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Energy Audit: A Case Study to Reduce Lighting Cost

P.Srinivasa Kumar
Associate Professor
Department of Mechanical Engineering
Malla Reddy College of Engineering & Technology
Hyderabad , Telangana , India
Psrinivasakumar16@yahoo.co.in

Absract----- An energy audit is an inspection, survey and analysis of energy flow for energy conservation in a building or system to reduce the amount of energy input into the system without negatively affecting the outputs. Energy demand is an increasing pressure for any government. For the developing country like India, the energy generated decides the economic growth of the country. Being the fifth largest power generator and the fourth largest power consumer in the world, energy demand and scarcity rules the country. Energy demand in our country is increasing exponentially. Energy conservation can be the best solution for the raising energy demand. Lighting is an area, which provides a major scope to achieve energy efficiency at the design stage, by incorporation of modern energy efficient lamps, luminaries and gears, apart from good operational practices. This paper focuses on energy auditing by conducting a case study of mechanical engineering block2 of MRCET on conventional lighting loads and replacing with energy efficient lamps and comparing the results.

Keywords---- Energy Demand; Energy Audit in; Lighting Loads; Energy Conservation.

I. INTRODUCTION

The country's annual electricity generation capacity has increased in last 20 years by about 120 GW, from about 66 GW in 1991 to over 100 GW in 2001, to over 185 GW in 2011[1]. Over 2010–11, India's industrial demand accounted for 35% of electrical power requirement, domestic household use accounted for 28%, agriculture 21%, commercial 9%, public lighting and other miscellaneous applications accounted for the rest. Energy conservation means reduction in energy consumption without making any sacrifice of quantity or quality. A successful energy management program begins with energy conservation; it will lead to adequate rating of equipments, using high efficiency equipment and change of habits which causes enormous wastages of energy. In spite of this, India currently suffers from a major shortage of electricity generation capacity, even though it is the world's fourth largest energy consumer. Of the 1.4 billion people of the world who have no access to electricity in theworld, India accounts for over 300 million. As of January 2012, the per capita total consumption in India to be 778kWh [2].

II. ENERGY AUDITING

As per the Energy Conservation Act, 2001, Energy Audit is defined as "the verification, monitoring and analysis of useof energy including submission of technical report containing recommendations for improving energy efficiency with cost benefit analysis and an action plan to reduce energy consumption". Implementation of recommended measures can help consumes to achieve significant reduction in their energy consumption levels[3]. An energy audit is an inspection, survey and analysis of energy flow for energy conservation in a building or system to reduce the amount of energy input into the system without negatively affecting the outputs. The objective of this paper is to study the energy consumption of an educational building and reduce the consumption without affecting the output.The institutional building is considered here because of the uncontrolled and unpredictable usage of light,fans and airconditioning facilities in number of classrooms, practical rooms, auditoriums and also rooms with computer facilitiesand UPS[4].

Energy audit analysis in general order involves:

- Analysis of the energy consumable systems and the utility bills
- Survey about the condition of the system
- Understanding the need of the consumer
- Evaluating the possible energy conservation measures and
- Estimating the energy savings potential.

Studies and researchers have shown that energy auditing and conservation in India can save

approximately Rs.1800 crores per year as there is a big potential for saving energy in industrial sector and save installation equivalent to 5250 MW.

III. METHODS OF ENERGY AUDITING

Energy audits can be carried outs in different ways. Depending on time span invested auditing can be classified in as:

i) Walk Through Audit

ii) Intermediate Audit

iii) Detailed / Comprehensive Audi

i) ***Walk Through Audit***

This is simple kind of energy, it carries rapid survey of plant. During rapid walk survey main focus is on the energy input, spots of energy wastages and ECO's. Data about plant is collected in such a way that, data should be utilized for next detailed audits. Usually audit is carried out at two periods viz. During off period & during working shifts Generally this kind of audit is carried out for three days to one week. As the time span required is short cost involve in auditing is also less.

ii) ***Intermediate Audit***

This kind of audit is conducted for detailed survey and measurement of systems compare with walk through audit. Major focus is made on energy loses measure and quantification to analyze energy efficiency of system. Generally low tech recommendations are preferred with first preference is given for -Switching off lights and fans when not required. -Placing of automatic thermostat to control temperature of water heaters etc -Spotting out golden ECO's which involves higher energy wastage cost. This type of audit is carried out for one week to one week; time span required is more so the cost associated with audit is also more compare with walk through audit.

iii) ***Detailed / Comprehensive Audit***

This is exhaustive audit than the previous types of audit. Detailed survey of systems as well as subsystems of an industry is done. Energy consumption of all subsystems and systems is compared with targeted energy consumption. This kind of audit also identifies the consumption of secondary energy like electricity, steam, gases etc. Modernization and changes in major retrofitting as suggested if required.

MEASURES IN ENERGY AUDITING OF EDUCATIONAL BUILDING

An educational building is selected for the energy auditing due to the fact that the number of people involved in an educational building is huge and the possibility of energy conservation is more. Lighting load is where most of the energy is wasted than consumed. In any educational building, lighting load consumes more than 20% of the total electrical energy consumption. Replacing the regular tube lights employingelectromagnetic ballast with Compact Florescent Lights (CFLs) and Light Emitting Diodes (LEDs) is discussed in the paper.

IV. ESTIMATION OF LIGHTING LOADS

Block 2 of MRCET consists of Mechanical engineering, Mining Engineering and Aeronautical Engineering departments,lighting loads of all these departments are considered for calculating lighting load.

Several places are identified during the audit, as the place for easy and efficient energy savings. A count on lighting is done after proper identification and calculation about the replacement of the light as it should not affect the consumers need. In the analysis, the energy consumption of tube lights along with ceiling fixture lights, CFLs and LEDs are evaluated and compared.

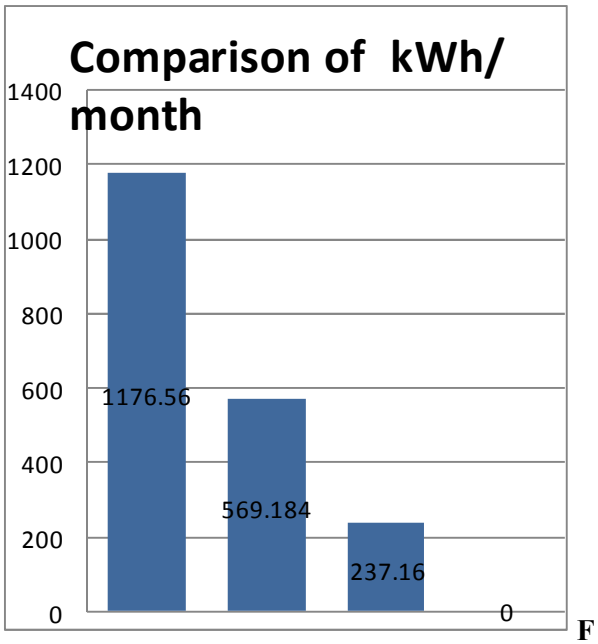
Florescent tubes: The usage of 40 W tube light and ceiling tube fixture each 14X4W consumes the specified energy: Total number of tube lights being 308,total energy consumed by the tube lights is (128X40)*1+ (14X180)*1 = 7.64 kWhour. Assuming 7 working hours a day and 22 working days per month, total energy consumption by the tube lights are 7.640*7*22=1176.56 kWh. The cost wise comparison is also done assuming Rs.6.00 per unit. The total amount is 1176.56*6.00 = Rs. 7059.36 per month.

CFLs: Replacing the 40W tube lights with 12 watts CFLs [5], total energy consumed by 128+180= 308 CFLs is, 308*12*1 =3.696 kWhour. Assuming7 working hours a day and 22 working days per month, total energy consumed by the CFLs are3.696*7*22=569.184kWh. The cost wise comparison is also done assuming

Rs.6.00 per unit. The total amount is 569.184*6.00 = Rs. 3415.10 per month[6] .

LEDs: Replacing the 40W tube lights with 5 watts LEDs [7], total energy consumed by 128+180=308 LEDs are, 308 *5*1=1.54 kW hour. Assuming 7 working hours a day and 22 working days per month, total energy consumed by the LEDs is 1.54*7*22=237.16 KWh. The cost wise comparison is also done assuming Rs.6.00 per unit. The total amount is237.16*6.00= Rs. 1422.96.

Fig 1. Shows the energy consumption comparison between tube lights along with ceiling fixture lights, CFL and LED.



IG-1: COMPARISON OF KWH/ MONTH

Fig.2. shows the comparison of cost/unit consumed between tube light, CFL and LED.

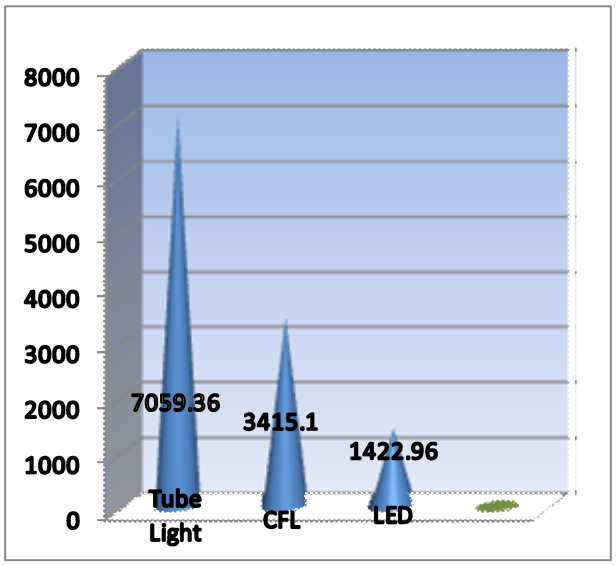


FIG-2: COMPARISON OF TOTAL COST OF ENERGY/MONTH

The table 1 below shows the cost wise comparison between the tube light, CFL and LED

TABLE 1. COST COMPARISON BETWEEN TUBE LIGHT, CFL AND LED

Details of bulbs	Tube lights	CFL	LED
Number of bulbs	308	308	308
Watt per bulb	40	12	5
Cost per bulb	Rs 45 &small FL@ Rs 26 each	140	Rs 250
Cost of 308bulbs (initial investment)	Rs10440	Rs43120	Rs77000
kWh energy consumed by the bulbs	7.64kWh	3.696kWh	1.54kWh
Cost of energy consumed at Rs.6 /kWh	Rs 45.84	Rs22.176	Rs 9.24
kWh energy consumed per month (assuming 7working	1176.56 kWh	569.184 kWh	237.16 kWh

hours and 22 working days)			
Cost of energy consumed per month	Rs7059.36	Rs. 3415.10	Rs. 1422.96

The the life span of a LED is generally 50,000 hours which is approximately 40 times more than the life span of tube light and 5 times more than the life span of CFL[8]. The pay back from the CFL and LED is more than the tube light as the energy consumed by the CFL and LED is less when compared with tube light.

V. CONCLUSION

It shows that replacing the conventional tube lights with energy saving CFLs or LEDs reduces the energy consumption drastically. In addition to this the CO_2 emission is also reduced when the tube lights are replaced.Replacing a single tube light with a CFL will keep a half-ton of CO_2 out of the atmosphere over the life of the bulb [9].A simple change in system can conserve energy and bring down the utility bill amount to a greater extent.Energy audit in all the sectors with few changes in the existing system can conserve energy, which in turn will reduce the power demands in our country. The government can decide policies to initiate the energy audit which will make a great change in the economical status of India in the global market.

VI. RECOMMENDATIONS

Setting timers for air conditioning units, installing automated sensor based fans and lights, replacing the copper ballast of the tube lights with electronic ballasts can reduce the energy consumption.

Using the computer, one of the widely used machine, at the optimum brightness level, which is 15 to 30 percentage in each LCD monitors, can reduce power drawn by three to five watts per computer.

The tubes not required during day time should be switched off and better arrangements for use of natural daylight should be made.

Replace incandescent lights in exit signs with LED fixtures, which can reduce costs of these signs by up to 95 percent[10]

Using energy efficient compact fluorescent bulbs especially in fixturesthat operate more than two hours a day. They cost more initially but use 75 percent less electricity and last about ten

times longer than incandescent bulbs.

Use long-life bulbs only in hardto-reach places. Selecting bulbs carefully; looking for the highest lumens at the lowest wattage..Keep light fixtures clean to gain the most illumination.Cleaning the lamps & fixtures regularly; Illumination levels fall by 20-30% due to collection of dust. Switching of thelights when they are not in use. Photo sensors to be installedin department to utilize optimum day lighting. There areseveral types of sensors available in the market at affordableprices with the help of which we can save a plenty amountof energy.

Natural lighting can be considered for corridor.

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