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Energy Audit of Commercial Building

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Abstract :- Subsidized tariffs provided no incentive for energy efficiency investments in the building sector in the past, but increasing energy tariffs now make such investments important for the economic development of any establishment. The energy costs for both residential and public buildings like schools, hospitals, colleges and offices comprise a substantial part of the municipal budgets. To reduce the energy consumption and costs, and to improve the indoor environment, it is necessary to renovate and implement energy efficiency measures in buildings. Projects should be developed and implemented in a structured and efficient way, requiring good Energy Auditing and Project Management methods and tools. This capacity does not exist at a sufficient level today. Therefore, capacity building on these issues is essential to achieve a sustainable development.

I. INTRODUCTION

Design and architect professionals as well as plant engineers have to recognize the importance of reducing overall energy consumption, whether it is a building, plant, or process that is under their jurisdiction for design construction or operation. Energy use reduction or conservation has four main steps. The planning of energy conservation requires setting goals to meet within the time frame available, prioritizing the use of resources, and determining a schedule for implementation. Conducting a survey of existing facilities, process, equipment, operation, and maintenance is very important. Some type of measurement may be needed. Data on the operating environment and the type of operation is necessary. Because the survey and the data collection may become labour intensive, it is necessary to plan and prepare survey forms, the type of data to be collected, computer data entry procedures, etc. before starting the survey. In large facilities and complex processes, it may be advisable to break this survey into several steps, such as a reconnaissance, and preliminary, detailed, and final survey. The subject "Energy Auditing" is highly technical and it involves many engineering branches like Electrical, Mechanical, Chemical, etc. For an energy auditor, it is necessary that he should have complete knowledge of the system for which he is going to perform energy auditing. For example, in a process plant energy auditor will come across pumps, motors, fans and blowers and many other types of equipments. Besides this, a little background of finances as well as project management is also needed. Decision-making skills based on available data are also a requirement for an energy auditor.

II. NEED OF AUDIT

An energy audit is an survey and analysis of flow of energy. Auditing helps in reduction of energy bills improving the efficiency of energy consumption in the house. This audit reduces the carbon footprint and helps to decrease unnecessary waste and pollution. This is very important to have a check on the energy saving and the devices consuming large amount of energy which can be replaced by the more efficient technologies.

III. BENEFITS OF ENERGY AUDIT

In any industry, the three top operating expenses are often found to be energy (both electrical and thermal), labour and materials. If one were to relate to the manageability of the cost or potential cost savings in each of the above components, energy would invariably emerge as a top ranker, and thus energy management function constitutes a strategic area for cost reduction. Energy Audit will help to understand more about the ways energy and fuel are used in any industry, and help in identifying the areas where waste can occur and where scope for improvement exists. The Energy Audit would give a positive orientation to the energy cost reduction, preventive maintenance and quality control programmes which are vital for production and utility activities. Such an audit programme will help to keep focus on variations which occur in the energy costs, availability and reliability of supply of energy, decide on appropriate energy mix, identify energy conservation technologies, retrofit for energy conservation equipment etc. In general, Energy Audit is the translation of conservation ideas into realities, by lending technically feasible solutions with economic and other organizational considerations within a specified time frame.

IV. METHODOLOGY FOR ENERGY AUDIT

A structured methodology is helpful in carrying out the energy audit in a more efficient way. Methodology varies from one organization to another; however, the

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objectives of energy auditing should be fulfilled whatever methodology adopted should be known to the external energy auditor before hand, so that the energy auditor remains aware about the activities, He is supposed to do during the auditing phase. This can be discussed during pre bid discussion. Some of the steps for finalizing the methodology for Preparation of single line diagram of electrical system. Average load on transformers and on various other feeders are required to be mentioned. Collection of energy audit is mentioned below; Predefine data related with energy consumption. Study of annual energy bill and energy consumption patterns. Preparation of pie chart, graph etc. of the energy consumption pattern. Identification of energy consumption per unit of product and also cost of energy per unit of product. Identification of cost of energy in total cost of product. These are all baseline data, which are neglected during the detailed analysis of energy consumption. A scheduled for taking measurements of site is to be prepared in consultation with the engineer-in-charge, so that plant personnel could be spared and deputed along with the auditing team. It should also be indicated that the suggested energy saving scheme is new one or retrofitting in the existing system is required. Further, it should be prioritized by short, medium and long-term measure. Training program for general awareness may also be kept in the scope of energy auditor however, this requirement is optional. The energy auditor may also study the existing energy monitoring and reporting scheme and if any improvement is required, it may be suggested along with the cost benefit analysis. Many times, harmonics study and thermography of the equipment are also kept as part of energy audit program. Sometimes, involvement of energy auditor in implementation of energy saving scheme is also kept as part of energy saving scheme is also kept as part of energy audit.

V. ENERGY AUDIT OF ENGINEERING

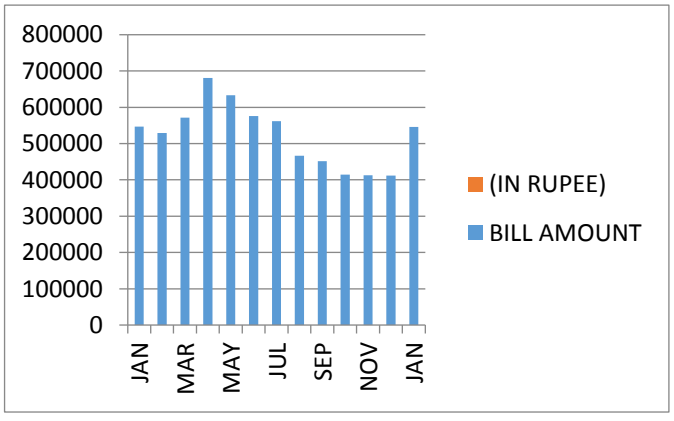

Fig 1-COST PER MONTH

The bill amount is seen maximum in the month of April and May and lowest in the month of October, November and December. Due to various practical exams the energy consumption in the month of April and May is more. Various motors and computers running the energy consumption is more. In these months the city of PUNE experiences the hottest period of the year and hence the usage of Fans, Water cooler, Air conditioners etc, due to this the energy consumption in these months are more than any other month in the whole year.Proper use of fan should be done so as to reduce the unnecessary load and to switch of the Fans where nobody is present Also use proper Energy efficient Air conditioners and Water coolers so as to reduce the energy consumption in the given period of time.

VI. KVAH

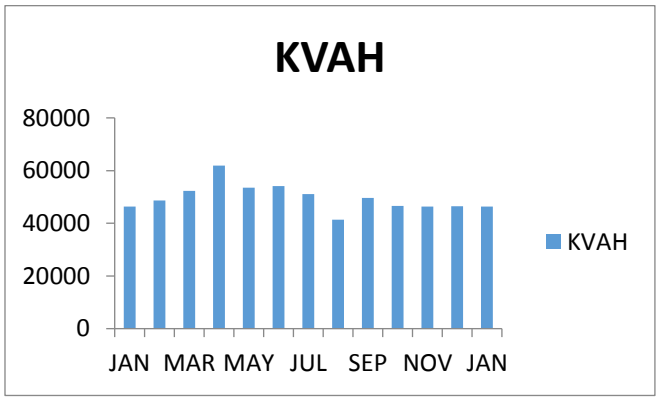

Fig 2 -UNITS UTILISED

In the conventional method of electricity metering, the active energy (KWh) is measured. And the tariff is fixed by most of the utility (duly authorized by the regulatory authority) for active energy consumed. When the reactive power factor of the load falls below unity or below specified value, the apparent energy (KVAh) delivered to the load increases for the same active energy (KWh) delivered. This means the supplier has to maintain an additional installed capacity due to poor power factor of the load maintained by the consumer. It indicates that the total energy consumption by the college is same throughout the year, and there is a same amount the total Active and Reactive power that has been consumed by the college every month.The use of proper Energy efficient Fans and other motors that are used throughout the years such as Water pumps for boring and to pump the water to the tanks and other fire fighting pipes installed all over the college.

KVAh = KWh + KWRh.

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VII. CONSUMPTION

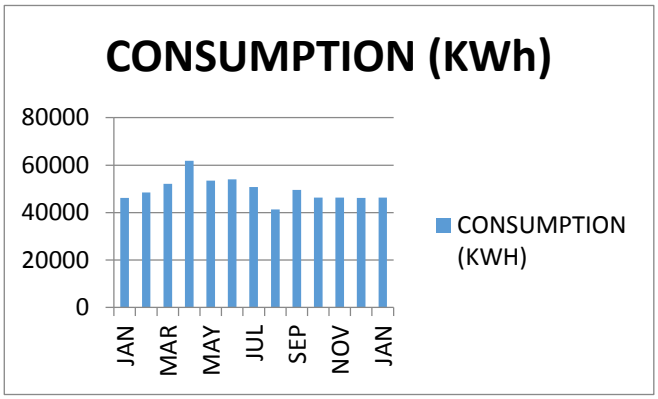

Fig 3. Consumption

The metering bill is calculated on the basis of KWh value. As seen from the graph the energy consumption is maximum in the month of April than any other month thus causing the bill amount to be maximum in this month. The consumption of energy is due to the summer season and due to various college activity, so as to reduce the load there is a need of power saving devices and as well as the use of energy efficient machines .

VIII. REACTIVE POWER

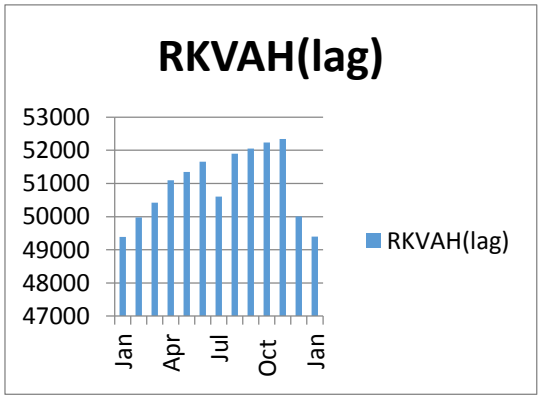

Fig 4 . RKVAH

The reactive power consumption can be seen from the above graph. The consumption is maximum in the month of November and is Minimum in the month of January. The reactive power consumption is increasing as the term end approaches to its end .It gradually increases from January to June as the terms (even semester) get over the reactive power consumption is thus decreased in the month of July , due to the commencement of new course (odd semester) . Then it increases to the highest value in the month of November .It can be seen that the graph follows an symmetric curve throughout the semester except it rises continuously in the month of August, September, October, November, then falls in December due to the ending of the term (odd semester).

IX. CALCULATION

WORKSHOP BUILDING CALCULATIONS:

Total Fan Load = 202; Total tubes = 229

Replacement of 60 watts fans with 50 watts good quality Havells/khaitan fans.

Total difference = 202 x 10 (difference) = 2020 watts total saving

Use of LED in case of tubes of 43 watts with 16 watts.

Total difference = 229 x 27 (difference) = 6183 watts total saving.

Total saving=2020+6183=8203; total cost saved per hour=8203x0.08=656.24perhr

Total cost per week=656.24x40=Rs26249.5.

Total investment=202x1700=343400(fan); 229X121=27709(light)

=Rs371109

Payback period=371109/26249.6=14 weeks approx..

WEST WING CALCULATIONS:

Total Fan Load = 175 ; Total Tubes = 265

Replacement of 60 watts fans with 50 watts good quality Havells/khaitan fans.

Total difference = 175 x 10 (difference) = 1750 watts total saving.

Use of LED in case of tubes of 43 watts with 16 watts.

Total difference = 265 x 27 (difference) = 7155 watts total saving.

Total saving = 1750 + 7155 = Rs 8905

Total cost saved per hour = 8905 x 0.08 = Rs712.4

Total cost saved per week = 712.4 x 40 = Rs 28496

Total investment (fan) = 175 x 1700 = Rs 297500

Total investment (tube) = 265 x 121 = Rs 32065

Total cost = Rs 329565

Payback period = 329565/28496

=11.5 or 12 approx.

CENTRAL WING CALCULATIONS:

Total Fan Load = 258; Total tubes = 292

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Replacement of 60 watts fans with 50 watts good quality Havells/khaitan fans.

Total difference = 258 x 10 (difference) = 2580 watts of total saving.

Use of LED in case of tubes of 43 watts with 16 watts,

Total difference =292 x 27 = 7884 watts total saving.

Total saving = 2580 + 7884 = Rs 10464

Total cost saved per hour = 10464 x 0.08 = Rs 837.12

Total cost saved per week = 837.12 x 40 = Rs 33484.8

Total investment (fans) = 258 x 1700 = Rs 438600

Total investment (tube) = 292 x 121 = Rs 35332

Payback period = 473932/33484.8 = 14 weeks approx.

X. CONCLUSION

In these days of uncertainty, it is important to keep operating expenses to a minimum. Unnecessary costs include costs for energy we don't, need to use. The major loads for a commercial buildings are the lighting loads, pumps and the major motors running for hours. Therefore major consumption in lightening system can be reduced by using efficient lamps with less power rating and the efficiency of which is more. The system for lightening can be modified by changing the filament bulbs the fluorescent lamps , these products incur high losses in power and more consumption therefore it should be replaced by LED bulbs the CFL's. these have high energy saving. Automatic lightening system may be used which detect the presence of a person this helps in improved lightening performance.

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