Optimizing Natural Lighting in Shophouses in the Pondok Lestari Housing Complex: A Case Study

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ABSTRACT

Natural lighting is crucial in building design as it can affect the occupants' visual comfort. However, in certain building designs, such as shophouses, the number of openings that can be utilized is limited, resulting in less optimal natural lighting. This condition can disturb the comfort of building occupants and result in energy waste, so optimizing natural lighting in buildings, especially shophouse Buildings, is necessary. This study utilizes a qualitative descriptive method, utilizing Revit software and simulating with the Enscape application. One of the ways to achieve this is by utilizing light from above (the sky) using a glass roof, determining the placement of openings based on the window-to-wall ratio (WWR), and employing other design strategies such as material selection and sun shading to enhance the comfort of building occupants. By optimizing the use of natural lighting, it is expected that shophouse building designs can maximize natural lighting to improve the comfort of its occupants. Therefore, research on optimizing natural lighting in buildings, particularly in shophouse Buildings, is crucial in creating comfortable buildings for their occupants. The outcome is an optimized redesign of shophouses in terms of natural lighting.

***Keywords** : Natural lighting, Shophouses, Optimization, Skylight, Visual comfort*

1. Introduction

Light is a medium that connects humans with the objects around them. Light is essential for human activities. Without light, all human activities and functions would be disrupted. Lighting is necessary for humans to perform activities and observe their surroundings, making it an essential factor in building design. The objects we see are reflections of those objects. This indicates that lighting affects how we see and respond to the objects around us [1]. Architecture's sunlight can dramatically affect a building and be used for exterior and interior facades [2].

Good lighting is needed in a building to achieve visual comfort. Natural lighting comes from sunlight entering the building through openings such as windows, skylights, etc. Good lighting is when the amount of light that enters is not deficient (dark) nor excessive (glaring), as this would affect the visual comfort of the building's users. However, obtaining natural lighting is difficult, especially for commercial buildings like shophouses. Shophouses can be used for living and business activities [3].

The problem of natural lighting in shophouse Buildings arises because they are designed to be connected (unified walls) to optimize land use. The design of the shophouse buildings with connected walls causes a limitation on the number of openings that can be used in the building, resulting in suboptimal lighting conditions [4]. This conventional Shophouses design cannot maximize lighting in the space, causing the building to become dark and uncomfortable for users and being wasteful of electricity. The research aim is to explore innovative design solutions and strategies that can address the challenge of inadequate natural lighting in shophouse buildings.

2. Material and Method

2.1. Theoretical Review

Daylighting: It is suggested that the optimal time for measuring natural daylight is between 8:00 AM and 4:00 PM. Good daylighting provides even lighting without causing a glare that could be disruptive [5].

Standard Useful Daylight Illuminance & SNI 03-6197-2000: Designers use UDI units to determine inadequate lighting (dark conditions), optimal illumination, and excessive lighting (causing glare and heat). The optimal category used is 200-2000 Lux. Designers use standard lighting levels in indoor spaces using SNI-03-6197-2000 [5].

Skylight: Skylights can bring natural light from the sky into a commercial building, thus maximizing and optimizing the amount of light in the space. Using glass film materials can also help control sunlight to prevent glare [6].

Windows Wall Ratio (WWR): The higher the WWR, the more natural light enters the room and the better the air ventilation. However, a WWR that is too high can make the room too bright and hot. Therefore, WWR needs to be carefully considered in building design to ensure the comfort and health of the occupants.

Material: The use and selection of materials can affect the amount of natural light that enters a building. Mirrors are the best material to reflect light into the room. The selection of materials such as white paint or glossy aluminium panels for walls can be considered to reduce the level of heat absorption from sunlight.

2.2. Research Method

This study used a qualitative descriptive method [7]. This method involves collecting and analyzing data by describing, interpreting, and understanding the phenomena under investigation. Sample data collection was conducted on a 4.50 x 15.00 meters land area of a two-story Shophouses representing the research area. In addition, data was also collected through interviews with shop owners and customers and direct observation of the phenomena through on-site surveys. The data was collected using a case study approach from literature sources such as books, journals, articles, and relevant documents related to the research topic. The final result of this study is a design created using Revit software and simulated using the Enscape application.

2.3. Case Study: Shophouses in the Pondok Lestari Housing Complex

Shophouses in the Pondok Lestari housing complex consists of 57 units out of a total of 66 units. These shophouses are in the Pondok Lestari housing complex, RT.001/RW.012, Karang Timur, Karang Tengah, Tangerang (See Figure 1).

**Figure 1.** Maps and view of the Pondok Lestari Complex.
Source: Google Maps downloaded in 2023

The field survey results showed that the phenomenon in the rooms inside the row of shops (shophouses) in the Pondok Lestari complex was not optimal for natural lighting. These rooms lighting conditions were uneven, and only entered through the front openings. Therefore, all rooms require artificial lighting so that activities can be carried out inside them (See Figures 2, 3, 4).
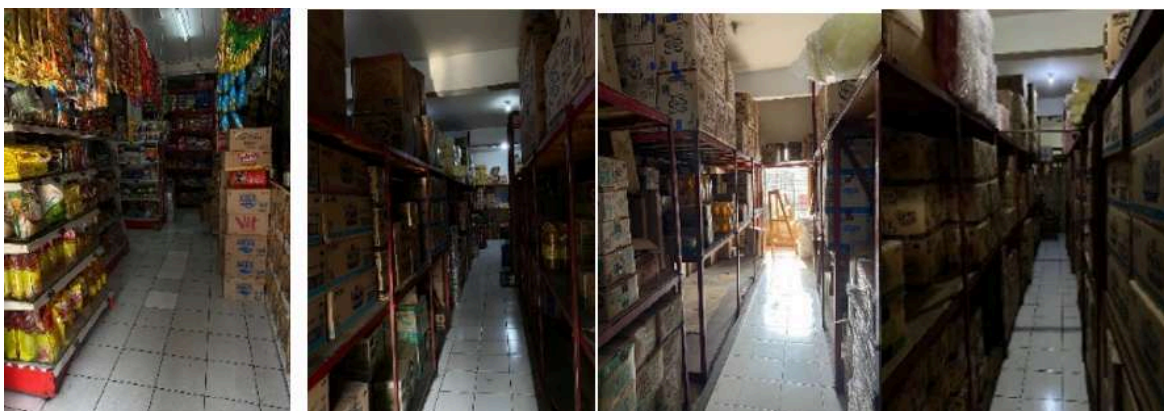
Figure 2. Shophouses includes the living and family rooms in the Pondok Lestari Complex.
Source: Authors, October 29-31th, 2022. Time: 08.00.
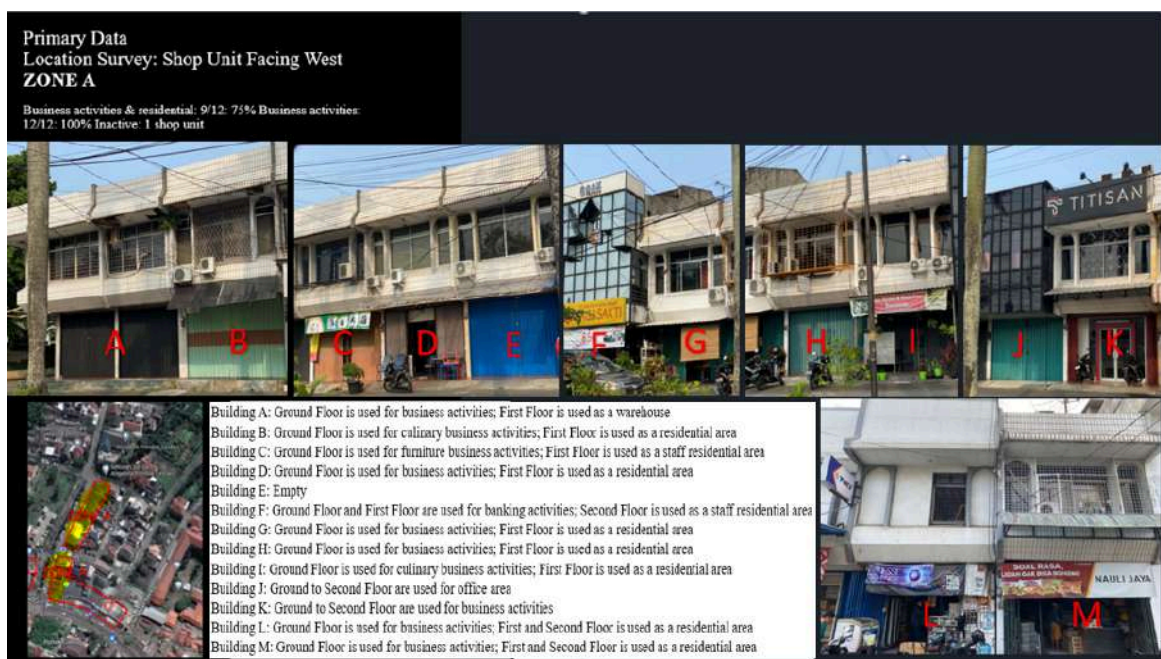
Figure 3. Functions Zone Mapping of Shophouses in the Pondok Lestari Complex.
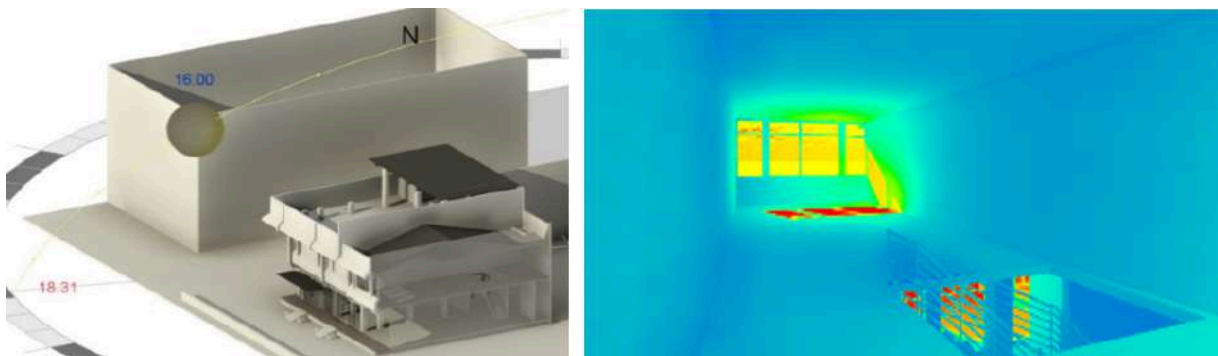Source: Authors, 2023

Figure 4. Business Room and Warehouse Function of Shophouses in the Pondok Lestari Complex.
Source: Authors, March 21st, 2023, at 15:30.

3. Results and Discussion

It can be concluded that the planning and designing of a multipurpose one-story commercial building with a residential area on the second floor, focusing on zone A area facing west and a typical land size of 4.5 x 15 meters, can provide many benefits. These include better space efficiency, better residential environment quality, and land use optimization.

In the Pondok Lestari complex, the conventional design of the west-facing shophouses cannot utilize natural lighting optimally. 3D application simulation showed that at 16:00, sunlight could only enter through the front façade (See Figure 5). At 13:30, the simulation showed that sunlight could not enter the shophouses with conventional design (See Figure 6). Therefore, optimization through architectural elements that can increase the use of natural lighting is needed. This can be done by adding elements such as large windows on the south side and using transparent roofs or high ventilation. Adding these elements would help maximize the entry of sunlight into the building. By considering factors such as building orientation and appropriate architectural elements, the design of shophouses can be optimized to maximize natural lighting and improve the comfort of occupants and the energy efficiency used.

Figure 5. Natural Lighting and Lightview Simulation (using the Enscape application) of Shophouses at 16:00
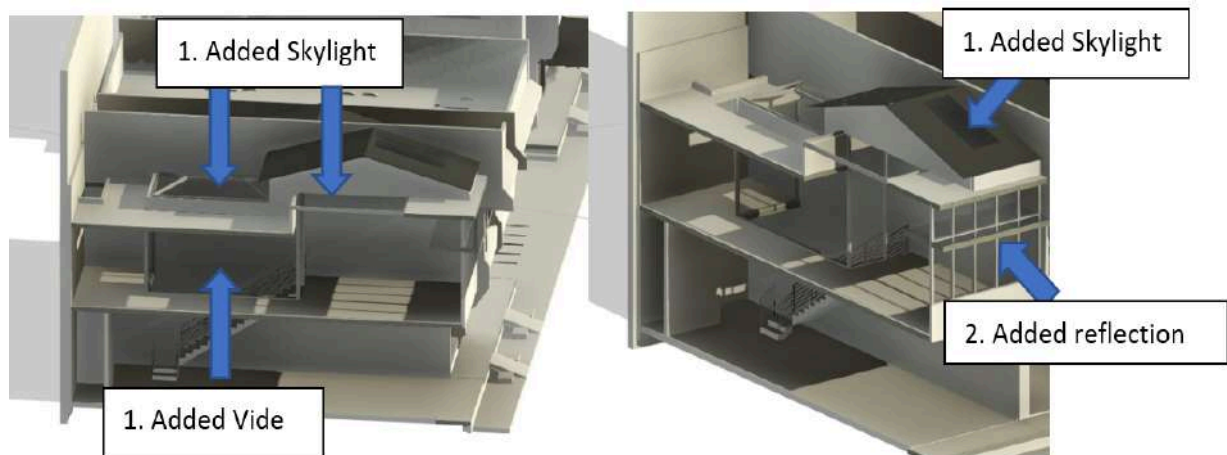Source: Authors, 2023
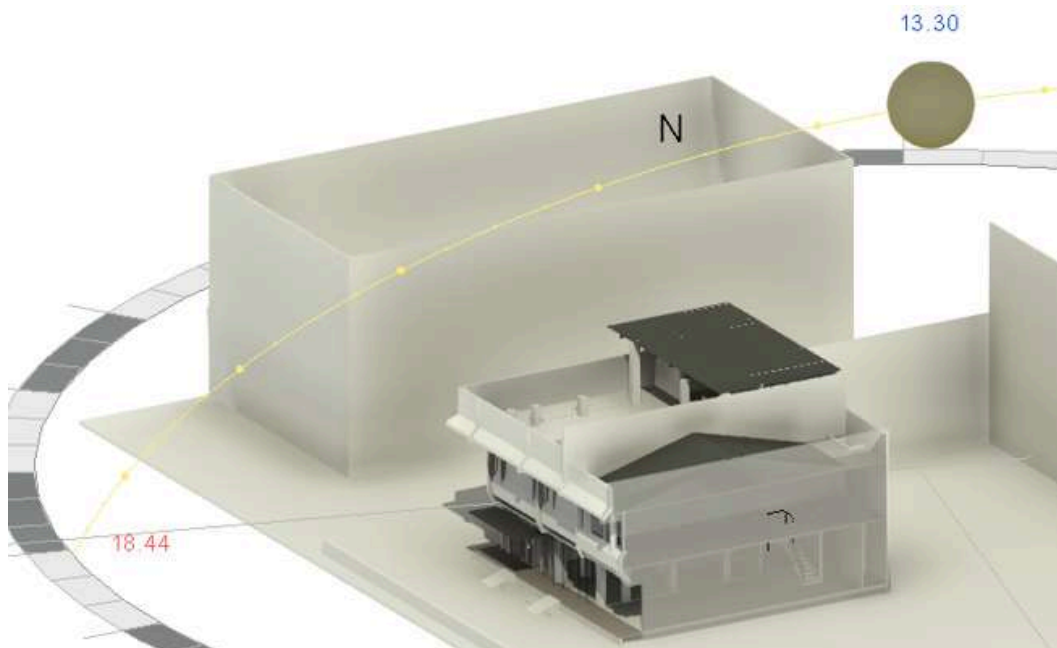
**Figure 6.** Natural Lighting Simulation of Shophouses at 13:30
Source: Authors, 2023

The authors attempted to use skylight as an architectural element to bring natural lighting into the 4.5 x 15m area (See Figure 7). With a skylight, light from the sky can be brought in so that each room can receive more light compared to conventional designs (See Figure 8).

Figure 7. Skylight Application Design on Shophouses with 4.5 x 15m and Using Material Reflection on Sunshade (using Revit software).
Source: Authors, 2023
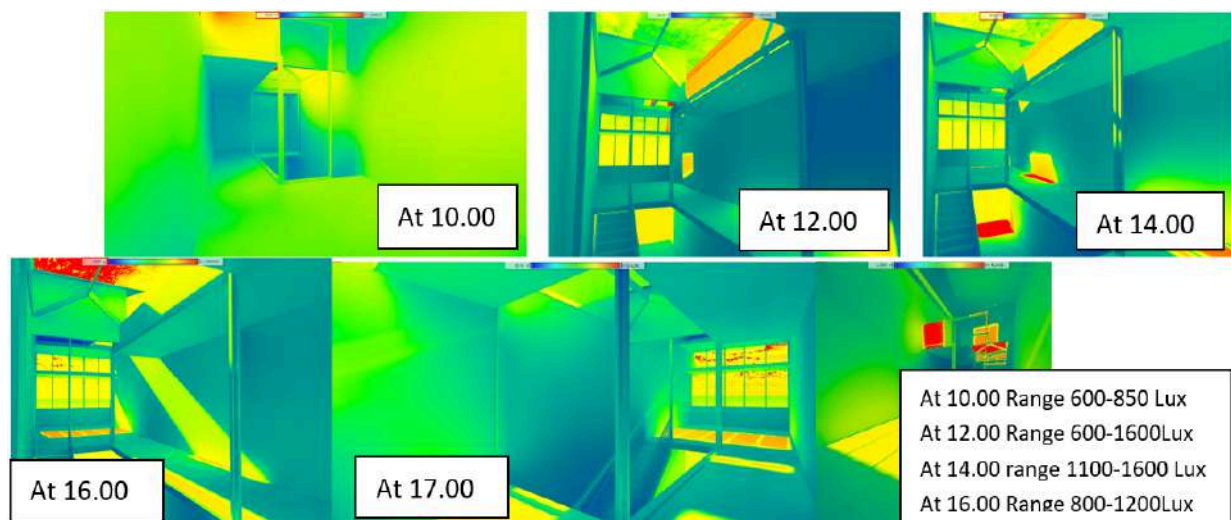
Figure 8. Simulation Design proposed using skylight and material reflection (using the Enscape application)
Source: Authors, 2023

4. Conclusion

In designing commercial buildings such as shophouses, it is essential to consider architectural elements that can increase natural lighting in the space. Skylights, reflective materials such as mirrors, and voids can effectively maximize natural lighting. To achieve optimal lighting conditions, architects and designers should prioritize incorporating these elements into the early design stages. By prioritizing natural lighting, a building can provide occupants with a more pleasant and productive environment and reduce energy consumption.

References

[1] P. E. Dora and P. F. Nilasari, "Pemanfaatan Pencahayaan Alami pada Rumah Tinggal Tipe Townhouse di Surabaya," Universitas Kristen Petra, Surabaya, 2011.

[2] M. Masrokan, W. S. Budi and E. Setyowati, "Pemanfaatan Cahaya Alami terhadap Meja Baca di Perpustakaan," *Jurnal Arsitektur ARCADE,* vol. 4, no. 2, pp. 176-185, 2020.

[3] D. D. Harisdani and M. D. Lubis, "Identitas Fungsi Shophouses Kesawan," Universitas Sumatera Utara, Medan, 2004.

[4]   A. Atthaillah and A. Bintoro, "Useful Daylight Illuminance (UDI) pada Ruang Belajar Sekolah Dasar Di Kawasan Urban Padat Tropis (Studi Kasus: SD Negeri 2 Dan 6 Banda Sakti, Lhokseumawe, Aceh, Indonesia)," *Langkau Betang: Jurnal Arsitektur,* vol. 6, no. 2, pp. 72-86, 2019.

[5]   C. Tarjono, "SNI 03-6197-2000 Standar Nasional Indonesia Badan Standardisasi Nasional: Konservasi Energi pada Sistem Pencahayaan," Standar Nasional Indonesia, 2000.

[6]   T. C. Hartono, "Studi Efektivitas Pencahayaan Atrium Lenmarc Mall di Surabaya," Universitas Kristen Petra, Surabaya, 2019.

[7]   J. W. Creswell, Qualitative Inquiry and Research Design: Choosing Among Five Approaches, Los Angeles: SAGE Publications, Inc., 2007.