Journal of Architectural Research
and Education
Vol. 4 (1) 85-94
@Ningrum. 2022
DOI: 10.17509/jare.v4i1.43496

Natural Lighting Compatibility Analisys in A Simple House Using Dialux Simulation

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Article History:

Received:	Revised:	Accepted:	Available online:
20 January 2022	16 February 2022	15 March 2022	30 April 2022

***Abstract* -** There are many benefits from the fulfillment of lighting in a building, especially in residential buildings, which are the main human buildings where they spend most of their time every day. These benefits include visual comfort, health, a general impression, and reducing humidity. Light compatibility analysis refers to the study adjustment of light in a building, whether the lighting in the building is met according to standards to provide benefits for its users or not. There are two kinds of lighting, natural lighting from sunlight and artificial lighting from lamps or candles. Both types of lighting can fulfill the benefits mentioned above, although the lighting discussed here is lighting from sunlight as a source of natural lighting and is the best light source for humans. The standard used is SNI, namely the Indonesian National Standard. This study will investigate lighting compatibility in a simple house in the Mangunreja sub-district, Tasikmalaya district. The aim is to evaluate the use of lighting, whether it is effective or not according to SNI standards. The method used in this research is an observational research method through a quantitative research approach. Data collection is carried out using measurement techniques on research objects and simulations (case studies) using the Dialux Evo 10 software. Dialux Evo software is software that functions to simulate light settings in a building or room. The simulation results show that the lighting in each room is good enough, but it needs additional lighting in the bathroom area, which looks so dark. Therefore, the recommendation is to add artificial lighting, but you can also take advantage of natural lighting by adding non-transparent skylights**.**
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Keywords – lighting compatibility; natural lighting; artificial lighting; simple house.

Introduction

Light compatibility analysis refers to studying the adjustment light in a building, whether the lighting in the building is fulfilling or not. There are many benefits from the fulfillment of illumination in a building, especially in residential buildings, which are the main human buildings continually inhabited every day. Some of these benefits are creating visual comfort for users or conditions where users feel comfortable. Visual comfort is not disturbed by environmental conditions(Susanti et al., 2020) seeing by their sense of sight. It can also affect users' health because eye health is influenced by good and bad lighting systems, which can add a general impression to the user. Building and can reduce humidity(Permana et al., 2020) in the building so that the furniture and walls of the building are not easily damp and damaged. Unfortunately, some people do not know if the fulfillment of light is essential, and they need it as residents of a building(Aprita, 2020)(Kencanasari et al., 2020)(Susanti et al., 2018).

There are two kinds of lighting: natural lighting from sunlight and artificial lighting(Permana, 2022) from lamps or candles. Both types of lighting can fulfill the benefits mentioned above, although the lighting prioritized is lighting from the sun because sunlight is the best light source for humans. To enter sunlight, a building must pay attention to openings, windows, and skylights, which means light circulation.

Meanwhile, artificial lighting or man-made lighting by utilizing natural resources that are also beneficial for humans. Artificial lighting is divided into four types: general lighting, task, decorative, and accent lighting. Soegandhi and his colleagues also classify room lighting techniques into four, namely downward lighting, upward lighting, direct lighting, and indirect lighting(Hermawan et al., 2021)..

The standard that can use to evaluate the suitability of light in a room in Indonesia is SNI or Indonesian National Standard 03-6197-2000 concerning Energy Conservation in Lighting Systems. While the standard used in the room is 120-250 Lux based on the Indonesian National Standard 03-6197-2000 concerning Energy(Azza and Natalia, 2019)(Vidiyanti et al., 2020). Conservation in Lighting Systems. These standards are the result of a review adapted to the tropical climate of Indonesia through the application of international standards(Paramita et al., 2021)(Christian & Kamurahan, 2021).

As mentioned above, this study will investigate the compatibility of lighting in a simple house located in the Mangunreja sub-district, Tasikmalaya district. The aim is to evaluate the use of lighting whether it is effective or not according to SNI standards. Using special software will show whether there will be problems regarding the lighting in the residence and recommendations will be given to overcome them. Research can be useful for finding alternative solutions that can be applied in solving lighting problems in residential homes(Satwikasari, 2020)(Nurrahman, 2019).

Method

The method used in this research is an observational research method through a quantitative research approach. Data collection was carried out using measurement techniques on research objects and simulations (case studies) using the Dialux Evo 10 software. Dialux Evo software functions as a means of simulating light settings in a building or room. The study used SNI 03-6197-2000 as the lighting suitability parameter. SNI 03- 6197-2000 is an energy conservation standard for lighting systems in Indonesia. In residential houses, there are seven standard lighting scales, in Lux, divided into seven rooms: terrace (60 Lux), living room (120-150 Lux), bedroom (120-250 Lux), dining room (120-250 Lux), kitchen (250 Lux), bathroom (250 Lux), workspace (120- 250 Lux) and garage (60 Lux). Therefore, the standards used for this research are the living room, bedroom, dining room, kitchen, and bathroom because the research object is a simple house.

The stages of this research consist of five stages (add graph): (1) Identify research problems, identify problems in the residence due to lack of lighting; (2) Review of literature from relevant sources. Be it books, articles, or other sources for a literature review. The aim is to provide prior knowledge regarding lighting compatibility and the benefits of lighting and ways to solve the problem if the lighting in the residence is not good; (3) Data collection was carried out using measurement techniques on the object of research and literature review, such as window and door sizes, location, and Lux lighting; (4) The results obtained from measurements are presented in a table, then analyzed according to SNI to determine the level of conformity with the standard; and (5) The simulation uses the DiaLux software on the research object to produce design recommendations and problem-solving.

In addition to using measurement data and literature review, it is also necessary to provide data in the form of a sun path to determine the direction of the sun's movement when the research was conducted on October 26, 2021.

Figure 1. shows the solar path data in Indonesia. Based on the diagram, the sun's path in October 2021 is above the equator (Equinox).

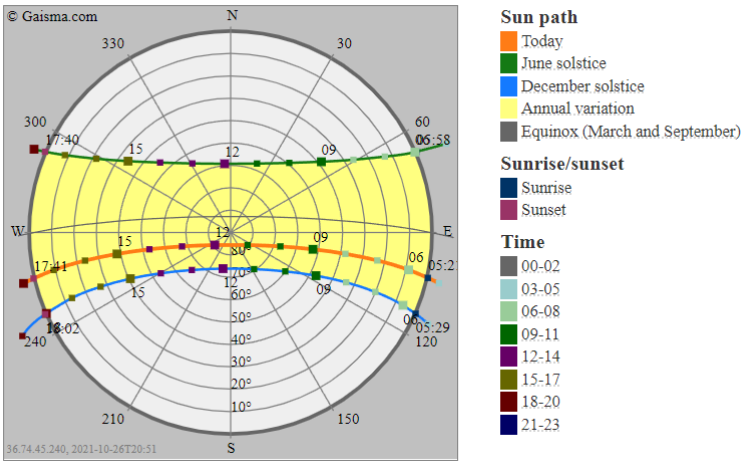


Figure 1: Tasikmalaya Sunpath Diagram, 2021.
Source: gaisma.com

Figure 2 showing data relating to sunrise and sunset times are also shown to provide a more detailed description of the sun rays duration at the study site, Kp. Royom, Rt/Rw 06/02, Margajaya, Mangunreja, Tasikmalaya West Java 46462 using sunscale.org . The data of Solar and Geodata in **Figure 3**.

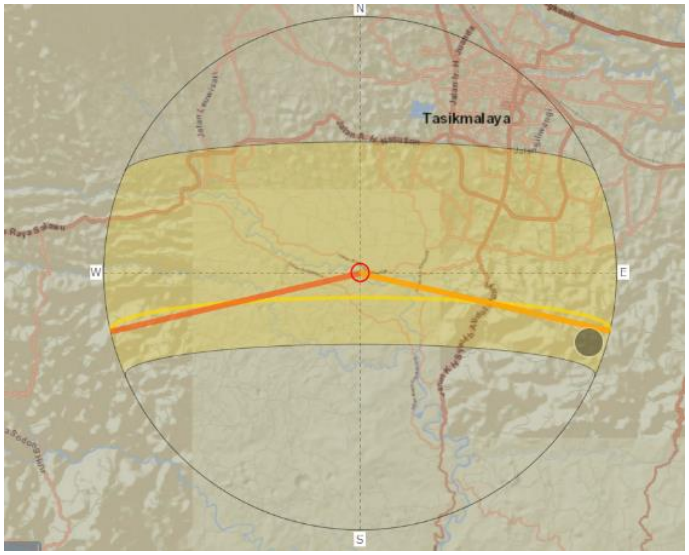


Figure 2 : Kp. Royom, Rt/Rw 06/02, Margajaya,Mangunreja, Tasikmalaya West Java 46462.
Source: gaisma.com

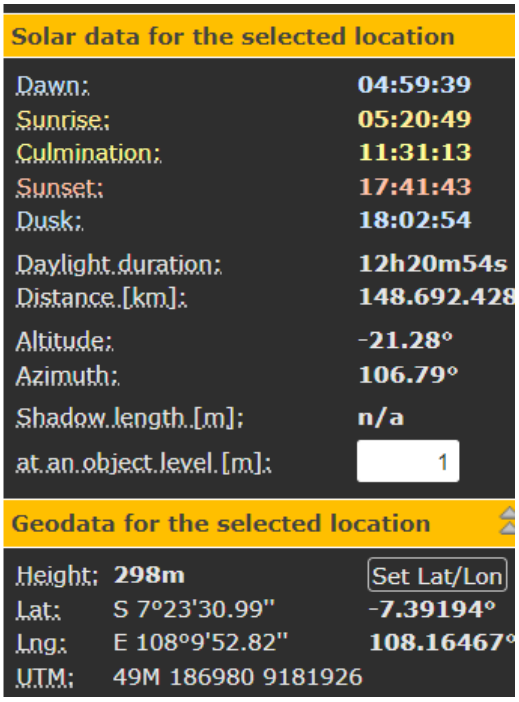


Figure 3: Solar data and Geodata for the selected location, 2021.
Source: gaisma.com

Result and Discussion

Research Object

The research was conducted in a simple house located in Kp. Royom, Rt/Rw 06/02, Margajaya, Mangunreja, Tasikmalaya West Java 46462. This residence has an area of 12 x 10 m2 with rooms including 1 front terrace (2 x 3 m), living room (3 x 3 m), 1 family room (3 x 3 m), 2 bedrooms (3 x 3 m), 1 dining room (3 x 3 m), 1 kitchen (2 x 6 m), 1 bathroom (2 x 3 m), and 1 back porch (For light circulation. There are 6 pairs of swing windows, 1 single swing window, 1 dead window in the bathroom, and 6 single swing doors. The window frame material is wood with a type of frosted glass and the door material is wood.

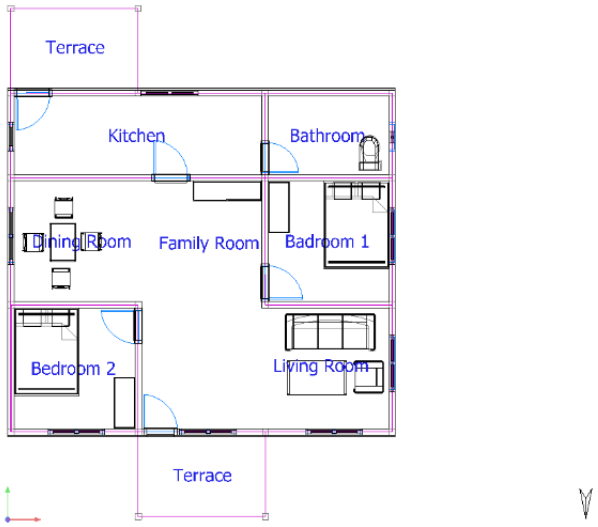


Figure 4: Ayu Setya Ningrum, House Plan, 2021.
Source: Autocad

Simulation of light intensity measurement using dialux was carried out once at 12.00 WIB for observations of natural lighting with a sun light source.

Measurement and Simulation

Natural Lighting Condition Measurement

The steps taken when measuring natural lighting in the research object:

1. Simulation is carried out once, namely at 12.00 WIB
2. Simulation with Dialux ovo 10 with SNI lighting standards
3. The measurement data will be entered into the table.

Table 1 *Input*

Rooms	*Lighting standard (Lux) SNI*
Living Room	150
Family Room	150
Dining Room	150
Bedroom 1	250
Bedroom 2	250
Bathroom	250

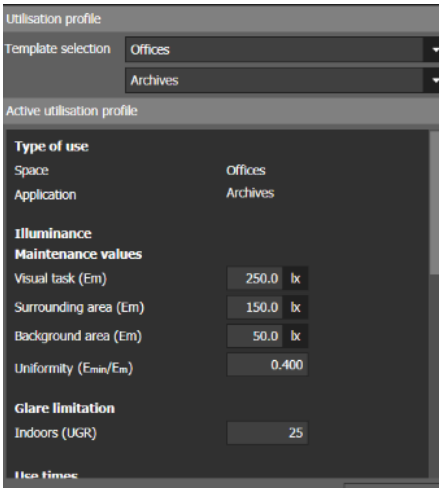


Figure 5: Utilisation profile of kitchen, bedroom, bathroom.
Source: Dialux

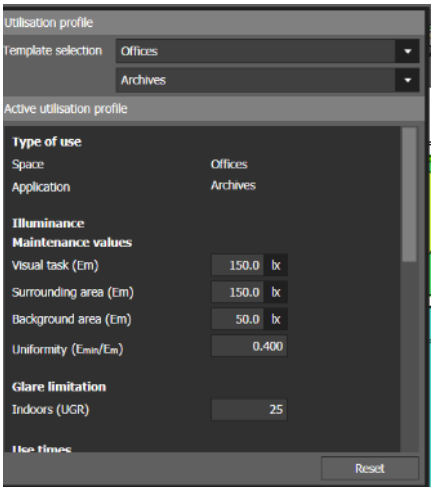


Figure 6: Utilisation profile of living room, family room, dining room.
Source: Dialux

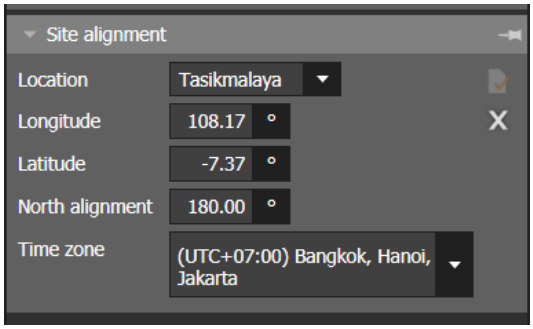


Figure 7: Site Alignment. Source: Dialux

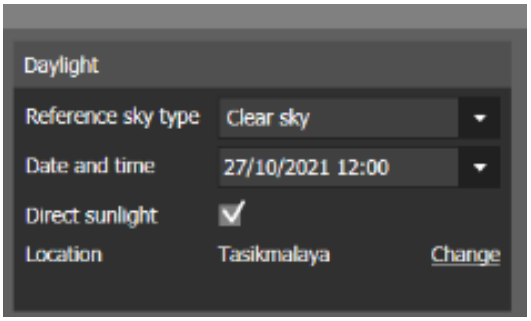


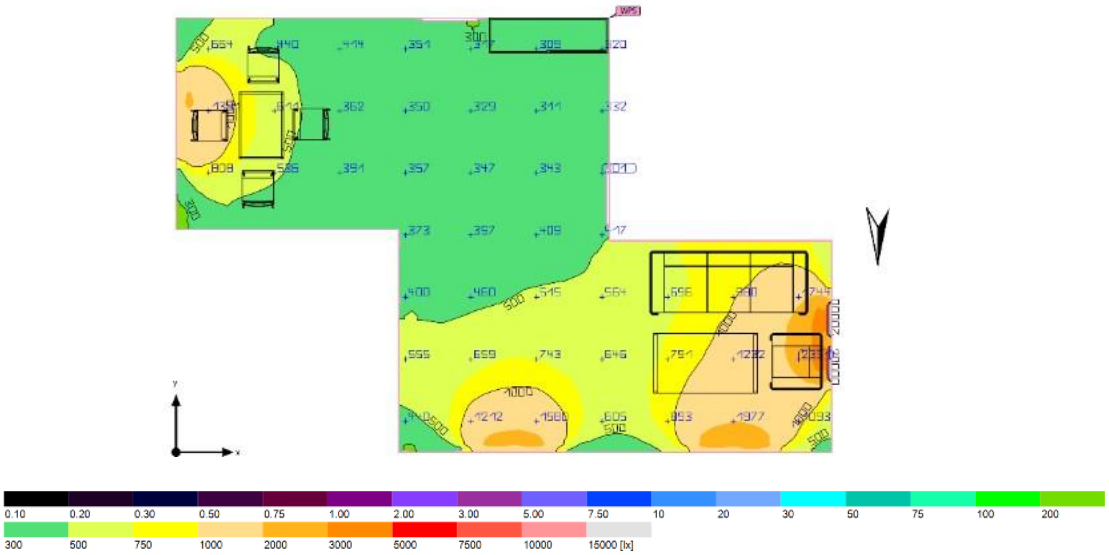
Figure 8: Daylight. Source: Dialux

Results and Discussion

Living Room, Family Room, Dining Room

In the Living Room, the lighting looks very fulfilled and illuminates every corner of the room because there are two windows around the living room which are quite large. Same with the living room, because of a large enough window, the lighting in the dining room is also fulfilled. Although not perfectly illuminating the corner of the room, the lighting in the dining room far exceeds the SNI standard.

Summary



Summary

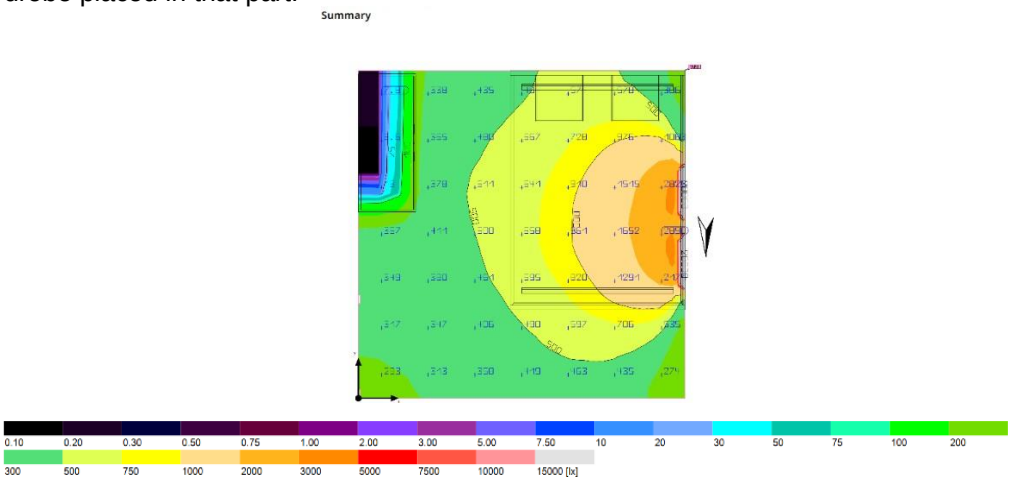
Results

	Symbol	Calculated	Target	Check	Index
Daylight	D	3.372 %	-	-	DF5
Workplane	$\bar{E}_{perpendicular}$	722 lx	≥ 250 lx	✓	WP5
	g_1	0.39	-	-	WP5
Consumption values	Consumption	0 kWh/a	max. 50 kWh/a	✓	
Room	Lighting power density	0.00 W/m²	-	-	
		0.00 W/m²/100 lx	-	-	

Meanwhile, the lighting is bright enough for the family room and meets SNI standards. However, the light in the family room is not like in the living room and dining room because there are no windows for light circulation, so the room only gets residual light from the front window, entrance, and dining room.

Bedroom 1

For bedroom 1, light enters well and far meets SNI standards, this is also due to the availability of large enough windows for light circulation. However, there is a dark part in one corner of the room, because a tall wardrobe placed in that part.



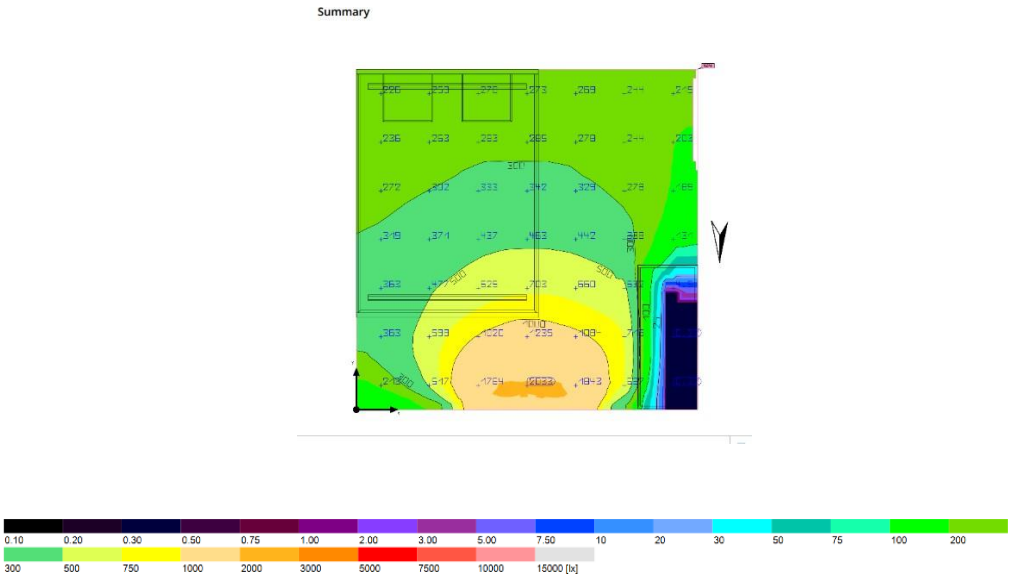
Summary

Results

	Symbol	Calculated	Target	Check	Index
Daylight	D	2.797 %	-	-	DF3
Workplane	Ē	803 lx	≥ 250 lx	✓	WP3
	g1	0.000	-	-	WP3
Consumption values	Consumption	0 kWh/a	max. 50 kWh/a	✓	
Room	Lighting power density	0.00 W/m²	-	-	
		0.00 W/m²/100 lx	-	-	

Bedroom 2

Same with bedroom 1, the light in bedroom 2 enters well and far meets SNI standards, this is also due to the availability of large enough windows for circulation of light. However, there is also a dark part in one corner of the room because a tall wardrobe is placed in that part.



Summary

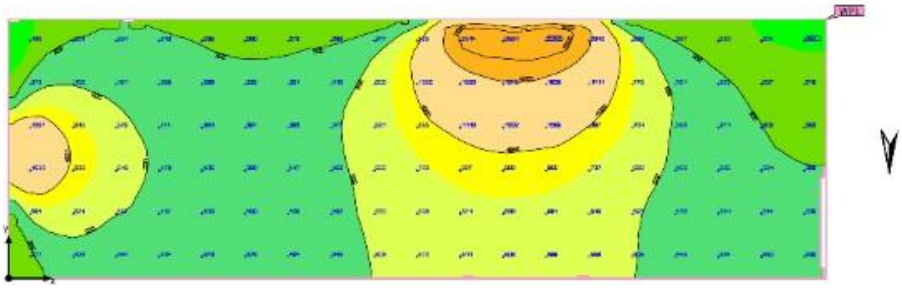
Results

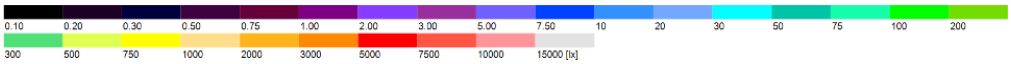
	Symbol	Calculated	Target	Check	Index
Daylight	D	2.731 %	-	-	DF4
Workplane	$E_{perpendicular}$	464 lx	≥ 250 lx	✓	WP4
	g_1	0.001	-	-	WP4
Consumption values	Consumption	0 kWh/a	max. 50 kWh/a	✓	
Room	Lighting power density	0.00 W/m²	-	-	
		0.00 W/m²/100 lx	-	-	

Kitchen

There are two windows for light circulation so that in the kitchen, the lighting is also fairly good and far meets SNI standards

Summary





Summary

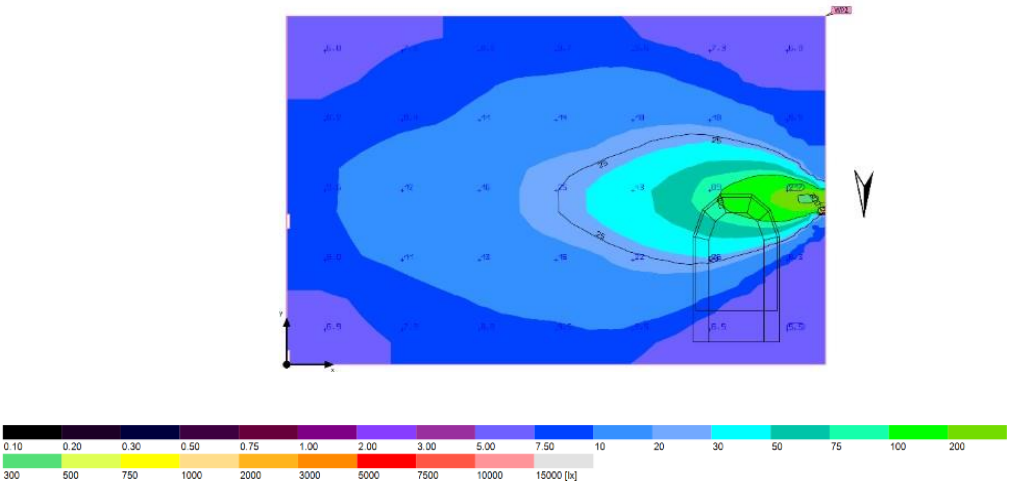
Results

	Symbol	Calculated	Target	Check	Index
Workplane	$E_{perpendicular}$	622 lx	≥ 250 lx	✓	WP1
	g_1	0.26	-	-	WP1
Consumption values	Consumption	0 kWh/a	max. 50 kWh/a	✓	
Room	Lighting power density	0.00 W/m²	-	-	
		0.00 W/m²/100 lx	-	-	

Bathroom

In contrast to the other rooms, the lighting in the bathroom was not very good, only a few parts near the window were bright while the other parts looked dark because there is only one window in the bathroom and its small size so that light cannot enter properly

Summary



Summary

Results

	Symbol	Calculated	Target	Check	Index
Workplane	$\bar{E}_{perpendicular}$	18.0 lx	≥ 250 lx	✗	WP2
	g_1	0.31	-	-	WP2
Consumption values	Consumption	0 kWh/a	max. 50 kWh/a	✓	
Room	Lighting power density	0.00 W/m²	-	-	
		0.00 W/m²/100 lx	-	-	

Conclusion

Lighting problems are seen in the bathroom which has little lighting. This can be overcome by using artificial lighting such as lamps. Still, because of saving electrical energy, it is more advisable to add windows for natural light circulation during the day or addition of skylights that are not transparent.

Figure 9: Skylight .
Source : Intagram.com

Figure 10: Skylight.
Source: tokopedia.com)\

References

A. Fanchiotti, K. Steemers, and Nick V. Baker. (1993). Daylighting in Architecture: A European Reference Book. London:James & James

Aprita, D. R. (2020). Arsitektur Tropis Pada Tata Ruang Dan Permukiman Di Kampung Pulo Garut. *Jurnal Arsitektur ZONASI*, *3*(3), 313–321. https://doi.org/10.17509/jaz.v3i3.26692

Azza, S., & Natalia, D. A. R. (2019). Penerapan Konsep Healing Architecture. *Jurnal Arsitektur ZONASI*, *2*(3), 210–219.

Christian, P., & Kamurahan, S. R. (2021). Pengaruh Aplikasi Material Fasade Bangunan terhadap Upaya Konservasi Energi dengan Pendekatan Evaluasi Desain Berbasis BIM (Building Information Modeling). *Jurnal Arsitektur Zonasi*, *4*(1), 73–83. https://doi.org/doi.org/10.17509/jaz.v4i1.30181

Hermawan, Hindaryanto, A., & Taoda, A. (2021). KARAKTERISTIK TERMAL RUMAH BATU EKSPOS DI TROPIS PEGUNUNGAN (Studi Kasus di Desa Kwadungan , Wonosobo). *Jurnal Arsitektur Zonasi*, *4*, 153–166.

Kompas.com. Ini Alasan Mengapa pencahayaan alami penting dalam rumah. URL: https://www.kompas.com/homey/read/2021/03/03/132000976/ini-alasan-mengapa-pencahayaan-penting-di-dalam- rumah?page=all

Kencanasari, R. . V., Surahman, U., Permana, A. Y., & Nugraha, H. D. (2020). Kondisi Kualitas Udara Di Dalam Ruangan Pemukimanan Non-Kumuh Kota Bandung. *Jurnal Arsitektur ZONASI*, *3*(3), 235–245. https://doi.org/10.17509/jaz.v3i3.28134

Nasional, Badan Standardisasi. "SNI 6197: 2011 Konservasi energi pada sistem pencahayaan."; 2011.

Nurrahman, H. (2019). Optimalisasi Desain Fasad Bangunan Restaurant Di Kebonwaru, Batununggal Kota Bandung. *Jurnal Arsitektur ZONASI*, *2*(2), 138. https://doi.org/10.17509/jaz.v2i2.17470

Paramita, T., Saladin, A., & Rahma, N. (2021). PEMANFAATAN PENCAHAYAAN ALAMI IKLIM TROPIS PADA BANGUNAN HOTEL RESORT DI BALI. *Jurnal Arsitektur Zonasi*, *4*(1), 114–120. https://doi.org/doi.org/10.17509/jaz.v4i1.27141

Permana, A. Y. (2022). Pengukuran Kinerja Apartemen Sebagai Tempat Tinggal Mahasiswa: Analisis Kepuasan Pengguna di Kawasan Edutown, Jatinangor, Indonesia. *Jurnal Arsitektur Zonasi*, *5*(1), 198–208.

Permana, A. Y., Nurrahman, H., & Permana, A. F. S. (2021). Systematic assessment with “poe” method in office buildings cases study on the redesign results of office interior after occupied and operated. *Journal of Applied Engineering Science*, *19*(2), 448–465. https://doi.org/10.5937/jaes0-28072

Permana, A. Y., Akbardin, J., Permana, A. F. S., & Nurrahman, H. (2020). The Concept Of Optimal Workplace In Providing A Great Experience To Improve Work Professionalism In The Interior Design Of PLN Corporate. *International Journal of Advanced Science and Technology*, *29*(7), 3238–3254.

Satwikasari, A. F. (2020). KAJIAN KONSEP ARSITEKTUR HIJAU PADA BANGUNAN MUSEUM GEOLOGI STUDI KASUS : MUSEUM GEOLOGI BANDUNG. *Jurnal Arsitektur Zonasi*, *3*(2), 211–219.

SNI. No. 03-2396-2001, 'Tata cara perancangan penerangan alami siang hari untuk rumah dan gedung' URL: sni.litbang.pu.go.id

Soegandhi, S. J and Indrani, H.C. Optimasi Sistem Pencahayaan Buatan pada Budget Hotel di Surabaya. Intra; 2015; 3(1):45-56.

Susanti, I., Permana, A. Y., Pratiwi, W. D., & Widiastuti, I. (2020). Territorial space: Structural changes in a religious tourism area (The case of Kampung Mahmud in Bandung,West Java, Indonesia). *IOP Conference Series: Earth and Environmental Science*, *447*(1). https://doi.org/10.1088/1755-1315/447/1/012031

Susanti, I. S., Komala Dewi, N. I., & Permana, A. Y. (2018). Tatanan Teritorial dalam Proses Transformasi Hunian. *Jurnal Arsitektur ZONASI*, *1*(1), 27. https://doi.org/10.17509/jaz.v1i1.11542

Vidiyanti, C., Siswanto, R., & Ramadhan, F. (2020). Pengaruh bukaan terhadap pencahayaan alami dan penghawaan alami pada masjid al ahdhar bekasi. *Jurnal Arsitektur Zonasi*, *3*(1), 20–33.

Wilson, M., and Peter Tregenza. (2011). Daylighting: Architecture and Lighting Design. New York, NY:Routledge.