# COMPARATIVE STUDY OF ENERGY SAVING IN THEME BASED AREA BY LUMINARY REPLACEMENT STRATEGY

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**Abstract:** Considerable consumption of power take place at different location like corridors, class rooms, laboratories, reading halls, and conference rooms in an educational institute. Light Emitting Diode (LED) and Compact Fluorescent Lights (CFL) bulbs have revolutionized energy-efficient lighting. The powers consumed by these are significantly less than the power consumed by Incandescent bulbs or fluorescent tubes. However higher initial installation costs is a limiting factor for the replacement of present lighting with LED lamps. Although CFLs are an excellent source of energy-efficient lighting, they are not always the best choice for all lighting applications. Due to its On/Off cycling, its mercury content further CFLs are not spot lights CFLs exhibit shorter life spans in light fixtures and sockets where there is low air-flow. It is advisable to change the present lighting with LED bulbs, but the cost factor comes in to picture and hence pay back period varies depending upon the area of space where luminaries are to be replaced. This paper reports the comparison of energy saving in study hall, conference room and laboratories in an educational institute having area of 1000sqft. The spread sheet based decision making system for luminary replacement strategy is adapted for the comparison. .

**Key words: Energy Saving, Fluorescent Tube, LED Lighting, Luminary Replacement.**

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**Introduction:**

Luminance required is different at different locations in an educational institute. The task based lighting is important aspect for energy saving. It is reported that required luminance at public spaces with dark surrounding is around 30 lux, for working spaces where visual task are only occasionally performed are 150 lux, visual task of medium contrast or small size are 750 lux where as visual task of low contrast and very small size over a prolonged period is about 3000 lux. The advisable solution for energy saving is to replace the present incandescent lighting to LED lighting. The replacement cost of present lighting with LED bulbs is complex. This paper presents a spreadsheet for calculation of energy saving and payback period of lighting equipment in conference rooms having different areas.

Lighting systems used at various places in the institution have the major potential to reduce the energy consumption. Lighting represents approximately one-third of electricity use in commercial buildings and more than one-half in lodging and retail [1][2]. From more the years, researchers are focusing on energy saving from lighting controls in commercial and residential and institutional buildings. This study provides analysis of lighting energy saving in literature and many research papers are published on this area. A few papers have provided limited overviews of lighting controls studies. The estimation of lighting energy saving for occupancy sensors in building space is given in [3]. The energy audit would give a marker to the energy cost saving. Such an audit program will help to reduce the recurring maintenance cost incurred by the institute. In an educational institute the requirement of lighting is different at different places like porches, laboratories, classrooms, conference rooms and study halls. It is reported that light intensity in lux is around at public spaces with dark surrounding is around 30 lux, for working spaces where visual task are only occasionally performed are 150 lux, visual task of medium contrast or small size are 750 lux where as visual task of low contrast and very small size over a prolonged period is about 3000 lux[4]. Further the number of light sources required then depends on the area of such places.

**Energy saving calculations:**

The major energy consumer in an educational system is classrooms, laboratories, study hall and conference rooms. At present most of the educational institute uses fluorescent tube lighting. Enormous energy savings are possible if we replace these tubes with led tubes. It also increases the comfort level. This paper presents a spreadsheet for calculation of energy saving and payback period of lighting equipment for various places like laboratory, conference room and study hall in an educational institute.

Table 1: Data Table

| Theme Area 1000 sqft. | Laboratory | Conference room | Study hall |
|---|---|---|---|
| Required Lux | 150 | 750 | 3000 |
| Lumen | 14 | 70 | 279 |
| No. fluorescent tubes (40watts) | 31 | 155 | 619 |
| No. LED bulbs (18 watts) | 15 | 77 | 310 |
| tube lights consumption (watts) | 1239 | 6193 | 24773 |
| LED bulbs consumption (watts) | 279 | 1394 | 5574 |

While designing the spreadsheet various factors such as energy cost, power consumption, usage time, life of light source and its fixture are considered. For the maintenance of proper and fixed lux level it is assumed that the area of these spaces is constant and is 1000 sqft. The formula used for the calculation of total energy cost is given below[5]:

Total cost (Rs.) = Installation cost + [(Power consumption per luminaire (W) X required lux X Area X use time in hours)/1000] X [Cost per unit]

For the calculation purpose it is assumed that fluorescent tubes (T8 size having 40W) are installed. Assuming 10 working hours per day and 25 working days in a month, the energy consumption by these fluorescent tubes for different duration is calculated. The total cost of this power consumption is calculated by assuming Rs.5/- per unit. The initial cost of the fluorescent tube is Rs.60/- and the cost of its fixture is Rs.300/-. The life of the fluorescent tube is approximately two years and its fixture can be used up to 15 years. So, after every 2 years, the fluorescent tube has to replace. This is the additional cost which is added in the power consumption. If these fluorescent tubes are replaced by the LED tubes, power consumption will be reduced. The 18W LED tubes are assumed in calculations. For the calculation the present day cost of Rs.3600 per tube of 18watt led is considered. The number of LED tubes required for the same lux level is calculated. After replacing all the fluorescent tubes by the LED tubes, the energy consumption gets reduced.

The figure 1 shows the per month saving due to replacement of existing fluorescent tubes with LED tubes for Laboratory, Conference hall and Study hall.

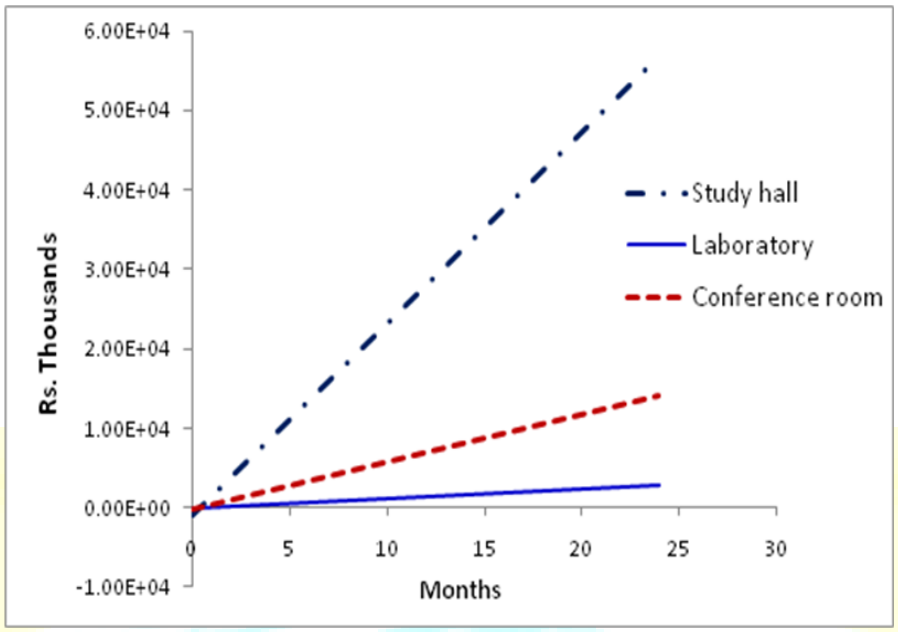


**Fig.1: Savings for 1000 sqft. theme based spaces**

From figure 1 it is clear that the saving is more in case of study hall than conference room and that of Laboratory. This is due to the fact that the lumens level in case of study hall is more than that of Conference room and is more than that of laboratory.

The figure 2 shows the total savings for conference rooms of different capacity.

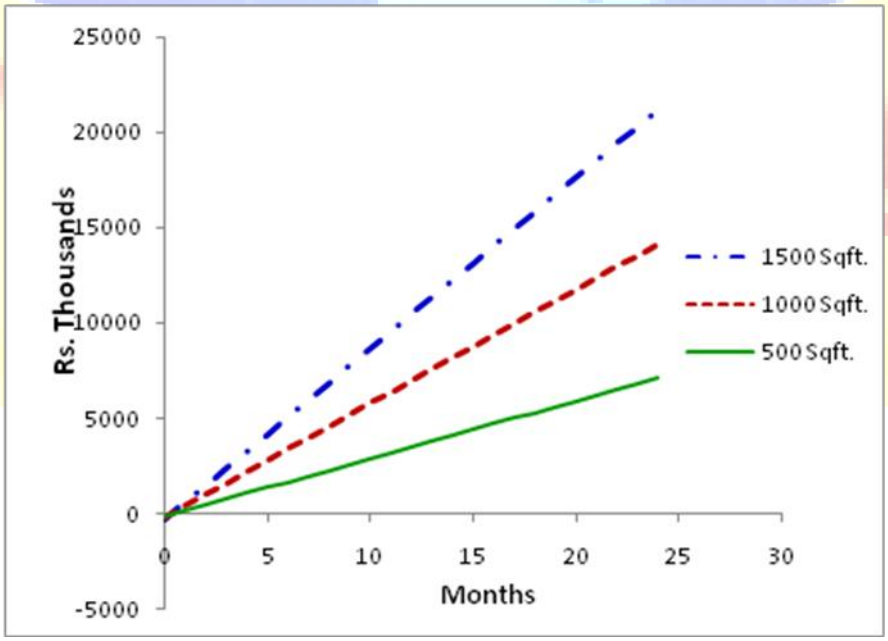


**Fig.2: Area dependence savings for conference rooms**

from figure 2 we see that the saving is area dependant and it is more for more area of conference room. Further the rate which this savings increases is more rapid for larger area.

**Conclusion:**

In this paper comparative study of savings by luminary replacement is done. It is found that if the fluorescent tubes are replaced by the LED tubes then there is considerable savings in terms of power consumption and money. The study is made for Laboratory, Conference hall and Study hall. It is found that for areas requiring high illumination and larger area the luminary replacement is more advantageous.

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