Skylight study for Santa Market in South Jakarta

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Abstract. This paper presents the study of using skylight as a way of giving access to daylight in a public market. Daylighting in this type of building is mainly important in order to achieve visual comfort while also minimalizing the glare effect. The Indonesian’s Ministry of Health also stated that every public market has to achieve the minimum 100 lux of luminance. The particular study is aimed to investigate the most optimum skylight strategy to create adequate daylighting inside the building. This aspect is necessary since the application of skylight will directly affect the luminance below it. The steps of study are as follows: (1) to study the optimum daylight illuminance for public market, (2) to study the skylight system applied in Indonesia, and (3) to study the ratio of skylight openings to floor dimensions.

Keywords: skylight, public market, daylight

1. Introduction

This study was raised based on one of The Health Ministry of Indonesia programs that focuses on creating healthier public markets. The Healthy Market regulation itself has a variety of requirements that must be fulfilled. From the location, the structure of the building, the ventilation, to the lighting aspect became the focus of the discussion as a base of the market’s ability to run this program. Apart from the architectural aspect, The Health Ministry of Indonesia also provides guidelines for both sellers and buyers in the pursuit of healthy market programs.

Based on criteria in the Healthy Market regulation, Santa Market has low value in some aspects that should be achieved to achieve healthy market standard in Santa Market. These aspects are some of the criteria that have been adapted according to the study in architecture. The following are aspects of the Health Markets in accordance with the Ministry of Health Regulations with the dominant negative values:

- Trademarking Aspects
- Manager Office Aspects
- Wet Food Sales Aspects
- Dry Food Sales Aspects
- Parking Area Aspects
- Roof Construction Aspects
- Construction of Walls Aspects
- Ventilation Aspects
- Lighting Aspects
- Door Aspect
- Toilet Aspects
- Hand Wash Aspects

According to the Daylighting in Buildings (2000) book by the IEA SHC [3] natural lighting on the market can create a visual comfort for both buyers and sellers, in relation to merchandise for sale. The stipulation set by the Minister of Health through the regulations of the Ministry of Health of the Republic of Indonesia Number: 51 / MENKES / SK / VI / 2008 [5] is that the required lighting level reaches 100 lux. Therefore, the use of sunlight is very important and needs to be a top priority in the market.

The book states, “Because the luminous output will not vary as widely as that of systems admitting direct sunlight, the anidolic zenithal opening should produce less glare and provide improved visual comfort. It should thus find favor in applications where there are clear indoor spaces for which visual comfort is essential (e.g., sport halls, museums, atria, and markets). It may, however, require larger aperture areas than systems that are designed to admit direct sunlight.”[3]

From these statements, there are three words that need to be emphasized in relation to the natural lighting of the market, namely market, visual comfort, and less glare. These three are closely related, where natural lighting in the market places a high priority on visual comfort (in accordance with the Ministry of Health of Republic of Indonesia Number: 51 / MENKES / SK / VI / 2008), and can be applied using strategies that focus on reducing glare in the market.

The strategy was achieved through theories from Mark DeKay's Sun, Wind, and Lighting Books. The book reveals various strategies for optimizing natural lighting. One is to observe the glare in the room. According to the Sun, Wind, Ang Lighting diagram from the book [1], it can be illustrated as follows (Table 1).

### Table 1. Daylight Strategies

| Whole buildings | Daylight building |
|-----------------|-------------------|
| Room Organizations | Skylight building |
| Rooms | Glare – Free Rooms |

**Source:** Sun, Wind, And Lighting Book [1]

2. The methodology

2.1. The method of study

The study is mainly a literature review of certain built projects, which applied skylight as one of their building structures as a way of creating daylight inside the public market. This study is based on opening ratio variables, sourced from Daylight in Buildings (2000), that may affect the intensity of luminance provided for the building itself. The result of the study then will be tested with a simulation, that is going prove if the particular skylight could provide adequate daylighting. The diagram in Figure 1 shows the methodology applied in this study.
2.2. The case study
The study selected is at Santa Market, a public market placed in South Jakarta (Figure 2). Santa Market is located at Jl. Cipaku I No 121 Road, RT.5 / RW. 4, Petogogan, KebayoranBaru, SouthJakarta. This location is among one of the densest housing that is only facilitated by the narrow dimensions of the road. The market itself hasn’t fulfill the Health Market Standard set by The Health Ministry of Indonesia. One of the regulations is to provide adequate daylighting throughout the building. Santa Market is known for its lack of daylighting (Figure 3). Therefore, the study of daylighting is considered suitable for this particular public market.

Figure 1. The diagram of methodology

Figure 2. (a) Santa Market site boundaries, (b). The location zoning based on rules and regulation (Source: Google Maps)
3. Result and Discussion

3.1. The optimum daylight illuminance for public market

The Health Ministry of Indonesia set the luminance needed inside the public market with the minimum of 100 lux. Although there are no specific guidelines for dwellings, it is believed that luminance variations of around 10:1 are suitable for daylighting design [3] (Figure 4). 10:1 ratio refers to the highest to lowest luminance difference (ex: 100 lux – 1000lux). Therefore, the most optimum skylight is the one that could produce adequate daylight between 1:10 in ratio, but also with the minimum of 100 lux spread evenly throughout the building.

3.2. The skylight system applied in Indonesia

There are several skylight structures applied in public market. From 8 different markets in tropical climate:

1. Pasar Johar, Semarang, Indonesia
2. Pasar Sarijadi, Bandung, Indonesia
3. Food Villa Market, Bangkok, Thailand
4. Marketland Village, Bangkok, Thailand
5. Pasar BSD, Indonesia
6. Pasar Sehat Bunder, Sragen, Indonesia
7. Pasar Delapan, Indonesia
8. Or Tor Kor Market, Bangkok, Thailand

Most of the skylight systems used from the list above are gable roof, which is basic roofing system applied in countries with tropical climate. These skylights have several different glazing sizes (Figure 5), but in general, they have similar pattern to allow daylight spread evenly and adequately. As already mentioned before, the ratio of skylight openings with the floor dimension will directly affect how daylight will illuminate the whole building. Figure below shows the identical skylight types used by the markets from the list above.
Advantages of using gable roof system:
- Commonly applied to tropical buildings
- Adequate daylighting throughout the building
- The use of daylight in North - South orientation

3.3 Ratio of skylight openings to floor dimensions

Based on the Heating, Cooling, Lighting Book [2] H, O, U, W floor plan are the most effective building mass to create natural lighting. With the consideration of site index, building capacity, and building facade, O – floor plan (Figure 6) is the most suitable building form that will be applied to Santa Market. The most suitable skylight then applied (Figure 5b), with the opening to floor plan ratio of 1:5. The 1:5 ratio refers to the area of openings in skylight to floor area. Simulations below show the illuminance inside the building based on the sun movement path, solstice and equinoxes (March 21 – June 21 – December 22).

Simulation on March (Figure 7):
1. Average illuminance at 09.00 = 185.5 lux
2. Average illuminance at 12.00 = 229.5 lux
3. Average illuminance at 15.00 = 163.5 lux

Simulation on June (Figure 8):
1. Average illuminance at 09.00 = 181 lux
2. Average illuminance at 12.00 = 235 lux
3. Average illuminance at 15.00 = 168.5 lux
4. Concluding Remarks
The study of skylight type in order to be applied has been conducted and the remarks can be concluded as follows:
- The optimal luminance of public market is around 100 lux within 1:10 range.
- The gable roof is the most common and optimum roofing structure used in tropical country especially in Indonesia.
- The most optimal skylight openings ratio to floor dimension is 1:5, as it can deliver daylight evenly and adequately.

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