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NATURAL LIGHTING ANALYSIS OF DESIGN CHANGES BETWEEN DESIGN AND IMPLEMENTATION OF APARTMENT UNITS (CASE STUDY: APARTMENT UNIT TWIN KEY MAHATA MARGONDA)

Submitted in Partial Fulfillment of the requirements for the D-IV Degree

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Depok, 28 March 2022

Salma Shafira R.P

Natural Lighting Analysis of Design Changes Between Design And Implementation of Apartment Units (Case Study: Apartment Unit Twin Key Mahata Margonda)

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ABSTRACT

As a tropical country, the sun line passes through Indonesia, and the abundance of sunshine that shines throughout the year provides abundant natural light. This sufficient natural lighting will save energy due to the minimal use of artificial lighting. This research attempts to find the natural lighting effect because room modification in apartment unit design on the Pondok Cina Transit-Oriented Development qualifies optimization of natural lighting. The specific objectives of this research are to evaluate methods and results analysis of natural lighting to make recommendations for building managers. Data processing is carried out with DIALux Evo 10 software simulations. First, a simulation is carried out, which obtains light intensity data. Then a comparison is made with SNI 03-2396-2001. If it meets, it can proceed to analyze data using Microsoft Excel. If it is not, it will be optimized with re-simulation until it meets SNI 03-2396-2001. The results of the simulation carried out on the DIALux Evo 10 application with the location of the Mahata Margonda Tower 2 Apartment on the 7th, 17th, and 28th floors at 08.00 am, 12.00 pm, and 04.00 pm. With the north solstice on June 21, 2022, the equator on September 23, 2022, and the south on December 22, 2022, after the simulation, test results on the modified unit meet the SNI of 13% and 15% for unmodified units. The comparison results showed that the unmodified unit is better than the modified one. Obtained efficiency after the design recommendations is pretty significant, reaching 76%. The furniture arrangement, blinds, opening material, and room openings affected the lighting level of the apartment unit. In this case, add a bouven at the top of the bathroom door and use a door with ice glass to connect the terrace.

Keywords: Design modification; Lighting simulation; Natural lighting; Unit apartment.

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CHAPTER I

INTRODUCTION

1.1. Background

As a tropical country, Indonesia, crossed by the imaginary equator causes it only has two seasons, summer and rainy (Tenia & Andri, 2020). Countries with four seasons can go through a reduction in productivity in certain seasons. However, the sun line passes through Indonesia, and the abundance of sunshine that shines throughout the year provides opportunities for activities year-round (Pramita, 2013).

Besides being famous for its tropical climate, Indonesia is also known for its population. Indonesia's high population density is commensurate with the populace's demand for housing (Prasetyo, 2019). One of the brainchild to meet these requests is the apartment. According to Kamus Besar Bahasa Indonesia (KBBI), an apartment is a multi-story residential building completed with a sitting room, bedroom, kitchen, dining room, latrine, and bathroom located on one floor, a multi-story building consisting of several residences.

With the high number of housing requests, the development in Indonesia itself nowadays can be observed through many construction projects that are currently underway or those that have just been planned (Permana, 2013). A construction project is a project that is usually in the form of building work or making physical products (NR & Daryanto, 2015). The construction projects often encounter issues, one of which is a plotted design modification. The emergence of design changes is difficult to predict. It is rare in a construction project that there is no design modification until the project is completed (Firdaus, 2019).

Pondok Cina Transit-Oriented Development project is one of the Apartment developments projects that function as apartments and flats with an exposure to ease the mode selection. Moreover, It is located strategically and has the potential of effortless preference due to its strategic development (Rahmawati & Agus Murdiyoto, 2021). After taking preliminary observation specifically, it was discovered that several cases could be investigated further, one of them was about the design modification of the twin key studio apartment unit.

The project did the design modification after the room started the architectural work. This design modification changes the 2BR room type interior partition from three parts to two parts in the twin-key room type and reduces the number of openings that have been planned from three openings with two double windows and one single window in a 2BR room type to two single windows in the twin-key room type.

The number of building-opening reductions will be analyzed further on its impact on the natural lighting of the building. Buildings designated as residential buildings are required to be comfortable to dwell. The primary function of the residential building itself is as a place to rest. One of the comfort factors is influenced by lighting (Saputra & Huwae, 2022). The use of natural light from the sun is advantageous for buildings located in tropical countries. However, these elements need to be optimized and implemented according to standards to ensure that the room inside the building gets optimal natural lighting.

SNI 03-2396-2001 are used as the references in designing natural lighting systems in buildings. Therefore, by referring to the standards of SNI 03-2396-2001 as the standard procedure for designing natural lighting systems in buildings, it is expected to form an appropriate quality of natural lighting. In addition, sufficient natural lighting will save energy due to the minimal use of artificial lighting (Avesta et al., 2017).

This research attempts to find the natural lighting effect. Because in apartment unit design on the Pondok Cina Transit-Oriented Development which underwent room modification project that never done before. Using the support of DIALux Evo 10 software, conceptualize how the design modification affects the building's natural light studied by the author.

1.2. Research Questions

This research is conducted to determine how the design modification impact building natural lighting. How to optimize it in the building directly by following the applicable standards. Based on the background above, several problems can be formulated:

1. Does the natural lighting of modified and unmodified design Apartment Mahata Margonda's Twin Key Studio Unit qualify SNI-03-2396-2001?

2. Is the natural lighting in the modified room better than the unmodified room design of the Twin Key Studio Unit Apartment Mahata Margonda?
3. How does the room design modification optimize the natural lighting of Apartment Mahata Margonda's Twin Key Studio Unit?

1.3. Research Scope and Limitation

Based on the literature analysis, the limitations of the issue in this study are as follows.

1. Simulation location: Studio Unit Twin Key tower two floors 7, 17, and 28 Mahata Margonda Apartment
2. Simulation time: 08.00 am, 12.00 pm, 4.00 pm with clear sky and sun. The sun rises at 06.00 am and sets at 06.00 pm so that the daily vertical angle of incidence of direct sunlight shifts by 15º every hour. In other words, the angle of incidence of direct sunlight at 08.00 am = 30º, at 12.00 pm = 90º, and 4.00 pm = 150º
3. Device: Software DIALux evo 10
4. Standardization: The reference used is SNI 03-2396-2001
5. The thermal effect of direct sunlight is not included in the discussion of this analysis.
6. Other objects, when clear sky conditions not overshadow the lighting openings in the building.

1.4. Purpose Statements

The specific objectives of this research are:

1. Analyze the average lighting level before and after modifying to SNI-03-2396-2001 Mahata Margonda Twin Key Studio Unit design.
2. Analyze the lighting level outcome of design modifications, whether it is considerably better or not on Apartment Mahata Margonda Twin Key Studio Unit
3. Evaluate the methods and results analysis of natural lighting on the Twin Key Studio Unit Mahata Margonda to make recommendations to save energy to building managers.

1.5. Writing System

1. Chapter I Introduction

   This chapter contains the background, research issues, issue identification, issue formulation, research objectives, limitations, and writing systematics.

2. Chapter II Literature Review

   This chapter contains an explanation of the literature regarding the definition of Apartment, natural lighting on Apartment, design modification, and the optimal lighting in buildings.

3. Chapter III Research Methodology

   This chapter describes the methods used in evaluating research designs. The method used and the research process

4. Chapter IV Data and Analysis

   The chapter contains simulation and analysis data of building lighting.

5. Chapter V Conclusions and Suggestions

   Conclusions and suggestions include conclusions from research results and suggestions to complete this thesis.

6. References

CHAPTER V

CONCLUSION AND SUGGESTION

5.1 Conclusion

The conclusions that can be drawn from this research are:

1. Simulations carried out on 2BRB units or unmodified units and Twin-key units or modified units on the 7th, 17th, and 28th floors. By observing the solstice when the sun is in the northern part of the earth, namely on June 21, 2022, when the sun is at the top earth's equator on September 23, 2022, and finally when the sun is in the southern part of the earth on December 22, 2022. With the testing time is at 08.00 am, 12.00 pm, and 04.00 pm. After the simulation, the test time at 04.00 pm with equator solstice gives a higher light level than the others. The test results on the modified unit fulfill the SNI 03-2396-2001of 13%, with 5861 lux in the 28th-floor living room, equator solstice being the highest. Next, 15% for the unmodified unit with the highest lux on the 28th floor with equator solstice in the bedroom with 3452 lux. Lastly, the part with the lowest lux on the modified unit is on the terrace with 0 lux. The bathroom also cannot be reached by daylight in both designs with 0 lux.
2. The modified unit distribution is not as good as in the unmodified unit because there are still some parts that are not reached by light. If viewed from the natural lighting standards based on the activities the modified unit has not been able to fulfill it so the unmodified unit is better than modified unit. According to SNI 03-2396-2001 standards, the working time is at 08.00 am-04.00 pm. The results indicate that the modified unit has a smaller illuminance than the unmodified unit, but the modified unit's average illuminance can meet the SNI standard with 242.08 lux while the unmodified unit exceeds the SNI standard with 916.27 lux. It is because the unmodified unit has more openings than the modified unit. Besides that, the unmodified unit has room partitions which cause better light distribution for each room function.
3. The way to optimize natural lighting in this research is to make design recommendations. Furniture arrangement is made to place furniture

according to the light spread. Starting from the workspace, which is placed in front of the window. Followed by the living room next to it and the bedroom opposite the workspace to avoid discomfort during rest due to excessive illumination. Then added, bouven at the top of the bathroom door so that light can reach the bathroom, and a door with ice glass is used on the door that connects to terrace, so the daylight can enter terrace. Installation of blinds on the windows was conducted to avoid high illuminance that enters in the afternoon because the building is facing west. The blinds are used only in the afternoon so that the room remains comfortable without excessive illuminance. The results obtained from the design recommendations on the modified unit show that the furniture arrangement, adding blinds to the windows, adding bouven to the the top of the bathroom doors, and changing the type of door in the terrace room resulted in 76% efficiency, successfully reduced, and reached the SNI standard.

5.2 Suggestion

1. Suggestion for the building manager recommends making a furniture arrangement so that each function of the room becomes more leverage, especially the kitchen. Recommended to be placed in the corner of the room next to the bathroom, far from the bedroom.
2. By adding a bouven at the top of the bathroom door to maximize the light can be used for bathroom lighting.
3. The use of blinds on the windows reduces the high illuminance that enters in the afternoon.
4. It is necessary to use the ice glass at the door between the terrace and the inside of the unit so the light can reach the terrace room. Use the ice glass that is not too clear to maintain the privacy of the room.

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