sharing room	23*	50
3.	Girls Hostel 5 Sharing room	44*	50
4.	Girls Hostel 4 Sharing room	44*	50
5.	Girls Hostel 3 Sharing room	91	50
6.	Main Building Class room	119*	300
7.	Main Building Common Staff room	110*	300
8.	Main Building Women Staff room	37*	300
9.	Vice Principal Room	110*	300
10.	MCA Class room	100*	300
11.	MCA Smart Class room	165*	300
12.	MCA LAB – 1 & 2	350	300
13.	Commerce Class room	85*	300

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S.No	Area	LUX Level	Baseline Lux Level as per NBC
14.	NCC Building	58*	300
15.	Life Science Building R-1	25*	300
16.	Life Science Building R-2	25*	300
17.	Viscom Block	35*	300
18.	Social Works R- 1	40*	300
19.	Social Works R- 2	40*	300
20.	Chemistry Block	40*	300
21.	Library	200	285
22.	Non Veg Mess	63*	200
23.	Veg Mess	68*	200
24.	Metro Mess	60*	200
25.	Jubli Mess	60*	200
*lux level measured during day light			

Comments:

Lux level is measured during day light availability and it is low compared to NBC standards.

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5.7 Lighting Power Density

S.No	Description	Fixture Details	Total Wattage	Area Sq.ft	Actual LPD w/sq.ft	ASHRAE LPD w/sq.ft
1.	Boys Hostel	1X36W TL	36	150	0.24	1.21
2.	Girls Hostel 6 Sharing room	4X36W TL	144	288	0.50	1.21
3.	Girls Hostel 5 Sharing room	4X36W TL	144	255	0.56	1.21
4.	Girls Hostel 4 Sharing room	1X36W TL	36	180	0.2	1.21
5.	Girls Hostel 3 Sharing room	1X36W TL	36	180	0.2	1.21
6.	Main Building Class room	6X36W TL	216	600	0.36	1.24
7.	Main Building Common Staff room	9X108W PL	972	832	1.16	1.24
8.	Main Building Women Staff room	4X28W TL	112	432	0.26	1.24
9.	Vice Principal Room	10X20W PL	200	144	1.38	1.24
10.	MCA Class room	4X36W TL	144	600	0.24	1.24
11.	MCA Smart Class room	18X36W TL	648	1240	0.52	1.24
12.	MCA LAB – 1 & 2	6X80W PL	420	620	0.67	1.24
13.	Commerce Class room	5X36W TL	180	750	0.24	1.24
14.	NCC Building	2X36W TL	72	150	0.48	1.24
15.	Life Science Building R-1	3X36W TL	108	640	0.28	1.24
16.	Life Science Building R-2	5X36W TL	180	960	0.18	1.24
17.	Viscom Block	5X36W TL	180	880	0.20	1.24
18.	Social Works R- 1	8X36W TL	288	1344	0.21	1.24
19.	Social Works R- 2	3X36W TL	108	640	0.21	1.24
20.	Chemistry Block	8X36W TL	288	1344	0.21	1.24

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S.No	Description	Fixture Details	Total Wattage	Area Sq.ft	Actual LPD w/sq.ft	ASHRAE LPD w/sq.ft
21.	Library	16X36W TL	576	3120	0.18	0.93
22.	Non Veg Mess	28X36W TL	1008	3300	0.30	0.90
23.	Veg Mess	16X36W TL	576	3300	0.17	0.90
24.	Metro Mess	22X36W TL	792	3300	0.24	0.90
25.	Jubli Mess	16X36W TL	576	3300	0.17	0.90

Comments:

LPD is within in the ASHRAE limit.

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6. HEATING VENTILATING & AIR CONDITIONING (HVAC)

In Loyola College in 28 blocks for human comfort sum of 60 TR capacities of split units installed, in MCA block, Library block and administrative block is installed in the building to meet the cooling requirement. Along with this, for ventilation in the facility, ceiling, wall mounted fans, totally of 90 kW approx. are installed.

6.1 PERFORMANCE ANALYSIS OF SPLIT UNITS

MCA LAB -1 Split – AC No - 1		
Description	Name Plate Details	
Make	Blue Star	
Motor Power, kW	1.9	
Rated Current, A	8.5	
Refrigerant & Charge	R-22, 1.65 kg	
Capacity, TR	1.5	
Performance Analysis		
Description	Actual	Units
Motor running current	3.7	A
Voltage	223.4	V
Motor power	0.73	kW
Supply air quantity	98.2	CFM
Return air temperature	25.6	°C
Relative humidity	52.4	%
Supply air temperature	24.5	°C
CO_2 Level	1241	PPM

Comments:

Power consumption is within the design limit and CO_2 level is high.

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MCA LAB -1 Split – AC No - 21		
Description	**Name Plate Details**	
Make	Blue Star	
Motor Power, kW	1.9	
Rated Current, A	8.5	
Refrigerant & Charge	R-22, 1.65 kg	
Capacity, TR	1.5	
Performance Analysis		
Description	**Actual**	**Units**
Motor running current	3.8	A
Voltage	209.8	V
Motor power	0.81	kW
Supply air quantity	96.7	CFM
Return air temperature	25.8	°C
Relative humidity	52.4	%
Supply air temperature	24.8	°C
CO_2 Level	1241	PPM

Comments:

Power consumption is within the design limit and CO_2 level is high.

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MCA LAB -2 Split – AC No - 1		
Description	**Name Plate Details**	
Make	Blue Star	
Motor Power, kW	1.9	
Rated Current, A	8.5	
Refrigerant & Charge	R-22, 1.65 kg	
Capacity, TR	1.5	
Performance Analysis		
Description	**Actual**	**Units**
Motor running current	4.6	A
Voltage	221.1	V
Motor power	0.83	kW
Supply air quantity	90.8	CFM
Return air temperature	25.6	°C
Relative humidity	53.5	%
Supply air temperature	24.8	°C
CO_2 Level	960	PPM

Comments:

Power consumption is within the design limit and CO_2 level is high.

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MCA LAB -2 Split – AC No - 2		
Description	**Name Plate Details**	
Make	Blue Star	
Motor Power, kW	1.9	
Rated Current, A	8.5	
Refrigerant & Charge	R-22, 1.65 kg	
Capacity, TR	1.5	
Performance Analysis		
Description	**Actual**	**Units**
Motor running current	4.1	A
Voltage	215.7	V
Motor power	0.89	kW
Supply air quantity	92.5	CFM
Return air temperature	26.2	°C
Relative humidity	58.6	%
Supply air temperature	25.3	°C
CO_2 Level	960	PPM

Comments:

Power consumption is within the design limit and CO_2 level is high.

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MCA Smart Class Room Split – AC No - 1		
Description	**Name Plate Details**	
Make	LG	
Motor Power, kW	1.9	
Rated Current, A	9	
Refrigerant & Charge	R-22, 1.09 kg	
Capacity, TR	1.5	
Performance Analysis		
Description	**Actual**	**Units**
Motor running current	9.6	A
Voltage	404.6	V
Motor power	0.89	kW
Supply air quantity	92.5	CFM
Return air temperature	26.6	°C
Relative humidity	58.6	%
Supply air temperature	25.3	°C
CO_2 Level	1080	PPM

Comments:

Power consumption is within the design limit and CO_2 level is high.

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MCA Smart Class Room Split – AC No - 2	
Description	**Name Plate Details**
Make	LG
Motor Power, kW	1.9
Rated Current, A	9.0
Refrigerant & Charge	R-22, 1.09 kg
Capacity, TR	1.5

Performance Analysis		
Description	**Actual**	**Units**
Motor running current	8.1	A
Voltage	223.1	V
Motor power	1.9	kW
Supply air quantity	92.5	CFM
Return air temperature	26.5	°C
Relative humidity	58.6	%
Supply air temperature	24.9	°C
CO_2 Level	1080	PPM

Comments:

Power consumption is within the design limit and CO_2 level is high.

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MCA Smart Class Room Split – AC No - 3		
Description	**Name Plate Details**	
Make	LG	
Motor Power, kW	1.9	
Rated Current, A	9	
Refrigerant & Charge	R-22, 1.09 kg	
Capacity, TR	1.5	
Performance Analysis		
Description	**Actual**	**Units**
Motor running current	8.5	A
Voltage	215.4	V
Motor power	1.72	kW
Supply air quantity	90.5	CFM
Return air temperature	26.6	°C
Relative humidity	58.6	%
Supply air temperature	24.9	°C
CO_2 Level	1080	PPM

Comments:

Power consumption is within the design limit and CO_2 level is high.

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MCA Smart Class Room Split – AC No - 4		
Description	**Name Plate Details**	
Make	LG	
Motor Power, kW	1.9	
Rated Current, A	9	
Refrigerant & Charge	R-22, 1.09 kg	
Capacity, TR	1.5	
Performance Analysis		
Description	**Actual**	**Units**
Motor running current	8.3	A
Voltage	253.1	V
Motor power	1.83	kW
Supply air quantity	87	CFM
Return air temperature	26.4	°C
Relative humidity	58.6	%
Supply air temperature	25.2	°C
CO_2 Level	1080	PPM

Comments:

Power consumption is within the design limit and CO_2 level is high.

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Main Building Common Staff Room – AC No - 1		
Description	**Name Plate Details**	
Make	Blue Star	
Motor Power, kW	1.9	
Rated Current, A	8.5	
Refrigerant & Charge	R-22, 1.65 kg	
Capacity, TR	1.5	
Performance Analysis		
Description	**Actual**	**Units**
Motor running current	9.5	A
Voltage	226.1	V
Motor power	2.15	kW
Supply air quantity	92.3	CFM
Return air temperature	26.1	°C
Relative humidity	55.3	%
Supply air temperature	24.5	°C
CO_2 Level	980	PPM

Comments:

Power consumption is within the design limit and CO_2 level is high.

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Main Building Common Staff Room – AC No - 2		
Description	Name Plate Details	
Make	Blue Star	
Motor Power, kW	1.9	
Rated Current, A	8.5	
Refrigerant & Charge	R-22, 1.65 kg	
Capacity, TR	1.5	
Performance Analysis		
Description	Actual	Units
Motor running current	7.8	A
Voltage	235.2	V
Motor power	1.84	kW
Supply air quantity	95.6	CFM
Return air temperature	26.1	°C
Relative humidity	53.5	%
Supply air temperature	24.8	°C
CO_2 Level	980	PPM

Comments:

Power consumption is within the design limit and CO_2 level is high.

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Main Building Common Staff Room – AC No - 3		
Description	**Name Plate Details**	
Make	Blue Star	
Motor Power, kW	1.9	
Rated Current, A	8.5	
Refrigerant & Charge	R-22, 1.65 kg	
Capacity, TR	1.5	
Performance Analysis		
Description	**Actual**	**Units**
Motor running current	8.1	A
Voltage	225.1	V
Motor power	1.8	kW
Supply air quantity	90.8	CFM
Return air temperature	26.1	°C
Relative humidity	53.5	%
Supply air temperature	24.7	°C
CO_2 Level	980	PPM

Comments:

Power consumption is within the design limit and CO_2 level is high.

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CONSERV

Betrum Hall – Digital Library AC No - 1		
Description	**Name Plate Details**	
Make	Blue Star	
Motor Power, kW	8.55	
Capacity, TR	4.5	
Performance Analysis		
Description	**Actual**	**Units**
Motor running current	13.1	A
Voltage	398.2	V
Motor power	3.9	kW
Return air temperature	26.5	°C
Relative humidity	58.7	%
CO_2 Level	1860	PPM

Comments:

Power consumption is within the design limit and CO_2 level is high.

Betrum Hall – Digital Library AC No - 2		
Description	**Name Plate Details**	
Make	Blue Star	
Motor Power, kW	8.55	
Capacity, TR	4.5	
Performance Analysis		
Description	**Actual**	**Units**
Motor running current	16.8	A
Voltage	392.2	V
Motor power	3.1	kW
Return air temperature	26.1	°C
Relative humidity	55.5	%
CO_2 Level	840	PPM

Comments:

Power consumption is within the design limit and CO_2 level is high.

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6.2 Indoor Air Quality

Indoor air quality (IAQ) is a term which refers to the air quality within and around buildings and structures, especially as it relates to the health and comfort of building occupants. IAQ can be affected by various gases, volatile organic compounds etc. Source control, filtration and the use of ventilation to dilute contaminants are the primary methods for improving indoor air quality in most buildings. Determination of IAQ involves the collection of air samples at various locations of the building.

During the course of audit, the Indoor air quality survey was carried out at various locations in the building.

S.No	Area	Temperature	CO_2 ppm	Relative Humidity %
1	MCA Lab-1	25.6	1241	52.4
2	MCA Lab-2	26.2	960	58.6
3	MCA Smart class	26.6	1080	57.9
4	Main Building Common Staff room	25.6	840	55.5

Comments:

On an overall observation, the occupant comfort temperature shall be maintained at 24◦C, & Humidity needs to be maintained at 60%. CO2 level is high in the above highlighted area.

7 WATER

Water for the entire hotel is by Municipal Corporation & bore well water. It is pumped to the raw water tank then the OHT at different levels, water treatment plant for the process and raw water used for the domestic purposes.

7.1 PERFORMANCE ANALYSIS OF WATER FAUCETS

Water flow is measured in faucets of Hotel rooms & common areas

S. No.	Description	LEED Baseline (LPM)	Actual (LPM)
Boys Hostel			
1	Wash basin tap 1	1.9	8.5
2	Wash basin tap 2	1.9	8
3	Urinals	1.9	4
4	Bathrooms	1.9	9.5
Girls Hostel			
1	Wash basin tap 1	1.9	11
2	Wash basin tap 2	1.9	13
3	Water Closets	1.9	6
Main Building– Gents Toilet			
1	Wash basin tap 1	1.9	7.5
Commerce Building– Gents Toilet			
1	Wash basin tap 1	1.9	7.5
Canteen Building			
1	Wash basin tap	1.9	13
Gents Toilet (Near bike Parking)			
1	Wash basin tap	1.9	12
Gents Toilet (Near Canteen)			
1	Wash basin tap	1.9	9.5

Comments:Water flow in the faucets and tap are high in above highlighted area comparing to the LEED standard.

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7.2 PERFORMANCE ANALYSIS OF DOMESTIC WATER PUMPS

Commerce Block Domestic Water Pump-1

Description	Domestic Water Pump -1
Make	Texmo
Capacity, m^3/hr	13.68
Motor efficiency, %	35
Motor current, A	9.3
Motor RPM	2900
Installed motor power, kW	5.5
Description	**Readings**
Voltage, V	393.7
Current, A	9.7
Power consumption, kW	5.6

Comments:

Power consumption is within the design limit.

Commerce Block Domestic Water Pump-2

Description	Domestic Water Pump -2
Make	Texmo
Capacity, m^3/hr	13.68
Motor efficiency, %	35
Motor current, A	9.3
Motor RPM	2900
Installed motor power, kW	5.5
Description	**Readings**
Voltage, V	412
Current, A	10.4
Power consumption, kW	6.3

Comments:

Power consumption is within the design limit.

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Domestic Water Pump -3 Bore to Sump

Description	Domestic Water Pump -3 Bore to Sump
Make	Taro Pumps
Motor efficiency, %	35
Motor RPM	1440
Installed motor power, kW	1.12
Description	**Readings**
Voltage, V	214
Current, A	4.9
Power consumption, kW	0.77

Comments:

Power consumption is within the design limit.

Domestic Water Pump -4

Description	Domestic Water Pump -4
Make	Besten Submersible
Installed motor power, kW	2.23
Description	**Readings**
Voltage, V	396.8
Current, A	4.4
Power consumption, kW	2.5

Comments:

Power consumption is within the design limit.

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MCA Block Domestic Water Pump-1

Description	Domestic Water Pump -1
Make	Crompton Greaves
Capacity, m^3/hr	12.24
Motor efficiency, %	38
Motor current, A	4.8
Motor RPM	2850
Installed motor power, kW	2.2
Description	**Readings**
Voltage, V	408.1
Current, A	6.1
Power consumption, kW	3.66

Comments:

Power consumption is within the design limit.

Women Common Rest Room Domestic Water Pump -1

Description	Domestic Water Pump -1
Make	Crompton Greaves
Capacity, m^3/hr	12.2
Motor efficiency, %	38
Motor current, A	4.8
Motor RPM	2850
Installed motor power, kW	2.2
Description	**Readings**
Voltage, V	389.6
Current, A	3.9
Power consumption, kW	2.2

Comments:

Power consumption is within the design limit.

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7.3 Performance Analysis of RO Pumps

Commerce Building RO Water Plant (1000 LPH)

Description	Raw Water Feed Pump
Make	Crompton Greaves
Capacity, m^3/hr	4
Motor current, A	2.3
Motor RPM	2800
Installed motor power, kW	1.1
Description	**Readings**
Voltage, V	214
Current, A	1.9
Power consumption, kW	0.4

Comments:

Power consumption is within the design limit.

Description	High Pressure Pump
Make	Grundfos
Capacity, m^3/hr	3
Motor efficiency, %	79.7
Motor current, A	8.5
Motor RPM	3430
Installed motor power, kW	2.2
Description	**Readings**
Voltage, V	392.6
Current, A	3.4
Power consumption, kW	1.73

Comments:

Power consumption is within the design limit.

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Jubilee Building RO Water Plant (750 LPH)

Description	Raw Water Feed Pump
Make	
Capacity, m³/hr	
Motor current, A	
Motor RPM	
Installed motor power, kW	
Description	**Readings**
Voltage, V	219
Current, A	2.4
Power consumption, kW	0.7

Comments:

Power consumption is within the design limit.

Description	High Pressure Pump
Make	Grundfos
Capacity, m³/hr	3
Motor efficiency, %	79.7
Motor current, A	8.5
Motor RPM	3430
Installed motor power, kW	2.2
Description	**Readings**
Voltage, V	386.7
Current, A	3.7
Power consumption, kW	1.2

Comments:

Power consumption is within the design limit.

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Jubilee Building RO Water Plant (500 LPH)

Description	Raw Water Feed Pump
Voltage, V	238
Current, A	1.8
Power consumption, kW	0.6

Comments:

Power consumption is within the design limit.

Description	High Pressure Pump
Make	Grundfos
Capacity, m^3/hr	3
Motor efficiency, %	79.7
Motor current, A	8.5
Motor RPM	3430
Installed motor power, kW	2.2
Description	**Readings**
Voltage, V	392.5
Current, A	3.9
Power consumption, kW	2.2

Comments:

Power consumption is within the design limit.

Girls Common Room RO Water Plant (500 LPH)

Description	Raw Water Feed Pump
Make	Mahendra Pumps
Capacity, m^3/hr	2.3
Motor current, A	2.5
Motor RPM	2800
Installed motor power, kW	1.2
Description	**Readings**
Voltage, V	215
Current, A	2.2
Power consumption, kW	0.7

Comments:

Power consumption is within the design limit.

Description	High Pressure Pump
Make	Mahendra Pumps
Capacity, m^3/hr	2.5
Motor current, A	9.5
Motor RPM	2900
Installed motor power, kW	1.5
Description	**Readings**
Voltage, V	225
Current, A	7.7
Power consumption, kW	1.5

Comments:

Power consumption is within the design limit.

Chemistry Block RO Water Plant (500 LPH)

Description	Raw Water Feed Pump
Voltage, V	215
Current, A	1.4
Power consumption, kW	0.8

Comments:

Power consumption is within the design limit.

Description	High Pressure Pump
Make	Grudfos
Capacity, m^3/hr	3
Motor current, A	8.5
Motor RPM	3430
Installed motor power, kW	2.2
Description	**Readings**
Voltage, V	388.4
Current, A	7.2
Power consumption, kW	2.2

Comments:

Power consumption is within the design limit.

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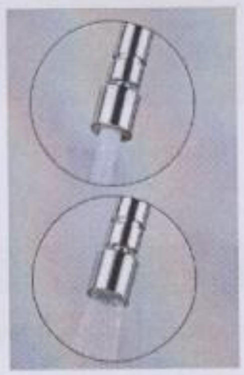
7.4 WATER NEUTRALITY

Presently fresh water i.e., bore well and tanker waters are used for the entire building. Sewage Treated water is used for the landscape.

Strategies for Water Neutrality:-

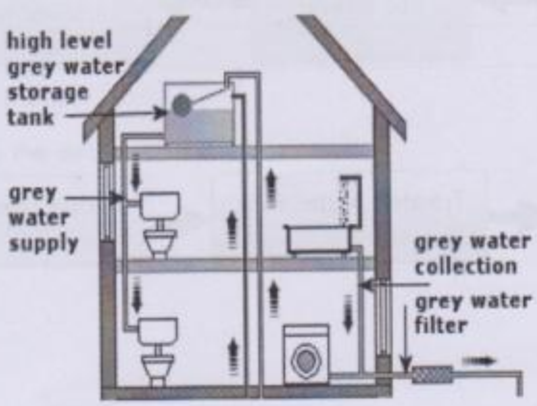
a. **Low flow aerators.**

To reduce the fresh water consumption by installing the aerators for faucets in all guest rooms, common area restrooms, kitchen etc., this reduces the 40% of water consumption from the baseline of LEED.



b. **Dual Plumbing System.**

To reduce the freshwater consumption by installing the dual flush system. This reduces the fresh water consumption and using the STP treated water & the fresh water consumption is zero.



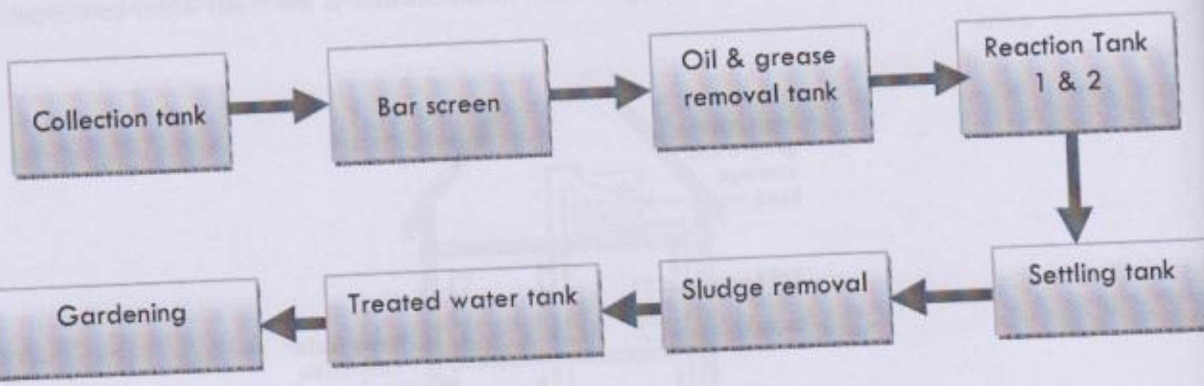
c. **Native Plant Species.**

For landscape STP treated water is used for irrigation. In landscape so many non-native species like Korean grass is high water consumption. To reduce the water consumption by replacing the drought tolerant/xeriscape species.

7.5 SEWAGE TREATMENT PLANT

In Loyola campus 250 KLD capacity of sewage water treatment is installed. Sewage treatment is done by Fluidized Bed Aeration by blower aeration method, and the treated water is used for the gardening. Equipment's studied are air blower, transfer pump & treated water pump.

Annual output of the STP product is 91,250 KLD which is costing of Rs 0.06 paise per liter and annual cost is Rs 54, 75, 000.



Loyola College Performance Analysis of STP Water Pump

Description	Raw Water Feed Pump - 1
Make	Crompton Greaves
Flow rate, m^3/hr	21
Head, m	9.5
Motor current, A	3.6
Motor RPM	2900
Installed motor power, kW	1.5
Description	**Readings**
Voltage, V	395.1
Current, A	2.5
Power consumption, kW	1.4

Comments:

Power consumption is within the design limit.

Description	Sludge Pump – 1
Make	Crompton Greaves
Flow rate, m^3/hr	21
Head, m	9.5
Motor current, A	3.6
Motor RPM	2900
Installed motor power, kW	1.5
Description	**Readings**
Voltage, V	398
Current, A	1.8
Power consumption, kW	1.05

Comments:

Power consumption is within the design limit.

Description	Filter Pump – 1
Make	Crompton Greaves
Flow rate, m^3/hr	21
Head, m	9.5
Motor current, A	3.6
Motor RPM	2900
Installed motor power, kW	1.5
Description	**Readings**
Voltage, V	397
Current, A	1.7
Power consumption, kW	0.99

Comments:

Power consumption is within the design limit.

Description	Filter Press feed Pump - 1
Make	Crompton Greaves
Flow rate, m^3/hr	13.2
Head, m	10.5
Motor current, A	3.6
Motor RPM	2870
Installed motor power, kW	0.75
Description	**Readings**
Voltage, V	399
Current, A	1.9
Power consumption, kW	1.12

Comments:

Power consumption is within the design limit.

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Description	Air Blower -1
Make	Everest Blowers
Capacity, m^3/hr	150
Motor efficiency, %	86.3
Motor current, A	7.1
Motor RPM	1380
Installed motor power, kW	3.7
Description	**Readings**
Voltage, V	398.5
Current, A	5.9
Power consumption, kW	3.4

Comments:

Power consumption is within the design limit.

8 WASTE MANAGEMENT SYSTEM

In Loyola campus for different type of waste collection bins are provided for collection of waste.

To provide educational inputs to the students on the Waste Management System.

Biogas:

Wet waste is collected from the canteen, kitchen & Mess is sent to biogas for bio gas production and the output of biogas waste is sent to composting. Garden waste is sent to composting. Biogas plant with a capacity of 1000 kg digestion it is a continuous type reactor which gives 100kgs of methane daily.

Month	Food Waste, Kg	Garden Waste, Kg	Total Waste, Kgs	Biogas Produces, Cubic meters	Compost Shipped, Kgs
Oct-18	17370	2100	19470	489	150
Nov-18	14630	2750	17370	452	50
Dec-18	13180	3700	16880	514	1545
Jan-19	12315	5100	17415	472	1015
Feb-19	14100	7100	21200	473	15400
Mar-19	13645	6600	20245	416	
Apr-19	7540	6900	14440	446	20
May-19	3825	5100	8925	294	170
Jun-19	7930	3800	11730	260	150
Jul-19	29715	5200	34915	274	.
Aug-19	27037	1800	28837	456	
Sep-19	29023	1300	30323	462	
Total	**190310**	**51450**	**241750**	**5008**	**18500**

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9 Renewable Energy System

Presently 160kW capacity of sola PV system installed to meet the power requirement. By 2021 target of 500kVA capacity entire campus with solar power. Loyola campus targeting to educate students on merits of solar power.

Solar panel is installed on the BOOT model (Build Operate Organise & Transfer) for 15 years. The cost per unit is 4.95/kWh while the current payment to TANGEDCO IS Rs 6.47/kWh.

Area	Generation Period	Energy Generated Units, kWh	Cost Savings Rs
Arts & Science	28th Aug to 27th Sep 2019	14919	25623
Jesuit Residence	28th Aug to 27th Sep 2019	2994	5142

Comments:

Above mentioned period the peak savings is 191kWp.

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10 MEASUREMENT & VERIFICATION

Measurement and Verification is an important method for energy management process of quantifying energy consumption to establish baseline/benchmarking. It is important to accurately determine how much energy has actually been saved. This can be done in part through metering and sub-metering of facilities and equipment. The final energy consumption figures are compared to an accurately determined baseline of energy use to come up with the energy savings figures. A good M&V in all critical areas shows more the 5% of energy savings in overall savings figure.

Improvement in the present M&V:-

Presently monitoring is being done in areas as listed below and daily data are recorded, this daily data represents overall utility. There is no individual or sub-metering for the system/sub system energy consumption, it is difficult to find the gap. Metering or sub-metering in individual system wise is very important to identifying the gaps and diagnosis.

S.no	Utility	Feeder Location	Meter installed (yes/no)	Type	Frequency of collection
1	Overall Building	LT Room	Yes	Energy	Daily Data
2	Water Bore well	OHT	Yes	Water	Daily Data
3	Water Tanker/Municipal	GF	Yes	Water	Daily Data

List of proposed M & V System

It is recommended to integrate all meters to capture hourly data in BMS. Additionally below mentioned energy shall be installed.

S.no	Utility	Feeder Location	Meter installed (yes/no)	Type	Frequency of collection
1	College Main Block	LT Room	No	Energy	Daily Data
2	JD hall	LT Room	No	Energy	Daily Data
3	Physics Block	LT Room	No	Energy	Daily Data
4	Life Building	LT Room	No	Energy	Daily Data
5	Chemistry lab	LT Room	No	Energy	Daily Data
6	Commerce Building	LT Room	No	Energy	Daily Data
7	Library	LT Room	No	Energy	Daily Data
8	Auditorium	LT Room	No	Energy	Daily Data
9	Workshop	LT Room	No	Energy	Daily Data

S.no	Utility	Feeder Location	Meter installed (yes/no)	Type	Frequency of collection
10	Day scholar canteen	LT Room	No	Energy	Daily Data
11	Social work department	LT Room	No	Energy	Daily Data
12	Chennai Mission Office	LT Room	No	Energy	Daily Data
13	Hostels	LT Room	No	Energy	Daily Data
14	Saulier Hall	LT Room	No	Energy	Daily Data
15	Mess	LT Room	No	Energy	Daily Data
16	NCC & Army office	LT Room	No	Energy	Daily Data
17	Visual Communication	LT Room	No	Energy	Daily Data
18	Ladies Hostel	LT Room	No	Energy	Daily Data
19	Commerce Block	LT Room	No	Energy	Daily Data

Ideally each system/sub system to be metered separately like interior lighting, exterior lighting, raw power, ventilation fans, water pumps, STP, RO etc., to monitor and continuously improve the energy performance through ratio analysis. Hence, if feasible existing cables to the systems shall be reconfigured to accommodate separate meters each and every system/subsystem.

Ratio Analysis:

The Ratio analysis will depict how much is the building and utility performance in numbers as per international and local standards. Since this analysis requires a lot of data from each tenant we would request the management to start collecting the data and send the same within the timeline for completion of this report. Data collected would be used for calculating the benchmark or arriving at figures to set the target for each and every occupant in the building. This exercise will allow us to reduce the carbon footprints; even though the numbers may not be larger today, we can strive to achieve bigger targets. Energy Benchmarking, water benchmarking, waste benchmarking to be done as a part of Ratio Analysis

Few pros of ratio analysis

1. Will be able to quantify the numbers in terms of Energy, Water and Waste, like EPI, water consumption (per person) etc.
2. Waste and water benchmarking can also be done on the similar lines of Energy.
3. Further analysis and optimization of consumption can be made possible.
4. These Ratios will be helpful for few certifications as most of the rating systems would be using the same ratios.

10 Site Observation Report

Site Observation Report (SOR)			
Report No.	C&A/SOR/01	Date	11.10.2019
Location	Hostel		

Observation Images

Description

Five star rated water heater in hostel for hot water geyser

Potential Sustainability Measures

It reduces the power consumption and it is highly efficient.

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Site Observation Report (SOR)			
Report No.	C&A/SOR/02	Date	11.10.2019
Location	Rest rooms		

Observation Images

Description

In rest single flush closets are used it consumes more water.

Potential Sustainability Measures

It is recommended to install dual flush closet to reduce the water consumption.

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Site Observation Report (SOR)			
Report No.	C&A/SOR/03	Date	11.10.2019
Location	Class Rooms		

Observation Images

Description

Daylight in the class rooms.

Potential Sustainability Measures

There is enough daylight available in the class rooms, views and natural ventilation also good.

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Site Observation Report (SOR)			
Report No.	C&A/SOR/05	Date	11.10.2019
Location	Dust Bin		

Observation Images

Description

Different type waste collection bins are kept for the collection of waste.

Potential Sustainability Measures

This helps in reducing the segregation of waste at source.

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Site Observation Report (SOR)			
Report No.	C&A/SOR/06	Date	11.10.2019
Location	Dust Bin		

Observation Images

Description

Centralized dust bins are provided for the collection of whole campus waste.

Potential Sustainability Measures

Except degradable waste all waste is sent to municipal landfilling. It is recommended to send the waste to Recyclers to reduce landfill dump

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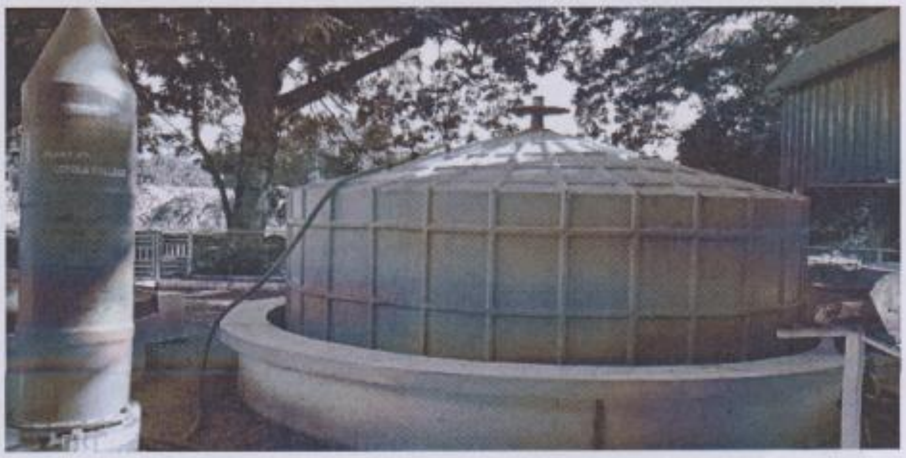
Site Observation Report (SOR)			
Report No.	C&A/SOR/07	Date	11.10.2019
Location	Bio gas		

Observation Images



Description

Biogas for the wet waste generated in the kitchen & mess

Potential Sustainability Measures

This helps to conversion of waste to energy for the kitchen

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Site Observation Report (SOR)			
Report No.	C&A/SOR/08	Date	11.10.2019
Location	Landscape		

Observation Images

Description

In maximum area landscape is done by grass, it requires high water consumption.

Potential Sustainability Measures

This grass shall be replaced with Druva grass and other native species of xeriscape plants

11 PERFORMANCE IMPROVEMENT MEASURES (PIM'S)

PIM 1: Install Solar PV in roof top to reduce overall power consumption

Annual Energy Savings	657, 000 kWh/annum
Recurring Annual Savings Potential	Rs 53.9 Lakhs
One-time Cost of Implementation	Rs 200.0 Lakhs
Payback period	45 Months

Present System:

Presently TNEB power supply is catering to whole building facility, this leads the power consumption.

Proposed System:

To avoid the TNEB power consumption, this can be avoided by installing Solar PV on Roof Top

Description	Value	Units	Formula
Area of the roof required for PV	40000	Sq.ft	A
Area required for 1 kW PV	100	sq.ft	B
Potential of PV panels in room	400	kW	C
Average Units generation per kW panel	1,800.0	kWh/day	E = C X4.5kWh
Annual Energy Generation	657,000	kWh	F = EX365
Unit power cost	8.2	Rs/kWh	G
Annual Cost Savings	53.9	Rs Lakhs	H
One time implementation	200	Rs lakhs	I
Payback	45	Months	J=I/HX12

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PIM 2: Water saving through the efficient water faucets

Annual Water Savings	12, 264 KL/annum
Recurring Annual Savings Potential	Rs. 1.1 Lakhs
One-time Cost of Implementation	Rs.2.0 Lakhs
Payback period	22 Months

Present System:

Presently average water flow in the faucets is 8 LPM it is high compared to the LEED Standards. This leads to lot of water consumption.

Proposed System:

It is recommended to install low flow aerator based faucets to maintain 2 LPM as per the standards in common/lavatory rooms. This saves huge of water consumption.

Description	Value	Units	Formula
Average measured flow	8	LPM	A
Average usage per day	60	min/day	B
No of taps	100	Nos.	C
Annual water consumption	175,200	KL/yr	D =(AxBxCx365)/1000
Water consumption cost	9	Rs/KL	E
Present Water Consumption cost	1,576,800	Rs/Yr	F=ExD
After installing aerators 70% water reduction	2.4	LPM	G
Annual water Savings	12,264	KL/yr	H =((A-G)xBxCx365))/1000
Annual Saving, Rs	1.1	Lakhs	I=HxE
Investment, Rs	2.0	Lakhs	J
Payback period	22	Months	K=J/Ix12

PIM 3: Convert Split Units to VRF unit to improves efficiency & power consumption reduction

Annual Energy Savings	27000 kWh/annum
Recurring Annual Savings Potential	Rs. 2.2 Lacs
One-time Cost of Implementation	Rs. 10.0 Lacs
Payback period	54 months

Present System

During our survey in plant premises split units are installed in MCA Labs and office areas. In this area split units were of non 5 star rated units. This AC unit consumes more energy compared to 5star rated.

Proposed System

It is recommended to replace these inefficient split units with VRF system to reduce the power consumption and increase the equipment life. This will reduce the power consumption 20 to 40% compared to individual split units.

Description	Value	Units	Formula
Power Consumption of Split units	23	kW	A
Decrease in power consumption after installing VRF system	40	%	B
Average power consumption after installing VRF	13.50	kW	C=A-(AxB%)
Annual saving hours considered	3,000.0	hrs/yr	D
Estimated annual energy savings	27,000	kWh	E=(A-C)xD
Unit power cost	8.20	Rs/kWh	F
Recurring annual savings	2.2	Lakhs	G=E x F
One-time cost of implementation	10	Lakhs	H
Payback	54	months	I=H/G x12

PIM 4: Exterior halogen lamps to be changed with appropriate LED lamps to reduce power consumption

Annual Energy Savings	8400 kWh/annum
Recurring Annual Savings Potential	Rs. 0.7 Lacs
One-time Cost of Implementation	Rs. 2.3 Lacs
Payback period	39 months

Present System

During the survey, it is observed that production exterior lights are 1000W halogen lamps are installed with electronic/electromagnetic ballast. These lamps are outdated and power consumption is higher with low lumens output.

Proposed System

It is recommended to replace 500W LED lamps. It gives more lumens and reduces power consumption.

Description	Value	Units	Formula
Total power consumption in Exterior Lighting	5	kW	A
Present Annual Operating Hours	4,200	hrs	B
Present Annual Energy Consumption	21,000	kWh	C=AxB
Proposed Power consumption after installing LED lamps (considering 40% reduction)	3	kW	D = (A-(A*40%))
Proposed Energy Consumption	12,600	kWh	E=DxB
Proposed Energy savings in Units	8,400	kWh	F=C-D
Power cost	8.20	Rs/kWh	H
Annual Power cost savings	0.7	Rs	I =GXH
One-time cost of implementation	2.3	Rs	J
Payback period	39	Months	K=J/I x12

PIM 5: Measurement & Verification (M&V) as per IPMVP

Annual Energy Savings	58,569 kWh/annum
Recurring Annual Savings Potential	Tk. 4.1 Lakhs
One-time Cost of Implementation	Tk. 15 Lakhs
Payback period	44 Months

Present System:

Presently there is no M&V in place; it is difficult to monitor the energy consumption & energy wastage in the facility.

Proposed System:

It is recommended to have a proper M&V as detailed explained in the section Measurement & Verification. There are 24 energy meters to be installed and monitored online through open platform. This online M&V will reduce the overall energy consumption.

Description	Value	Units	Formula
Annual Energy Consumption	2219530	kWh/yr	A
Proposed M&V energy saving	10	%	B
Annual Energy Savings	221953	kWh/yr	C =BX10%
Unit power cost	8.2	Rs/kWh	D
Annual Cost Savings	18.2	Rs Lakhs	E
One time implementation cost	20	Rs lakhs	F
Payback	13	Months	G=F/EX12

10 Good Practices at Loyola Campus

During Conserve's Audit, it is observed that M/s Loyola College has already adopted the following Performance Improvement Measures in its facility;

1.1 LED lamps in Building facility

In guest rooms, utility area, common areas are installed with LED lamps and the lux level is maintained. This Energy Conservation Measure gives savings in lighting energy consumption.

1.2 Solar PV System

Solar PV is installed in the roof top of 35kW is a good replacement of Energy. It reduces the EB energy consumption.

1.3 Bio gas

Biogas is a good example of waste to Energy. It reduces the LPG consumption in the kitchen.

1.4 Composting

Biogas waste and landscape waste are converted to composting, it is a good example of waste to Energy. It enriches nutrients to the fertilizer.

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