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Energy Efficient Lighting Scheme OfBuildings Using Computer Tools

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ABSTRACT

In many of places or buildings uses only artificial lighting scheme. The daylight is reduces the cost of energy consumption with lighting load. In case of cloudy condition there is less availability of daylight. Thus for proper visualization of objects, manage lighting scheme with artificial as well as daylight harvesting. Using RELUX software design building with proper combination of artificial and daylight schemes with help of sensor element for automatic ON-OFF control.The another tool like DIALUX software reduces the unwanted shadow and glare effect in building. Thus paper aim is design building with proper and efficient lighting scheme with control action of sensor on combination of artificial and daylight with saving of electrical energy cost.

KEYWORDS :building, daylight harvesting , efficient lighting , sensor.

INTRODUCTION

The demand of electricity is more than its production in day today life.The demand of lighting load is increased for housing, domestic purposes, commercial offices and playgrounds. In many of places or buildings uses artificial lighting scheme. When artificial light is used the lighting energy contribution is more compared to daylight scheme.

Thus the artificial and daylight harvesting methods with energy efficient luminaries is dominant in today life. Not only efficient lighting but also proper lighting control gives properly authorized building. As daylight produce less heat per unit illumination than many artificial lighting systems thus day lighting may reduce the cooling requirement when it replace artificial lighting.[1-2]The daylight is reduces the cost of energy consumption with lighting load. In case of cloudy condition there is less availability of daylight. Thus for proper visualization of objects, manage lighting scheme with artificial and daylight harvesting.

This paper approach towards the proper combination of daylight and artificial lighting scheme for saving of energy cost .Using RELUX software design building with proper combination of artificial and daylight schemes with help of sensor element for automatic ON-OFF. The tool like DAILUX software reduces the unwanted shadow and glare effect in building.

Thus paper aim is to design building with proper and efficient lighting scheme with control action of sensor on combination of artificial and daylight lighting load with saving of electrical energy cost.

CASE STUDY

The college building chosen for case study is situated in Vathar near Pune-Banglore highway in Kolhapur district. This college building has 3 floors with classrooms, Laboratories, office and library. The building is RCC framed structured. As per existing design there uses luminaries TL-D 36W and only uses artificial lighting during college hours from (10.00AM -5.00 PM)

So as an electrical engineer we planned to use daylight harvesting scheme for illuminating total college building. Thus author felt that by taking up this case study and with help of RELUX software they could give advantages of daylight harvesting. Also author felt that the unwanted glare and shadow could remove with DIALUX software. Thus the solution is made by the authors could help in convincing the college authority for changing the existing plan for illumination and go towards the reducing cost of lighting load as fulfillment made by author.

The external front view of first floor of college building shown in figure 1

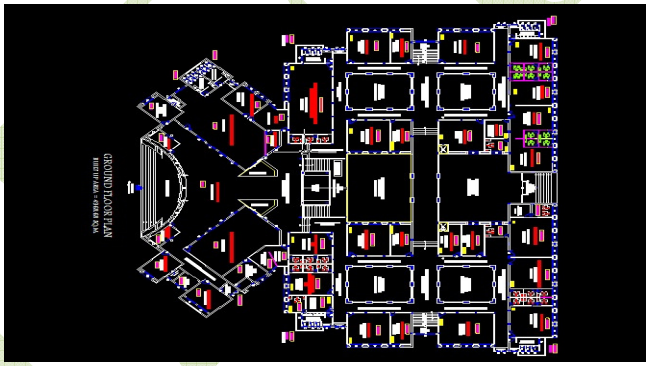

Figure 1.External front view of first floor of college building.

CONVENTIONAL METHOD

A) Artificial illumination

In this section the RELUX software analysis of artificial lighting control for fluorescent luminaries. Consider building with artificial illumination with no use of daylight harvesting. The proper illuminance is considered as per Indian standards[3]

B) Existing illumination action

The existing lighting scheme is provided classrooms and labs with 36 watt fluorescent tubes. The scheme is designed for a services illuminate as per Indian standard IS-3646; 1992[3] considering maintenance factor of 1 using RELUX software. The design using

RELUX software of a seminar hall in college building with existing lighting level shown in figure 2

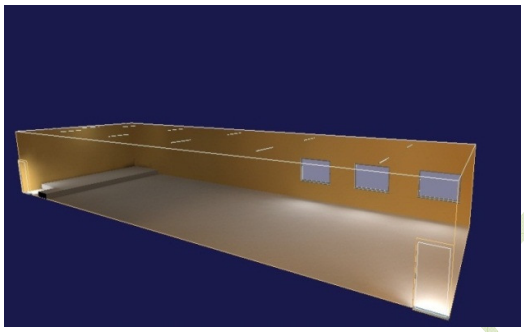

Figure 2. Seminar hall design with existing lighting level

The current trend is to use the artificial illumination through the college hours. The Kolhapur city has much more availability of daylight during college hours. The design shown of artificial or daylight harvesting acting alone shown in figure 3and 4

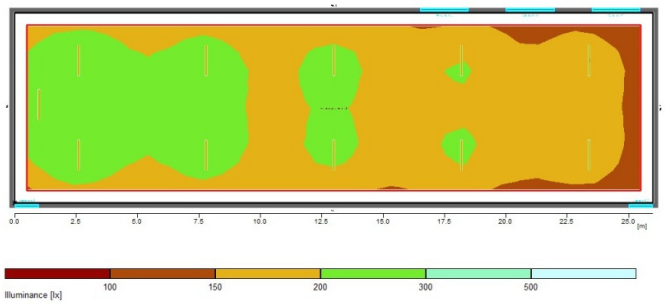

Figure 3.Seminar hall -Artificial result.

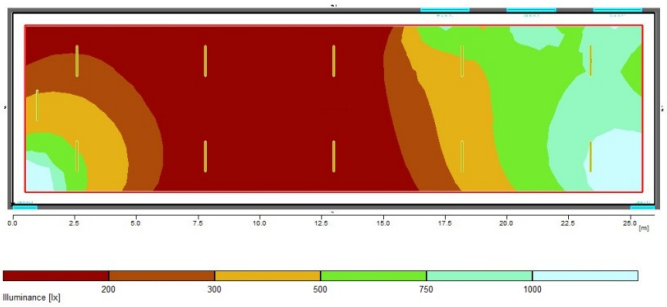

Figure 4.Seminar hall - Daylight result.

PROPOSED METHOD

A) Daylight illumination

If the daylight harvesting is done we can save around70% energy cost. The college building having no availability of desired amount of daylight due to building design with its orientation and classroom dimensions. Thus there is requirement of artificial light to fulfill the need of proper illumination.

One of seminar hall was simulated using RELUX software to check performance of daylight effect. The simulation and hardware had done for 28 days in October 2014 under given sky situations. In time of 10 AM to 12 PM and 3.30 PM to 5 PM there was less availability daylight. The simulated design of seminar hall shown in figure 5

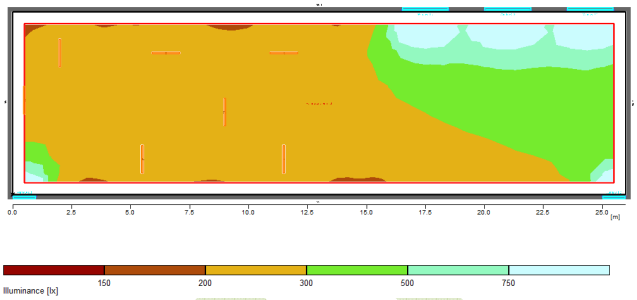

Figure 5. The effective illumination level of seminar hall with artificial and daylight scheme

Thus to maintain 300 lux as per Indian standard [3] there was requirement of artificial light.

B) Effective proposed method

To fulfill the remaining need of lighting while using artificial method or daylight method acting alone there is best solution to use energy efficient lighting scheme. The quantity of light reaching certain surface is usually the main consideration while designing a lighting system with proper combination of artificial method as well as daylight method. In this proposed method uses effective daylight during clear sky. The ratio between the solar heat gain coefficient and visual transmittance is called light- to – solar gain ratio [4].When over sky condition occur then lighting load recovered by using artificial method. The existing fluorescent luminaries can be replaced by proposed LEDs.

The no of luminaries given by Lumen method that should be installed for given area.

The number of lamps is given by the formula

N=E*A/ F*UF*MF

N= No. of lamps required

E= Illuminance level required (lux)

A= Area at working plane height (m^2)

F= Average luminous flux from each lamp (lm)

UF= Utilization factor, an allowance for the light distribution of the luminaire and the room surface.

MF= Maintenance factor, an allowance for reduced light output because of deterioration and dirt.

For example-
Area of seminar hall of college building measures 201.5 sq. m
Illumination required for seminar hall is 300 lux
Utilization factor = 0.70[5]
Lamp maintenance factor = 1[4]

$$N = (300\text{lux} * 201.5)/(2800 * 0.70 * 1)$$
$$N = 30.84$$
$$N = 31 \text{ lamps}$$

Glare And Shadow Removal (Using DILUX Software)

The light cost will be reduced by energy efficient lighting scheme with using software tool. Using DIALUX software minimizes the unwanted glare and shadow of windows, walls and chairs present inside room.The designing of building is same as in RELUX software but only glare and shadow removal of artificial light takes place. Also luminaries are set using various angle for proper light and glare removal purpose.

The conventional lighting deals with halogen lamps, mercury vapour lamps and metal halide used in the substation for carrying maintenance at night [5]. But now day uses metal halide for more light effects.The software have more selections like selection of no of luminaries, types,height,angles and lux requirement for efficient scheme.
Using DILUX software maximum 70% of glare effect should be minimized.Take case study of seminar Hall of AMGOI College building with removal of 70% glare shown in figure 6.

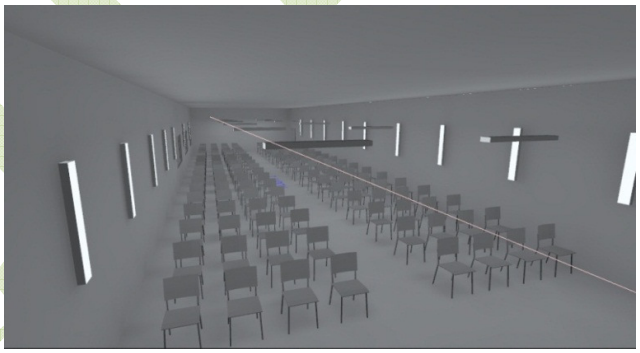

Figure 6.Seminar Hall with removal of 70% glare and shadow.

Daylight harvesting

Daylight harvesting systems which automatically adjust lights in response to the amount of daylight in a space can provide significant energy and demand of saving. The buildings has automated controls on light in presence of daylight called daylight

harvesting. The daylight harvesting method improves control action when requirement of lighting source.

This daylight harvesting system provides sensors to set light ON/OFF. When efficient light is available in room the automatic dimming sensors are used to dimming the luminaries. Most of sensors operates and switch OFF luminaries when room is not in use. These sensors create system more reliable and user friendly. The cost of daylight harvesting system should be low because it uses small components and create automatic control action. So this system is cost efficient.Result using automatic ON/OFF sensor shown in figure 7.

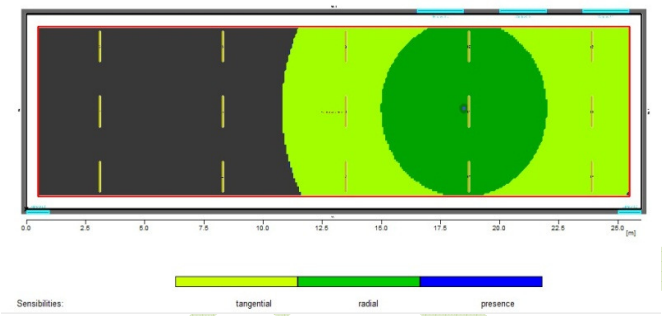

Figure 7. Result using automatic ON/OFF sensor

A) Daylight dimming sensors-

Occupancy sensors are more sensitive they can detect fine movement and small in size. This occupancy sensor most effective to save energy also daylight dimming sensors [6] is effective for individual's luminaries. These sensors have high demand for simpler ON/OFF application as soon as certain amount of daylight is present and artificial light is reduced. When efficient light available in room then this dimming sensorsoperates and dimming of light takes place. Using sensors saving of 80% light take place. Automatic dimming sensor shown in figure 8

Figure 8. Automatic dimming sensor

CONCLUSION

Energy efficient lighting simulation proves beneficial for given building. Using DIALUX software tool removal of unwanted shadow and glare effect of walls and chairs takes place. The direct effect of efficient lighting on reducing of total cost. This paper aim is to focus on lighting simulation tools for advanced efficient lighting methods. The day lighting will provide cost reduction if properly controlled.

The RELUX software used to design proper integration of day light and artificial lighting scheme. The sensors are mounted in room for adjustment of light. The sensors are provided which are automatically ON/OFF when no use of light. Thus sensor are reduces the total cost and gives proper illumination using software tools.
In short

- Using RELUX software we uses both artificial and daylight methods for efficient lighting schemes.
- DIALUX software uses effectively for removal of glare and shadow effect.
- The sensors are provideautomatic ON/OFF operation and automatic dimming of light which saving of energy in terms of cost.

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