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Lighting Design Strategies in Energy Saving in the Education Building

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Abstract-When you think of good design, we have to consider it one of the most important stages of lighting design (Interior or exterior). All engineers in the world think the design, sustainability, and energy saving. Lighting consumes 25% of the building's consumption, especially in educational buildings.

In this study, we explain how to save energy through lighting and luminance distribution to achieve illumination and better efficiency and lower consumption.

Keywords- *Sustainability, Lighting, Saving Energy*

I. INTRODUCTION

There is a misunderstanding in the construction industry, especially among engineers, as part of the electricity consumed by the lights ends up as heat in the room because the electrical lighting will produce more thermal energy than the electrical energy it consumes. Unfortunately, many engineers Don't study lighting controls and study new technologies.

The law says that heat dynamics cannot create or destroy energy it means that 100% of the electricity used by the lighting device will turn into heat and thus the electricity will be consumed [8]. In short, we can say that the same amount of electricity used by the lights will end up as a heating in the building, this should reduce the energy consumption of the lights in the building and thus also reduce the cooling load of the premises, providing special double advantages in this climate.

In addition, the design for effective lighting will provide much of the loading capacity of the air conditioner and we will focus this chapter on several points studying at SEGi University and one of the most important points focus on

- Lighting Terms
- Lighting techniques
- Lighting controls and current energy efficiency

II. LIGHTING EFFICIENCY

A. Candela

The Candela (CD) is the standard unit of luminous intensity in the International System of Units (SI). It is scientifically determined as the magnitude of an electromagnetic field, in a specialized direction, that suffers a power level of 1/683 watt (1.46 x 10 -3 W) per steradian at a frequency of 540 terahertz (540 THz or 5.40 x 10 14 Hz)]1].

B. LUMEN

The lumen is a measure of the total "amount" of visible light emitted from a source. It is defined by Equation 1 shown below.

Lumen = cd. sr (1)

Where cd = Candela

s r = steradian (a measurement of a unit angle in 3D Spherical coordinate system) [2].

C. LUX LEVEL

The Lux is a measurement of luminous flux per unit area at a distance from the light source. It is defined as:

Lux = Lumen /Area (2)

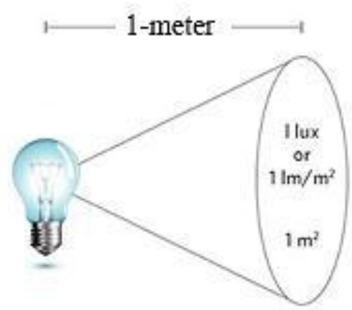

Figure 1. The LuxMeasur 1 cd

Figure 1 show Lux is measured at a distance of 1-meter radius from one candela light source [6].

D. LAMP

A lamp is a light emitting device. Fluorescent tubes, incandescent bulbs, and solid-state lighting (LED) diodes are considered as lamps. Most suppliers of lamps provide the

Lumens output and the power consumption on their packaging and brochures as a quick indicator of their efficiency [3].

E. LUMINOUS EFFICACY

Luminous Efficacy is an indicator of the efficiency of the lamps. It is defined as:

Efficacy=Lumen / Watt (3)

F. LIGHTING POWER DENSITY

Lighting power density (LPD) is defined as the installed lighting power per square meter of a space.

LPD= Light Power / Area (4)

This is a useful indicator of the efficiency of the installed lighting system. The MS 15252 has specified the maximum allowable LPD for different types of spaces. A sample is reproduced herewith [7].

TABLE I. A SELECTION OF LIGHTING POWER DENSITY FROM MS 1525

Type / Space Type of Usage	The maximum is Lighting Power Density W/m2
Offices	15
Supermarkets/ Department Stores/	25
Stores/ Warehouses/ Stairs/	10
Car Parks	5

Documents such as MS 1525 and ASHRAE 90.1 provide recommendations on the maximum allowable installed lighting power density [4].

Unfortunately, they do not provide an indication of how low the lighting power density can be. As a reference guide, the Malaysian Green, Technology Centre (MGTC), has an installed lighting power density of 4.8 W/m2, while providing an average of the 350 Lux level [4].

III. THE RELATIONSHIP BY LIGHTING

The table (II) shows the examines the relationship between

Watt (Electric Power)

Lumen (amount of visible light)

LPD (Lighting power density)

TABLE II. THE RELATION TO LIGHTING POWER

Power (Watt)	Amount of visible light (Lumen)	Lighting Power Density (LPD)
20	215	10.75
40	430	10.8
60	730	12.2
100	1380	13.8
500	8400	16.8

We can see in Table II that the relationship between lumen and watt are linear any more watt increase Lumen [5].

A. Case study

As shown in the Figure (2) an area of 136 m^2 where there are 53 bulbs 100-watt bulb and all estimated when measuring is equal to 5300 W and calculate the amount of the cost of energy was the result worth 47.7 kilowatts per day.

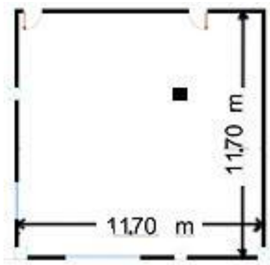

Figure 2. Hall layout

The interior dimensions of the hall are 11.7 meters by 11.7 meters and there are two doors inside the door is open in the inside (corridor) while the windows are closed as in the Figure (3).

Figure 3. Close windows

The lighting position is the same as in Figure (3) which is the illumination of the ceiling lighting directly and shows the distribution of lighting and the number of lamps there is (56) bulb and by measuring the intensity of light in the hall which is measured by the LUX we found the hall is worth 600 Lux.

B. Saving Power:

For saving the power we have to know for Energy cost Calculation in this [4].

$E = (P \times T) / 1000$ (5)

E: Energy Cost Calculation Per Day

P: Power in Watt

T: Time number uses Hours per Day

We distribute the lighting as follows, each light point at a 120 cm angle and in the hall area within By.

Number of lamps = Area of meter / 6 (6)

And we can see in Figure 4 the connection between the number of light point and area.

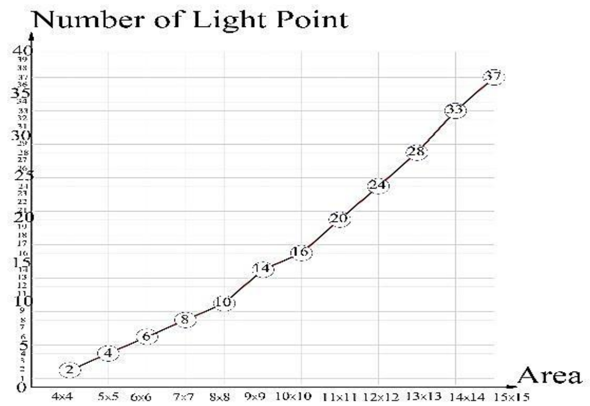

Figure 4. Connection between the number of light point and area

TABLE III. COMPARING THE CURRENT STUDY AND OUR CALCULATION

	Current study	Calculations
Lux	600	628
Lumen	22790 lm	86000 lm
Luminous Efficacy	4.3 lm/w	70 lm/w

TABLE IV. COMPARING THE CURRENT STUDY AND SAVING STUDY FOR OUR CALCULATION

	Current study	Calculations	Saving Present
Lighting Power Density	38.6 w/m	1.3 w/m	28%
Energy Cost Calculations per Day	47.7 kW/m	1.6 Kw/m	
Number of Light Points	53	23	

In this Area, we can save 28% in each hall.

We have studied several rooms for teaching and found that they're not dependent on external lighting (Daylighting), but only use indoor lighting.

IV. CONCLUSION

Contribute to educational buildings bulbs provide up to 25% of the energy used in buildings, including by using the additional equipment and effective lamps plus a wide light distribution Broad and evenly for size as also contributing to the final of the lighting system efficiency. The lighting system must be designed properly and monitored constantly and will include improved lighting system installed for the convenience of users and provides energy efficiency throughout the lifetime of the building. Through these measures will help to reduce energy consumption considerably and that his participation and practice in the design of all buildings.

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Mr. Ghayath Dbes is a Master Degree graduate of Architectural Studies from Damascus University in Syria in 2012, after having completed his basic degree in 2010. He went on to take on and completed his Master Degree in Project Management in Malaysia in 2015, and is now pursuing his Ph.D. studies at SEGi University in the area of Environmental Engineering with emphasis on Green Building Conversion of Existing Building Facilities. He has prior industrial experiences in Syria working as a Design Architect and Interior Design Consultant in Syria, Kuwait and most recently in Malaysia. Ghayath has a keen interest as a student of Architectural Engineering in the search for solutions to combat global warming and green technology to enhance home and work comfort for the masses.