ELECTRICAL ENERGY CONCEPTIONAL ANALYSIS BY ANALYTIC METHOD

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ABSTRACT

An energy audit is an inspection, survey and analysis of energy flows for energy conservation in a building, process or system to reduce the amount of energy input into the system without negatively affecting the output. When the object of study is an occupied building then reducing energy consumption while maintaining or improving human comfort, health and safety are of primary concern. Beyond simply 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.

Energy Audit is the key to a systematic approach for decision-making in the area of energy management. It attempts to balance the total energy inputs with its use, and serves to identify all the energy streams in a facility. It quantifies energy usage according to its discrete functions. Energy audit is an effective tool in defining and pursuing comprehensive energy management is to achieve and maintain optimum energy procurement and utilisation, throughout the organization.

Through this project we can prioritize the energy uses according to the greatest to least cost effective opportunities for energy savings in our college campus

Key words:- *Energy Audit, Energy Consumption, Energy efficiency, Bill, Saving, Payback Period, Measure*

1. INTRODUCTION

Energy Audit is an inspection, survey and analysis of energy flows for energy conservation in a building or system to reduce the amount of energy input to the system without negatively affecting the output.

As per the Energy Conservation Act, 2001, Energy Audit is defined as "the verification, monitoring and analysis of use of energy including submission of technical report containing recommendations for improving energy efficiency with cost benefit analysis and an action plan to reduce energy consumption".

It is an effective and concrete method to achieve rapid improvement in energy efficiency in buildings and industrial process. First step in identifying opportunities to reduce energy expense. Which is a Systematic procedure including some steps. Energy auditing is also called as Energy assessment, Energy survey etc…

The objectives are

- To minimize energy costs / waste without affecting production & quality
- To minimize environmental effects.

The primary objective of Energy Audit is to determine ways to reduce energy consumption per unit of product output or to lower operating costs. Energy Audit provides a "bench-mark" for managing energy in the organization and also provides the basis for planning a more effective use of energy throughout the organization

2. LITERATURE REVIEW

Duke Ghosh and et. al (2011) describes that it is an established practice in India for firms to engage consultants to study the usage of energy and suggest ways and means to improve energy efficiency. The study finds that only 14 percent of the respondent firms have employed an energy consultant and conducted a detailed process study with a focus on energy usage. Further investigations suggest that the majority of these firms have either implemented the process to reduce the costs associated with energy consumption or to ensure uninterrupted power supply. Becoming energy efficient was definitely not the motivation for these firms to hire consultants to study their energy usage. It is also important to note that 33 percent of the firms which appointed a consultant to monitor energy usage did not implement the recommendation(s) by the consultants.

Raphael Wentemi Apeaning (2013) explains the importance on the judicious use of energy by industries is a key lever for ensuring a sustainable industrial development. The cost effective application of energy management and energy efficiency measures offers industries with an effective means of gaining both economic and social dividend, also reducing the negative environmental effects of energy use. Unfortunately, industries in developing countries are lagging behind in the adoption of energy efficiency and management measures; as such missing the benefits of implementation.

Irawati Naikand et. al (2011)describes that energy is crucial to human sustenance and development. Due to the increase in the Demand of energy and deficiency in power generation, day by day the gap between demand and supply of electric energy is widening. Bridging this gap from the supply side is very difficult and expensive proposition. Also limited energy resources, scarcity of capital and high interest costs for the addition of new generation capacity is leading to the increased cost of electrical energy in India. The only viable way to handle this crisis, apart from capacity addition, is the efficient use of available energy, which is possible only by continuously monitoring and controlling the use of electrical energy.

3. ENERGY AUDITING METHODS

Energy Audit can be classified into the following two types.

1. Preliminary Audit
2. Detailed Audit

3.1 Preliminary Energy Audit Methodology

Preliminary energy audit is a relatively quick exercise to:

- Establish energy consumption in the organization
- Identify areas for more detailed study/measurement
- Preliminary energy audit uses existing, or easily obtained data

3.2 Detailed Energy Audit Methodology

A comprehensive audit provides a detailed energy project implementation plan for a facility, since it evaluates all major energy using systems.

This type of audit offers the most accurate estimate of energy savings and cost. It considers the interactive effects of all projects, accounts for the energy use of all major equipment, and includes detailed energy cost saving calculations and project cost.

In a comprehensive audit, one of the key elements is the energy balance. This is based on an inventory of energy using systems, assumptions of current operating conditions and calculations of energy use. This estimated use is then compared to utility bill charges.

Detailed energy auditing is carried out in three phases: Phase I, II and III.

Phase I - Pre-Audit Phase

Phase II - Audit Phase

Phase III - Post Audit Phase

4. INSTRUMENTS USED FOR ENERGY AUDITING

4.1. Lux meter

Illumination levels are measured with a lux meter. It consists of a photo cell which senses the light output, converts to electrical impulses which are calibrated as lux.

Fig-1: Lux meter

4.2.Power Factor Meter

A power factor meter is a type of electrodynamometer movement when it is made with two movable coils set at right angles to each other. The method of connection of this type of power factor meter, in a 3 phase circuit. The two stationary coils, S and S_1, are connected in series in Phase B. Coils M and M_1 are mounted on a common shaft, which is free to move without restraint or control springs.

Fig-2: Power factor meter

4.3. Energy meters

An electricity meter, electric meter, electrical meter, or energy meter is a device that measures the amount of electric energy consumed by a residence, a business, or an electrically powered device. Electric utilities use electric meters installed at customers' premises to measure electric energy delivered to their customers for billing purposes. They are typically calibrated in billing units, the most common one being the kilowatt hour [kWh]. They are usually read once each billing period. When energy savings during certain periods are desired, some meters may measure demand, the maximum use of power in some interval. "Time of day" metering allows electric rates to be changed during a day, to record usage during peak high-cost periods and off-peak, lower-cost, periods. Also, in some areas meters have relays for demand response load shedding during peak load periods.

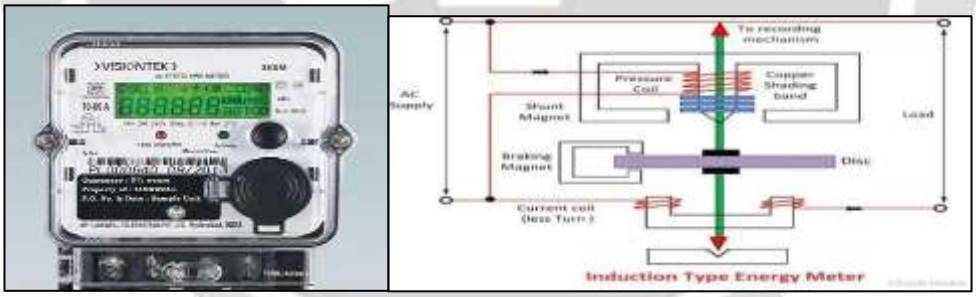

Fig-3: Energy meter

4.4. ELECTRICAL MEASURING INSTRUMENTS

These are instruments for measuring major electrical parameters such as, kW, PF, Hertz, amps and volts. In addition, some of these instruments also measure harmonics. These instruments are applied on line, i.e., on running motors without stopping the motor. Instantaneous measurements can be taken with hand held meters.

5.DESIGN FOR ENERGY SAVINGS

5.1 Illumination

Lighting or illumination is the deliberate use of light to achieve a practical or aesthetic effect. Lighting includes the use of both artificial light sources like lamps and light fixtures, as well as natural illumination by capturing daylight. Day lighting (using windows, skylights, or light shelves) is sometimes used as the main source of light during daytime in buildings. This can save energy in place of using artificial lighting, which represents a major component of energy consumption in buildings. Proper lighting can enhance task performance, improve the appearance of an area, or have positive psychological effects on occupants. Indoor lighting is usually accomplished using light fixtures, and is a key part of interior design. Lighting can also be an intrinsic component of landscape projects.

To find number of light fittings, N

$$N = \frac{EA}{O \times CU \times MF}$$

Where,

N= Number of Light Fittings Needed

E= Required Illumination (lux)

A= Working Area (m2)

O = Luminous Flux Produced Per Lamp (Lumens)

CU= Coefficient of Utilization

MF: Maintenance Factor

5.2 Lux

The lux is the SI unit of illuminance and luminous emittance, measuring luminous flux per unit area. It is equal to one lumen per square meter. In photometry, this is used as a measure of the intensity, as perceived by the human eye, of light that hits or passes through a surface. It is analogous to the radiometric unit watts per square meter, but with the power at each wavelength weighted according to the luminosity function, a standardized model of human visual brightness perception.

5.3 Lumens

The lumen (symbol: lm) is the SI derived unit of luminous flux, a measure of the total quantity of visible light emitted by a source. Luminous flux differs from power (radiant flux) in that radiant flux includes all electromagnetic waves emitted, while luminous flux is weighted according to a model of the human eyes sensitivity to various wavelengths. Lumens are related to lux in that one lux is one lumen per square meter. The lumen is defined in relation to the candela as

$$1\ lm = 1\text{cd/m}^2$$

5.4 Coefficient of Utilization

It is the ratio of the lumens actually received by a particular surface to the total lumens emitted by a luminous source. It is an indication of the effect of the lighting equipment and the interior combined in producing horizontal

illuminance. For example UF of 0.3 means that the lumen reaching horizontal plane is 30% of the lumens of the lamp operated bare under standard conditions. The value of this factor varies widely and depends on the following factors: Type of lighting system, whether direct, indirect etc, the type and mounting height of fittings, the colour and surface of walls and ceiling to some extent the shape and dimensions of the room

5.5 Maintenance Factor

It is the ratio of illuminance halfway through a cleaning cycle, to what the illuminance would be if the installation was clean. This factor allows for the fact that the effective candle power of all lamps or luminous sources deteriorates due to blackening and/ or accumulation of dust or dirt on the globes and reflectors etc. Similarly walls and ceilings also do not reflect as much light as when they are clean.

6. CONCLUSION AND FUTURE SCOPE

The Proposed project gave strong warning to the consumer not only in terms of the energy bills but also the energy crisis in the near future to all sectors of people. This projects recommendation reduces around 15-20% of the energy and 25-30% of cost reduction excluding some issues likes more payback period. There is a scope of improvement to include the advanced lighting scheme to reduce further 10% of the operating cost. As per the ECBC building ratings, 5 Star labeled buildings are most efficient and we found that our campus could be labelled as 5 stars as per ECBC criterion. As per ECBC, a building exceeding an EPI of 1000kWh/m^2 per year comes under the ECBC complaints. In the AIT campus we observed that only an EPI of 3.3kWh/m^2 per year, so the campus found to be free from the ECBC complaints.

The future aspect is that an energy audit systematically identifies and develops opportunities to help reduce energy consumption and decrease a building's operating costs. The audits can vary in scope and complexity. Through energy auditing, institutions and systems can study and research certain parameters of energy management. Those are stated below

1. Legal Requirements
2. Entity Aspects
3. Reliable Information
4. Evaluation
5. Test
6. Proper Communication
7. Comparison
8. Judgments

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