Evaluation of Daylight of Communal Isolation Houses for COVID-19
(Case study: Isolation Houses in Lam Neuheun Village, Kuta Baro, Aceh Besar, Aceh)

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ABSTRACT
Lam Neuheun Village, Kuta Baro, located in Aceh Besar, Aceh, is one of the villages in Aceh Besar district, Aceh that strongly supports the government in preventing the spread of the COVID-19 virus. Currently, the transmission of COVID-19 is extremely fast and widespread in rural areas. Therefore, the village apparatus along with the citizens formed several task forces responsible for the transmission of COVID-19. Otherwise, they provide communal isolation houses for isolation COVID-19 sufferers and village people who have just returned from a long trip. Based on several recent studies, including airflow and daylight into the room to prevent the transmission of covid-19. The airflow that flows through the opening can replace the air pollution in the room, while natural light other than lighting can also provide health effects for humans. Therefore, this paper aims to evaluate the intensity of daylight in communal isolation houses to the community during this pandemic. Daylight intensity will be measured using the Velux daylight visualizer and Andrewmarsh: Dynamic Daylight. Based on the simulation results using the Velux daylight visualizer, Andrewmarsh application: Dynamic Daylight based on a certain time can provide strategies and design recommendations for isolation and quarantine for the people of Lam Neuhen Village, Kuta Baro.

Keywords: *Communal house, Isolation, Daylight, Air flow.*

1. INTRODUCTION

The pandemic caused by the emergence of the Corona-19 Virus has lasted for 2 years, and until now all parties still do not know when this pandemic will end. The very fast spread of the virus through the air and contact with humans can expand access to its spread. In addition, with the genetic mutation of the Cov-19 virus, it becomes a more dangerous virus and worsens the condition. To minimize the spread of the virus, it is necessary to stop human-to-human transmission, separate one another through isolation and quarantine, social distancing, and community containment [1]. Isolation and quarantine are the most effective first steps to control the spread of the Cov-19 virus, where isolation is separating people who have been infected from people who have infectious diseases while quarantine is the most effective way to prevent outbreaks of infectious diseases [1].

The very fast and widespread transmission has made various regions form a task force team to handle the Cov-19 virus. They control the people exposed and restrict any movement of people coming from outside the area. As was done in Lam Neuheun Village, Kuta Baro, one of the villages in Aceh Besar, Aceh. They provide a place for quarantine for newcomers from the city before assembling with family. The place provided by the government in Lam Neuhen Village is in the form of 2 units of couple houses with an area of 48 m2 each, belonging to the village government, which are used as places for isolation and quarantine. By providing the communal isolation house, the Government and the residents of Lam Neuhen village have tried to prevent and break the chain of the spread of the Cov-19 virus. Isolation rooms located outside the hospital can help ease the burden on the hospital in handling various conditions of patients who are exposed case by case [2]. According to Yatmo [3], an adaptive isolation room for patients with mild to moderate conditions during a pandemic. Of course, for an isolation room, it is necessary to pay attention to the adequacy of sunlight and good air circulation.

A study conducted by Peters [4] related to the quality of health in housing during this pandemic, where one of the six most important factors is the level of lighting that can provide satisfaction to the user and according to the use of the room. To get the optimal level of daylight intensity into the room, it is strongly influenced by the dimensions and position of the opening area [5]. Furthermore, in this pandemic period, daylight from sunlight can increase the body's immunity from viruses that cause disease, by basking in the sun. Sunlight has UV B particles that can provide the body's need for vitamin D. In Indonesia, the quarantine tends to be carried out independently by increasing the body's immunity by sunbathing [6]. Based on research results [7], sunlight can not only help the immune system but also the recovery process during a pandemic. High doses of vitamin D in sunlight can help patients reduce inflammation without side effects and a disinfectant to treat the immune system [8,9]. Thus, exposure to natural sunlight is an important factor in increasing the immune system [10]. For this reason, a room that can provide a sufficient intensity of sunlight is needed.

The need for sunlight for health and increasing immunity is an important issue in the isolation house in Lam Neuhen village, Aceh Besar. There is a need for preliminary research to evaluate the level of sunlight that occurs in existing spaces so that it can provide the needs of natural sunlight for sunbathing purposes for those who are self-isolating. The accuracy of the size and placement of the openings greatly affects the amount of sunlight that enters the room (figures 1, 2).

Figure 1 Existing condition of isolated houses in Lam Neuheun Village, Aceh Besar.

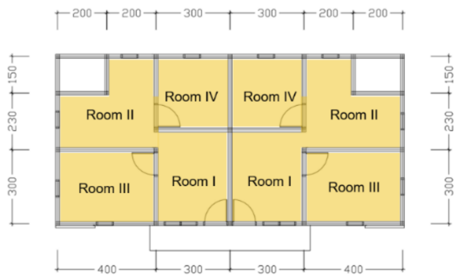

Figure 2 Plans of isolated houses in Lam Neuheun Village, Aceh Besar.

Based on the existing conditions of the isolation house, this study aims to evaluate the intensity of natural light that occurs in the isolation house spaces during the pandemic for the people of Lam Neuheun village, Aceh Besar.

2. METHODS

This research was conducted through an experimental-based design approach to determine the space design for optimal daylight. The intensity of daylight against the need for sunlight for sunbathing purposes is needed to increase the body's resistance and the healing process from disease. Therefore, we need a design that can meet these needs. Daylight is important even though excessive light exposure can be harmful to health, therefore there needs to be a balance so that it can create optimal quality and quantity of daylight [11]. Architecture must be able to respond to pandemics that have repeatedly occurred on this earth [4].

Based on a similar study on lighting optimization [12] this study can be carried out in 3 stages, namely: (1) existing 3D modeling, (2) measuring the quantity and quality of natural light using the Digital Lux Meter application, and (3) simulation using Velux Daylight Visualizer and (4) Andrewmarsh: Dynamic Daylight.

The existing condition of the isolation house is modeled using the Google SketchUp application based on the results of space measurements using a laser meter (Krisbow series 10106734) (figure 3).

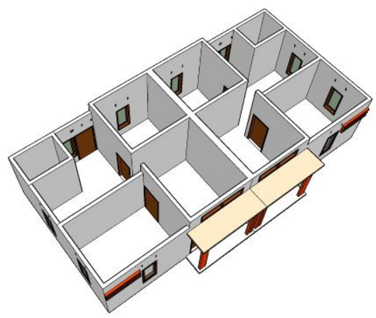

Figure 3 3D modeling of isolated houses in Lam Neuhen Village, Aceh Besar.

The next step is to take direct measurements in the field to see the existing conditions of daylight during the day. Measurements are carried out indoors and outdoors, using a Digital Lux Meter (figure 4). Due to the limitations of measuring devices, each space is only measured at one measurement point, namely in the middle of the room. Measurements were carried out in 3 good times for sunbathing, 10.00, 12.00, and 14.00 WIB.

Figure 4 Digital lux meter.

After direct measurement, then the intensity of daylight is analyzed using computer simulation applications for the environmental and room-scale. The use of the Andrewmarsh PD application: Dynamic Daylight for environmental scales and the VELUX Daylight Visualizer application for room-scale (figure 5). These two applications measure the required and desired amount of sunlight at any given time between 10:00 and 15:00 along with the position of the sun in a year, March 21, June 21, September 21, and December 21.

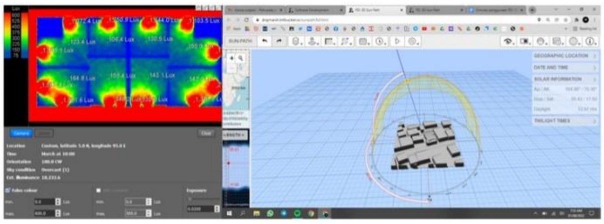

Figure 5 VELUX daylight visualizer and Andrew Marsh PD application: dynamic daylight.

3. RESULTS AND DISCUSSION

The Andrewmarsh PD: Dynamic Daylight application, used to perform a 3D modeling simulation of the Isolation House to see how the sun moves throughout the year towards the building at 10.00, 12.00, and 15.00 WIB. Below are the simulation results for the four dates of the movement of the sun in one year (figure 6-8).

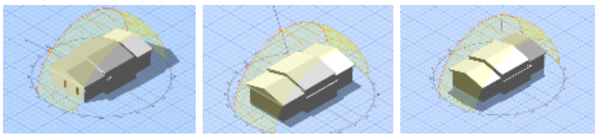

Figure 6 Simulation II, June 21 at 10 am, 12 pm, 03 pm.

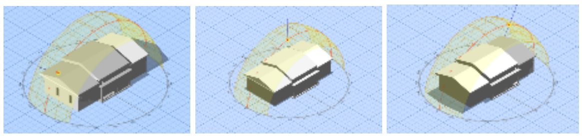

Figure 7 Simulation III, September 21 at 10 am, 12 pm, 03 pm.

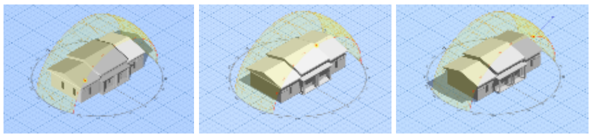

Figure 8 Simulation IV, December 21 at 10 am, 12 pm, 03 pm.

Based on the simulation results showing the front and back of the building facing north-south, sunlight can efficiently enter the building. Openings are placed on each side of the building so that it is possible to receive sunlight in every room. At present, the building is located on land that is not too dense.

Furthermore, the simulation results using the VELUX Daylight Visualizer application for room-scale (figure 9-12) will be compared with measurements using a Lux Meter digital sensor. This simulation is used to measure the amount of light in each room in the Isolation house.

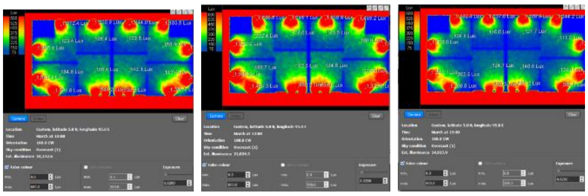

Figure 9 Simulation I, March 21 at 10 am, 12 pm, 03 pm.

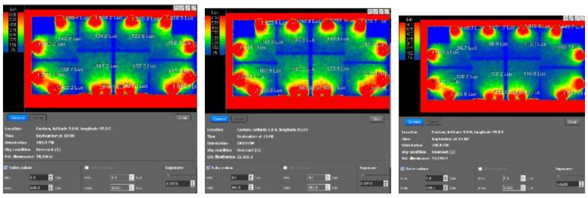

Figure 10 Simulation II on June 21 at 10 am, 12 pm, 03 pm

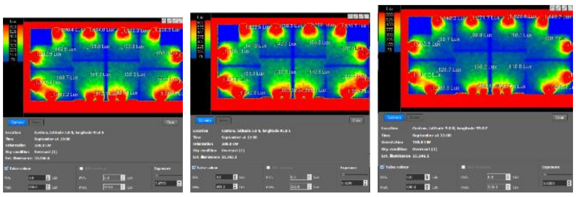

Figure 11 Simulation III, September 21 at 10 am, 12 pm, 03 pm

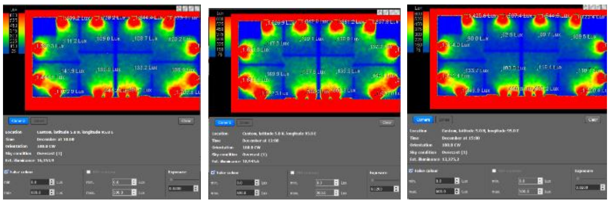

Figure 12 Simulation IV, December 21 at 10 am, 12 pm, 03 pm

From the simulation results, most of the sunlight for the three-time variables 10.00, 12.00, and 15.00 WIB from the four dates of the sun's movement in one year is on the outer side of the wall. The amount of sunlight for each room of the two isolation housing units, shown in table 1-5.

Table 1. Measurement result with lux meter home isolation 1

Isolation House I	10 A.M	12 P.M	3 P.M
Room I (Lux)	220	298	304
Room II (Lux)	65	225	110
Room III (Lux)	211	304	45
Room IV (Lux)	195	209	95

Table 2. Simulation results of velux daylight visualizer isolation house 1

Isolation House I	10 A.M	12 P.M	3 P.M
Room I (Lux)	148,9	177,7	122,4
Room II (Lux)	124,56	158,5	101,7
Room III (Lux)	154,75	188,5	150,8
Room IV (Lux)	112,75	146,9	146,9

Table 3. Measurement results with lux meter home insulation 2

Isolation House I	10 A.M	12 P.M	3 P.M
Room I (Lux)	219	291	302
Room II (Lux)	57	219	137
Room III (Lux)	207	287	71
Room IV (Lux)	189	199	89

Table 4. Simulation results of velux daylight visualizer isolation house 2

Isolation House I	10 A.M	12 P.M	3 P.M
Room I (Lux)	143	165	127
Room II (Lux)	143	178	114
Room III (Lux)	142	197	137
Room IV (Lux)	118	150	106

Table 5. The average value of natural light exposure in the whole room

Isolation House I	10 A.M	12 P.M	3 P.M
Room I (Lux)	899	1061	760
Room II (Lux)	925	943	755
Room III (Lux)	843	991	963
Room IV (Lux)	977	995	817

Based on the simulation results, each room has met the criteria for the level of daylight that is suitable for the user and its use [4].

4. CONCLUSION

Direct measurements on the two models of Isolation Houses in LamNeuhen village show that the natural light required for each room meets the standards, for workspaces and bedrooms 120 -150 lux, kitchens, and bathrooms 250 lux. Preliminary simulation results for Isolation Houses I, each room 1-4, most optimally occur at 12.00 (178 lux, 159 lux, 189 lux, 147 lux), as well as the results of the preliminary simulations for Isolation House II of each room 1- 4, the most optimal, occurs at 12 o'clock (165 lux, 178 lux, 197 lux, 150 lux). The results of the preliminary simulation of the need for light for insulation houses I and II are following the required light standards.

Lighting is one of the most important factors for the quality of health in housing, which can produce vitamin D that is needed for immunity during this pandemic. The simulation results have been described above, showing that the Isolation House in Lam Neuheun Village can be recommended as a place to isolate villagers who are exposed to the Covid-19 Virus.

This research can still be developed open to further research by linking the behavior of patients with an isolation room that is following the appropriate level of light intensity.

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