

Natural Lighting System to Provide Visual Comfort in Library Reading Room at Universitas Budi Luhur, Jakarta

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Submission date: 09-Apr-2023 05:13PM (UTC+0700)

Submission ID: 2059466645

File name: ICPEU_2019_Extended_Abstract_Sri_Kurniasih_revisi_ok.pdf (348.06K)

Word count: 1798

Character count: 9454

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Natural Lighting System to Provide Visual Comfort in Library Reading Room at Universitas Budi Luhur, Jakarta

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Abstract. The general purpose of natural lighting is to produce quality light that is efficient and minimizes direct glare, and excess light level ratios. The natural light that enters through a window can come from several sources, namely direct sunlight, clear sky, clouds or reflections of the lower surface and surrounding buildings. The light from each source varies not only from the amount and heat it carries, but also on other qualities, such as color, spread, and savings. Light is the most important part of human life, to get the right lighting in a space, the right lighting system is needed according to their needs so that visual comfort can be achieved. The library is an important means to support teaching and learning activities and in supporting the implementation of the Three Principles of Higher Education, the library should be the center of attention, especially in its lighting system. This study applies a quantitative analysis method with a descriptive approach where the measurement of natural lighting levels and calculation of the dimensions of shading devices are carried out as part of the research stage. The independent variables in this study are the use of shading devices, while the dependent variables observed are natural lighting levels and natural lighting factors. The results of this study are natural lighting systems in the form of design solutions that allow it to be applied to the 3rd-floor library reading room at Budi Luhur University.

Keyword: daylighting; visual comfort; natural lighting system; shading devices; library

1. Introduction

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The library is one of the **work** places where most of its activities rely heavily on the work of one of our five senses, namely the eye. Therefore, good lighting in the library will increase **comfort** in working for employees and students. Go **3** lighting includes natural lighting and artificial lighting. The existence of libraries in higher education is an important means to support learning and teaching activities and in supporting the implementation of the Three Principles of Higher Education, the library must be the **center** of attention.

Visual comfort is the need for a good level of lighting in a room. Good lighting is lighting that can meet the needs of **17** users, related to the types of activities carried out in the **space**. To achieve visual comfort in a room, it is necessary to adjust the intensity of the incoming light. Based on SNI 03-6197-2000 on Energy Conservation in Lighting Systems, the average lighting level in the library reading room

is 300 lx. The following is the level of lighting in accordance with SNI for energy conservation in the lighting system [1];

Table 1. Average lighting levels recommended color rendering and temperature

The Function of the room	Illumination Level (Lx)	Color Rederation group	Color temperature	
Educational institutions				
Classroom	250	1 or 2	•	•
Library	300	1 or 2	•	•
Laboratory	500	1	•	•
Studio of Architecture	750	1	•	•
Canteen	200	1	•	•

Sumber: Indonesian National Standards on energy conservation in lighting systems

Based on the results of measurements of the intensity of natural lighting obtained the average value of natural lighting intensity in the 3rd-floor library reading room of Budi Luhur University is 663 lx, this indicates that the average lighting power that occurs exceeds the SNI standard. The problem that arises in the library on the 3rd-floor is the occurrence of glare that can disrupt library users' comfort, this glare is influenced by the position of the library which is located on the 3rd floor with a floor to floor height of 11.10 m with that height without a shade tree barrier on the outside of the building [2].

The design of a natural lighting system needs to know the availability of natural light received at a local location. The general purpose of natural lighting is to produce quality light that is efficient and minimizes direct glare, reflective layers, and excess light level ratios [3]. The basic strategy of natural lighting can be imagery, natural lighting transfer and view taking [4].

Based on the results of the measurement of the intensity of the lighting, it is necessary to have a daylighting system strategy that can be applied to achieve visual comfort in the library reading room. The object of the research is the library reading room on the 3rd-floor, this is due to the glare that disturbs the reader in the space. The scope of this study is a daylighting system strategy that can be applied to window openings in the 3rd-floor library of Budi Luhur University, Jakarta.

2. Methodology

The research method used in this study is a quantitative research method with a descriptive approach. The quantitative research method is one type of research whose specifications are systematic, planned and structured clearly from the beginning to the making of the research design. Research with a descriptive approach aims to describe the object of research or the results of research [5]. The application of quantitative methods is by measuring the intensity of natural lighting as data to analyze the visual comfort level in the 3rd-floor library reading room and calculating the dimensions of shading devices. While the application of the descriptive approach is done by designing shading devices as a natural lighting system strategy in the openings of the 3rd-floor library reading room window. The scope of this research is visual comfort.

The research steps carried out were a theoretical study of the level of natural lighting and shading devices, measuring the intensity of lighting and calculating dimensions of elements of shading devices, designing alternative lighting systems, analyzing and synthesizing results and making conclusions.

3. Discussion

Based on SNI 03-6197-2000 on Energy Conservation in Lighting Systems, the average lighting level in library reading rooms is 300 lx. The conditions for measuring the level of lighting in the reading room of the Budi Luhur University library are:

1. Library reading room on the 3rd floor with window openings facing East and West.
2. Measurements are made ¹¹ each reading room table with a height ⁶ of 75 cm from the floor.
3. Measurements are made in the morning at 09.00 a.m., at noon at 11.00 a.m. and in the afternoon at 3:00 p.m. when the sky is clear.
4. Measurements are carried out ¹ in March, April, and May.
5. Measurements are made on the level of lighting in the reading room with conditions without artificial lighting.

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The measurement results of the average illumination of the reading room in the 3rd-floor library of Budi Luhur University:

Table 2. The average illumination of the library reading room without artificial lighting
The condition of the room with daylighting

Location	Time : 09.00 a.m Illumination (Lx)	Time : 11.00 a.m Illumination (Lx)	Time : 15.00 a.m Illumination (Lx)	Average Illumination (Lx)
3 rd -floor reading room	294	462	1232	663

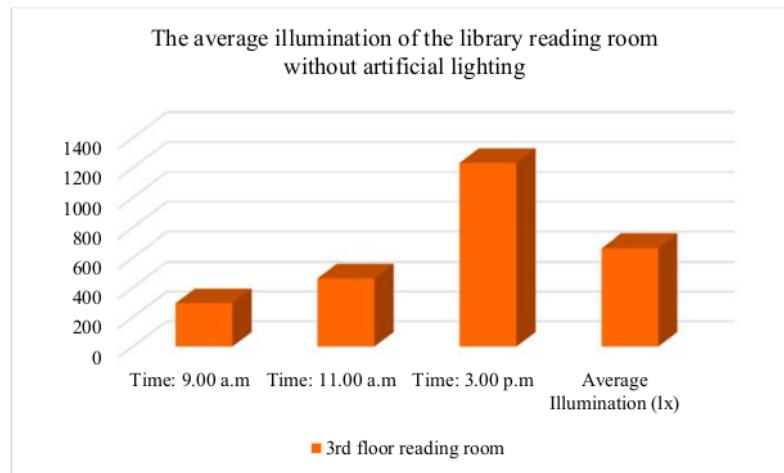


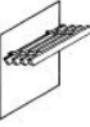
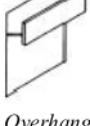
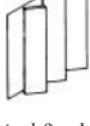
Figure 1. Graph of illumination without artificial lighting

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Based on the results of these measurements it can be seen that the average intensity value in the library of the 3rd-floor is 663 lx with conditions using daylighting. The lighting intensity exceeds the lighting intensity value required in SNI 03-6197-2000, giving rise to glare problems that can disturb the comfort of reading in the room.

The following are some lighting system strategies in the form of shading devices [6] that can be applied in the 3rd-floor library to reduce the lighting that goes into the reading room. The design of shading devices is a design strategy for daylighting systems that can reduce glare problems that occur in the 3rd-floor library reading room.

Table 3. Various shading devices

No	Description	Best orientation	Information
1	 <i>Overhang Horizontal panel</i>	South, East, West	<ul style="list-style-type: none"> • Hot air traps • Can be loaded by wind
2	 <i>Overhang Horizontal louvers in a horizontal plane</i>	South, East, West	<ul style="list-style-type: none"> • Free air movement • Small wind loads
3	 <i>Overhang Horizontal louvers in a vertical plane</i>	South, East, West	<ul style="list-style-type: none"> • Reducing the length of the overhang • Vision limitation • There are decorative lines on the window
4	 <i>Overhang Vertical panel</i>	South, East, West	<ul style="list-style-type: none"> • Free air movement • Vision limitation
5	 <i>Vertical fin</i>	South, East, West	<ul style="list-style-type: none"> • Vision Limitation • For the northern facade in only hot climates
6	 <i>Vertical fin slanted</i>	East, West	<ul style="list-style-type: none"> • Tilt to the North • Significantly limits vision

No	Description	Best orientation	Information
7	 <i>Eggcrate</i>	East, West	<ul style="list-style-type: none"> For very hot climates Very limited vision Hot air traps
8	 <i>Eggcrate with slanted fins</i>	East, West	<ul style="list-style-type: none"> Tilt to the North Very limited vision Hot air traps For very hot climates

Resource: Lechner, Heating, Cooling and Lighting, 2001

Based on some of the designs of the shading devices, the design of shading devices chosen and used to overcome glare problems in the 3rd-floor library is horizontal panel overhang and vertical fin. The selection of the selected shading devices design is based on the orientation of the building that is facing East-West and the criteria for its use.



Overhang Horizontal Panel



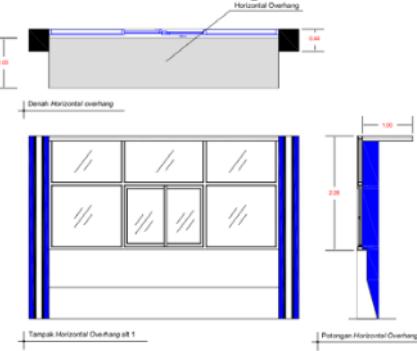
Vertical Fin

Figure 2. Recommended shading device

Here are the alternative designs of shading devices as a strategy for designing natural lighting systems to overcome glare problems that occur in the library on the 3rd floor of Budi Luhur University;

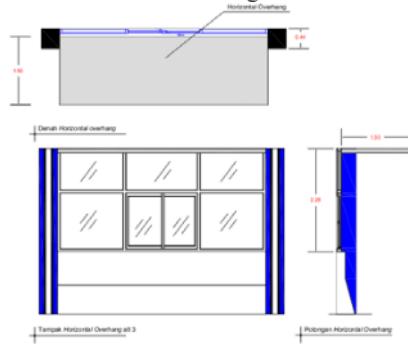
a. *Shading Devices type Horizontal Overhang*

- Alternative 1 with overhang width = 100 cm



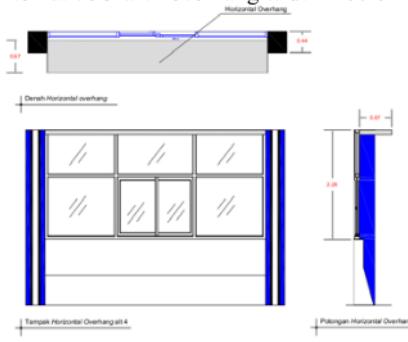
Perspective

- Alternative 2 with overhang width = 150 cm



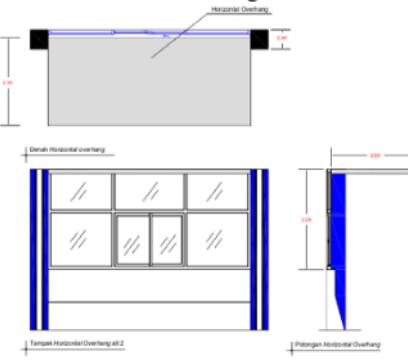
Perspective

- Alternative 3 with overhang width = 67 cm



Perspective

- Alternative 4 with overhang width = 200 cm

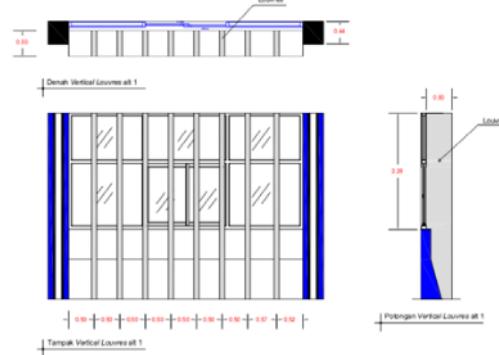


Perspective

b. Shading Devices Vertical Fin type

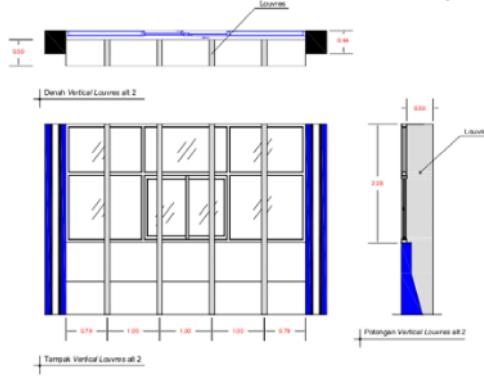
Based on the dimensions of shading devices, the width of the vertical fin is 50 cm.

- Alternative 1 with a distance of louvers every 50 cm



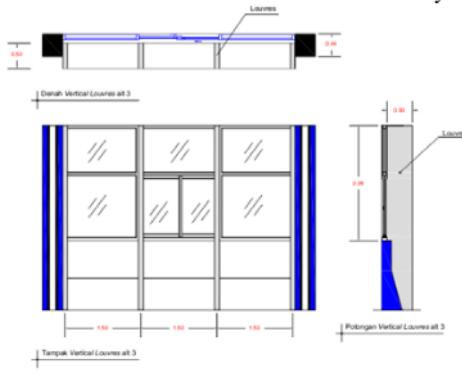
Perspective

- Alternative 2 with a distance of louvers every 100 cm



Perspective

- Alternative 3 with a distance of louvers every 150 cm



Perspective

4. Conclusion

The natural lighting system design strategy that can be a design solution to reduce glare problems is to use horizontal type shading devices and vertical fin with louvers so that the sunlight entering the reading room can be reduced.

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