# Study of Building Lighting System to Support Activities Using Dialux Simulation

Choirul Mufit and Duta Jontara Pasaribu

*Electrical Engineering, Faculty of Engineering, Universitas 17 Agustus 1945 Jakarta, Indonesia*

Abstract:        Lighting is basically very much needed for work activities. The light produced by the lamp and reflected to objects that can make you see clearly and provide a sense of comfort when conducting research activities aims to find out whether the lighting at PT X has been installed properly so that it can see clearly and provide a sense of security and comfort when carrying out activities. Then this study was able to find out that the lighting installed in the room at PT X had met the SNI standard, 03-6575-2001. The method used in this study uses qualitative methods by observing data collection on. Building at PT X by taking measurements using the Luxmeter measuring instrument. The result of this study is that the lighting in VIP-type rooms and staff offices has not met the Indonesian National Standards because there are several factors that affect the value taking, namely floors, walls, and ceilings, so the researchers recommend the level of lighting produced by the lights in the office space. VIP-type staff and rooms using DIALux 3.14 visualization.

## 1   INTRODUCTION

Lightning is basically Is it right needed for work activity or to see an object directly It lamp that is produced by the lamp and reflected to object that can make You see clear and provide a reason from convenience When is working on activities, and building Lightning is one of the factors What designer Should pay attention to in the design process to produce good Lightning(Ekawati, 2018).

Therefore, a good building is a building that has sufficient lighting in each room so that it can increase maximum work results, As for providing services on reflexology, it is not only with massage skills, However, lighting is also beneficial in adding a sense of calm to consumers, therefore in the field of reflexology service providers require lighting that is neither too bright nor too dark(Iksan et al., 2018)

## 2   LITERATURE REVIEW

Research conducted by Erix Extrada et al (2021) with the title Impact Analysis of Pharmacy Room Lighting Intensity With Complaints of Eye Fatigue on Workers at Mesra Hospital in Kampar Regency in 2020 it is known that the lighting in the pharmacy room at Mesra Hospital in Kampar Regency has not met the standards of the Regulation of the Minister of Health of the Republic of Indonesia Number 7 of 2019 on Hospital Environmental Health (Gunawan, 2001).

Research conducted by Guntur & Putro (2017) with the title Analysis of Light Intensity in Production Areas on Work Safety and Comfort in accordance with Lighting Standards, adjusting the lighting determined by the minister of health, which is 300 lux Therefore, the light intensity throughout the production area, for now, is still not good for the safety and comfort of workers To increase the light intensity in the production area in order to meet the lighting standard, which is 300 lux, each production area is required to increase the number of lamps or replace the type of lamp in each production area (Rachman, 2018).

Research conducted by Widiyantoro et al (2017) with the title Lighting Analysis on Visual Comfort for Office Users (case study: PT Sandimas Intimitra Marketing Division office in Bekasi) The results of this study, based on the measurement of the light intensity of the room and the responses of the room users from the questionnaire Then the resulting zone A has reached the SNI standard for office space of 350lux when the curtain is open Namely, the value of the A1 zone is 365 lux, the A2 zone is 365.33 lux and the A3 zone is 341.33 lux and the respondents stated

that they were comfortable Then in zone B it reaches the SNI standard in closed curtain conditions with the results of zone B1 347.67 lux, zone B2 350.67 lux and zone B3 355 lux and in this condition the respondent feels comfortable (Widiantoro at el., 2017).

## 3 METHOD

The research method used in the preparation of this research is

    a. The literature study examines the theories,national Indonsian standart which are required from the supporting handbooks, and relates to the themes taken as the basis for the theory

    b. Discussions, with supervisors and data collection and field observations

    c. Observation method, go directly to the field to study and obtain the appropriate data

    d. Visualize using DIALux and evaluate.

## 4 RESULTS

The lighting of the building in this study was carried out using the shape of the room that was made as closely as possible to the conditions in the field using DIALux. 4.13, the research that will be carried out is focused on the quality of the light emitted. by the lights in the room. Based on Indonesian National Standard with ideal lighting. Against the room at PT X in conducting research that will be carried out in a room because this research is focused on VIP type room and staff offices.

### 4.1 Lighting Level Calculation VIP Type Room

To find out the lighting in the VIP type room, you must know the light flow (Luminous flux) and the average lighting level produced by the lamps used in the VIP type room using the following types of lamps:

LED Spotlights
Lumen              = 230 lm
Power              = 3 w
xColor temperature  = 3000 k
Length of the room   = 4.12 meters
Width of the room    = 3.23 meters

Based on equation on the theory, the light current (Luminous flux) is obtained as follows
    $F = \phi = Lumen . daya$

$= 230 . 3$
$= 690 \ lm/w$

The lighting level can be found using this equation so as to produce the following values

$$E_{average} = \frac{F_{total} \ x K_p \ x K_d}{A} \ (\text{lux})$$

$$E_{average} = \frac{460 \ x \ 0,9 \ x 0,8}{13,30} \ (\text{lux})$$

$$E_{average} = 24,9 \ (\text{lux})$$

Based on the above calculations, it can be seen that the average light emission from the 3 watt LED Spotlight (24.9) used in VIP type rooms does not meet the Indonesian National Standard.

Table 1: VIP room lighting level calculation.

| Lamp type | Nto tal | F1(Lu men) | n | Ftotal(l umen) | K p | Kd | A( m$^2$) | E$_{Avera ge}$ |
|---|---|---|---|---|---|---|---|---|
| Spotli ght LED 3 watt | 2 | 230 | 1 | 460 | 0, 9 | 0,8 | 13, 30 | 24,9 |

### 4.1.1 Measurement of VIP Room Illumination Level Using Lux Meter

Measurements carried out in VIP-type rooms using the measure the lux meter by performing several measurement positions and three measurements at the same position with a distance of 0.8 cm from the ground surface as can be seen in the table 2.

Table 2: Vip type room lighting measurements

| Potition | Measurement(Lux) | | | Avarage Measurement(Lux) |
|---|---|---|---|---|
| | First | Second | Third | |
| 1 | 113 | 111 | 112 | 112 |
| 2 | 237 | 233 | 130 | 200 |
| 3 | 314 | 312 | 311 | 312,33 |
| 4 | 162 | 160 | 162 | 161,33 |
| 5 | 356 | 352 | 354 | 354 |
| 6 | 175 | 170 | 170 | 171,66 |
| 7 | 137 | 130 | 136 | 134,33 |
| 8 | 71 | 70 | 70 | 70,33 |
| 9 | 14 | 14 | 13 | 13,66 |
| 10 | 22 | 21 | 20 | 21 |
| 11 | 32 | 31 | 30 | 31 |
| 12 | 30 | 28 | 25 | 27,66 |
| 13 | 20 | 17 | 18 | 18,33 |
| 14 | 18 | 15 | 16 | 16,33 |
| 15 | 10 | 11 | 10 | 10,33 |
| Avarage | | | | 110,264 |

### 4.1.2 Simulation of Lighting Levels in VIP Type Rooms Using Dialux

The VIP type room at PT X has a length of 4.12 meters, 3.23 meters wide and with a height of 3 meters in this study shows a visualization of the shape of the VIP-type room with the appearance of a floor plan, 3D in the VIP-type room with a height of 3 meters and because of not finding the Results of the lights that match the lights installed at PT X, then in the dialux simulation, the author uses an approach to the simulation using Philips (China) Investment Co., Ltd. lamps. Multi Voltage MR16 (1,000) which can be seen in the figure 1 to figure 4.



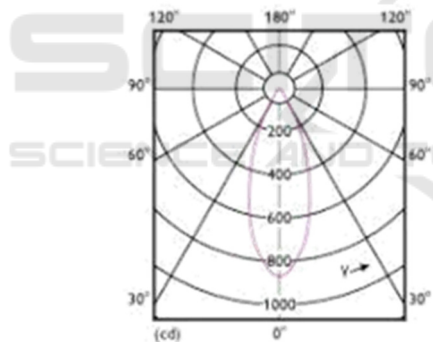Figure 1: amp Investment Co., Ltd. Multi-Voltage MR16.



Figure 2: Floor plan Lampu Investment Co., Ltd. Multi-Voltage.



Figure 3: Visualization of VIP type room with a height of 3 meters 3D view.
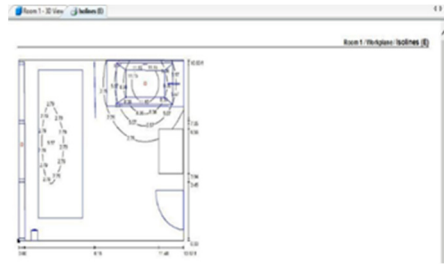


Figure 4: Visualization of VIP type room with 3 meter floor plan.

The VIP-type room at PT X has a room height of 3 meters. As seen in Figure 3, it can be seen that the lighting level in the VIP-type room does not meet the 150 lux standard with no orange color from the measurement results shown in Fig. 3 is clarified by the floor plan display in Figure 4 which shows the lighting level of the VIP-type room by displaying the highest value of 11.15 lux and in the calculation, there is the result of the VIP-type room luminance of 7.88 lux so that the lighting in the VIP-type room does not meet the Indonesian National Standard.

Table 3: Luminance calculation VIP type room with a height of 3 m.

| Surface | Average illuminances [fc] | | | Reflection factor [%] | Average luminance [cd/m²] |
|---|---|---|---|---|---|
| | Direct | Indirect | Total | | |
| Workplane | 2.13 | 5.75 | 7.88 | / | / |
| Floor | 0.97 | 2.85 | 3.82 | 80 | 10 |
| Ceiling | 2.71 | 6.09 | 8.80 | 80 | 24 |
| Wall 1 | 2.13 | 4.94 | 7.07 | 82 | 20 |
| Wall 2 | 2.47 | 5.92 | 8.39 | 82 | 24 |
| Wall 3 | 2.23 | 4.93 | 7.16 | 82 | 20 |
| Wall 4 | 1.58 | 4.02 | 5.60 | 82 | 16 |

### 4.1.3 Recommended Lighting Level VIP Room

In this study, to achieve lighting that is Indonesian national standard, the researcher provides a lighting recommendation in VIP type rooms, in order to add some lights that are installed on the wall. With a different switch installation for each lamp to facilitate the replacement process.



Figure 5: VIP room visualization recommendations.

Based on the researchers' recommendations, the VIP type room at PT X has a room height of 3 meters as shown in Figure 9 that the lighting level in the VIP. type room can meet the standard of 150 lux with the addition of lights with a floor plan display that displays values. The luminance has reached 150 lux so the room has met the Indonesian National Standard, with the type of lamp used PHILIPS CR250B PSU W30L120 IP65 1 xLED55S/840. (1,000).



Figure 6: CR250B PSU W30L120 IP65 1 xLED55S/840 Lamp.



Figure 7: floor plan Lamp CR250B PSU W30L120 IP65 1 xLED55S/840.

## 4.2 Calculation of Lighting Level Office Staff

To find out the lighting in the office, the staff must know the flow of light (Luminous flux) and the average level of lighting produced by the lamps used in the staff office using types of lamps such as:

Led Lam DayLight Lumen = 470 lm
Power = 5 w
xColor temperature = 3000 k
Length of the room =4.91 meters
Width of the room =2.5 meters

Same as before with equation, the light current on Office staff is obtained as follows

$F = \phi = Lumen . daya$
$= 470 .5$
$=2.350 \, lm/w$

The lighting level can be found using this equation so as to produce the following values

$$E_{average} = \frac{F_{total} \, x K_p \, x K_d}{A} \, (lux)$$

$$E_{average} = \frac{1.880 \, x \, 0,9 \, x 0,8}{13,30} \, (lux)$$

$$E_{average} = 110,31 \, (lux)$$

Table 4: Office Staff lighting level calculation.

| Lamp type | LED lamp Daylight |
|---|---|
| Ntotal | 4 |
| F1(Lumen) | 470 |
| n | 1 |
| Ftotal(lumen) | 1880 |
| Kp | 0,9 |
| Kd | 0,8 |
| A(m$^2$) | 12,27 |
| E$_{Average}$ | 110,31 |

### 4.2.1 Measuring the Lighting Level of Staff Office using Lux meter

Measurements were made at the staff office using a lux meter measuring instrument by performing several measurement positions and three measurements at The same position with a distance of 0.8 cm from the ground surface as can be seen in the table

Table 5: Office Staff lighting level calculation.

| Potition | Measurement(Lux) | | | Avarage Measurement(Lux) |
|---|---|---|---|---|
| | First | Second | Third | |
| 1 | 138 | 135 | 130 | 134,33 |
| 2 | 144 | 142 | 141 | 142,33 |
| 3 | 122 | 120 | 120 | 120,66 |
| 4 | 115 | 115 | 114 | 114,66 |
| 5 | 138 | 136 | 136 | 136,66 |
| 6 | 142 | 140 | 142 | 141,33 |
| 7 | 138 | 135 | 135 | 136 |
| 8 | 194 | 195 | 195 | 194,66 |
| 9 | 301 | 132 | 132 | 188,33 |
| 10 | 321 | 325 | 324 | 323,33 |
| 11 | 205 | 210 | 215 | 210 |
| 12 | 142 | 145 | 143 | 134,33 |
| 13 | 241 | 241 | 240 | 240,66 |
| 14 | 376 | 376 | 375 | 375,66 |
| 15 | 354 | 354 | 352 | 353,33 |
| Avarage | | | | 196,418 |

### 4.2.2 Simulation of Lighting Levels in Staff Offices Using Dialux

The staff office at PT. X has a length of 4.19 meters, a width of 2.5. meters and a height of 3 meters in this study shows a visualization of the shape of the staff office with the appearance of a floor plan, 3D in the staff office with a height of 3 meters and because it does not find the results of the lamps are in

accordance with the lamps installed at PT X, then in the dialux simulation, the .author uses an approach to the simulation using the Signify lamp type (1,000).
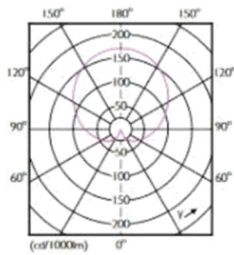


Figure 8: Signify (1.000)



Figure 9: floor plan lights Signify



Figure 10: *Office Staff Visualisazion.*

The staff office at PT X has a room height of 3 meters. As shown in Figure 14, it can be seen that the lighting level in the staff office does not meet the 350 lux standard with no orange color. from the staff office by displaying the highest value of 9.29 lux and the calculation there is a luminance result in the staff office of 8.38 lux so that the lighting in the staff office does not meet the Indonesian National Standard

Table 4: Calculation of luminance for staff offices with a height of 3 m3.

| Surface | Average illuminances [fc] | | | Reflection factor [%] | Average luminance [cd/m²] |
|---|---|---|---|---|---|
| | Direct | Indirect | Total | | |
| Workplane | 2.56 | 5.81 | 8.38 | / | / |
| Floor | 1.09 | 2.91 | 4.00 | 80 | 11 |
| Ceiling | 2.76 | 5.67 | 8.43 | 80 | 23 |
| Wall 1 | 2.28 | 4.81 | 7.09 | 82 | 20 |
| Wall 2 | 1.92 | 5.26 | 7.17 | 82 | 20 |
| Wall 3 | 2.14 | 4.76 | 6.91 | 82 | 19 |
| Wall 4 | 1.27 | 3.62 | 4.89 | 82 | 14 |

### 4.2.3 Recommended Office Lighting Levels Staff

In this study, to achieve lighting that is Indonesian National Standard, the researcher provides a lighting recommendation for the office staff to replace the type of lamp and add additional lamps that are installed. By installing a different switch for each lamp to make i.t easier to replace the lamp and not turn on at the same time as can be seen in the picture.
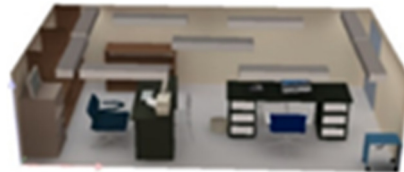


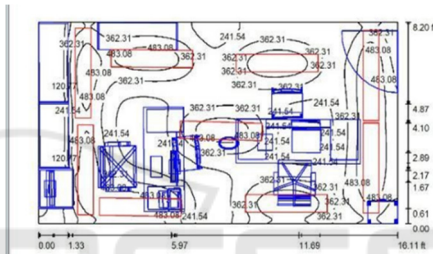Figure 11: Staff office visualization 3 meters high 3D view.



Figure 12: Recommended staff office visualization with a 3-meter floor plan.

Based on the. recommendations of researchers at the staff office at PT X, which has a room height of 3 meters, it can be seen in Figure 11 that the level of lighting in the staff office can meet the 350 lux standard by adding lights which can be seen from Figure 12 with a floor plan display that displays the luminance value. has reached 350 lux so that the staff office has met the Indonesian National Standard with the type of lamp used PHILIPS CR250B PSU W30L120 IP65 1 xLED55S/840 (1,000)
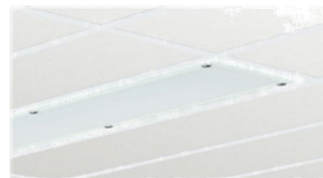


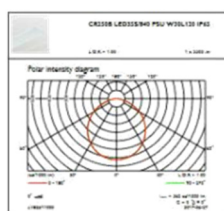Figure 13: CR250B PSU W30L120 IP65 1 xLED55S/840 Lamp.

Figure 14: floor plan Lamp CR250B PSU W30L120 IP65 1 xLED55S/840.

## 4.3 Comparison of DIALUX Calculation, Measurement and Analysis Values

In study this compars score calculation use score equation,measurement use tool luxmeter and results from analysis data which generated by DIALux which have destination for produce,eq or difference score which in generate which could seen from table 8 which form comparison from results measurement tool luxmeter,and results from analysis data which generated by DIALux.

Table 5: Comparison of DIALux Calculation, Measurement and Analysis Values.

| No | Room Type | SNI Standart | Ideal Calculation | Measurement with Lux Meter | DiaLux Analysis |
|----|-----------|--------------|-------------------|-----------------------------|-----------------|
| 1 | VIP Room Type | 150 | 24,9 | 110,264 | 7,88 |
| 2 | Office Staff | 350 | 110,31 | 196,418 | 8,38 |

Results calculation more small because score which there is from data which listed in lamp the, whereas measurement which conducted use luxmeter installed a number of lamp which already long and there is a number of lamp which already dead which not yet in replace, whereas on analysis dialux there is a number of factor which influence in taking score ie, floor, wall, and ceiling.

## 5 CONCLUSIONS

From the results of the analysis of the study of the building lighting system at PT Dwidaya Mitar which was carried out on several bags at PT Dwidaya Mitar where measurements were made using a Luxmeter measuring instrument and recommendations were made using the DIALux 4.13 application, the following conclusions can be drawn:

a. The results of the calculation of the level of lighting contained in the VIP type room with a room area of 13.30 m2 with a height of 3 meters obtained 24.9 lux using LED Spotlight lamps and in the staff office with a room area of 12.27 m2 with a height of 3 meters obtained 110.31 lux

b. The results of measurements using the Luxmeter measuring instrument in VIP type rooms and staff offices have an average value of 110.264 lux and 196.418 lux so that the lighting in the room does not meet the Indonesian National Standard.

c. There are differences in the results of measurements using DIALux 4.13 in VIP type rooms and staff offices due to the measurement of the lighting produced by lights, there are several factors that influence the taking of values, namely, from choosing a wall color that is too dark or too light, and choosing a bright or light ceiling.

## REFERENCES

Ekawati, R. (2018). Pertumbuhan dan produksi pucuk kolesom pada intensitas cahaya rendah. *Kultivasi*, *16*(3). https://doi.org/10.24198/kltv.v16i3.13719

Iksan, A. M., Bintoro, A., & Sadli, M. (2018). Perancangan Dan Perhitungan Ulang Penerangan Buatan Pada Pustaka Gedung A Fakultas Pertanian Universitas Malikussaleh. *Jurnal Energi Elektrik*, *7*(2). https://doi.org/10.29103/jee.v7i2.1052

Ir. Setia Gunawan, M. s. (2001). *Teknik Pencahayaan Fundamental Teknologi Aplikasi* (makasar,yo). PT.Nas Media Indonesia.

Rachman, T. (2018). Hubungan Intensitas Pencahayaan Dan Beban Kerja Dengan Keluhan Kelelahan Kerja Pada Pekerja di Bagian Produksi PT. Johan Sentosa. *Angewandte Chemie International Edition, 6(11), 951– 952.*

Widiyantoro, H., Mulyadi, E., & Vidiyanti, C. (2017). Analisis Pencahayaan Terhadap Kenyamanan Visual Pada Pengguna Kantor (Studi Kasus:Kantor PT Sandimas Intimitra Divisi Marketing di Bekasi). *Jurnal Arsitektur, Bangunan & Lingkungan*, *6*(2).