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The Influence of Perforated Aluminum on Lighting in the Classroom of New Media Tower Building of Multimedia Nusantara University

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The Influence of Perforated Aluminum on Lighting in the Classroom of New Media Tower Building of Multimedia Nusantara University, Tangerang, Indonesia

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Abstract. The one solution for reducing solar radiation and glare in the high rise building is by using a façade or secondary skin building. New Media Tower Building at University Multimedia Nusantara in Tangerang, Indonesia is buildings that use perforated aluminum as secondary skin. Using Perforated Aluminum for reducing solar radiation and glare has an impact in reduction amount the energy for New Media Tower operation. Beside natural lighting that going through secondary skin, the building will also affect the level of lighting or powerful lighting that happens in a room. Therefore we need to know the level of natural lighting is going in a room that uses perforated aluminum. As for the purpose of this research is to do an analysis of the natural lighting and artificial lighting in the classroom so it can be known how far the level of lighting (illumination) on the classroom in the buildings that use perforated aluminum. The research method used descriptively of quantitative is a description from the primary data on the field and the basic theories associated over some literature, then perform measurements of the lighting of the classroom as the object of research where the measurement results will be adapted to Indonesian National Standard about lighting. The results explain the level of lighting New Media Tower building is still within the limits of visual comfort as big as 243,6 lux when the lights are turned off and 265,6 lux when the lights on. So by using perforated aluminum as a secondary skin building will economize operation costs in the use of electrical energy for natural lighting and artificial light.

Keyword: secondary skin, perforated aluminum, lighting, illumination

INTRODUCTION

Natural lighting and ventilation not only can save energy in buildings but can also increase one's workability. According to Heschong (1999) of Heschong Mahone Group, there is a link between increasing the use of natural lighting and increasing human capacity [1]. Every job requires proper lighting on its surface. Good lighting is important to see visual related tasks. Better lighting will make people work more productively, for example reading books can be done with lighting between 100 to 200 lux. "Badan Standard Nasional" stipulates that SNI 6197: 2011 related Energy Conservation in Lighting Systems has issued a recommended level of illumination for various occupations. These recommended numbers have been used as national standards for lighting design. SNI 6197: 2011

states that the recommended lighting level for workspace is 350 lux [2]. On the other hand, natural lighting that enters through the building envelope will also affect the level of lighting or strong lighting that occurs in a room. Thus it is necessary to know also the level of natural lighting that occurs in a room that uses a building envelope (secondary skin). The formulation of the problem obtained is the extent to which the effect of using perforated aluminum on natural lighting level in the Multimedia Nusantara University classroom.

One of the building material that is useful as the second skin of the building is Perforated Aluminum. Perforated aluminum can also function as a second layer of the building that supports the aesthetic value of the facade. Besides, it can also be a natural lighting source while reducing excess heat through the holes in the Perforated Aluminum panel. This research was conducted in order to obtain the value of natural lighting levels in classrooms with facades that use Perforated Aluminum as a secondary skin. The scope of this research is the level of natural lighting in multi-story buildings that use Perforated Aluminum as a secondary skin. While the object under study is the classroom in the North-South and East-West oriented buildings.

This research was also motivated by research made by Adhityo Nur Huda and Abraham Seno in 2015 with the title "Optimizing Front Openings for Natural Lighting in a shophouse that functions as an Office". The problem of this research focuses on the intensity of natural lighting which will not interfere with the performance of activities in the workspace. The results of this study are by adding a light shelf to the front opening and proven to be effective in increasing the intensity of light entering the room and increasing the value of the distribution of light entering the room. But it has not been able to meet the standards of comfort, but only increases the intensity of light and increases the value of indoor light distribution [3]. In addition to research related to lighting, this research was also motivated by research related to building facades. The research carried out by Mufidah, Farida Murti, Benny Bintarjo DH, Hanny Chandra Pratama, Yunantyo Tri Putranto in 2016 under the title Analysis of Façade Ventilation Holes to Floor Area. The problem of this study is how the area of ventilation in the facade of flats in SIER is compared to the area of ventilation in the facade of flats in Grudo. The results of this study are the size of ventilation openings in SIER or Grudo flats which ventilation is still below the ideal standard required. Therefore, it is necessary to use aids such as fans or other equipment to form wind flow, lighting and thermal insulation into the building, so that it can reduce body temperature and reach the optimal limit of indoor comfort. [4]

RESEARCH METHODOLOGY

The method used for this research is quantitative descriptive. Descriptive means in the form of descriptions obtained from primary data in the field and related basic theories from some literature. While the quantitative method is done by measuring the existing conditions which will then be compared with the applicable standards. The sequence of methods used is a descriptive method in the form of a description of literature review, looking for primary data in the field which is then analyzed to obtain hypotheses and get recommendations in improving the quality of design. The object under study is a workspace that represents the orientation of the North-South and East-West wind directions in high buildings using Perforated Aluminum. Quantitative method is to measure the level of natural lighting in the existing condition of classrooms which will then be compared with the intensity of light that meets the standards for space that functions as a classroom.

RESULTS AND DISCUSSION

Existing Condition

Existing conditions are the conditions in the research site in terms of dimensions, design, and material used. Existing conditions relate to the physical data that is obtained, namely the physical data of the building which is the case study.

Building name: New Media Tower Building
Address: Jl. Scientia Boulevard, Gading Serpong, Tangerang, Banten Indonesia
Architect: Budiman Hendropurnomo
Land area: 8 Ha (land constructed 2.4 Ha)

Building area: 32,000 m2
Number of floors: 13 floors, Typical 11 floors, and 2 Floor Top Floor

Maps and facades of buildings will be shown in Figure 1 and Figure 2 below:

FIGURE 1. Map of Multimedia Nusantara University

FIGURE 2. New Media Tower Building Multimedia Nusantara University

The inauguration of the New Media Tower Building was held in September 2012. In 2013 won the first prize in the Energy Saving Building at the National Energy Efficiency Award. In September 2014 won the award as Energy Efficient Building in the category of Tropical Building which was contested at the ASEAN Energy Award 2014 in Vientiane, Laos. Top floor New Media Tower Building UMN is used for Business Incubator or Skystar Ventures in the form of a half-oval shaped classroom equipped with an open garden that is beautifully arranged. The upper part is a cover of the outer layer of the building made of aluminum and given many holes.

Each floor consists of 14 classrooms, with a total of 125 classes. Half-oval-shaped classrooms can accommodate 40 students. The overall capacity of the building is 5,000 students. The NMT Building Floor starts from the basement, which is used to park 2,000 motorbikes and a mosque. The 1st floor is used for the canteen. Level 2 has a canteen, class, and student activity unit rooms. 3rd floor, there is a Theater and class. 4th floor does not exist. 5th floor of the top of the Theater and classrooms. Levels 6 to 11 for classrooms and Visual Communication Design Laboratories and Computer Laboratories. Whereas on the 12th floor is used for Business Incubator which is referred to as Skystar Ventures. The measurement of the research was conducted at the New Media Tower Building Multimedia Nusantara University Campus on the 3rd floor because on the 3rd floor there was an open garden. The 3rd-floor plan of New Media Tower Multimedia Nusantara University will be shown in Figure 3 and Figure 4 below:

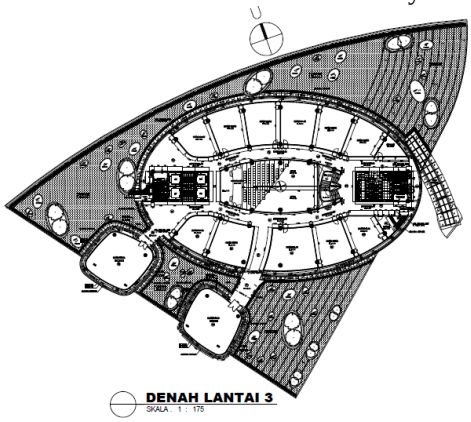

FIGURE 3. Plan 3rd stories New Media Tower Multimedia Nusantara University

FIGURE 4. Plan 3rd stories with oriented building New Media Tower Multimedia Nusantara University

Measurements were made on four classrooms representing classes with openings to the east, classes with openings to the south, classes with ventilation openings to the west and classes with ventilation openings to the north. Each classroom will be measured at nine points so that the conditions of air temperature, humidity, wind speed, and lighting

can be represented. The measurement points in the classrooms used as research objects will be shown in Figure 5, fugure 6, figure 7, and figure 8 below:

FIGURE 5. Classroom measurement points with east oriented

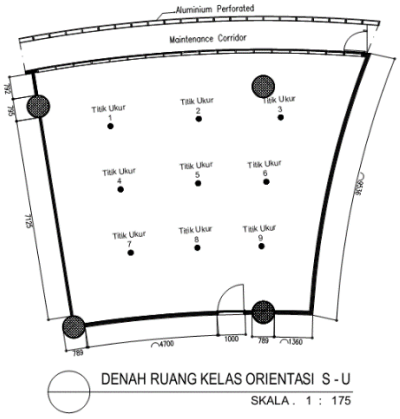

FIGURE 6. Classroom measurement points with south oriented

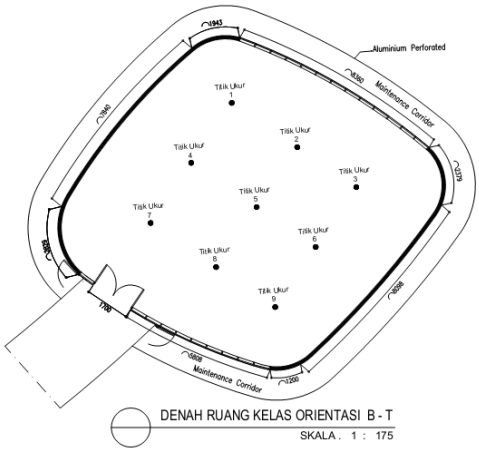

FIGURE 7. Classroom measurement points with west oriented

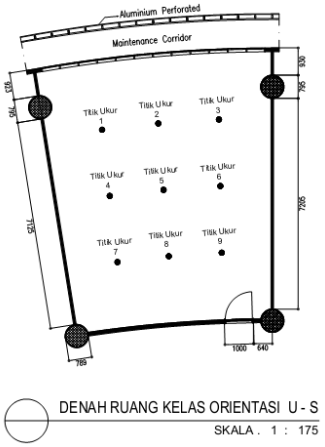

FIGURE 8. Classroom measurement points with north oriented

The lighting measurement conditions at the New Media Tower Building Multimedia Nusantara University Campus are:

1. Lecture room on the third floor facing the direction of the East, South, West, North winds.
2. Measurements are made at nine points in each lecture hall.
3. Measurements are made in the morning at 8:00 a.m., noon at 12.00 a.m. and afternoon at 4:00 p.m. when the sky is clear.
4. Measurements are made on the level of lighting in lecture halls with conditions without artificial lighting and with artificial lighting.

Based on the measurement results, the average lighting intensity at the New Media Tower Building Multimedia Nusantara University Campus will be shown in table 1 below:

TABLE 1. Illumination on average classrooms at New Media Tower Building Multimedia Nusantara University

Without artificial lighting

Orientation	Time : 08.00 a.m Illumination (Lux)	Time : 12.00 a.m Illumination (Lux)	Time : 04.00 p.m Illumination (Lux)
East Classroom	257.3	286.2	230.1
South Classroom	219.6	233.0	187.0
West Classroom	210.6	258.1	330.9
North Classroom	259.4	259.3	191.6
Average	**236.7**	**259.2**	**234.9**

With artificial lighting

Orientation	Time : 08.00 a.m. Illumination (Lux)	Time : 12.00 a.m. Illumination (Lux)	Time : 04.00 p.m. Illumination (Lux)
East Classroom	263.9	313.2	279.3
South Classroom	241.2	253.3	207.1
West Classroom	239.3	279.0	338.3
North Classroom	279.5	279.6	213.2
Average	**256.0**	**281.3**	**259.5**

The following is the strong illumination chart of the average class room shown in Figure 9 and Figure 10 below:

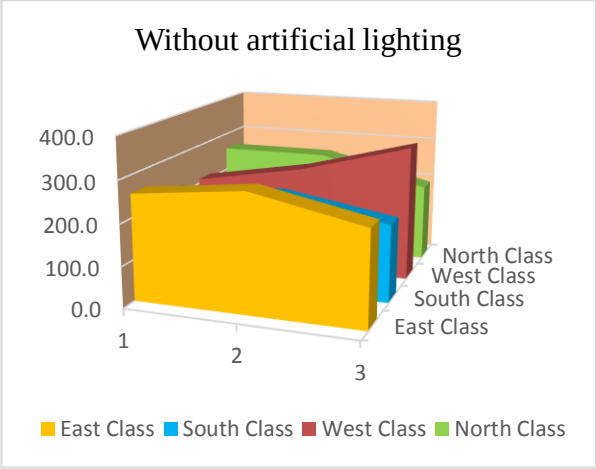

FIGURE 9. Illumination of the average condition of classrooms without Artificial Lighting

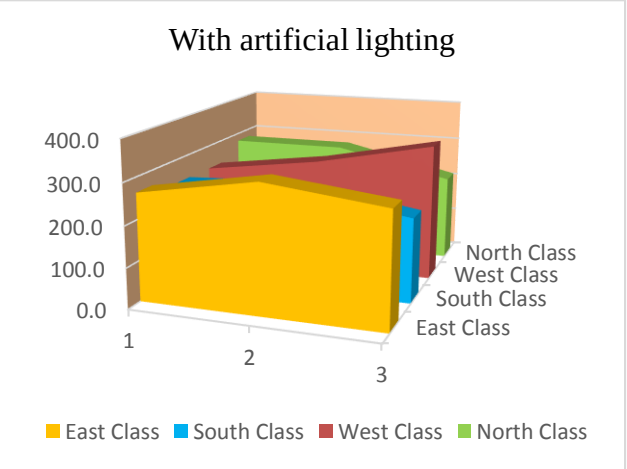

FIGURE 10. Illumination of the average condition of classrooms with Artificial Lighting

The average illumination values in the east, south, west and north will be shown in table 2 below:

TABLE 2. Total Illumination at the New Media Tower Building Multimedia Nusantara University Campus

Illumination average classroom

Information	East Class (Lux)	South Class (Lux)	West Class (Lux)	North Class (Lux)	Total (Lux)
Without artificial lighting	257.9	213.2	266.5	236.8	**243.6**
With artificial lighting	285.5	233.9	285.5	257.4	**265.6**

Thus the average illumination strength in the classrooms of the New Media Tower Building Multimedia Nusantara University Campus in a room condition without artificial lighting is 243.6 lux and the room conditions with artificial lighting are 265.6 lux. The average lighting power of the classrooms in the New Media Tower Building Multimedia Nusantara University Campus in a room without artificial lighting is 243.6 lux and in-room conditions with artificial lighting of 265.6 lux. Based on SNI 03-6197-2000 concerning Energy Conservation in Lighting Systems, the average lighting level in classrooms is 250 lux. This shows that the average illumination strength in classrooms with conditions without artificial lighting does not meet standards that are less than 250 lux, while the average illumination strength in classrooms with room conditions using artificial lighting meets standards and is said to be visually comfortable. i.e. above 250 lux in accordance with SNI 03-6197-2000 concerning Energy Conservation in Lighting Systems.

CONCLUSION

By using a secondary skin, air conditioning is only directed at classrooms. Passages outside the classroom do not require air conditioning, because the wind can pass freely. Besides that, double skin also provides optimal lighting for classrooms. The advantage of using a wall system with secondary skin is that even though there are glass parts on the wall with a thickness of 3 mm, but on the outside side of the building there is a perforated aluminum covering the entire building. With the right calculation, perforated aluminum made holes with different amounts. The point is that the sun's light into the room but not dazzling and air circulation can process well and cool.

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