An Approach to Energy Efficient & UV free Lighting Design for an Educational Building Blocks

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Abstract:

Nowadays, standard lighting is provided in educational buildings in addition to ambient or general lighting. This is done with the aid of a wide selection of lamps and luminaires that are readily available and come in a variety of shapes, colours, and energy-efficiency levels. This allows for accurate characterization of particular areas in any part of the building. Any educational building block's typical floor is designed with traditional lighting systems that consume a lot of energy and have low lux levels compared to recommended levels. With the aid of contemporary, energy-efficient bulbs and DIALux-Lighting Software, this article primarily focuses on providing an energy-efficient lighting and UV-free lighting design[1] that may be suggested to redesign the currently existing traditional lighting.

Keywords: Energy, Luminaire, Illumination, Ultra Violet UV Ray, Lighting Software.

1. Background:

Today's market is extremely competitive, and there is frequently a problem with higher education levels falling short of what the sector requires. Seminar rooms are crucial in bridging this divide and providing the pupils of the next generation with current technology. ensuring proper knowledge flow Seminars help students' abilities and knowledge by fostering passionate connection and active participation. Students' need for seminars is frequently identified as a top priority. Seminars are a creative and appreciated move towards modern education, keeping in mind the significance of seminars for students. the market is very much challenging and often come across the issue regarding the level of higher education not meeting the industry expectation. To connect this gap and equip the students of new generation with modern technologies, seminars room play an essential role. Ensuring a proper flow of knowledge Seminars assist in passionate interaction and active participation uplifting the skills and expertise of students. Importance of seminars for students is often acknowledged as a prime concern. Keeping in mind the importance of seminars for students, seminars an innovative and welcomed step towards modern education.

2. Aims & Objects:

To develop a framework for choosing contemporary artificial light sources that are economical, energy-efficient, and UV-free

3. Methodology:

- On-site examination of the lecture room's full interior.
- Take note of the photometric information for a particular area's lighting system.
- Determine the general issue with conventional lighting design in terms of energy effectiveness and illumination needs.

- Learn about various lamps and luminaires [2] that might be utilised for the overall indoor lighting design of educational buildings [3].
- Redesigning the seminar room to be more cost-effective, energy-efficient, and compliant with standard codes. The suggested design will be supported by DIALux software.

4. Physical survey and existing lighting design of seminar hall of GKCEM

Fig 1: Existing Lighting Design of Seminar Hall

5. Existing lamp and luminaires of typical area (Seminar Hall of GKCEM)

Table 1: Uses of lamps & Luminaire (Existing)

Area	Lamp type	No. of quantity	Luminaries type
Seminar hall	T12	6	Wall Mounted
	T5	1	

6. Measurement of Light Power Density (LPD) and Lux Level of Seminar Hall (Existing)

Fig 2: Photometric view of Seminar Room

- **Area Calculation:** Total Area of Seminar hall = 97.12m^2
- **Wattage Calculation :** In the Seminar hall there are 6 nos. of 40 watts T12 luminaire and 1 nos. 28watts T5 luminaire available. (Due to electromagnetic choke 12 watts loss will take in

every T12 luminaire and electronic choke 4watts loss will take in every T5 luminaire). Total power consumptions = [(40+12) x 6] + [(28+4) x 1] = 344 watt.

- **LPD (Light Power Density) :** Total wattage/Total area = (344/97.12) =3.54 watt/m2.
- **Lux Calculation :** Avg. Level of illuminance = (5639/40) = 141 lux.

7. Comparative Studies with Guidelines of ECBC: 2009 and IS-3646

Here, calculated LPD and Lux value are compared with standard codes and guidelines.

Table 2 : Comparison between LPD and Lux value with standard code (existing)

Area	Calculated LPD Value (watt/m2)	Recommended LPD Value as per ECBC (watt/m2) [4]	Remarks
Seminar hall	3.54	14	no
	Calculated Illuminance Value (Lux)	**Recommended Illuminance Value as per IS-3646 (Lux) [5]**	**Remarks**
	141	300	Low

8. Some Proposal of Modification on Lighting Designing

CHALLENGE 1: Most of the existing lighting system are designed with T12 fluorescent lamp (including Electromagnetic Ballast).

PROPOSAL: Here all T12 lamps (40watt) are fitted with electromagnetic ballast. This consumes 12watt more power. So total power consumption of each T12 lamp is (40+12) =52 watt. It can be replaced by T5 fluorescent lamp with electronic ballast. That consumes (28+4) = 32 watt. So, (52-32) =20-watt power can be saved from each fluorescent lamp. Upcoming LED lamps that is less power consuming and give a proper visualization.

CHALLENGE 2: Illuminance level is not satisfied compare to standard guidelines like IS-3646 [3].

PROPOSAL: Here all luminaries are comprising with T12 (40 watt) lamp and light output is 1980lumen. So, distribution of illuminance level is not so good. So replaced all T12 by T5 or LED. This way, light output (lumen output) is increased and Lux level is also increased compare to existing system. Changes of T8 and T5 lighting system is not only the solution to increase illumination level. Other parameter and condition should be considered for design with Ambient and accent lighting as per IS-3646.

CHALLENGE 3: Object visualization is not satisfied due to poor lighting arrangement system.

PROPOSAL: For this, the design notion of ambient and accent lighting is absolutely crucial. A single object cannot be illuminated by ambient lighting, which instead illuminates the entire space. The right lighting scheme is crucial for conveying a place's culture, history, and overall

atmosphere. Due to the seminar room's limited ambient lighting, a visitor cannot see every unique thing. To do this, accent lighting is a wonderful way to draw attention to a particular location. But it should be remembered that the IS-3646 limit on illumination intensity cannot be exceeded. [3]

9. Proposed design with Energy efficient and UV free lamp:

It is known that all artificial lamps incorporate with ultraviolet ray. The amount or percentage of UV is differing with several artificial light sources according various distances**.** UV is one of the offenders which have severe fading effects. It is already known that the energy efficient lamp LED which is extensively increased day by day, almost free from Ultraviolet radiations. The percentage of UV is comparatively less compared to other lamps. So, this paper tries to develop an energy efficient and UV free lighting design in educational building blocks.

10. Proposed design[6] with DIALux simulation software

Fig 3: Proposed lighting Design of Seminar Room

11. Proposed lamp and luminaires of typical area (Seminar Hall of GKCEM)

Table 3: Uses of lamps & Luminaire (Proposed)

Area	Lamp type	No. of quantity	Luminaries type
Seminar hall	LED	12	Ceiling Mounted

12. Measurement of Light Power Density (LPD)[4] and Lux Level[5] of Seminar Hall (Proposed)

- **Area Calculation:** Total Area of Seminar hall = 97.12m^2
- **Wattage Calculation :** In the Seminar hall there are 12 nos. of 18 watts LED are to be installed. So, Total power consumptions = [18*12]= 216 watt.
- **LPD (Light Power Density) :** Total wattage/Total area = (216/97.12) =2.22 watt/m2.
- **Lux Calculation :** Avg. Level of illuminance through software = 320 Lux

13. Comparison of Proposed Photometric data with Existing Design

Table 4: Comparison between LPD and Lux value with standard code (proposed)

Area	Calculated (Existing) LPD Value (watt/m2)	Calculated (Proposed) LPD Value (watt/m2)	Recommended LPD Value as per ECBC (watt/m2) [4]	Remarks
Seminar hall	3.54	2.22	14	Within limit
	Calculated (Existing) Illuminance Value (Lux)	**Calculated (Proposed) Illuminance Value (Lux)**	**Recommended Illuminance Value as per IS-3646 (Lux) [5]**	**Remarks**
	141	320	300	Satisfactory

14. Total energy saving for this typical area

- Power consumption with existing arrangement = 344 watt
- Power consumption after modification = 216 watt
- Total Energy Savings = 128 watt
- Percentage of energy savings = [(344-216/344] x 100%= 37.2%

15. Uses of LED lamps instead of conventional light sources

Table 5: Uses of lamps & Luminaire (Proposed)

Distance in mt.	UV-A (micro watt / sq mt.)		UV-B (micro watt / sq mt.)		UV-C (micro watt / sq mt.)	
	FL	LED	FL	LED	FL	LED
0.3	26.7	**4.2**	6.5	0	4.7	1.0
0.6	17.9	**3.4**	2.8	0	2.2	0.6
0.9	9.1	**1.3**	0.8	0	1.3	0.3
1.2	3.5	**0.9**	0.3	0	0.8	0.2
1.5	2.8	**0.7**	0.2	0	0.6	0.1
1.8	1.6	**0.**	0.1	0	0.4	0
2.1	1.5	**0.3**	0.1	0	0.2	0
2.4	1.3	**0.2**	0.1	0	0.2	0
2.7	11	**0.2**	0.1	0	0.2	0
3.0	1	**0.2**	0	0	0.1	0

It can be observed that all lamps like fluorescent Tube (FL) and LED consist significant amount of UV-A, B, C which are corrosive in nature. But the value of UV is low in case of LED. For human safety optimum distance of separation need to be maintained from several light sources in an educational building block. That's why energy efficient LED lamps are used for this purpose.

16. Conclusions:

This paper is focused on the Interior Lighting Design of an Educational building blocks,where main objective was to energy efficient and UV free lighting system with modern technologies that need to follow all standard in lighting guidelines and create a warm and inviting environment [7] for all while making it functional and safe.

17. References:

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