International Journal of Engineering Technology and Applied Science
(ISSN: 2395 3853), Vol. 2 Issue 1 January 2016

Energy Audit: A Case Study of an Academic Hostel, Bhopal

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ABSTRACT:- This paper presents a case study of academic hostel energy audit exercise carried out in Bhopal Madhya Pradesh to analyze the energy consumption patterns and to provide specific recommendations to improve energy consumption efficiency and to reduce the energy bills. The process of audit executed was data collection during on-site survey, analysis on data obtained and recommendation for improvement of performance. The energy audit showed that the academic hostel consumed an annual electrical energy of 7.2981 MWh and having a potential to save 2.6056 MWh of energy, a 35.7% electrical energy saving potential. To improve the electrical energy performance in academic hostel an enhanced level of awareness to reduce energy waste, the use of efficient equipment and control systems is found to be the most effective energy efficiency measures strategy to improve the lighting and electrical system efficiency in the academic hostel. The benefits of implementing the energy efficiency measures in academic hostel are substantial both in terms of energy savings and cost savings.

KEYWORDS:- Energy audit, Energy Consumption.

I. INTRODUCTION

Energy audits apply energy analysis methods to evaluate patterns and trends of energy consumption and efficiency opportunities in households, government agencies, and private commercial and industrial firms. Energy audit is the first step which can be conducted within an organization for the development of electrical energy efficient measures EEMs. In 2013-14, the commercial and domestic sector consumed 9% and 22% electrical energy of total energy consumption in India. The electricity consumption in commercial sector has increased at a much faster rate as compared to other sectors during 2005-06 to 2013-14 with compound annual growth rates of 8.82% respectively. Therefore energy conservation is becoming an important issue. Though there are well known remedial measures to address the issues and to advise the commercial and domestic consumers on the usage of type of equipment and other necessary adjustments to save energy and also energy bill. An energy audit is an evaluation of energy consumption in a domestic, commercial, or any other premises. It is generally used to determine where energy can be saved, conserved or used more efficiently. Energy Audit can be classified into

i) Preliminary Audit
ii) ii) Detailed Audit.

Preliminary energy audit is relatively quick exercise; it estimates the scope for saving using the existing or easily obtained data and helps identify the areas for more detailed study.

The detailed energy audit is carried out in three phases: Phase I - Pre Audit Phase, Phase II - Audit Phase, Phase III - Post Audit Phase. This is a comprehensive audit which offers the most accurate estimate of energy savings and cost. In this present study, the methodology used for detailed energy audit was adopted. This paper highlights energy saving potentials and feasibility of achieving the same in the existing academic hostel in Bhopal.

II. OBJECTIVE OF THE WORK

The main objective of the work was to perform lighting and electrical energy audit by taking a case study of frequently used of an academic hostel. Depending on audit findings suggest ways to optimize energy consumption.

Improvement in performance /Energy efficiency through energy audit covers the following areas:

1. Study of Lighting System.
2. Study of electrical system

III. METHODOLOGY

Ten Steps Methodology for Detailed Energy Audit:

Phase-I Pre Audit Phase

Step No.	Plan Of Action	Purpose/Results
Step-I	Plan organized Walk-through Audit Informal interview with owner.	Resource planning, Establish/organize a energy audit team Organize Instruments and time frame Macro Data collection First hand observation & Assessment of current level operation and practices.
Step-II	Conduct of brief meeting / awareness programme with all persons concerned (2-3hrs.)	Building up cooperation Issue questionnaire for each persons. Orientation, awareness creation.

Phase-II Audit Phase

Step-III	Primary data gathering,	Baseline data collection Design, operating data and schedule of operation Annual Energy Bill and Energy consumption pattern.
Step-IV	Conduct survey and monitoring	Measurements: Electrical system and Lighting system survey with portable instruments for collection of more and accurate data. Confirm and compare operating data with design data
Step-V	Conduct of detailed trials /experiments for selected energy guzzlers	Trials/Experiments: 24 hours power monitoring (MD, PF, kWh etc.). Load variations: trends in fans, tubes ,geyser motor pump and water cooler etc.
Step-VI	Analysis of Energy Use	Energy loss/waste analysis.
Step-VII	Identification and development of Energy Conservation (ECOs) opportunities	Conceive, develop, and refine ideas Review the previous ideas suggested by energy audit if any. Contact vendors for new/efficient technology.
Step-VIII	Cost benefit analysis	Assess technical feasibility, economic viability and prioritization of ECOs options for implementation. Select the most energy efficient equipments.
Step-IX	Reporting & Presentation to top management	Documentation, Report Presentation to the top management.

Phase-III Post Audit Phase

Step-X	Implementation and Follow-up	Action plan, Schedule for implementation.

IV. ANALYSIS

Energy consumption in academic hostel: As shown in pie chart, the major energy consumption equipment is tube light 44.30% of total energy consumption. The second highest energy consumption equipment is fan 26.70% of total electrical energy consumption. The third highest energy consumption equipment is water cooler 11.57% of total energy consumption. Also motor pump 6.23%, geyser 5.88% % and laptops 11.44% energy consumed of total energy consumption.

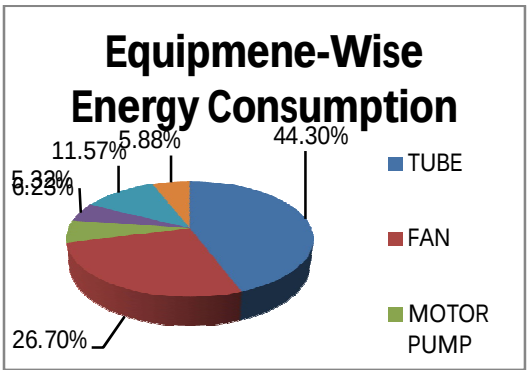

Fig. 1. Equipment-Wise Energy Consumption

As shown in column chart, the location-wise energy consumption in an academic hostel.

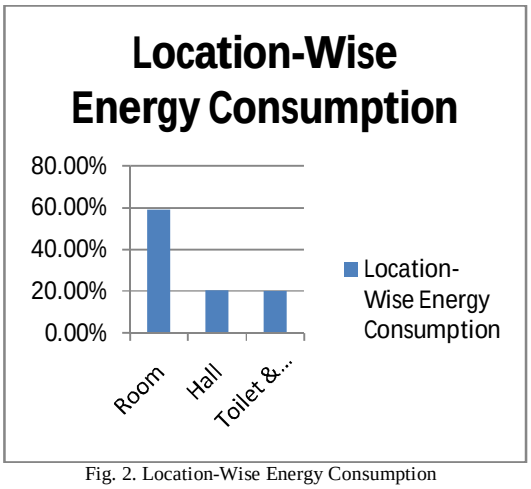

Fig. 2. Location-Wise Energy Consumption

The Month-Wise Energy Consumption in an academic hostel as shown in pie chart

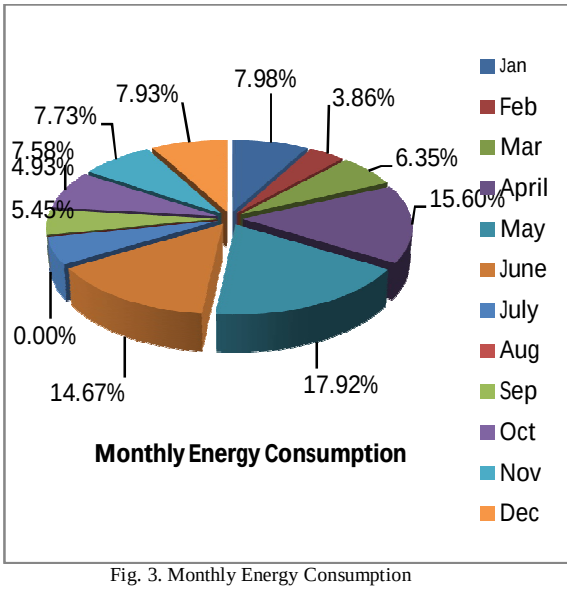

Fig. 3. Monthly Energy Consumption

V. IMPLENENTATION

1) Replacement of resistance regulator of fan by electronic regulator: In the academic hostel all fan are connected with resistance regulator. Therefore by replacing all resistance regulators with an electronic regulator the average power save for each fan 9-10W.

Analysis: -

□ Total number of fan in an academic hostel = 18
□ Average Power saving by each fan = 9W
□ Total Power saving by all fan = 18*9 = 0.162KW
□ Total utilization of fan in a year = 1805h
□ Total energy saved per year = 0.162* 1805 KWh
=292.41KWh
□ Energy cost @Rs 8 per year = 292.41*8 = Rs 2339.28 per year
□ Cost of each electronic regulator = Rs190
□ Total investment in electronic regulators =18*190
= Rs 3420
□ Payback period= (Total investment)/ (Energy cost)
= (3420)/ (2339.28)
= 1.461 year

2) Replacement of tube light by White LED Bulb in room and hall: In the academic hostel, there are 24 tube lights in room and hall can be replaced by white LED bulb.

Analysis: -
□ Power consumed by tube light =50W
□ Power consumed by White LED bulb = 13W
□ Power saved by each White LED bulb = 50W-13W = 37W
□ Total number of White LED bulb= 24
□Total power saved by white LED bulb =24*37 = 888W=0.888KW
□ Total utilization of white LED bulb in a year = 2192h
□Total energy saved per year = 2192*0.888=1946.496 KWh
□Energy cost @ Rs 8 per year = 1946.496*8= Rs 15571.968 per year
□ Cost of each White LED bulb = Rs 550
□ Total investment in White LED bulb = Rs 550*24 =Rs 13200
□ Payback Period= (Total Investment)/ (Energy cost)
= (13200)/ (15571.968)
=0.8476 year

3) Replacement of tube light by CFL in Toilet & Corridor: In the academic hostel, there are 11 tube lights in the toilet and corridor can be replaced by 9W CFL.

Analysis: -

□ Power consumed by tube light = 50W
□ Power Consumed by CFL= 9W
□ Power saving by each CFL=50W-9W=41W
□ Total number of CFL= 11
□ Total power saved by CFL=41*11W=451W=0.451KW
□ Total utilisation of CFL in a year= 852h
□ Total energy saved per year= 0.451*852KWh
=384.252KWh
□ Energy cost @Rs 8 per year= 384.252*8
= Rs 3074.016 per year
□ Cost of each CFL= Rs 130
□ Total investment in CFL bulb=Rs 130*11= Rs1430

□ Payback period = (Total Investment)/ (Energy cost)

= (1430)/ (3074.016)
= 0.465 year

VI. SUMMARY OF COST ANALYSIS

S.N	Recommendation	Cost of Implementation	Energy Saving (KWh)	Payback period
1	Replacement of resistance regulator with electronic regulator of ceiling fan	Rs 3420	292.41	1.461 year
2	Replacement of tube light with White LED bulb	Rs 13200	1928.96	0.855 year
3	Replacement of tube light with CFL	Rs1430	384.252	0.465 year

VII. RESULT

□ Total Annual Energy Consumed= 7298.514KWh
□ Total Annual Energy Saved After Implement =292.41+1928.96+384.252=2605.622KWh

□ Percentage Energy Saved Annual
= (2605.622)/ (7298.51) =0.3570*100
=35.70%

VIII. OTHER ENERGY EFFICIENT EQUIPMENTS/OPPORTUNITIES

- Use solar water heater at the place of geysers.
- Use energy efficient water cooler.
- Installation of servo voltage stabilizer
- Use star rating for all new installation
- Minimize water wastage and ensure that the proper plumbing of the water cooler and water filter.
- Use motion sensor in toilet & corridor.

IX. CONCLUSION

Total energy consumption of academic hostel is 7298.11 KWh per year. Total energy consumption is reducing by 35.7% after the installation of electronic regulator, White LED bulb and CFL. Therefore total energy consumption is saved 2605.62 KWh per year. To achieve optimal energy performance in buildings, energy audit is able to reduce energy wastes and improve the energy efficiency of the lighting and electrical equipment. Finally, electrical energy audit will develop the EEMs and only if management of organizations implement these EEMs measures in the buildings, they will be able to achieve the benefits of energy and cost saving.

REFERENCES

[1]. Parash Goyal, B.Shiva Kumar and K sudhakar "Energy Audit: A Case Study of energy center and hostel of MANIT", Bhopal, ICGCE, 2013
[2]. X. Wang, C. Huang, and W. Cao, "Energy Audit of Building: A case study of a Commercial Building in Shanghai," Power and energy engineering conference (APPEEC) 1-4, 2010
[3]. Ms Shradha chandrakant Deshmukh, Mr. Varsha Arjun Patil " Energy Conservation and Audit" International Journal of Scientific and Research Publications, Volume 3, Issue 8, August 2013 1 ISSN 2250-31 53
[4]. Rajesh Tilwani, C. Sethuraman " Energy saving potentials in buildings through energy audit- A case study in an Indian building" , IEEE, 2015
[5]. Nissanga Nishad Rasanajan Mendis, Nisal Perera, "Energy Audit- A case Study", ICIA 2006,IEEE
[6]. Suresh K.S., M. Nair, "Energy Conservation and Management".
[7]. W. N. W. Muhamad, M. Y. M. Zain, N. Wahab, N. H. A. Aziz, and R. A. Kadir, "Energy Efficient Lighting Design for Building", *2010 International Conference on Intelligent Systems, Modelling and Simulation*, 282-286, 2010
[8]. *Saving Energy at Home and School, Student and Family Guide*, National Energy Education Development Project, 2012-2013.
[9]. Mohit, Oumesh Kumar, and Vishwamitra Oree. "*Assessing the energy savings potential in public buildings through retrofi measures in tropical climates-A case study in Mauritius*." In AFRICON 2013, pp. 1-5. IEEE, 2013
[10]. Bureau of energy efficiency guide books, book 1, chapter 03 "*Energy Management and Audit*", Pg. 55-56.