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Energy Audit of Sanjay Ghodawat University

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***Abstract*: India is the Fifth largest electrical energy producer in the world. In spite of such achievements the gap between supply and demand of energy is increasing day by day. An energy audit is a study of a process to determine how and where electrical energy is used and to also identify methods for conserving energy. Energy audit also provides opportunities for the use of renewable energy. In this project we are going to undertake the case of Sanjay Ghodawat University campus, Atigre. Lighting loads, computers and air-conditioners as well as inductive loads are recommended for the energy conservation methods. To improve the electrical energy performance, the use of energy efficient equipment's and control mechanism with less energy consumption is suggested. The recommended implementation helps us to reduce the energy consumption, which in turn reduces its cost of the Electricity.**

***Keywords*: Audit, Energy conservation, Electricity management.**

1. Introduction

Energy audit is defined as ―A thorough mapping of energy use, all beneficial saving possibilities and the renewable form of energy usable possibilities of the building and the production process carried out by experts or it can also be defined as an analysis of building or equipment, which identifies how and where that building or equipment can reduce energy consumption and save energy costs. Energy audit is an attempt to balance the total input of energy with its use

As energy audit, sometimes as referred to as energy survey or an energy inventory, is an examination or total energy used in particular property. The analysis is design to provide a relatively quick and simple method of determining not only how much energy is being consumed but where and when. The energy audit will identify deficiency in operating procedure and in physical facilities. Once these deficiencies have been identified, it will be apparent where to concentrate efforts in order to save energy. The energy audit is the beginning of and the basis for an effective energy management program. Before planning this project we studied various papers related to the Energy Audit available in the IEEE archives were studied.

The gap between the demand and generation capacity is high. As to reduce the gap between the demand and generation capacity energy should be managed. An audit is an essential first step to managing energy. The reimbursement of implementing the energy efficiency measures in buildings is giving both in terms of energy and cost savings. Apart from saving the energy and cost, pollution can also be controlled by conserving electric energy; most of the energy is generated in thermal power plant which causes more air pollution. An Energy audit is the first step for conservation of electrical energy.

Energy audits are meant to determine the energy consumption of an industry or organization or laboratories different process lines with a view to generate energy improvement options, to prevent energy wastage, to estimate the cost of energy improvement, calculate payback period and evaluate the various options. Energy Audit is an effective energy management tool. By identifying and implementing the means to achieve energy efficiency and savings, not only can lead to energy savings, but also equipment/system services life can be extended. All these savings in money can possibly improve productivity. Based on the principle "The less energy is consumed, the less fossil fuels will be burnt", both the buildings and the power generation companies will generate lesser amount of power which can lead to lesser pollutants. Therefore, all parties that are concerned contribute to conserve the environment and to enhance sustainable development.

As we know the hostel areas consume the most energy and most of the energy is wasted because of students using illegal equipment and not turning the light and fan off whenever going out. So this could fulfill the moral of our project by surveying the hostel areas in depth.

This would act as a prototype project, the lessons learnt here can be put to practice in the future as we progress and move to other parts of the campus. Hostels have been chosen because they are quite familiar to us and are very accessible and have conspicuous energy wastage that can be reduced.

We are confident that the results that will come out of this exercise are bound to be of interest to everyone and can be the first step to make Sanjay Ghodawat University energetically the most efficient campus in India.

2. Literature Survey

Availability of power has an important role in the economic development of a country. In today's world, energy is very precious. The detail breaks up share of different type of generating stations are given in the paper studied [1]. Availability of power has an important role in the economic development of a country. In today's world, energy is very precious. The detail breaks up share of different type of

generating stations are given in the paper studied [2]. Further in another paper studied had the Energy Auditing has been dealt as the index of the consumption which normalizes the situation of Energy crisis by providing the conservation schemes. This has been done to minimize the unwanted power shutdown either incidentally or by load shedding. Here author has defined Energy auditing is one of the tools through which balancing of demand and supply is determined. The recommendations reduce around 10-15% of the energy and 20-25% of cost reduction [3].

3. Methodology

In preliminary data collection phase, exhaustive data collection was made using different methods such as observation, interviewing key persons, and measurements. We have visited the faculty of management block in which we have visited each classroom, labs, Corridors, Library and respective faculty rooms as well as B block and mainly Hostel (H5, H6 & H7). Information about the general electrical appliances is collected by observation and interviewing. The details of usage of the appliances is collected by interviewing key persons e.g. Electrician, caretaker (in case of departments) etc.

A. Data Analysis

Detailed analysis of data collection is done. Energy consumption per day in kW is calculated based on department. The analysis of our data is done in the following way:

- Power Flow diagram
- Evaluation of collected data department wise analysis and location wise analysis.

Reasons for the Variance between connected load and actual consumption will be evaluated.

4. Case Study and Data Collected

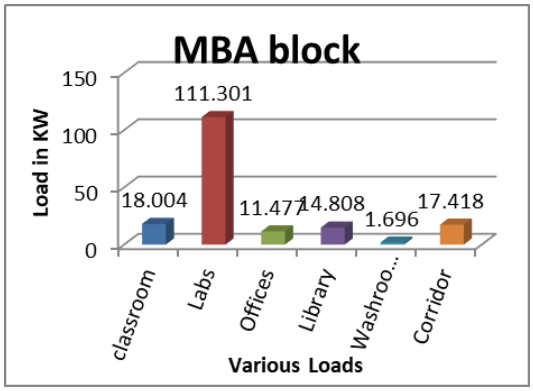
We have analyzed the load of Faculty of Management building and also the load of AC Machine lab.

- The load of class rooms for even semester is nearly about – 4.028 Kw/day
- The load of class rooms for odd semester is nearly about - 2.87Kw/day
- The load of AC machine Lab for even sem. is nearly about – 22.70 Kw
- The load of AC machine Lab for odd sem. is nearly about – 19.32Kw
- The total load of the whole block is about - 174.564KW
- For B Block we have collected the following data
- The total connected load of the B block is 130.68KW.

A. Data collection chart for Management block

Table 1
Data collection chart for Management block

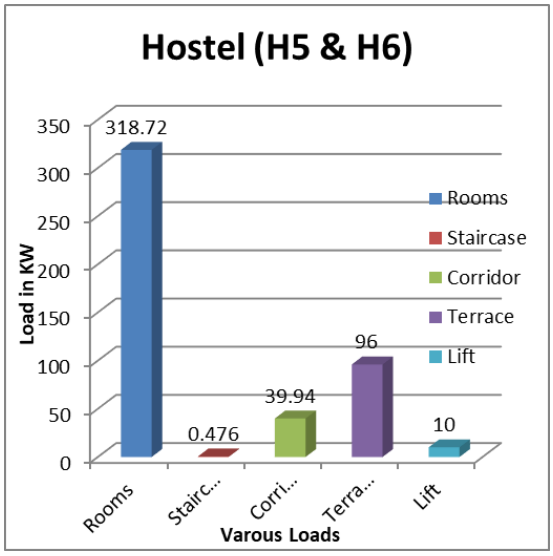
Sr No.	Locations	Total Watts	Working Hour
	Ground Floor		
1.	Class Room	4308	4
2.	Faculty Room	6696	6
3.	Computer Lab	5696	2
4.	HOD Cabin	1929	6
5.	Washrooms	552	6
6.	Sports Room	772	6
7.	Switch gear Lab	1564	1
8.	Machine Lab	52239	-
9.	Corridor	11632	4
10.	Electrical Lab	3440	2
11.	Cultural Room	448	1
	First Floor		
12.	Reference Room	2152	6
13.	Class Room	6068	4
14.	Corridor	1864	4
15.	Digital Library	4416	4
16.	Library	8240	6
17.	Washroom	352	6
18.	Stairs	1064	3
19.	Processing Room	632	1
	Second Floor		
20.	Class Room	7628	4
21.	DSM Lab	8404	-
22.	EM/IT	14436	2
23.	AEC Lab	4668	2
24.	ECA Lab	5668	2
25.	Computer Lab	15186	4
26.	HOD Lab	1000	6
27.	Washroom	792	6
28.	Corridor	2858	4
	TOTAL	**174564**	



B. For Hostel

Table 2

Sr no.	Location	Nos.	Watts	Total Wattage(in Kw)
1.	Rooms	180	1992(for one room)	358.560
2.	Staircase	3	158	0.476
3.	Corridor	3	-	39.94
4.	Terrace	2	-	96
5.	**Lift**	1	10000	10.00
Total	**484.076**			



- Here in the above table we have shown the total number of corridors as 3 consisting of H5, H6 and the middle main corridor.
- The staircase is also considered as corridor, one of H5 another of H6 and the middle main staircase.
- There is a common lift between both blocks.
- The terrace load consists of a water filter which is common and load is distributed over both of the blocks equally and water pumps which are individually installed for H5 and H6.

C. *H7 Block*

Table 3
Total Connected Load of H7

Sr. No.	Location	Nos.	Watts	Total Wattage (in KW)
	Rooms	90	1150 (for one room)	103.5
	Staircase	1	158	0.158
	Corridor	1	-	14.6
	Terrace	1	-	49
	Lift	1	-	8.5
Total	175.758			

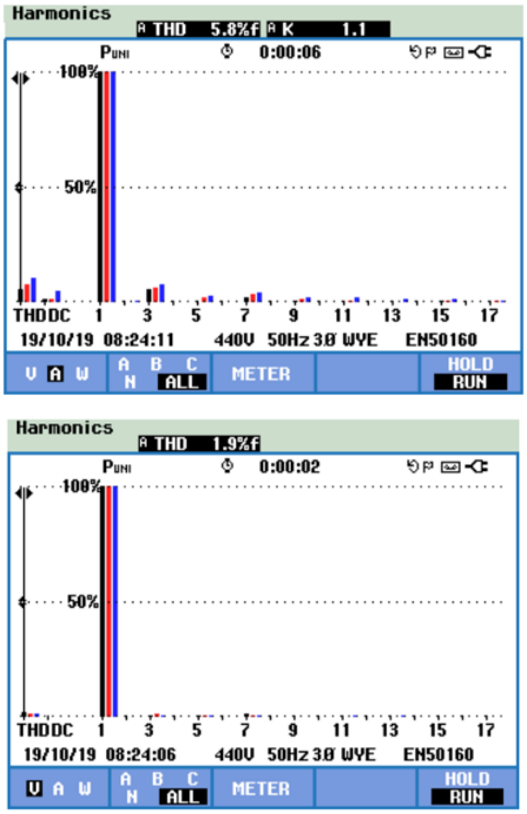
5. Result and Analysis

A. *Measurements Performed*

Measurement Summary

Measurement topology	Wye mode
Application mode	Volts/Amps/Hertz
First recording	19/10/2019 8:32:27 AM 959ms
Last recording	19/10/2019 8:35:27 AM 959ms
Recording interval	0h 0m 10s 0msec
Nominal Voltage	440 V
Nominal Current	300 A
Nominal Frequency	50 Hz
File start time	19/10/2019 8:32:17 AM 959ms
File end time	19/10/2019 8:35:27 AM 959ms
Duration	0d 0h 3m 10s 0msec
Number of events	Normal: 1 Detailed: 0
Events downloaded	No
Number of screens	18
Screens downloaded	No
Power measurement method	Unified
Cable type	Copper
Harmonic scale	%H1
THD mode	THD 40
CosPhi / DPF mode	Cos Phi

B. *Harmonics generated during analysis*



C. *Faculty of Management*

- For Machine Lab actual total load consumption is different for both the semesters.
- For Odd Sem the consumption is 19329 W, and for Even Sem the consumption is 22702 W
- And for the class rooms also Odd sem consumption is 2087 W, and for Even Sem consumption is 4002W.
- The total load of the Faculty of Management Block is 174.56KW.
- For the ground floor the connected load is 89.13KW.
- For the first floor the connected load is 24.78 KW.

For the second floor we have done a detailed analysis in this we have calculated the actual energy consumption on per day basis.

- The total load connected is 60.64KW
- For Odd sem. the actual load of classroom is 4.028 Kw/day
- For even sem. the actual load of classroom is 2.87Kw/day
- Other Loads such as (Water machine /corridors/ HOD cabin/Labs) the actual load is 30.21Kw/day

D. *Hostel (H5 & H6)*

The coil we studied that is used in the solar unit has a rating

of 3.0KW each. There are 32 such solar tanks present on the top of H5 and H6 terrace. The total load for the same is calculated 96KW. The above diagrams show the current variation before and after the coil of water heater are switched on.

- The current here changed for 'A' phase is approximately 97A.
- The current here changed for 'B' phase is approximately 129A.
- The current here changed for 'C' phase is approximately 136A.

We also understood from above analysis that the current on 'C' phase is very less than that of other phases but when the solar water heater coils are started the load gets evenly distributed on each phase.

This is because of uneven distribution of load on each phases, this basically results in overheating of each phases which are overloaded.

We can also observe that the neutral carries a current which is nearly equal to 46 amperes and this is because of the unbalanced phases and because of uneven distribution of load in the building.

The unbalance load also causes more I^2R losses.

E. Hostel (H7)

The coil we studied that is used in the solar unit has a rating of 3.0KW each. There are 16 such solar tanks present on the top of H7 terrace. The total load for the same is calculated 48KW.

As we saw the total connected load is 175.735 KW but the total usage with the coils off is nearly 8.3-9.5 KW and with the coils turned on it goes up to 41 KW.

F. Recommendation Based on survey

1) Technical Recommendation

The following recommendations are hereby made based on the findings of this study.

- Changing CFL's with new LED light could nearly reduce the lighting load by half the consumption of present lighting load.
- We could replace the coils in water heater of (3KW) each by a solar water heater pump which consumes only 1KW and it could nearly replace 2 coils.
- We can also combine our solar power plant with Wind Power Plant forming a hybrid system so that we don't have to rely on MSEDCL for the electric supply and we could also store the energy and provide to the MESDCL/TRANSCO grid reducing our electricity bill.
- The external lighting should be controlled automatically using light sensing devices such that they are off in the day time and on at night.
- We should install no-man sensor/ motion sensors in hostels as well as classrooms so that when there is no one in the room the lights and fan should automatically turnoff and when there is someone present then the light should turn on.
- Submersible pump set is recommended to overhaul after three month to avoid wastage of energy due to poor performance.
- The computers in the lab should always have a setting of sleep timer within 2 minutes so that the PC consumption is reduced.

2) Non –Technical recommendations

- Awareness on energy saving habits and their benefits should be created, through mediums such as the hostel notice board.
- Inefficient appliances such as electric hot plate that are not allowed in the hostel should be listed in the hostel rules and regulations and given to students before they are admitted into the hostel.
- The university should set up an energy audit committee with representatives in each hostel. These representatives should ensure energy saving habits for areas such as common room, kitchen, toilet and bathroom. These representatives could be among the porters or security personnel so as to avoid any cost in hiring new staffs.
- The University's metering system should be decentralized to enable effective monitoring of consumption pattern for each block.
- Electrical energy audit should be conducted for other parts of the institution to uncover areas of waste and potential savings.

G. Savings

If we replace all the CFLs and TUBES present in MBA

Table 4
Savings

	MANAGEMENT BLOCK			**B BLOCK**		
EQUIPMENTS	QUANTITY	WATTAGE	TOTAL KW	QUANTITY	WATTAGE	TOTAL KW
Current Setup						
TUBE	418	72	30.096	536	72	38.592
CFL	272	14	3.808	40	14	0.56
After Replacing						
SURFACE LED	418	36	15.048	536	36	19.296
LED BULB	136	9	1.224	20	9	0.18

Sr. No.	Recommendations	Quantity	Savings in KWh	Savings in Rs.	Initial Investment	Payback period
1	Replacing CFL with LED fitting	156	3	134/day	24,960/-	7 months
2	Replacing Tubes with surface LEDs	954	34	1519/day	7,63,200/-	1 year 4 months
3	Replacing water heater coil with solar water heater pump	39	105	2345/day	37,05,000/-	4 year 4 months
4	Installation of no man sensors	270	-	-	4,05,000/-	

building and B Block with a lesser and more efficient LED lamps the Watts consumed and ultimately the bill cost will get reduced.

6. Conclusion

- Energy audit can help us learn a lot about the power usage of the entire area and lets us know where the energy is being consumed or being wasted.
- Energy audit can improve efficiency of the system by eliminating the over consumption of energy/ or by using renewable resources.
- By making use of lite colors in rooms and maximum use of sunlight can also help reduce the energy bill to a certain level.

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