© 2015 IJIRT | Volume 1 Issue 12 | ISSN: 2349-6002

REDUCTION OF LIGHTING COST IN AN EDUCATIONAL INSTITUTE

Hemant Tiwari

B.E. 8th sem, Mechanical Engineering, Shankersinh Vaghela Bapu Institute of Technology, Gandhinagar

***Abstract*- The paper presents effective and efficient ways to reduce the lighting cost in an educational institute but the application can be extended to any kind of institute or buildings. Lighting is one of the most important factors when it comes to aesthetics, working conditions and such. It uses considerable amount of electrical energy. In India, it is not mandatory to perform energy auditing in educational institution as it is not in the list of designated (power) consumer. Despite the considerable energy consumptions by educational institutes, they are often overlooked when it comes to energy conservation. There are no energy conservation laws particular to academic institutions.**

***Index Terms*- Educational Institute, Energy audit, Energy Consumption, HVAC, LEDs, Lighting cost, Lights, Power.**

I. INTRODUCTION

Lighting can account for as much as 10 % of overall energy consumption in a building. It is also an important factor when calculating cooling load of a building or other HVAC calculations. Lighting ability of a lamp or any object that emits light is measured in lumens. Lumens (denoted by lm) are a measure of the total amount of visible light (to the human eye) from a lamp or light source. The higher the lumen rating the "brighter" the lamp will appear. It is the SI derived unit of luminous flux. The minimum amount of illumination necessary or required depends on various factors such as the application or work being performed etc. The Energy Conservation Building Code (ECBC) provides standards and codes for various types of room and for various activities and these codes must be followed strictly for good comfort conditions and safety. Reducing energy consumption and wastage not only reduces financial burden but also helps prevent global warming and pollution.

II. LITERATURE REVIEW

There are various types of lamps and fixtures available in market according to usage, cost etc. care must be taken while selecting these as they may increase the overall cost of lighting while having no significant effect in comfort or illuminance. Energy audit can be performed for the institute to determine exactly how much amount of energy is being utilized of lighting although it is not necessary. A walk through or limited-scope audit is recommended for better and accurate results with minimum efforts. The principle of energy audit is not only identifying the sources of energy use, an energy audit seeks to prioritize the energy uses according to the greatest to least cost effective opportunities for energy savings.

III. METHODOLOGY

Site surveys were performed to collect data regarding various types of lights used in the campus and their quantity along with rated power. Usage pattern or amount of time each light is used can vary greatly. For sake of ease of calculation, all lights are assumed to work 6 hours a day. The campus has 907 tube lights, 20 compact fluorescent lamps and other types of lights include flood lights and small lights used for decorative purposes. Following graph table shows type and wattage of lights used in the campus:

Table 1: Types of lights and their installed capacity

Type of light	Quantity	Rated Power (Watts)	Total Installed Capacity (Watts)(Quantity*Rated Power)
Tube lights	907	40	36280
CFL	20	35	700
Other Lights	15	35	3725
Total			**40705**

Table 2: Comparison of popular light types

Parameter	Light Emitting Diode Bulbs	Compact Fluorescent Lamps	Tubelight
Cost (price per watt)	More expensive than CFL or TL	Cheaper than LED but expensive than TL	Cheaper than LED and CFL
Lumens Per Watt	Very high, much higher than CFL or TL	Higher than TL but lower than LED	Lower than LED bulb and CFL
Durability	Highest	Medium	Lowest
Turns on instantly	Yes	Yes	No
Sensitive to low temperatures	No	No	Yes
Cost per Lumen	Very Low	Higher than LED	Highest
Efficiency of heat dissipation	Poor	Good	Excellent
Heat Generated	Extremely low compared to CFL and TL	Low but higher than TL	Higher than CFL and LEDs
Sensitive to humidity	No	Yes	Yes

The most technological advanced and cost effective and efficient replacement for a tubelight will be an LED bulb which is unique for their excellent illumination despite extremely low power usage. They require no start-up time and also are more robust then a tubelight. It's not only hard to break an LED bulb but also it doesn't use any glass part which may harm someone when it's broken

A tubelight provides about 45 lumens per watt while an LED bulb gives 100 lumens per watt of electricity consumed. Hence a 40W tubelight provides 40*45 = 1800 Lumens. To provide 1800 lumens an LED bulb must have a wattage of 1800/100 = 18Watts. An average 15 Watt LED bulb costs around Rs. 300 can provide almost equivalent amount of illumination or at least necessary illumination for studying purposes. Fluctuation in market value and effect of bargaining and bulk buying is ignored. CFLs are best installed in situations where they are left running for long periods. Constant on-offs, like toilets, or bathrooms shorten their lives.
Average price per unit of electricity can be considered to be around Rs. 6 including service and other applicable taxes.

Cost of running one
Tubelight for 1 hr in Rs = (40/1000)*1*7
= Rs. 0.280

Cost of running one
LED bulb for 1 hr in Rs = (18/1000)*1*7
= Rs. 0.126

From the above calculation it is clear that an LED bulb offers a cost saving by a factor of (0.280-0.126) = Rs 0.154. In other words, running an LED bulb instead of a tubelight for 1 hour is saves Rs 0.154.
If all the Tubelights are replaced by LED bulbs, power saved will be,

=907*(40-18)

= 199454W

This translates to cost saving of

= (199454/1000)*1*7

= Rs. 139.67

Cost of buying 18 WLED bulbs at market value of Rs 300 in the required quantity,

= 300*927

= Rs 2, 78,100

This investment will start making profit in,

= 278100/ 139.67

= 1991.12 Hours.

At an average continuous usage of 8 hours per day, the bulbs will start making profit in

=1191.12/8

=248.89 Days

i.e., on 249th day since 1st use. If this change is done before starting of one academic year, the profit will start before subsequent academic year. And after that, there will be net saving of around Rs.139.67 each hour if the bulbs will be in use instead of tube lights. It is not advised to dump away the tube lights; they should be sold at reasonable rates to third parties or donated to charities or to other academic institutions such as small schools etc.

IV. CONCLUSIONS AND RECOMMENDATIONS

An LED turns out to be better alternative then a tube light or a CFL. Calculations shows it is financially feasible and economical to switch over to LED from tube light and LED.take some work to their home if they want or have to so no work remains pending for next day.

Student must be made aware regarding the energy crisis and environmental damage which occurs due to wastage of electricity so they will not only follow energy conservation principles at the institute but also at their own homes which shall reduce overall wastage of electricity by the society and serving as an example for quality education and effective and efficient implementation of education and hard earned knowledge.

Whole class should be fined in case energy wasting malpractices are observed. Student squad from each department shall be formed by faculties or by students themselves. These squads will be responsible for creating awareness among other students and prevent any wastage of electricity or any such useful resources.

REFERENCES

[1] ASHRAE Fundamentals -2009
[2] ASHRAE Handbook 1997
[3] ECBC-User-Guide(Public) - July 2009
[4] Energy audit of IIT - Roorkee campus, Technical Report, January 2010
[5] Energy Audit Report On a Technical Institute, Dr. K. Umesha, M.E, PhD, Miste.Mieee (Madras Section)
[6] Energy Auditing in an Educational Institution with Special Focus on Reduction in Maximum Power Demand, Jayesh R, Jagdish V, Julian George and Jayanth Premachandran, Department of Electrical and Electronics Engineering, Amrita University,
[7] Energy Management Handbook, John Wiley And Sons - Wayne C. Turner
[8] Energy Savings Toolbox –An Energy Audit Manual and Tool, Canadian Industry Program for Energy Conservation (CIPEC), a joint initiative of Canadian industry and the Office of Energy Efficiency of Natural Resources Canada.
[9] Guide To Energy Management, Cape Hart, Turner And Kennedy
[10] HVAC Applications, ASHRAE Handbook, SI Edition, 1999.
[11] ISHRAE HANDBOOK- 1997
[12] McQuiston, F. C., and Spitler, J. D., Cooling and Heating Load Calculation Manual, ASHRAE, Inc., 2nd Edition, 1992.