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Lighting Improvement in Building Renovation

Dina Maizana[1] Syarifah Muthia Putri[2]*, Muhammad Rizal Irhami[3]
[1]Electrical Engineering, Universitas Medan Area, Jl. Kolam No. 1, Medan, 20223, Indonesia,maizanadina@gmail.com
[2]Electrical Engineering, Universitas Medan Area, Jl. Kolam No. 1, Medan, 20223, Indonesia, syarifahmuthiaputri@gmail.com
[3]Electrical Engineering, Universitas Medan Area, Jl. Kolam No. 1, Medan, 20223, Indonesia, rizal.irhami123@gmail.com

*Corresponding Author: syarifahmuthiaputri@gmail.com | **Phone: +6285262058398**

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Abstract
Lighting systems that are not up to standard will have an impact on eye fatigue so that the work results of the staff are not optimal. This problem can be solved by designing a lighting system according to the standards that have been determined through the results of previous studies. The 1st floor of the Faculty Engineering, Universitas Medan Area building requires lighting improvements to provide comfort to all staff and lecturers. This research was conducted by measuring the value of light intensity in each room and improving the lighting system which was analyzed through the shape of the room, the color of the walls, and the position of the lights. The results of the research provide additional light points and lamp positions so that they are in accordance with the standard of utilization. Lighting according to the standard in the building of the Faculty of Engineering, Universitas Medan Area has been suitable to improve staff performance.
Keywords : eye fatigue, illumination, lighting standard

Introduction

Electrical installation is an important component of a building. Electrical installation in a building must be planned and implemented in accordance with applicable standards and regulations in order to obtain an efficient and safe electrical system. General Electrical Installation Requirements/Persyaratan Umum Instalasi Listrik (PUIL) are rules related to electrical installations. PUIL provides requirements for the design, installation and verification of electrical installations. So that it can provide safety to humans, livestock, and property that might arise in the use of electrical installations. Improved performance through standardized electrical installations can provide benefits in the form of electrical short circuit safety, simplifying maintenance or checking, simplifying interior design arrangements, and making comfort.

Lights as the main device used in a building have a big effect. Lighting that fits the standard will provide viewing comfort for the occupants. This comfort can allow residents to do their activities optimally. Planning for room lighting with lamps is carried out by considering the dimensions of the room, the color of the walls, and the position of the lamp.

The renovated 1st floor the Faculty of Engineering, Universitas Medan Area, has a bad lighting system that requires improvement in term of lighting. The carried out of this paper is tocomply the lighting with lighting standard. When the lighting standard is achieved, the staff can work comfortably and optimally.

Literature Review

- **Room lighting system**

The lighting system or lighting in the room must pay attention to the supporting factors in order to produce a good lighting system (Wagiman, K.R & Abdullah, M. N, 2017). The factors that affect lighting, namely:

1. Light flux
   Light flux is a light source in the form of light streaks and emits light in all directions. The unit of light flux is the lumen.
2. Light intensity

$$E = \frac{\phi}{F} \text{ [lx]} \qquad (1)$$

where ϕ is luminous flux [lm]
F is area which the light is fall [m²]

By using the data table 2 and 3 and substitute into equation (1) will be obtained illuminance that produced at the room with different room form is shown in table 4:

Table 4. Influence Room Form to Illuminance

The Form of Room	Illumination [lx]		
	Bulb	Fluorescent lamp	Mercury lamp
Foursquare	1500 – 2200	4500 – 7000	3500 – 6000
Cycle	1900 - 2800	5730 – 8917	4460 – 7640
Triangle	3000 - 4400	9000 - 14000	7000 - 12000

- **The quality of the lighting at the lamp position**

The position of the lights in a room is usually placed at the top and in the middle of the room. Adjustment of lamp position is carried out to obtain lighting power according to the purpose by the room user (Dila, H, 2014). Some examples of lamp positions can be seen in the picture

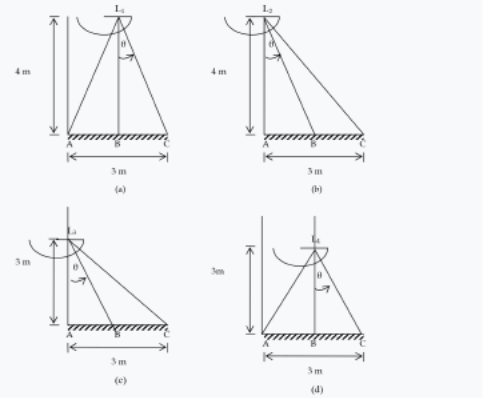

Figure 2. Different Position Location of Lamp at the same Room

By using theorem of phitagoras at figure 2 will be found by distance height of lamp evaluated from position of b is shown in calculation below.

Light intensity is the light flux emitted in a certain direction per unit corner of a certain room. The unit of light intensity is candela.

3. Illumination
   Illumination is the intensity of light on a plane. The unit of illumination is lux.

The Faculty of Engineering, University of Medan Area is a building in an educational institution that requires lighting according to standards and can be seen in the following table 1:

Table 1. Illumination Standard (Phillips Lighting Manual, 2015)

Room Function	Illumination (lux)
Classroom	250
Library	300
Laboratory	500
Kitchen	250
Toilet	250
Dean's Room	350
Staff Room	350
Meeting Room	300
Archive Warehouse	150

- **The Shape of a Room**

The shape of a room affects the quality of the lighting because it relates to the large in that shape (Feri, D, Anita, H, 2014). The figure 1 shows that squares will create a larger area than circles and triangles.

Figure 1. The Forms of Room

Table 2. Large of Area

Room form	Area [m²]
Foursquare	1
Cycle	0.785
Triangle	0.5

Table 3. Lumen Size Measure for Different Lamp with is same Watt.

The type of lamp	Luminous flux [lm]
Bulb	1500 – 2200
Fluorescent lamp	4500 – 7000
Mercury lamp	3500 – 6000

Illuminance or strength of lighting at one point on the area which the light is falling can be calculated by using the formula below.

$$Lb = \sqrt{(t^2 + s^2)} \qquad (2)$$

Angle θ is obtained by determine angle cosine between La and Lb that is:

$$\cos\theta = \frac{t}{\sqrt{(t^2+s^2)}} \qquad (3)$$

To obtain strength of lighting at a position as follows:

$$E_a = I/t^2 \qquad (4)$$

To obtain strength of lighting at b position as follows:

$$E_b = I\cos\theta/\sqrt{(t^2+s^2)} \qquad (5)$$

Table 5. Strength of Lighting at Different Position of Lamp

Lamp	Strength of lighting [lx]		
	A position	B position	C position
L1	4.9	5.97	4.9
L2	5.97	4.9	5.07
L3	10.6	7.59	3.73
L4	7.59	10.6	7.59

- **Effect of Wall Color on Lighting**

Wall color affects the ability of light to reflect light flux in a room (Azis, M. A,Supriadi, B, & Lesmono, A. D, 2016). There is a wall and ceiling color reflection factor which can be seen in the table 6:

Table 6. Reflection Factor Based on the Color of the Walls(Phillips Lighting Manual, 2015)

Color	Reflection Factor	Color	Reflection Factor
White	0,7 – 0,8	Orange	0,2 – 0,25
Light Brown	0,7 – 0,8	Dark Green	0,1 – 0,15
Light Yellow	0,55 – 0,65	Dark Blue	0,1 – 0,15
Light Green	0,45 – 0,5	Dark Red	0,1 – 0,15
Pink	0,45 – 0,5	Black	0,04
Blue Sky	0,4 – 0,45	Gray	0,25 – 0,35

Table 7. Power Comparison between LED, CFL and Incandescent Lamps(Phillips Lighting Manual, 2015)

Lumen	LED	CFL	Incandescent
400-500	6 – 7 W	8 – 12 W	40 W
650 - 850	7 - 10 W	13 – 18 W	60 W
1000-1400	12 – 13 W	18 – 22 W	75 W
1450-1700	14 – 20 W	23 – 30 W	100 W
2700	25 – 28 W	30 – 55 W	150 W

- **Effects of Illumination on Eye Health**

Based on the results of research, eye health problems occur because they are in a room with non-standard lighting conditions (Lin, K. H, Su, C. C, Chen, Y.Y, Chu, P,2019). Poor lighting quality will cause the iris muscle to work harder to adjust the pupil to adjust to the intensity of the incoming light. If someone stays in the room for a long time it will cause eye fatigue, reduce work efficiency, and cause the potential for accidents.

- **Determination of the number of light points**

Several factors influence the determination of the number of lighting points in a room, namely:

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Keywords

illumination; eye fatigue; lighting standard

Full Text:

PDF

References

R. Wahyu Pramon, K. Kamono, and T. Nurhayati. (2018). Evaluasi Instalasi Listrik Pada Gedung Multi Centre of Excellent (Moe) Rumah Sakit Islam Sultan Agung Semarang. ELEKTRIKA, vol. 9, no. 1, p. 17.

Lin, K. H, Su, C. C, Chen, Y.Y, Chiu, P. (2019). The Effects of Lighting Problem on Eye Symptoms among Classroom Microscope Workers. International Journal of Environmental Research and Public Health 16(1):101

Hendarmin, R. G. D. (2017). Perancangan Instalasi Listrik Gedung Fakultas Ilmu Pendidikan Universitas Pendidikan Indonesia. Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu," pp. 1–3.

Badan Standarisasi Nasional SNI 04-0225/2000, Persyaratan Umum Instalasi Listrik 2000, Yayasan PUIL, Jakarta, 2000.

Aziz, M. A, Supriadi, B, & Leemono, A. D. (2016). Analisis Pengaruh Warna dan Ukuran Binding Ruangan Terhadap Intensitas Pencahayaan. Jurnal Pembelajaran Fisika Vol. 5 No. 1 p. 35.

Adelakun, N. O, Olanipekun, B. A, & Samuel, A. (2020). Design of Electrical Installation of a Storey Building. IJTEM, Vol. 4, No. 1 p. 28.

Berziņa, K. (2019). Electrical Installation of Residential Buildings. RTU Press, Riga Technical University Institute of Power Engineering, Department of Electrical Power Supply.

Schneider Electric. (2016). Electrical Installation Guide According to IEC International Standard.

Wagiman, K. R. (2017). Lighting System Design According to Different Standards in Office Building : A Technical and Economic Evaluations. International PostGraduate Conference on Applied Science & Physics.

Orlight from Source to Site. (2014). Guide on Lighting Risks and Regulations. www.orlight.com

Bella, I., Pedace, A., Fraghasso, F. (2015). Indoor Lighting Equality : Effects of Different Wall Colours. Lighting Research and Technology 49 (1)

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