

**M/s Lala Lajpat Rai College of Commerce and Economics
Lala Lajpatrai Marg, Haji Ali Government Colony
Mahalakshmi Mumbai 400034**

Dear Sirs,

Sub: **Green Audit**

As per the requirement, we carried out the 'Green Audit' (Environmental Audit) at Lala Lajpat Rai College of Commerce and Economics, Mahalakshmi from 11th June 2019 to 12th June 2019.

Following work were completed during the course.

1. Illumination measurements.
2. CO2 and VOC measurements.
3. Measurements for performance of AC's.
4. Power measurements of electrical equipment's.
5. Analysis of electricity bill and water bill.
6. General audit.

Collected Data will be analysed, and detailed report will be submitted within 20 days.

Thanking you and assuring you of our best services all the time.

Yours faithfully,
For **SENERGY CONSULTANTS PVT LTD**



Tushar Kamble
(Project coordinator)




Principal
Lala Lajpat Rai College
of Commerce & Economics
Lala Lajpat Rai Marg,
Mumbai - 400 034.

Helping you to Conserve Resources

Report

On

GREEN AUDIT

For

**Lala Lajpat Rai College of Commerce and Economics,
Mahalaxmi,
Mumbai**

Prepared

By

**Senergy Consultants Pvt Ltd
Mumbai**




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June 2019

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5 Introduction

Green Audit was undertaken at Lala Lajpat Rai College, Mahalaxmi, Mumbai, during the month of June 2019.

The organization is very keen to promote green culture wherever possible, as a commitment towards better environment and conservation of energy. To further optimize consumption and identify saving opportunities, M/s Senergy Consultant Private Limited was assigned to carry out Green Audit of the premises.

This 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.

Team:

The team members of the audit study.

- Mr. Ravindra Datar
- Mr. Umesh Phatakare
- Mr. Chirag Patel
- Mr. Swapnil Jadhav

Instruments:

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

1. Power Analyzer
2. Hygro-temp meter
3. Vane Type Anemometer
4. Hot Wire Anemometer
5. Lux meter
6. Environmental meter
7. Measuring Tape

Acknowledgment:

We would like to express our gratitude towards Prof. Kranti Ukey and Dr. Neelam Arora for given us the opportunity for conducting the study and the support provided during the study.

We are also thankful to the entire team for extending the necessary help and co-operation from their side.




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II

Executive Summary

The premises were evaluated against the various criteria laid down by the National Assessment and Accreditation Council (NAAC). The major observations are

1. Lighting & Ventilation
 - a. Energy efficient light fittings has not been installed at all the places.
 - b. Illumination level is within the norm, but for the few places where it is marginally lower than the standard level.
 - c. The ventilation is adequate, and the carbon dioxide as well as the Volatile Organic Matter contents are within a limit for all the classrooms and other premises.
 - d. The possibility of replacing the fans with high efficiency fans may be ascertained; especially while making new purchases.
 - e. The fans & lights are switched off when not in use.
2. Water Quality & Conservation
 - a. The water supplied by the Municipal Corporation is used for drinking after purification
 - b. Water Purifier is provided at convenient locations.
3. Waste Management
 - a. The generation of waste is minimized through use of electronic communication and effective water management system.
 - b. The wastewater is disposed of through Municipal system; this is a common practice in Mumbai city area.
 - c. The solid waste is segregated; while organic waste is converted in to manure in a composting pit, the non-organic waste is disposed of through the Municipal system.
4. Infrastructure usage
 - a. Movement on-campus is distributed with multiple entrances.
 - b. The adequate parking space is available and provisions for bike parking are made for staff and students. However, many prefer public transport due proximity to bus stops / station.
 - c. There are adequate fire extinguishers located in key areas.
 - d. The draining system for washrooms is efficient and effective.
 - e. Seepages were not observed in the building premises.
5. Green IT culture
 - a. Energy efficient computers and monitors have been procured.
 - b. In most of the cases, the computers are switched off, when not in use.
 - c. Energy efficient air conditioners with higher star rating have been procured during recent purchases.
 - d. The air conditioners are switched off, when not in use.
 - e. The performance of the air conditioners was observed to satisfactory.
 - f. Electronic communication is encouraged to minimize usage of papers.
 - g. Most of the papers are reused for doubled sided printing.

6. Renewable Energy



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- a. Roof-top Solar Panels are not installed.

Potential Saving Area:

- The saving can be achieved by maintaining unity power factor for Meter No- P151085.
- The savings can be achieved by replacing tube-lights with LED lights.



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Electrical System & Bill

Electricity Bill

The electricity for the entire premises is supplied by Adani Power and Reliance Energy low tension (LT) connection. The details of energy consumption with costs are as under.

Consumer Name - Lala Lajpat Rai College, Mahalaxmi							
Consumer No. - 202-028-575*5							
Category - LT II B	Contract Demand- 25.6 KVA						
Meter No.- P151085	Cycle No.- 24						
Description	Unit	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18
Consumption	KWH	881	777	855	930	912	984
Maximum Demand	KVA	4	3	3	3	4	4
Billed Demand	kVA	10.24	10.24	10.24	10.24	10.24	10.24
Power Factor (PF)		0.923	0.916	0.890	0.899	0.904	0.923
PF Penalty/Incentives	Rs	0	0	192	0	0	0
Bill Amount	Rs	12700	11530	11870	11640	12880	13010
Cost	Rs/KWH	14.4	14.8	13.9	12.5	14.1	13.2

Consumer Name - Lala Lajpat Rai College, Mahalaxmi								
Consumer No. - 202-028-575*5								
Category - LT II B	Contract Demand- 25.6 KVA							
Meter No.- P151085	Cycle No.- 24							
Description	Unit	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	Average
Consumption	KWH	1038	817	853	937	902	913	899.92
Maximum Demand	KVA	6	4	4	4	4	4	
Billed Demand	kVA	10.24	10.24	10.24	10.24	10.24	10.24	
Power Factor (PF)		0.91	0.873	0.875	0.881	0.888	0.903	0.90
PF Penalty/Incentives	Rs	0	185.41	137	144	96	0	
Bill Amount	Rs	13370	11430	22030	11960	6500	12430	12612.50
Cost	Rs/KWH	12.9	14.0	25.8	12.8	7.2	13.6	14.0

Consumer Name - Lala Lajpat Rai College, Mahalaxmi							
Consumer No. - 685-308-001*0							
Category - LT IX BT	Meter No.- N126599						
Description	Unit	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18
Consumption	KWH	226	182	191	100	125	174
Bill Amount	Rs	3000	2470	2420	1350	1800	2250
Cost	Rs/KWH	13.3	13.6	12.7	13.5	14.4	12.9



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Consumer Name - Lala Lajpat Rai College, Mahalaxmi								
Consumer No. - 685-308-001*0								
Category - LT IX BT	Meter No.- N126599							
Description	Unit	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	Average
Consumption	KWH	314	323	298	323	270	266	232.67
Energy Charges	Rs	1978	2035	1877	2035	1701	1671	
Demand Charges	Rs	330	330	330	330	330	330	
Bill Amount	Rs	3670	3770	7010	10620	2350	3230	3661.67
Cost	Rs/KWH	11.7	11.7	23.5	32.9	8.7	12.1	15.7

Consumer Name - Lala Lajpat Rai College, Mahalaxmi							
Consumer No. - 202-002-443*1							
Category - LT II C	Contract Demand- 356.25 kVA						
Meter No.- T111482	Cycle No.- 24						
Description	Unit	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Sep-18
Consumption	KWH	29640	32640	24480	23280	28920	31560
Maximum Demand	KVA	176	191	138	127	161	175
Billed Demand	kVA	142.5	142.5	142.5	142.5	142.5	142.5
Power Factor (PF)		0.997	0.998	0.996	0.996	0.999	1.000
PF Penalty/Incentives	Rs	-23814	-24945	-19294	-17245	-19296	-23787
Bill Amount	Rs	394960	414090	320110	286450	321200	394970
Cost	Rs/KWH	13.3	12.7	13.1	12.3	11.1	12.5

Consumer Name - Lala Lajpat Rai College, Mahalaxmi								
Consumer No. - 202-002-443*1								
Category - LT II C	Contract Demand- 356.2500 kVA							
Meter No.- T111482	Cycle No.- 24							
Description	Unit	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Average
Consumption	KWH	34440	45120	26160	19800	18600	20160	27900.00
Maximum Demand	KVA	185	219	180	165	116	128	
Billed Demand	kVA	142.5	142.5	142.5	142.5	142.5	142.5	
Power Factor (PF)		0.999	1.000	1.000	0.997	0.999	0.999	1.00
PF Penalty/Incentives	Rs	-24365	-14513	-9028	-6792	-6360	-7003	
Energy Charges	Rs	246246	264854	153559	116226	109182	118339	187364.40
Description	Unit	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Average
Demand Charges	Rs	35625	39189	39188	39188	39188	39188	36990.76
Bill Amount	Rs	410010	498070	309360	197270	217910	211060	331288.33
Cost	Rs/KWH	11.9	11.0	11.8	10.0	11.7	10.5	11.9



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Consumer Name - Lala Lajpat Rai College, Mahalaxmi							
Consumer No. - 202-028-593*7							
Category - LT IX BT	Contract Demand- 43.75kVA						
Meter No.- P151697	Cycle No.- 24						
Description	Unit	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18
Consumption	KWH	5202	5381	4371	4049	5107	4921
Maximum Demand	KVA	29	33	28	18	26	23
Power Factor (PF)		0.870	0.870	0.872	0.825	0.886	0.911
PF Penalty/Incentives	Rs	2015	2075	1567	3011	969	0
Energy Charges	Rs	37194	38474	31253	28950	36515	35185
Demand Charges	Rs	300	300	300	300	300	300
Bill Amount	Rs	63450	65380	49250	43870	60330	54000
Cost	Rs/KWH	12.2	12.2	11.3	10.8	11.8	11.0

Consumer Name - Lala Lajpat Rai College, Mahalaxmi								
Consumer No. - 202-028-593*7								
Category - LT IX BT	Contract Demand- 43.75 kVA							
Meter No.- P151697	Cycle No.- 24							
Description	Unit	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	Average
Consumption	KWH	5884	3838	6430	4387	5192	5223	4998.75
Maximum Demand	KVA	36	27	29	22	28	27	
Power Factor (PF)		0.912	0.848	0.959	0.864	0.941	0.885	0.89
PF Penalty/Incentives	Rs	0	997	-265	884	0	457	
Energy Charges	Rs	37069	24179	40509	27638	32710	32905	
Demand Charges	Rs	330	330	330	330	330	330	
Bill Amount	Rs	62040	41380	101900	44510	49020	56950	57673.33
Cost	Rs/KWH	10.5	10.8	15.8	10.1	9.4	10.9	11.5

Consumer Name - Lala Lajpat Rai College, Mahalaxmi							
Consumer No. - 202-010-173*5							
Category - LT II C	Contract Demand- 110.00 kVA						
Meter No.- T160629	Cycle No.- 24						
Description	Unit	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18
Consumption	KWH	3660	4800	2220	60	3960	4500
Maximum Demand	KVA	94	96	94	1	93	151
Billed Demand	kVA	61.07	62.47	60.95	44	60.25	152.04
Power Factor (PF)		0.880	0.881	0.890	0.447	0.872	0.741
PF Penalty/Incentives	Rs	1564	1893	715	5285	2145	13436
Penalty Demand	Rs	0	0	0	0	0	15765
Energy Charges	Rs	26169	34320	15873	429	28314	32175
Demand Charges	Rs	15269	15620	15239	11000	15064	38010
Bill Amount	Rs	64730	78620	43590	18670	67790	125130
Cost	Rs/KWH	17.7	16.4	19.6	311.2	17.1	27.8



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Consumer Name - Lala Lajpat Rai College, Mahalaxmi								
Consumer No. - 202-010-173*5								
Category - LT II C	Contract Demand- 110KVA							
Meter No.- T160629	Cycle No.- 24							
Description	Unit	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	Average
Consumption	KWH	5520	420	6480	2400	4440	3660	3510.00
Maximum Demand	KVA	148	120	92	96	150	107	
Billed Demand	kVA	147.66	120.48	60.06	62.32	150.06	69.81	
Power Factor (PF)		0.735	0.759	0.720	0.725	0.736	0.731	0.76
PF Penalty/Incentives	Rs	7834	2752	6535	3216	6602	4536	
Penalty Demand	Rs	15535	4323	0	0	16525	0	
Energy Charges	Rs	32402	2465	38038	14088	26063	21484	
Demand Charges	Rs	40607	33132	16517	17139	41267	19198	
Bill Amount	Rs	128990	50450	134160	46410	112760	65790	78090.83
Cost	Rs/KWH	23.4	120.1	20.7	19.3	25.4	18.0	22.2

Contract Demand:

The billed demand of Meter No-P151085, meter no-T111482, Meter No-P151697 is within the contract demand of 25.6 kVA, 356.250 kVA and 43.75 kVA respectively. Billed Demand for Meter No- N126600 and Meter No- N126599 is not monitored. Therefore, no penalty demand has been levied. For Meter No- T160629, billed demand in few months is higher than contract demand which resulted in Penalty charges.

Power Factor:

The power factor was observed to be around unity for meter no-T111482. Power Factor is not monitored for meter no-N126600, N126599 and meter no-7665757 for most of the period.

Power Factor for Meter No- P151697 is 0.89. The saving for the respective meter can be achieved by maintaining power factor at unity.

The details of saving by maintaining power factor at unity is as under,

Description	Unit	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18
Meter No.- P151697							
Power Factor		0.870	0.870	0.872	0.825	0.886	0.911
Power Factor Incentive	Rs	0	0	0	0	0	0
Power Factor Penalty	Rs	2015	2075	1567	3011	969	0
PF Incentive/Penalty % as per BEST	%	4	4	4	8	2	0
PF saving	%	9	9	9	13	5	3.5
	Rs	4533	4668	3525	4892	2423	0



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Description	Unit	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19
Meter No.- P151697							
Power Factor		0.912	0.848	0.959	0.864	0.941	0.885
Power Factor Incentive	Rs	0	0	265	0	0	0
Power Factor Penalty	Rs	0	997	0	884	0	457
PF Incentive/Penalty % as per BEST	%	0	3	0.5	2.5	0	1
PF saving	%	3.5	6.5	3	6	3.5	4.5
	Rs	0	2160	1590	2122	0	2055

The expected saving shall be around Rs 27969/-per year.

The incentive is paid on the entire current bill amount including charges for energy, maximum demand, fuel adjustment charges (FAC) and reliability charges but excluding taxes and duties.



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Light fittings:

Location	Operation		LED 36W		LED 22W		LED 25W		Tube-light 40W	
	Hr/D	D/M	F	W	F	W	F	W	F	W
Ground Floor										
Stationery Room	6	25	0	0	0	0	0	0	2	2
Canteen Worker Room	16	30	0	0	0	0	0	0	2	1
Auditorium Foyer	4	25	0	0	48	48	0	0	0	0
First Floor										
Auditorium	3	15	0	0	0	0	0	0	35	35
Auditorium Changing Room	4	15	0	0	0	0	0	0	2	2
Second Floor										
Library	6	25	0	0	0	0	0	0	21	19
Stack Room	6	25	0	0	0	0	0	0	28	28
Librarian Room	6	25	0	0	0	0	0	0	2	2
Room No 205	6	25	0	0	0	0	0	0	10	7
Room No 206	6	25	0	0	0	0	0	0	12	6
Room No 207	6	25	0	0	0	0	0	0	9	6
Office	6	25	0	0	8	0	0	0	8	4
Trustee Room	6	25	0	0	4	4	0	0	0	0
Principal Room	6	25	4	4	6	6	0	0	0	0
Account Section	6	25	5	5	0	0	0	0	0	0
Corridor	6	25	0	0	0	0	0	0	8	6
Third Floor										
Room No 301 Computer Lab	6	25	0	0	0	0	0	0	6	6
Room No 301 Student Council	6	25	0	0	2	2	0	0	1	1
Room No 301 Placement Rotaract	6	25	0	0	2	2	0	0	1	1
Room No 301 Law Principal Office	6	25	2	2	0	0	0	0	1	1
Room No 301 Law Office	6	25	0	0	2	2	0	0	0	0
Room No 303	6	25	0	0	0	0	0	0	6	5
Room No 304	6	25	0	0	0	0	0	0	6	4
Room No 305	6	25	0	0	0	0	0	0	7	6
Room No 306	6	25	0	0	0	0	0	0	6	6
Room No 307	6	25	0	0	0	0	0	0	3	3
Room No 308	6	25	0	0	0	0	0	0	6	6
Corridor	6	25	0	0	0	0	0	0	8	7



Handwritten Signature
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Location	Operation		LED 36W		LED 22W		LED 25W		Tube-light 40W	
	Hr/D	D/M	F	W	F	W	F	W	F	W
Fourth Floor										
Room No 401	6	25	0	0	0	0	0	0	7	7
Room No 402	6	25	0	0	4	4	0	0	6	6
Room No 403	6	25	0	0	2	2	0	0	7	5
Room No 404 Staff Room	6	25	0	0	0	0	0	0	8	8
Room No 404 HOD Room	6	25	0	0	0	0	0	0	1	1
Room No 404 Exam Room	6	25	0	0	0	0	0	0	3	3
Room No 405	6	25	0	0	0	0	0	0	6	6
Room No 406	6	25	0	0	0	0	0	0	6	4
Room No 407	6	25	0	0	0	0	0	0	3	3
Room No 408	6	25	0	0	0	0	0	0	9	6
Room No 409 HOD PG	6	25	0	0	2	2	0	0	1	1
Room No 409 Classroom	6	25	0	0	0	0	0	0	8	7
Corridor	6	25	0	0	0	0	0	0	8	6
Fifth Floor										
Room No 500	6	25	0	0	0	0	0	0	3	3
Room No 501	6	25	0	0	0	0	0	0	6	6
Room No 502	6	25	0	0	0	0	0	0	6	5
Room No 504	6	25	0	0	0	0	0	0	7	6
Room No 505	6	25	0	0	0	0	0	0	3	3
Room No 507	6	25	0	0	0	0	0	0	6	6
Room No 508	6	25	0	0	0	0	0	0	6	4
Room No 509	6	25	0	0	0	0	0	0	6	5
Room No 510	6	25	0	0	0	0	0	0	6	6
Room No 511	6	25	0	0	0	0	0	0	6	5
Corridor	6	25	0	0	0	0	0	0	8	7
Total			11	11	80	72	0	0	326	283

F: fitted

W: Working

Number of places have been found where tube-lights are installed. It is recommended to replace the tube-lights with LED lamps for better savings in terms of cost and energy.



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LED Lamps:

The saving details are as under,

Description	Unit	TL
		40 W EB
Number of lamps	No	283
Rating of the lamp	Watt	40
Rating of the switchgear	Watt	5
Power consumption of the lamp	Watt	45
Alternative Lamp: LED Lamp		
Rating of the lamp	Watt	18
Rating of the switchgear	Watt	2
Power consumption of the lamp	Watt	20
Saving Potential		
Cost of power	Rs/kWh	10.00
Operating Period	Hr/Day	5
	Day/Year	250
Energy Saving	kW	7.1
	MWh/Year	8.8
	Rs/Year	88438
Economics		
Investment	Rs	113200
Payback period	Month	15.4

The saving potential shall be around 8.8 MWh/Year or Rs 88438/- per year.

The investment shall be around Rs 1,13,200/-.

The pay back period shall be around 15.4 months.



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Power Consumption:

The power consumption of some of the gadgets is as under.

Sr No	Description	Operation		Voltage	Current	Power	Power Factor
		Hr/Day	Day/Year	V	A	Kw	
Computers							
Computer Lab Fourth Floor							
1	PC-11	6	280	240.0	0.12	0.02	0.58
2	PC-17	6	280	242.2	0.13	0.02	0.62
3	PC-24	6	280	241.8	0.23	0.04	0.69
4	PC-06	6	280	240.5	0.25	0.05	0.70
5	PC-05	6	280	241.3	0.35	0.06	0.71
6	PC-14	6	280	242.1	0.22	0.04	0.69
7	PC-07	6	280	243.4	0.30	0.05	0.70
8	PC-13	6	280	241.7	0.32	0.05	0.68
Copying Machine							
9	Fourth Floor 407	6	280	231.7	2.14	0.36	0.74
Water Cooler							
10	Second Floor	8	280	239.8	0.29	0.48	0.67
11	Third Floor	8	280	232.8	0.28	0.44	0.68
12	Fifth Floor	8	280	230.7	0.29	0.46	0.67
Air Conditioners							
13	Room No-504	5	280	232.6	7.10	1.63	0.98
14	Room No-505	6	280	231.8	3.48	0.79	0.99
15	Room No-507	4	280	233.5	7.10	1.61	0.98
16	Room No-508	4	280	235.8	7.14	1.66	0.98
17	Room No-409 PG Classroom	5	280	230.1	8.14	1.77	0.95
18	Room No-409 PG HOD	6	280	230.8	4.51	1.03	0.97
19	Office Second Floor	6	280	236.5	5.80	1.57	0.98

Fan Fittings:

Location	Rating	Quantity	Operation	
	W	No	Hr/Day	Days/Year
Ground Floor				
Stationery Room	60	2	6	280
Canteen Worker Room	60	1	20	280
Auditorium Foyer	60	5	5	280
First Floor				
Auditorium	60	10	4	150
Auditorium Changing Room	60	2	6	280



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Location	Rating	Quantity	Operation	
	W	No	Hr/Day	Days/Year
Second Floor				
Library	60	13	6	280
Stack Room	60	14	6	280
Librarian Room	60	1	6	280
Room No 205	60	6	6	280
Room No 206	60	3	6	280
Room No 207	60	8	6	280
Office	60	3	6	280
Trustee Room	60	1	6	280
Principal Room	60	1	6	280
Account Section	60	2	6	280
Corridor	60	6	6	280
Third Floor				
Room No 301 Computer Lab	60	5	6	280
Room No 301 Student Council	60	1	6	280
Room No 301 Placement Rotaract	60	1	6	280
Room No 301 Law Principal Office	60	1	6	280
Room No 301 Law Office	60	1	6	280
Room No 303	60	9	6	280
Room No 304	60	8	6	280
Room No 305	60	6	6	280
Room No 306	60	6	6	280
Room No 307	60	7	6	280
Room No 308	60	5	6	280
Corridor	60	6	6	280
Fourth Floor				
Room No 401	60	9	6	280
Room No 402	60	6	6	280
Room No 403	60	6	6	280
Room No 404 Staff Room	60	5	6	280
Room No 404 HOD Room	60	1	6	280
Room No 404 Exam Room	60	2	6	280
Room No 405	60	9	6	280
Room No 406	60	7	6	280
Room No 407	60	3	6	280
Room No 408	60	4	6	280
Room No 409 HOD PG	60	1	6	280
Room No 409 Classroom	60	7	6	280
Corridor	60	6	6	280



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Location	Rating	Quantity	Operation	
	W	No	Hr/Day	Days/Year
Fifth Floor				
Room No 500	60	3	6	280
Room No 501	60	3	6	280
Room No 502	60	3	6	280
Room No 504	60	9	6	280
Room No 505	60	2	6	280
Room No 507	60	9	6	280
Room No 508	60	3	6	280
Room No 509	60	3	6	280
Room No 510	60	3	6	280
Room No 511	60	3	6	280
Corridor	60	6	6	280

Opportunity for Conservation of energy:

Energy Efficient Fans:

The possibility of replacing the fans with energy efficient new fans may be evaluated. These fans can save 50 to 60% energy while delivering similar air flows.

The expected saving works out to about Rs 700/- per year per fan.

The investment shall be in the range of Rs 3,500/- per fan; giving a payback period of 60.0 months

The installation of energy efficient fans may be considered for new purchases.



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IV

Energy Management & Efficiency

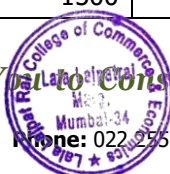
Illumination & Lighting

The illumination level was measured at various locations; the details are as under.


Location	Illumination Level (Lux)		
	Minimum	Maximum	Average
Ground Floor			
Stationery Room	30	320	176
Canteen Worker Room	6	130	70
Auditorium Foyer	250	500	378
First Floor			
Auditorium	10	200	112
Audi Changing Room	85	400	234
Second Floor			
Library	345	1250	772
Stack Room	70	200	130
Librarian Room	210	420	327
Room No 205	150	300	225
Room No 206	150	440	274
Room No 207	70	260	166
Office	160	404	273
Trustee Room	110	200	158
Principal Room	75	470	264
Account Section	150	260	220
Corridor	419	728	612
Third Floor			
Room No 301 Computer Lab	115	280	203
Room No 301 Student Council	800	1700	1292
Room No 301 Placement Rotaract	700	1500	1123
Room No 301 Law Principal Office	750	1800	1297
Room No 301 Law Office	250	360	321
Room No 303	150	830	501
Room No 304	300	1200	757
Room No 305	20	150	91
Room No 306	200	450	342
Room No 307	500	1700	1093
Room No 308	300	1500	840

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Location	Illumination Level (Lux)		
	Minimum	Maximum	Average
Fourth Floor			
Room No 401	100	1000	568
Room No 402	150	1100	550
Room No 403	100	1150	586
Room No 404 Staff Room	153	350	254
Room No 404 HOD Room	170	800	493
Room No 404 Exam Room	375	1400	908
Room No 405	200	1000	594
Room No 406	300	1300	846
Room No 407	200	1200	697
Room No 408	100	1100	556
Room No 409 HOD PG	170	250	213
Room No 409 Classroom	40	550	274
Corridor	404	750	615
Fifth Floor			
Room No 500	120	135	128
Room No 501	125	250	192
Room No 502	50	250	163
Room No 504	110	215	167
Room No 505	200	350	281
Room No 507	225	375	305
Room No 508	80	180	142
Room No 509	60	165	120
Room No 510	120	235	177
Room No 511	80	270	187
Corridor	389	690	542



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Observations:

- The illumination level is generally as per the norms; however, illumination level is low at some places.
- The lamps should be strategically located to optimize usage of day light.
- The use of daylight has been maximized through windows.
- The practice of switching off the lamps in the unoccupied areas has been followed.
- There is no major improvements/saving potential in this area.
- It is not economical to provide occupancy sensors for the class-rooms due to lesser light fitting and practice of switching off the lamps during the unoccupied area.

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Ventilation & Air Quality:

The air quality was checked by measuring carbon dioxide & VOC contents at various locations in the class rooms as well as administrative areas. The details are as under.

Location	Carbon Dioxide (PPM)			VOC		
	Minimum	Maximum	Average	Minimum	Maximum	Average
Ground Floor						
Stationery Room	955	970	963	259	270	265
Canteen Worker Room	910	930	920	230	250	240
Auditorium Foyer	860	880	870	220	240	230
First Floor						
Auditorium	895	920	908	240	255	248
Auditorium Changing Room	925	950	938	245	260	253
Second Floor						
Library	620	630	625	190	205	198
Stack Room	575	585	580	140	160	150
Librarian Room	500	515	508	128	136	132
Room No 205	590	603	597	154	168	161
Room No 206	585	600	593	152	163	158
Room No 207	435	455	445	125	128	127
Office	639	655	647	339	180	260
Trustee Room	525	540	533	135	150	143
Principal Room	443	460	452	116	130	123
Account Section	600	620	610	155	170	163
Corridor	675	700	688	270	285	278
Third Floor						
Room No 301 Computer Lab	450	460	455	125	130	128
Room No 301 Student Council	450	470	460	125	135	130
Room No 301 Placement Rotaract	450	465	458	125	140	133
Room No 301 Law Principal Office	465	480	473	122	125	124
Room No 301 Law Office	622	638	630	162	177	170
Room No 303	439	456	448	125	127	126
Room No 304	449	450	450	124	125	125
Room No 305	1129	1150	1140	310	322	316
Room No 306	588	603	596	132	150	141
Room No 307	501	515	508	133	142	138
Room No 308	429	450	440	112	125	119
Corridor	709	723	716	262	278	270



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Location	Carbon Dioxide (PPM)			VOC		
	Minimum	Maximum	Average	Minimum	Maximum	Average
Fourth Floor						
Room No 401	619	629	624	155	175	165
Room No 402	692	710	701	179	197	188
Room No 403	643	660	652	168	182	175
Room No 404 Staff Room	750	768	759	200	213	207
Room No 404 HOD Room	514	530	522	134	148	141
Room No 404 Exam Room	677	696	687	185	193	189
Room No 405	659	674	667	171	187	179
Room No 406	567	582	575	147	162	155
Room No 407	628	643	636	163	179	171
Room No 408	440	452	446	122	129	126
Room No 409 HOD PG	531	543	537	138	151	145
Room No 409 Classroom	723	742	733	189	206	198
Corridor	800	819	810	311	320	316
Fifth Floor						
Room No 500	592	611	602	155	169	162
Room No 501	583	600	592	152	160	156
Room No 502	560	576	568	145	160	153
Room No 504	721	736	729	193	206	200
Room No 505	921	945	933	302	317	310
Room No 507	652	667	660	302	315	309
Room No 508	721	738	730	192	204	198
Room No 509	523	540	532	126	145	136
Room No 510	539	559	549	157	175	166
Room No 511	588	603	596	153	168	161
Corridor	910	930	920	266	290	278

Observations:

- The carbon dioxide and VOC level is within the limit at most of the places. The standard norm is to maintain the carbon dioxide level below 1000 ppm & VOC level below 400 ppb.



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V

Water Management

Consumption Pattern:

The water supplied by the municipal corporation is used for drinking & other applications like toilets, washing of utensils and other requirements. The incoming water from the municipal corporation is metered.

The consumption pattern was analyzed by the water bills. The details are as under.

Connection No- GS@9300003				
Period	Days	Consumption	Bill Amount	Cost
		KL	Rs	Rs/KL
04/01/18 to 02/04/18	88	3802	31736.00	8.35
02/04/18 to 02/07/18	91	3585	31398.00	8.76
02/07/18 to 01/10/18	91	3359	30270.00	9.01
01/10/18 to 01/01/19	92	3396	29386.00	8.65

Connection No- GS@0002726				
Period	Days	Consumption	Bill Amount	Cost
		KL	Rs	Rs/KL
04/01/18 to 02/04/18	88	83	6936.00	83.57
02/04/18 to 02/07/18	91	88	7847.00	89.17
02/07/18 to 01/10/18	91	98	8963.00	91.46
01/10/18 to 01/01/19	92	99	8582.00	86.69

Connection No- GS@0002740				
Period	Days	Consumption	Bill Amount	Cost
		KL	Rs	Rs/KL
04/01/18 to 02/04/18	88	1251	NA	NA
02/04/18 to 02/07/18	91	1294	NA	NA
02/07/18 to 01/10/18	91	1294	51438.00	39.75
01/10/18 to 01/01/19	92	1308	42883.00	32.79

Connection No- GS@0002738				
Period	Days	Consumption	Bill Amount	Cost
		KL	Rs	Rs/KL
04/01/18 to 02/04/18	88	260	7610.00	29.27
02/04/18 to 02/07/18	91	613	20050.00	32.71
02/07/18 to 01/10/18	91	829	27234.00	32.85
01/10/18 to 01/01/19	92	838	26615.00	31.76



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Specific Water Consumption:

The specific water consumption details are as under.

Period	Days	Consumption	Total No. Of Person	Water Consumption
		KL		L/Person/Day
04/01/18 to 02/04/18	88	5396	1430	42.88
02/04/18 to 02/07/18	91	5580	1430	42.88
02/07/18 to 01/10/18	91	5580	1430	42.88
01/10/18 to 01/01/19	92	5641	1430	42.88

There are around 1393 students and 37 teaching & non-teaching staff and other Visitor members.

The specific water consumption is higher than nominal range against the typical values of 6 to 8 Liters per person.

The possibility of providing low flow taps/flushing system at major locations may also be evaluated.

Water Purifiers:

The water purifiers are installed within the premises floor wise and bottled water is not used in the campus. As such quality of municipal water is quite satisfactory.

Rain Water Harvesting:

The rainwater harvesting is been practiced in the premises.



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2 Waste Generation & Management

Sewage & Waste Water:

The sewage is fed in to the municipal drainage. This is a common practice and the municipal corporation which charges less towards the sewage charges.

Solid Waste:

The organic, as well as inorganic waste, is segregated in the college premises. The organic waste is used to generate manure by composting. The non-organic waste is collected in garbage bins and disposed of through Municipal system.

E-Waste:

Electronic waste donation is been implemented for E-waste Management Organization.




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26 Infrastructure & Safety

Movement on-campus (Distributed / non-distributed leading to crowds)

The premises are provided with multiple entrances to ensure quick and effective movement in normal as well as emergency conditions.

Parking space:

The adequate parking space is available and provisions for bike parking are made for staff and student. However, many prefer public transport due proximity to bus stops / station.

Fire-fighting & fire escape system:

The fire extinguishers have been installed at various places in the premises & Laboratories; which are checked/refilled as per the stipulated frequency.

The premise is provided with requisite entrances to ensure quick and effective movement in emergency conditions.

Draining system:

The drains from the washrooms are connected to the municipal drainage; which is a common practice in the colleges in Maharashtra.

The municipal corporation charges cess for water disposal.

Seepage in the building:

The premise was visually inspected for seepages.

Seepages were not observed in the building premises.



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VIII Air Conditioners

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 $24 \pm 2^\circ\text{C}$ and at relative humidity (RH) of $60 \pm 5\%$.

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 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 are placed in an indoor unit located inside the premises.

Performance:

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 the flow rate and subsequently mass flow rate.
- Temperature and relative humidity of the air at the inlet of the evaporator coil to determine the enthalpy of the air.
- Temperature and relative humidity of the air at the outlet of the evaporator coil to determine the enthalpy of the air.
- Power drawn by the air conditioning unit

The chilling effect can be computed as under,

Flow Rate of Air (kg/hr)
= Average Air velocity (M/s) x Cross sectional area of the air flow (M²) x Specific Gravity of Air

Chilling or Air Conditioning Effect (TR)
= Air flow rate (kg/hr) x Enthalpy difference between the air at inlet & outlet of the evaporator coil (kJ/kg) / (4.18 x 3024)

Chilling or Air Conditioning Effect (kW)
= Air flow rate (kg/hr) x Enthalpy difference between the air at inlet & outlet of the evaporator coil (kJ/kg) / 3600
= 3.5112 x Chilling Effect (TR)

Specific Power Consumption (kWh/TR) =
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)



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The performance of a few of the randomly selected air conditioning units (of different make, capacity and age) were carried out as described above.

Description	Unit	Room No. 504	Room No. 505	Room No. 507	Room No. 508
Design Data					
Make		Voltas	Voltas	Voltas	Voltas
Star Rating		3	2	3	3
Rating - AC (Capacity)	TR	1.37	0.73	1.37	1.37
Energy Efficiency Ratio		2.91	2.75	2.91	2.91
Power	kW	1.64	0.80	1.64	1.64
kW/TR		1.20	1.10	1.20	1.20
Operating parameters					
Operating period	Hr/D	6	6	6	6
	D/M	25	25	25	25
Velocity	M/s	3.6	2.6	3.8	4
Area	M ²	0.04	0.02	0.04	0.04
Air flow	M ³ /Sec	0.145	0.049	0.153	0.161
	M ³ /hr	522	178	551	580
Supply air - Temperature	°C	17	9.6	16	18.5
Supply air - RH	%	92.5	86.6	87.8	89.5
Return air - Temperature	°C	27.9	27.4	27.7	28.6
Return air - RH	%	73.1	63.1	66.3	70.5
Total Power Consumption	kW	1.63	0.79	1.61	1.66
Supply Enthalpy	kJ/kg	45.5	25.8	42.4	48.8
Return Enthalpy	kJ/kg	72.3	64.5	67.4	73.2
Operating Status					
Cooling Effect	TR	1.35	0.68	1.33	1.36
Total Cooling Effect	TR	1.35	0.68	1.33	1.36
Specific Power	kWh/TR	1.21	1.16	1.21	1.22
Energy Efficiency Ratio		2.90	3.02	2.91	2.87
Desired parameters					
Cooling Effect	TR	1.35	0.68	1.33	1.36
Specific Power	kWh/TR	1.21	1.16	1.21	1.20
Energy Efficiency Ratio		2.90	3.02	2.91	2.93
Input Power	kW	1.63	0.79	1.61	1.63
Variation	%	0.00%	0.00%	0.00%	1.93%
Hall Temperature					
Maximum	°C	24.3	25	25	24.6
Minimum	°C	22	22.6	22.4	22.1
Average	°C	23.2	23.8	23.7	23.4
Variation - Room	%	10%	10%	11%	11%
Variation - Norm	°C	0.7	0.0	0.0	0.0
	%	3%	0%	0%	0%

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Description	Unit	Room No. 409 PG Classroom	Room No. 409 PG HOD	Office 2nd Floor
Design Data				
Make		O general	Panasonic	Voltas
Star Rating		NA	3	3
Rating - AC (Capacity)	TR	NA	0.74	1.37
Energy Efficiency Ratio		NA	3.02	2.91
Power	kW	NA	0.86	1.64
kW/TR			1.16	1.20
Operating parameters				
Operating period	Hr/D	4	6	6
	D/M	25	25	25
Velocity	M/s	5.2	2.9	4.1
Area	M ²	0.04	0.04	0.04
Air flow	M ³ /Sec	0.226	0.124	0.165
	M ³ /hr	812	446	595
Supply air - Temperature	°C	18.5	17.2	14.6
Supply air - RH	%	88	90.3	88.8
Return air - Temperature	°C	29	25.5	27.7
Return air - RH	%	66.6	70.5	56.4
Total Power Consumption	kW	1.77	1.03	1.42
Supply Enthalpy	kJ/kg	48.3	45.3	37.9
Return Enthalpy	kJ/kg	72.1	62.5	61.4
Operating Status				
Cooling Effect	TR	1.85	0.74	1.36
Total Cooling Effect	TR	1.85	0.74	1.36
Specific Power	kWh/TR	0.96	1.40	1.05
Energy Efficiency Ratio		3.68	2.52	3.36
Desired parameters				
Cooling Effect	TR	1.85	0.74	1.36
Specific Power	kWh/TR	1.20	1.20	1.20
Energy Efficiency Ratio		2.93	2.93	2.93
Input Power	kW	2.22	0.89	1.63
Variation	%	-25.60%	14.03%	-14.71%
Hall Temperature				
Maximum	°C	24.7	24.2	25
Minimum	°C	23	21.8	23.3
Average	°C	23.9	23.0	24.2
Variation - Room	%	7%	10%	7%
Variation - Norm	°C	0.3	0.8	0.0
	%	1%	3%	0%

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Observations:

- The performance of all the AC machines is satisfactory.
- The temperatures are maintained as per the stipulated norms and variation across the room is marginal.




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IX Green Culture

The power consumption of some of the personal computers is as under

Sr No	Description	Operation		Voltage	Current	Power	Power Factor
		Hr/Day	Day/Year	V	A	Kw	
Computers							
Computer Lab Fourth Floor							
1	PC-11	6	280	240.0	0.12	0.02	0.58
2	PC-17	6	280	242.2	0.13	0.02	0.62
3	PC-24	6	280	241.8	0.23	0.04	0.69
4	PC-06	6	280	240.5	0.25	0.05	0.70
5	PC-05	6	280	241.3	0.35	0.06	0.71
6	PC-14	6	280	242.1	0.22	0.04	0.69
7	PC-07	6	280	243.4	0.30	0.05	0.70
8	PC-13	6	280	241.7	0.32	0.05	0.68

Observations:

- The LED / LCD monitors have been procured, which are energy efficient.
- These monitors are not only energy efficient but also generate minimal heat and cut down on air conditioning load.

Recommendations:

The following steps may be initiated to further enhance efficiency of various PCs

- An efficient power management system may be incorporated to
 - Switch off the display if not in use.
 - Put the computer in Sleep mode / switching off the machines, if not used for a prolonged period.
- Optimize brightness of the screen.
- Discourage use of screen savers, which has similar power consumption.

Paper-less communication:

The major internal, as well as external communication, is through an electronic medium.

Re-using one sided paper for printing:

It was observed that two side printing/printing on the back side of the used paper in more than 80% of the cases.

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Environmental Awareness:

1. Various awareness programs have been carried out to promote 'Save Environment'.
2. People actively participate in Exhibitions, Seminars, Nature's trip organized by the college.



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X

Renewable Energy

Solar Photovoltaic:

The Solar photovoltaic system has not been installed in the campus.

Bio-methanation:

1. The possibility of installing biogas plant to generate biogas for canteen usage from plate and canteen waste is could be initiate.




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