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Energy Audit of a Building for Efficient Energy Consumption

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Abstract: Now a day's energy management and conservation is necessary this shoves to save energy by using efficient equipment and use them effectively. The optimization of energy load can help us to reduce the energy consumption for the given load. Recent researches in energy management have shown that a major portion of the electrical energy is lost in buildings because of improper use of various equipments and appliances. Tore solve the aim of conservation of energy, the concept of Smart building is proposed. Smart building involves the use of monitors for consumptionofenergyandcontrollingtheworkingbehaviorofappliances.Moreover, this paper also highlights the various techniques that can help tore duce the amount of energy consume dinan official building and also the various factors responsible for energy wastage.

Keyword: Energy Audit, Energy Consumption, Energy Tips, Pre audit, Post audit.

I. INTRODUCTION

The idea is to facilitate a general residential building with all required facilities and infrastructure, to keep it on meeting and chasing the yardsticks of comfortable and energy audited building in the world.

This also provides best accommodation facilities to the people so that they can carry their job work, studies and daily activities properly to meet daily challenges of technical growth.

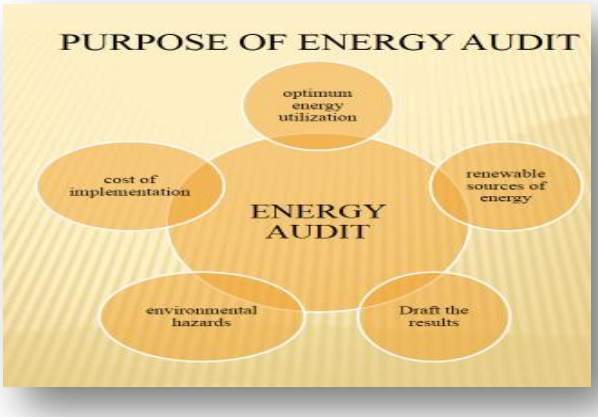
A. Objective of the Energy Audit

Broadly energy audit program initiated at Walk through Audit with the aim of inspection, then reach higher level of Audit know as Mini Audit or Primary Audit to evaluate and recheck the inspected area and the carried to next and final level called Major Audit or Secondary Audit. The purpose of energy audit is shown in fig 1.

The time required to completely audit a plant depends on the size of plant. The purpose of Energy Audit is to inspect, identify, evaluate, quantify, describe and prioritize energy saving measures for Energy Conservation.

The objective of Energy Management is as:

- To attain and maintain optimum energy utilization.
- To minimize energy wastage and cost without affecting desired objectives and quality
- To minimize environmental hazards
- To evaluate energy saving and efficiently utilizing potential.
- To estimate the cost of implementation, payback periods and future extension for each recommended action.
- Draft the results & all important information generated through process.
- To identify potential usages and implementation of co-generation, renewable sources of energy (like solar, wind etc.) for cost effectiveness.



B.Introduction to Building

i. Building Layout:-

Building has total five floors. Each floor has total 10 rooms i.e. in total building have fiftyrooms. Out of which five rooms are utilized as TV room on each floor. Each room has separated bathroom and each floor has separated water cooler area.

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ii. General Building Load Details: -

Table1: Building Load Details (Generator Load)

Generator Load				
Sr. No.	Electrical Load/ equipments	Total Nos.	Ratings in Watt	Total load in Watt
1	Tube Light	50	40	2000
2	Fan	50	60	3000
3	Bathroom lighting (Tube Rod)	50	40	2000
4	Fan (passage)	1	60	60
	Total load			7060

Table 2: Building Load Details (Main Load)

Mains Load				
Sl. No.	Electrical Load/ Equipment	Total Nos.	Ratings in Watt	Total load in Watt
1	Night lamp	50	8	400
2	Tube Light	50	40	2000
3	3-pin socket	58	100	5800
4	Power socket	60	1000	60000
5	Fan	50	60	3000
6	Passage lighting	20	15	300
7	Fan (passage)	1	60	60
8	Outside Illumination(CFL)	50	15	750
9	Bathroom lighting (Tube Rod)	50	40	2000
10	Exhaust fan	50	55	2750
11	Water Heater	50	2000	100000
12	Water cooler	5	775	3875
13	Cooler	50	200	10000
14	Washing machine	5	2000	10000
15	Panasonic LCD TV	5	140	700
16	Kitchen room lighting	50	40	2000
	Total Load			203635

➢ COMPONENT OF CONSUMPTION COST:-

a. Electrical Energy.
b. Water Energy.

➢ MAJOR ENERGY CONSUMPTION AREAS:-

a. Cooling
b. Illumination
c. Heating of Water

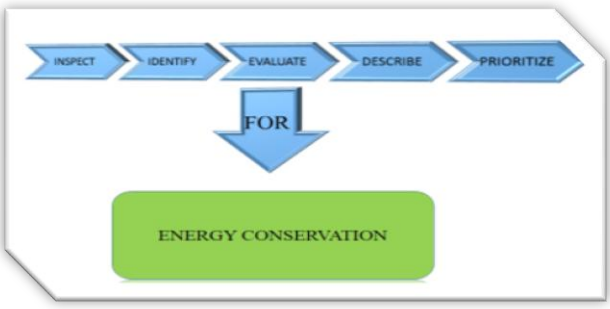

Fig. 2 Energy Auditing Process

II. ENERGY AUDIT

A. Methodology

An energy audit consists of a detailed examination of how a facility uses energy, what the facility pays for that energy, and finally, a recommended program for changes in operating practices or energy-consuming equipment that will cost-effectively save dollars on energy bills. The energy auditis a positive experience with significant benefits to the business or individual, and the term ”audit” should be avoided if it clearly produces a negative image in the mind of a particular business or individual.

The audit process starts by collecting information about a facility’s operation and about its past record of utility bills. This data is then analyzed to get a picture of how the facility uses-and possibly wastes” energy, as well as to help the auditor learn what areas to examine to reduce energy costs. Specific changes-called Energy Conservation Opportunities (EC0’s)-are identified and evaluated to determine their benefits and their cost-

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effectiveness. These ECO's are assessed in terms of their costs and benefits, and an economic comparison is made to rank the various ECO's.

Finally, an Action Plan is created where certain ECO's are selected for implementation, and the actual process of saving energy and saving money begins.

The audit is conducted in three Steps, viz:

1. Step I - Pre Audit Phase
2. Step II - Audit Phase
3. Step III - Post Audit Phase

The audit team visited rooms at all the three buildings and interviewed several residents. During such visit the audit team collected macro information like number of hours of actual usage of fluorescent light, fan, power points etc. The data thus collected is enclosed.

The main objective of the Pre-Phase audit is to create awareness among the residents about the energy conservation.

The team also photographed some of the electrical load points. A questionnaire was circulated to the residents of building and the sample is enclosed.

III. QUANTIFICATION BY END USER

A. Distribution of Energy Consumption

The loads are in previous time isolated on the basis of lighting and fans, washing machines, television, sockets, heaters, coolers and water coolers. Quantification, types and necessary measurements were carried out. The details are given here.

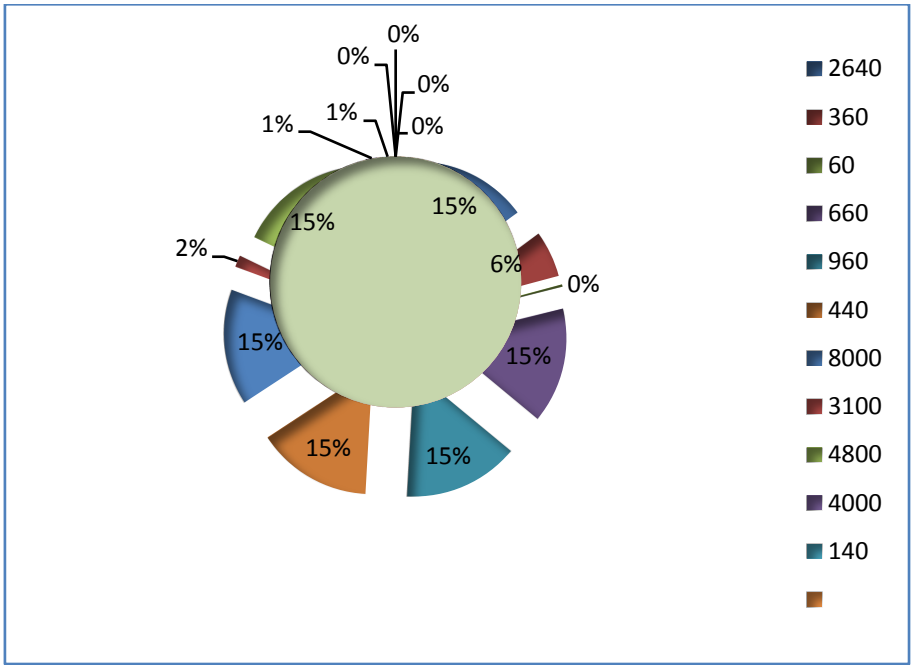

Fig3. Flow Chart for Energy Audit

B. Calculation of Energy consumed in 20 days

The energy consumed by various components is listed below in table no 3 with detailed calculation of energy consumption and cost.

Table 3: Energy Consumption by End User

Sl. No.	Electrical Load/ Equipments	Total Nos.	Ratings in Watt	Total load in Watt	Usage in day(hrs)	Total KWh a day	June July (20 days) kWh	Cost of Energy @Rs 5.50
1	Night lamp	50	8	400	6	2.400	48	264
2	Tube light	50	40	2000	10	20.000	400	2200
3	3-pin socket	58	100	5800	4	23.200	464	2552
4	Power socket	60	1000	60000	4	240.000	4800	26400
5	Fan	50	60	3000	18	54.000	1080	5940
6	Passage lighting	20	15	300	6	1.800	36	198

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7	Fan (passage)	1	60	60	18	1.080	21.6	118.8
8	Outside Illumination(CFL)	50	15	750	4	3.000	60	330
9	Bathroom lighting (Tube Rod)	50	40	2000	4	8.000	160	880
10	Exhaust fan	50	55	2750	10	27.500	550	3025
11	Water Heater	50	2000	100000	NA	0	0	0
12	Water cooler	5	775	3875	24	93.000	1860	10230
13	cooler	50	200	10000	18	180.000	3600	19800
14	Washing machine	5	2000	10000	8	80.000	1600	8800
15	Panasonic LCD TV	5	140	700	3	2.100	42	231
16	Kitchen room lighting	50	40	2000	8	24.000	480	2640
	Total Load			204635	Total cost(Rs.) for 20 days			83608.8

The major energy consuming components can be strictly monitored. These components are

i. Power sockets: The load of power sockets is variable as per consumer's requirement. The load shown above is considered with maximum load.

Fig 4. Power socke

ii. Cooler: The coolers in the corridors are not utilized efficiently for the purpose of cooling, hence they can be eliminated.

Fig.5. Coolers Used In building

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iii. Water cooler: They are on all the time; they can be used during peak hours i.e. during day time.

Fig.6. water cooler

iv. Fans: Although fans are required all the time in summer but the power can be saved by using regulators whenever required.
v. Washing machine: Washing machine consumes lot of water and electricity which can be saved by the proper use by the consumer. Corrective measures should be taken such as using machine in correct mode, switching off supply when not in use.

IV. RECOMMENDATIONS

A. Benchmarking

Energy benchmarking involves the development of quantitative and qualitative indicators through the collection and analysis of energy-related data and energy management practices. Benchmarking in simplistic terms is the process of comparing the performance of a given process with that of the best possible process and to try to improve the standard of the process to improve quality of the system, product, services etc.

It allows organizations to develop plans on how to adopt such best practices, usually with the aim of increasing some aspect of performance. Benchmarking may be a one-off event, but is often treated as a continuous process in which organizations continually seek to challenge their practices. Benchmarking is a method which should be used on a continual basis as best practices are always evolving.

Benchmarking of energy consumption is a powerful tool for performance assessment and logical evolution of avenues for improvement.

Historical data, well documented, helps to bring out energy consumption and cost trends month-wise / daily. Trend analysis of energy consumption, cost, relevant production features, specific energy consumption, help to understand effects of capacity utilization on energy use efficiency and costs on a broader scale.

B. Suggestions:

1. Passage lights can be reduced to 3 per floor.
2. CFL's can be replaced by efficient LED's.
3. For bathroom illumination LED lights of 7W can be used 4 in number per floor.
4. Coolers at corridor can be removed.
5. For outside illumination LED lights of 10W can be used.
6. The main area where energy is being wasted is corridor and bathroom. As no one is bothered to switch off the appliances when not needed.
7. A lot of water is being wasted due to damaged valves, as the water through tap run all the day. For avoiding this we can use automatic water sensing taps.
8. Water cooler and refrigerator should be placed in a location with sufficient air circulation.
9. Condenser of old fan may be replaced by new to avoid losses.
10. Cloth curtain may be replaced be replaced by Strip curtain of light color (benefit of solar light may be harvested in better way)
11. Proper alignment of light will improve the light condition and reduce no of tube light required. After using recommendations, the cost can be reduced as shown in the table 4.

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Table 4: Energy Consumption by End User with Recommended Plan

Sl. No.	Electrical Load/ equipments	Total Nos.	Ratings in Watt	Total load in Watt	Usage in Day (hrs)	Total KWh a day	June July (20 days) kWh	Cost of Energy @Rs 5.50
1	Night lamp	50	8	400	6	2.400	48.00	264
2	Tube Light	50	40	2000	10	20.000	400.00	2200
3	3-pin socket	58	100	5800	4	23.200	464.00	2552
4	Power socket	60	1000	60000	4	240.000	4800.00	26400
5	Fan	50	60	3000	18	54.000	1080.00	5940
6	Passage lighting	20	15	300	6	1.800	36.00	198
7	Fan (passage)	1	60	60	18	1.080	21.60	118.8
8	Outside Illumination(CFL)	50	8	400	4	1.600	32.00	176
9	Bathroom lighting (CFL)	50	18	900	4	3.600	72.00	396
10	Exhaust fan	50	55	2750	10	27.500	550.00	3025
11	Water Heater	50	2000	100000	NA	0.000	0.00	0
12	Water cooler	5	775	3875	24	93.000	1860.00	10230
13	Cooler	50	200	10000	18	180.000	3600.00	19800
14	Washing machine	5	2000	10000	8	80.000	1600.00	8800
15	Panasonic LCD TV	5	140	700	3	2.100	42.00	231
16	Kitchen room lighting	50	18	900	8	7.200	144.00	792
	Total Load			201085	Reduced cost(Rs.) for 20 days			81122.8

For 20 days in summers (without water heater):

Net saving in Wattage =204635-201085=3550 Watts
Net saving in cost= 83608.8 - 81122.8 =Rs. 2486

Energy Saving Tips

- Turn off lights when you leave the room or an area that is unoccupied, especially at night and on weekends.
- When working in the room, open the window for light.
- Shut down computers and turn off monitors at the end of the day.
- Set printers and copiers to go into a "Power save" mode after one hour of idle time, and turn off over weekends.
- Use laptop computers and ink jet printers, if available, since they use 90% less energy than desktop and laser printers. ¬ Limit the use of elevators.
- Close drapes and blinds to keep heat/cold out.
- Implement paper-reducing strategies, such as double-sided printing, re-using paper, and using e-mail instead of sending memos or faxing documents not only to save energy, but to conserve other resources. Doubled sided print will also save you money in the student computer labs. A single-sided sheet of black and white costs 8 cents while a double sided black and white page costs 12 cents.
- Connect PCs, monitors, fax machines and computer "peripherals" to one power strip, and then turn off that power strip when not in use.
- Adopt a last-person-out policy. The last person to leave labs, lecture rooms and meeting rooms should be responsible for turning off lights and unnecessary equipment.
- Fume hoods are a major source of energy consumption. Lab workers should keep fume sashes at a minimum working height after setting up experiments, and close sashes when not in use.
- Turn off lights in unoccupied offices, classrooms, conference rooms and restrooms. Check these areas as you leave the office for the day, especially before weekends and holidays.
- Keep exterior doors and windows closed in climate controlled spaces. This reduces heat loss in the winter and heat gain in the summer.
- Dress appropriately for the seasons and the comfort level of your work area. ¬ Recycle every chance you get.
- Get heading for Renewable Energy Sources and Green Power.

V. CONCLUSION

Improving energy efficiency of rooms as well as all on the basis of power consumption. Complete cost analysis of implementation of recommended measures has been analyze and calculated. It can be performed wherever

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necessary or required. Energy efficiency devices are listed that as fossil fuels like coal and petroleum that provide electricity and gas to power our growing energy needs. These resources are non-renewable which means that we will eventually run out and deplete or vanish with the time. Conservation don't stop to assess the amount of resources we are using. Depleting resources are not boundless which will lead to energy crises.

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