

Visual study of type 36 square meters (T.36) by sunlight because of physical changes in the surrounding environment

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Abstract

Background/Objectives: A study of the residential complex type an area of 36 square meters, become different when growing a multi-storey building, which creates a large barrier wall for buildings beside it.

Methods/Statistical analysis: Therefore conducted research with qualitative methods in combination with quantitative methods. That is by measuring the light on the terrace (A), living room (B), family room (C), and a terrace at the back of the house (D). Research on the four types of house 36 square meters.

Result: Bright light of 10,000 Lux theoretical from the sky, in front of the building, just reached 13,73% up to 37,15%; On the position of measure D, C, do not meet the requirements of the health of the eyes; Measure B which consists of B1, B2, shows that people build stories building on the west side, room in the building is considered dark; Measurement on the outside terrace (B3) on a clear day, the light inside the building is sufficient for the first, second, and fourth case study; Measurement on the outside terrace (B3) on a cloudy day, the light inside the building doesn't reach the minimum standard of 200 Lux on the third case study.

Conclusion/Application: The conclusion is a reduced intensity of sunlight that affects vision, comfort in the house due to obstructed by terraced houses next to it.

Keywords: Row house T-36, visual comfort.

1. Introduction

Margahayu Raya (MR) housing built in the city of Bandung about 1980s. Bandung is the capital of West Java province, which is located at 107° BT and 6° 55 ' LS, with a tropical climate. Tropical climate in Bandung is a humid climate with cool air, crisp air mountains, temperatures average 23.6°C (74.5° F), rainfall average of 200,4 mm and the average number of rainy days 21.3 days every month [1]. The sun rises in the morning from the east and sets in the west. MR Housing built in block B is type house row the with broad building 36 square meters (Fig. 1).

There are 111 houses on the block B, which consists of 18 houses facing east and west, and 93 houses facing north and south. This block built in 1987, and now become one of the most densely populated. In block B contained most houses facing north or to the south. The focus of the research had done in the house facing the north and to the south of this. Row house built in block B, at this early stage until now has many renovations by their inhabitants.

After more than twenty years, physical changes resulting in decreased quality, especially lighting inside the building (Fig. 2). So that needs to be addressed through legislation or other means so that the spaces remain airy-quality housing and its occupants healthy.

Figure 1. MR Housing and location of house T-36



Figure 2. The condition of the current block B (1); Floor plan T-36 (2); The condition of the house will survives (3)



2. Materials and Methods

The method employed in this study is a qualitative method, with the help of quantitative methods. That is by using a measuring instrument Lux & fc Light Meter by Krisbow product (Fig. 3). This measurement to determine whether the standards are met at the light need spaces in the survey. Measurements were taken in the morning (07:00 to 9:00), afternoon (11:00 to 13:00), evening (16:00 to 18:00).

Figure 3. LuxMeter



3. Framework theory

Natural light source is the sun, the bright sky conditions are reached 10,000 Lux. The sky is a bright blue sky with no clouds or sky covered by clouds of gray / white [2, 3]. System shadowing by sunlight showed in Figure 4, with measurements in the whole room, which is at position A, B, C, D.

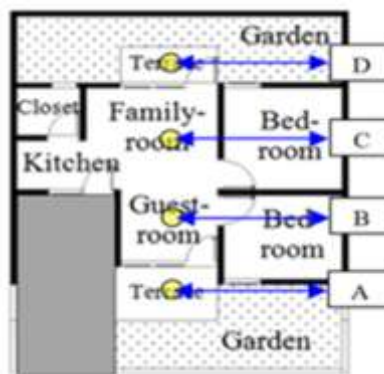
Figure 4. Shadowing by sunlight.



- (A) is a point in the terrace area which measured one meter from the wall plane (Fig. 5).
- (B) is a point in the family room area measured, within two meters of the wall that has openings and is associated with the direction of the outside. At point B, performed three attitudes, namely: (B1) The doors and Windows with glass closed; (B2) The door closed and the glass window is open; (B3) The doors and windows with glass open (Fig. 5).
- (C) is a point of the family room that measured two meters from the boundary wall of the back room (Fig. 5).
- (D) is a point in the back room (Fig. 5).

The design of natural lighting in residential buildings is very important, because it is a way to save energy lighting in the room. Therefore, the effectiveness of the use of natural light both quantity and quality of an interior room needed to be very specific [4].

Figure 5. Measure the point position on the object of study



There are some significant differences between using the sun as a light source with electric lights. To determine the effectiveness of the light source, usually the experts using the value of Lumens/watt. Natural lighting has a value of among 100-200 Lumens/watt. Depending on the angle of the sun at each location and weather conditions[5].

Required a minimum of 100 lux bright light for eye health [6]. Lights that are a source of artificial light in general have bright light 63-64 Lumens/watt. Thus, it is clear that the quality of the light of experience far greater in number compared with the artificial light [7]. Thus need to be investigated more in depth about the design of the facade and interior design, because the design greatly influences the value of bright light [8]. In the book Data Architects, grouped bright light in relation to human activity [9].

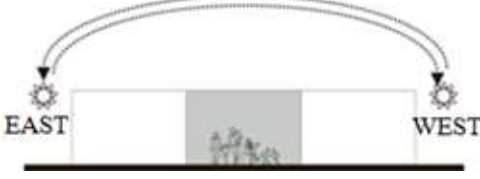



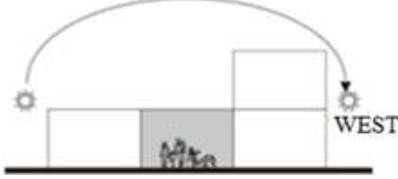



Table 1. Light the need for activities.

Category	Range of Illuminance (Lux)	Type of activity	Notes
Lighting common entire room	20 – 30 – 50	The public areas are quite dark	20 lux = required for recognition of the important features. 20 lux is the smallest value for the horizontal lighting internal areas, except for the work area
	50 – 75 – 100	Simple orientation for short temporary vision	
	100 – 150 – 200	A workspace where visual tasks performed only occasionally	
Illuminance on task	200 – 300 – 500	For visual work with high contrast or large size writing, make prints, make handwritten, make a rough bench with machine work, regular examination, and a rough assembly	200 lux = lighting on a work area that looks exhausting, because that is the smallest value 200 lux lighting for work areas carried out constantly

3. Results and Discussion

Tempers four variations of the physical changes that developed up to now (Fig. 6).

Figure 6. The position of case studies

Case study	Schematic	House existing
THE FIRST CASE STUDY: A study on the house has made the addition of a room in the back. There is a tree in the front yard, and location of the house side by side with buildings that aren't in the renovation of many stories.		
THE SECOND CASE STUDY: A study on the house has made the addition of a room in the back. There is a tree in the front yard, and location of the house east side with buildings that in the renovation of many stories.		
THE THIRD CASE STUDY: A study on the house has made the addition of a room in the back. There is a tree in the front yard, and location of the house west side with buildings that in the renovation of many stories.		
THE FOURTH CASE STUDY: A study on the house has made the addition of a room in the back. There is a tree in the front yard, and location of the house side by side with buildings that in the renovation of many stories.		

All the houses in the study have changed on the back of his house. The back of the House is the position of measure D. There is a garden in the back room was closed by the roof. On the roof a roof lighting that made the room into the light (Fig. 7). While at the front, all the size and dimensions of the door and the window no change occurred.

Figure 7. Shape and size of doors and glass windows on the front of the building (A), the shape and the lighting on the roof on the back of the house (B).



3.1. A Case study in the first house

In the front house there is a shady tree, and also the addition of a room at the back of the building of origin. Which results in the garden behind the house became lost. Right next to the house is the renovated neighboring buildings, but not becoming multi-storey. A case study of the first house meet minimum standards of lighting, especially in the living room, either in the morning, afternoon and evening when the condition of the windows and doors open (Table 2 + Fig. 8).

Table 2. The results of the measurements in the first case study

Times \ Rooms	LUX					
	A	B			C	D
		B1	B2	B3		
Morning 07:00 – 09:00	3715	106	176	322	131	98
Afternoon 11:00 – 13:00	3510	117	163	292	113	93
Evening 16:00 – 17:00	3050	97	129	219	106	90


Notes: performed measurements on a sunny outdoor air conditions;
 standards

Figure 8. The first case study house plans

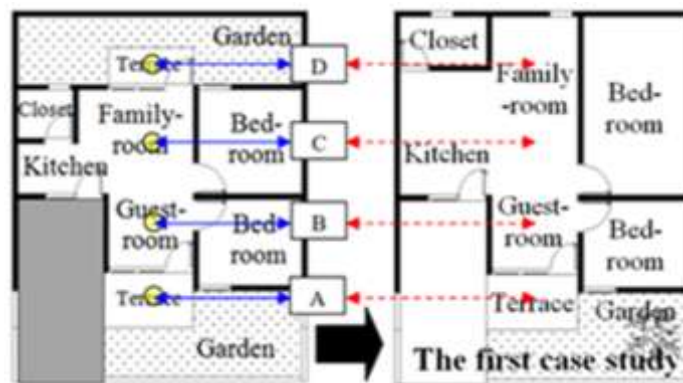
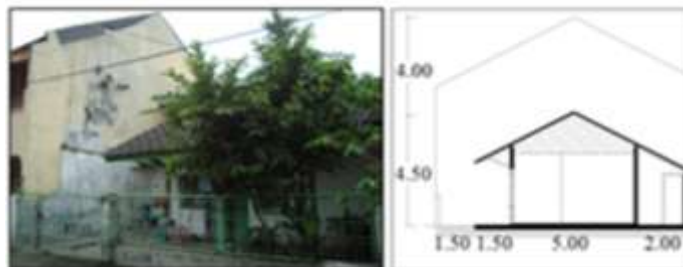


Figure 9. The second case study.



3.2. A Case study in the second house

The house for this study has shade trees and room additions have taken place behind the building earlier. Which results in the garden behind the house became lost. Right next to the house is the renovated neighboring buildings becoming multi-storey in the east side (Fig. 9). A case study of the second house meets minimum standards of lighting, especially in the living room, during in the morning, afternoon and evening when the condition of the windows and doors open (Table 3 + Fig. 10).

Table 3. Measurement results of a case study of a second house

Times \ Rooms	LUX					
	A	B			C	D
		B1	B2	B3		
Morning 07:00 – 09:00	2503	104	169	297	128	87
Afternoon 11:00 – 13:00	3115	108	180	330	149	98
Evening 16:00 – 17:00	2480	102	115	215	117	81
Notes: performed measurements on a sunny outdoor air conditions; standards						

Figure 10. The second case study

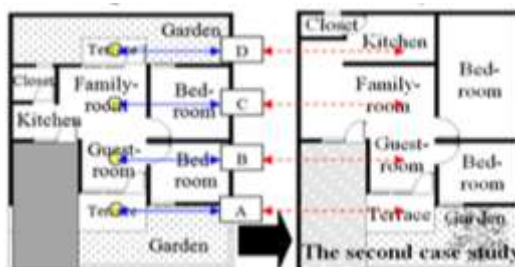
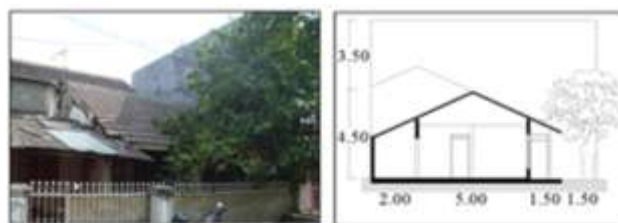


Figure 11. The third case study



3.3. A Case study in the third house

The house for this study has shade trees and room additions have taken place behind the building earlier. Which results in the garden behind the house became lost. The house to the west of this case study has been renovated becoming multi-storey (Fig. 11). The third case study house does not meet the standard of natural lighting throughout the day, when the conditions of the windows and the door open (Table 4 + Fig. 12).

Table 4. The third case study house plans

Times \ Rooms	LUX					
	A	B			C	D
		B1	B2	B3		
Morning 07:00 – 09:00	2205	46	60	98	26	51
Afternoon 11:00 – 13:00	1914	69	103	117	36	68
Evening 16:00 – 17:00	1373	94	74	97	25	48
Notes: performed measurements on a sunny outdoor air conditions; standards						

Figure 12. Measurement results of a case study of a third house

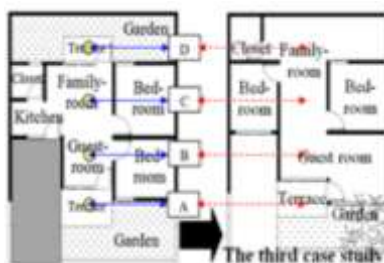
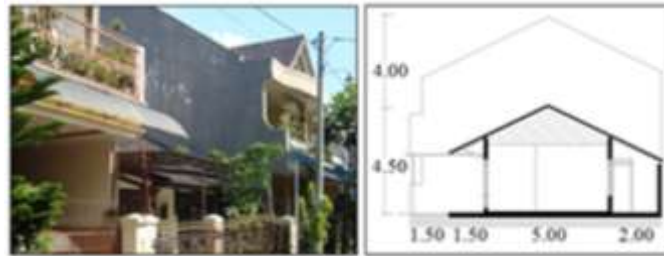


Figure 13. The fourth case study



3.4. A Case study in the fourth house

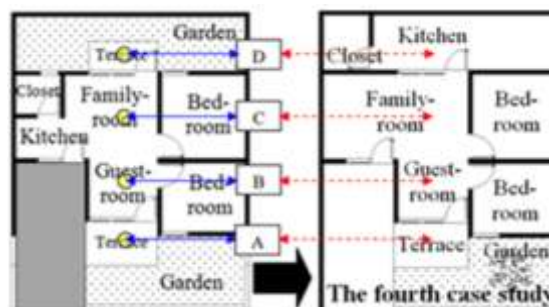
The house for this study has shade trees and room additions have taken place behind the building earlier. Which results in the garden behind the house became lost. The house in the condition of the neighboring building to the east and the west has been renovated becoming multi-storey (Fig. 13). The fourth case study house does not meet the minimum standard of natural light in the morning, in conditions the windows and the door open (Table 5 + Fig. 14).

Table 5. Measurement results of a case study of a fourth house

Times \ Rooms	LUX					
	A	B			C	D
		B1	B2	B3		
Morning 07:00 – 09:00	2254	97	102	191	103	80
Afternoon 11:00 – 13:00	2878	106	180	328	139	115
Evening 16:00 – 17:00	2343	98	137	213	105	81

Notes: performed measurements on a sunny outdoor air conditions;
 standards

Figure 14. The fourth case study house plans.



4. Conclusion

1. Bright light of 10,000 Lux theoretical by the sky, which turned out to be on the front porch just reached 1373 Lux (13.73%), up to 3715 Lux (37.15%).
2. On the position of measure D, no influence with the building next to it, as covered by the roof. They do not meet the requirements of the health of the eyes due to the intensity of light <100 lux. It is necessary to extend the field of glass in the roof on.
3. On the position of measure C, which is in the west side building was built terraced. Then the room was darkened (25 Lux) to bright light outside 1373 Lux (1.8%).

4. Measure B which consists of B1, B2, B3 shows that people build stories building on the west side. As a result, room in the building is considered dark (94 Lux, 74 Lux, 97 Lux) when the outside daylight is 1373 Lux.
5. When a measurement on the outside terrace (B3) consists of 3715 Lux – 3050 Lux -2480 Lux on a clear day, the light inside the building is sufficient because it is greater than 200 Lux on the first, second, and fourth case study.
6. When a measurement on the outside terrace (B3) consists of 2254 – 1373 Lux on a cloudy day, the light inside the building doesn't reach the minimum standard of 200 Lux on the third case study.

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