



Optimizing the Use of Natural Lighting

Case Study: Library Room of Dean's Building, Faculty of Engineering, Sam Ratulangi University

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Abstract

Lighting constitutes a crucial element in spatial design aimed at enhancing user comfort. However, the efficacy of natural lighting in buildings remains suboptimal due to prevalent preferences for artificial illumination. This study identifies instances where the utilization of natural lighting, particularly sunlight, can be optimized, focusing on the Dean building of the Faculty of Engineering Unsrat, specifically the Library room, also known as the E-Library room. The objective is to investigate the most effective timing for natural lighting usage compared to artificial lighting from lamps.

Keywords: Library, lighting, nature, UNSRAT

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Introduction

Lighting plays a critical role in spatial design, contributing significantly to user comfort. It can be categorized into two main types: natural lighting and artificial lighting. Natural lighting involves harnessing light emitted by natural sources such as the sun, moon, and stars to illuminate a space. However, natural light is inherently variable, contingent upon factors such as climate, season, and weather conditions. Among natural light sources, sunlight stands out for its potency, making it particularly valuable for interior illumination, commonly referred to as daylight (Dora and Nilasari 2011).

The efficacy of natural lighting in buildings is often compromised due to prevailing preferences for artificial illumination over natural sources. However, excessive reliance on artificial lighting not only contributes to energy wastage but also poses significant environmental repercussions, notably exacerbating global warming. Given the gravity of environmental concerns, including global warming, there is a pressing need to prioritize the adoption of environmentally sustainable practices, such as utilizing natural resources and employing green architectural principles, in material selection and design (Dinas PUPR 2020).

In this study, it was observed that numerous buildings, including the Dean's building of the Faculty of Engineering Unsrat, specifically the library room, or the E-Library room, have yet to fully harness the potential of natural lighting. Notably, the building's orientation, facing directly eastward, inherently lends itself to optimal utilization of sunlight. As per the guidelines outlined in SNI No. 03-2396-2001 regarding the Design Procedure for Natural Lighting Systems, the adequacy of natural lighting within a space is determined by the level of sky illumination on a horizontal plane in an unobstructed setting simultaneously. The prescribed Natural Lighting Standard for the library room is 300 Lux.

Hence, the author seeks to investigate the optimal hours for leveraging natural lighting, specifically sunlight, as opposed to relying on artificial lighting from lamps. Comprehensive deliberation is essential and should be integrated into every stage of the design process, ensuring that the resulting buildings are not only environmentally sustainable but also offer universal comfort and possess distinct characteristics and identity (Manurung 2012).

Methods

Research methodology

The research methodology employed in this study is quantitative research. Quantitative research is a methodology aimed at generating findings that are quantifiable through statistical procedures or other means of quantification (Sujarweni 2014). Adhering to systematic steps in research is crucial for effectively addressing research problems.

Research location

The research was conducted at the Library Room within the Dean's Buildi-

ing of the Faculty of Engineering, Sam Ratulangi University, located in Manado City.

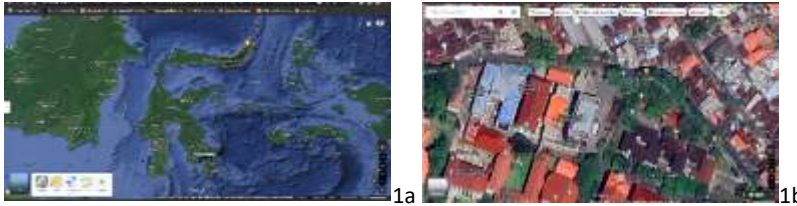


Figure 1
1a. Sulawesi Maps
1b. Research sites

Data collection

Data collection is a method utilized by researchers to gather information pertinent to their study. The collected data serves to aid researchers in conducting their investigations. The data collection process entails two stages: primary and secondary data collection. Primary data collection involves field surveys and observational studies. Observational studies are conducted directly by researchers through firsthand observation of the subject. Secondary data is obtained from literature reviews, including books, journals, websites, and other sources relevant to the issue of natural lighting.

Data analysis

Researchers analyze data collected through direct observations pertinent to the research subject. In pursuit of optimal outcomes, the researcher undertakes various processes.

1. Observing the Sun's trajectory over the Dean's Building Library Room at the Faculty of Engineering, UNSRAT, utilizing the Sun-Path 2D web application.
2. Quantifying light intensity within the Library Room of the Dean's Building, Faculty of Engineering, UNSRAT, utilizing an Android-based Luxmeter.
3. Evaluating the results of natural lighting intensity can be aligned with the recommended average as per the SNI standard No. 03-2396-2001.

Result and Discussion

The research was conducted at the Dean Building of the Faculty of Engineering, Sam Ratulangi University, which faces eastward. The study took place on May 29, 2023. The designated research site, the library, is also aligned with the building's front orientation and features windows. Operating hours for the building are from 08:00 to 16:00.

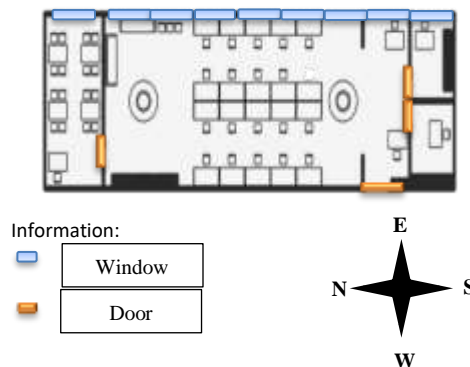


Figure 2
Layout of the library at the Faculty of Engineering, Sam Ratulangi University

Analysis employing the Sun-Path 2D Web application to track the movement of the sun

Essentially, to utilize this application, we require knowledge of the Latitude and Longitude coordinates. The research site's coordinates are approximately (1.4589372526340598, 124.82555667783787), rounded to (Latitude 1.50) and (Longitude 124.85). The analysis of sun movement using the Sun-Path 2D web application, with readings taken every two hours, reveals the following pattern: at 06:00 WITA, the sun rises; by 08:00 WITA, it becomes visible, casting its light; at 10:00 WITA, the sun starts nearing the research site; and by 12:00 WITA, it moves away from the object. A schematic representation is provided in the figure below as:



3a



3b



3c

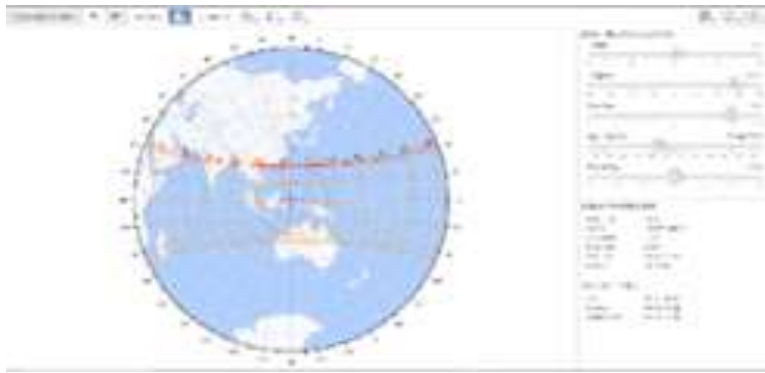


Figure 3
 3a. o'clock 06:00
 3b. o'clock 08:00
 3c. o'clock 10:00
 3d. o'clock 12:00

Analysis of sunlight intensity measurement using the Luxmeter Android application

According to the results obtained from measuring incoming light intensity with a Luxmeter via the Light Meter application, readings were taken hourly. Below is a table presenting the measurement outcomes recorded using the application.

Measurement Results	
Time	Lux
08.00	153
09.00	195
10.00	247
11.00	282
12.00	279
13.00	252
14.00	220
15.00	195
16.00	121

Table 1
 Lux measurement results
 Source: Personal data

Assessment of daylighting utilization

According to the SNI 03-2396-2001 standard specifying that the recommended lux level for a library room is 300 lux, analysis of the measurement data table reveals that effective utilization of natural lighting occurs primarily during specific hours, notably from 10:30 am to 11:30 am.

Conclutions

Optimizing natural lighting is crucial given the prevailing circumstances; however, it's equally important to ensure that minimum light intensity requirements are met in specific rooms. In the case of the research site, the Library Room within the Dean Building of the Faculty of Engineering at Sam Ratulangi University, reliance solely on sunlight for natural lighting aligns closely with the minimum standard of 300 lux only during the hours of 10:00 to 12:00. This limitation arises from the sun's rotation, which may not consistently illuminate the building's facade, particularly the windows of the library room. Consequently, researchers observe that effective utilization of natural lighting is confined to specific times. Therefore, supplementary artificial lighting is necessary to achieve the minimum standard lighting intensity in the library room.

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