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Research paper



Natural Illuminance Level of the Expansion House in Suburban Housing Area of Makassar City

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Abstract

The house must guarantee the family interests, to grow, providing a socialization likelihood with the neighbourhood, and more. An expansion house without an early concept planning before the occupation, sometimes does not consider on comfortable for the occupant, especially on visual comfort. Aim of this research is to measure a illuminance level in the expansion house in the suburban area housing of Makassar city. Visual comfort in this research is related on natural illuminance, particular to natural illuminance of the house. As a result, the householder must provide an artificial light in the morning or even in the daylight. As a result, there is an excess of energy consumption and not maximum of room utility or even not function.

Keywords: *Housing, Illuminance, Comfort, Ecotech, Natural, Utility*

1. Introduction

The house is not only as a building (structure), but the house is a resident to fulfill an appropriate life condition, in terms of any aspect of life society. The house may define as a shelter, a place to enjoy the life, gathering and having a good time with the family. The occupant will have their first impression of the life experience of the world from the house. The house must guarantee the family interests, to grow, providing a socialization likelihood with the neighborhood, and more. The house must present a peace of mind, pleasure, happiness, and relaxation for all life event [3]. The house is frequently distributed as finished goods package or container, without considering on opportunity to grow and not specific for Indonesian family, moreover for the lower middle class [1]. Automatically, every people will try to renovate, develop their house as their specific need [3].

An expansion house without an early concept planning before the occupation, sometimes does not consider on comfortable for the occupant, especially on visual comfort. Basically, the light requires by the human to see the visual object. After a reflection of the object the eyes will see the object clearly. Therefore, visual comfort will present if there is a brightly illuminance. When the illuminance is poor or excessively, then it will disturb visual comfort. This condition will cause a health of visual problem especially for the eyes vision sense [5]. Visual comfort in this research is related on natural illuminance, particular to natural illuminance of the house. Function of room natural illuminance is to fulfill all daily activity in the house. Poor natural illuminance with room standard quality will cause the activity inside the house would not perform adequately. Therefore, aim of this research is to measure a illuminance level in the expansion house in the suburban area housing of Makassar city.

2. Methodology

This research is quantitative research. Quantitative method is known as scientific research method because the research has meet scientific principles, concrete, objective, rational, and measurable [5]. The research location placed in Perumnas Panakukkang Permai, specifically in Tamalate Street of Makassar City, South Sulawesi Province, from December 2015 until Mei 2016. All The object of this research is the 36-house type, in Perumnas Panakukkang Permai, specifically in Tamalate street that a development progress into 1,164 units. The 36-house type is selected because this is the modest house with great potential development, up to 100 %.

Research sampling of this research is cluster random sampling method. Cluster random sampling is a sampling method to determine a sample when the object-researched or the data source is wide-ranging [5]. Furthermore, Slovin formula applied in this study to determine a sample data number and the result of the total sample are 92 houses unit. Then the sample categorized into 5 clusters, sample determination in every clusters is proportional. The first sample draws randomly, then the second sample and the next sample defined systemically.

Research data in this study is obtained from primary and secondary data. Primary data is the data from direct measurement in the field study and computer simulation. Secondary data is from documents and references data which relevant to the research problems. A requirement of data category in this research is adapted with the illuminance variable practiced. Tools of this study are: (a) Digital lux meter, calculating illuminance value or number of light shed into an object, (b) A meter, measuring the space dimension, distance, and window size, (c) Stationary, writes a result of calculation, (d) Digital camera, documenting the research object, (e) Laptop, processing the data and simulating the illuminance. Soft-

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ware application in this research for computer simulation and illuminance analysis are Ecotech Analysis 2011 and Radiance.

In addition, positioning method of the measuring point is following the Indonesian National Standard or SNI. Measuring tool position is 0.75 m height above the floor surface, with general assumption if the horizontal work-plane as height as the office desk. The distance between each measuring tools is three-meter, Side Measured Point distance is 1/3d from wall openings, and Main Measured Point positioned is in the middle of the room [4]. Room selection is the guest room and the house terrace because these are the public room, located in the front of area for the access of the light and the most functional room in the daylight. Standard of illuminance value for the guest room is 120-150 lx and the terrace is 60 lx.

Data collection activity especially the primary data practices in some steps; initial observation, measurement and field recording, measuring existing illuminance, and computer simulation. An initial observation of the research object practiced by direct observation in the quantity of room illuminance quality. The examination performs without specific equipment but observe with subjective measurement visually. Data collection is the category of material data in the building element, such as wall, floor, plafond, and window.

Element and material data will practice as material selection for simulation activity, the simulation should have similarity with the real condition. Building physical data collection applied by calculation method of room formation elements and the openings with natural illuminance quantity potency inside the room. Physical data includes building and rooms geometry size, either the distance, the height of the building, or the overhang. Physical measurement employs the meter equipment to calculate the room dimension. The measurement result will generate three dimensions model image that would practice as the primary data in the simulation program.

Data analysis conducts descriptive statistics. The characteristic is explaining and describing the result finding. The analysis is in form of basic data accumulation in form of description. The result of the field data then analyzed by three methods:

a. Data reduction, collecting, selection, and simplifying the field data.
b. Data presentation, presenting by table, graphic, and narrative text to draw a necessary conclusion
c. Conclusion, the process to answer the problems, the objective of the study, and providing a suggestion as the solution.

3. Results and Discussion

The result on the level of natural illuminance measurement is based on openings width of the window and ventilation and simulated by Ecotech Analysis and Desktop Radiance. Specifically, the illuminance calculation started with the calculation of illuminance level by with lux meter. Illuminance analysis is started with the analysis of the window dimension in of the rooms that directly connected with the outdoor space, such as quest room, bedroom, or kitchen, etc.

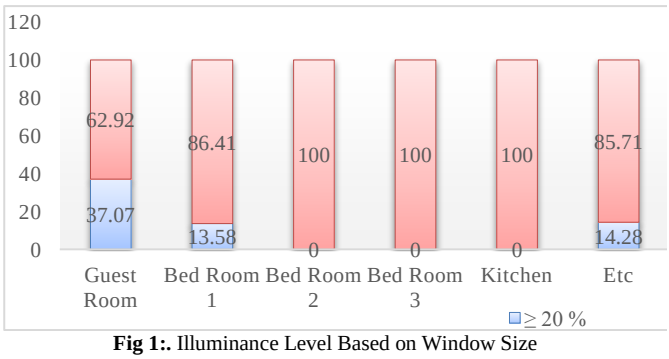


Fig 1:. Illuminance Level Based on Window Size

Table 1:. Illuminance Level Based on Window Size

Window Wide Percentage		≥20 %	< 20 %	Total
Guest House	n	30	56	**89**
	%	37.07	62.92	**100**
Bed Room 1	n	11	70	**81**
	%	13.58	86.41	**100**
Bed Room 2	n	-	14	**14**
	%	-	100	**100**
Bed Room 3	n	-	5	**5**
	%	-	100	**100**
Kitchen	n	-	60	**60**
	%	-	100	**100**
Etc.	n	1	6	**7**
	%	14.28	85.71	**100.0**

Table 2:. Guest room illuminance Level

Average of Illuminance (lx)	N	%
< 120	63	68.47
120 – 150	14	15.21
> 150	15	16.30
Total	**92**	**100**

As stated by Table 1, significantly, the guest room is 62.92 % and the first bed room is 86.41 % that are not qualified based on SNI standard. Whereas the guest room is 37.07% and the first bedroom is 13.58 % that are qualified with the standard, 20 % of the room area. An illuminance calculates with lux meter in the guest room and the terrace with sunny weather condition in January 13-23, 2015 at 09.00AM – 02.00 PM UTC+9. As stated by Table 2, significantly the value are 68.47 % then the illuminance level is less than 120 lx and only 15.21 % are qualified the standard which is 120-150 lx.

Table 3:. Terrace illuminance Level

Average of Illuminance (lx)	N	%
< 60	3	3.2
60	-	-
> 60	89	96.73
Total	**92**	**100**

As stated by Table 3, significantly, all orientation of whole the expansion house terrace illuminance level are not qualified, 60 lx and only 96.73 % over the standard. Other than illuminance level measurement in opening width, this research is also measuring the lux meter, analysis of ecotech simulation, and desktop radiance. Before simulation process, sample reduction is based on expansions house room pattern and produced 12 samples.

Table 4:. Illuminance level based on Ecotech analysis and Desktop radiance Simulation

Sample	Average of illuminance (lux)		
	Guest room (120-150 lx)		
	09:00 AM	12:00 PM	02:00 PM
A	171	696.67	470.3
B	36	54.93	72.8
C	63	48.97	42.2
D	219	35.77	25.5
E.	155	220.00	326.3
F	115	121.00	120.0
G	68	115.30	124.44
H	68	92.50	74.1
I	121	55.31	44.1
J	725	389.00	305.3
K	437	328.33	276.0
L	194	238.67	572.7

Table 5:. Illuminance level based on Ecotech analysis and Desktop radiance Simulation

Sample	Average of illuminance (lux)		
	Terrace (60 lx)		
	09:00 AM	12:00 PM	02:00 PM
A	6584	2513.3	1787.3

Sample	Average of illuminance (lux)		
	Terrace (60 lx)		
	09:00 AM	12:00 PM	02:00 PM
B	4899	2944.0	6226.7
C	8184	2904.3	2368.3
D	8487	3069.7	2315.7
E.	3432	4939.3	8343.0
F	3910	3869.3	3684.0
G	2566	4606.7	4914.0
H	2652	3873.0	3778.0
I	8900	2994.3	2805.0
J	8022	2695.7	2134.7
K	7636	3253.7	2598.0
L	2610	3803.3	8131.7

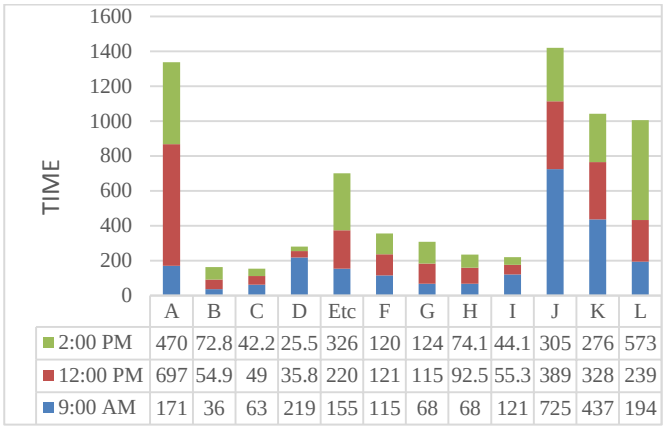


Fig 2:. Average of illuminance Guest room (120-150 lx) based on Ecotech analysis and Desktop radiance Simulation

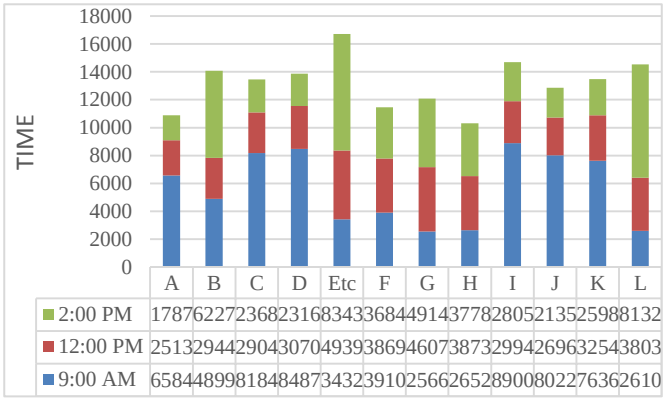


Fig 3:. Average of illuminance Terrace (60 lx) based on Ecotech analysis and Desktop radiance Simulation

According to the simulation result in figure 4, the guest room at 09:00AM is only I as qualified in sample, which is 121 lx. At 12:00AM, only F sample is qualified the standard which is 121 lx. 02:00 PM, only sample G is qualified the standards, 124.44 lx, sample F 120 lx. There is no qualified samples for terrace area, 60 lx. All illuminance value of terrace sample is more than 1000 lx.

This research evaluated the illuminance level based on the window wide and illuminance value (lux). Direct measurement of window wide found most of the house rooms are not qualified the standard of SNI or WWR (wall window ratio) where the minimum value is 20 % of wall wide. Similarity with the level of illuminance value (lux), most of illuminance level is less than 120 lx for the guest rooms, none of the result are qualified with the standard, which is 60 lx and even 96.73 % is over the standards for the terrace area.

Based on simulation result, there are only 4 house samples that qualified whit illuminance standard value and in different of time specification. Therefore, based on illuminance value (lux), most of the illuminance level are not qualified as SNI. The house with a good illuminance system expectation, turns into inappropriate cause by no initial planning in the development of the house expansion. The front rooms, such as the guest room and the terrace that should have a proper natural illuminance, are not achieved a proper natural illuminance. Even more for the other rooms, bed room, family room, or kitchen which are minimum in appropriate natural illuminance or even they totally have no naturally illuminance. As a result, the householder must provide an artificial light in the morning or even in the daylight.

As a result, there is an excess of energy consumption and not maximum of room utility or even not function. This should explore the significance of the results of the work, not repeat them. A combined Results and Discussion section is often appropriate. Avoid extensive citations and discussion of published literature.

4. Conclusion

The expansion house without an appropriate initial planning had presenting inappropriate on illuminance level based on the Indonesia National Standard and the rooms are not function maximally. Utility in artificial light in daylight cause a high consumption of the energy. An early planning should draw for house expansion to keep a natural illuminance system at the house for visual comfort of the living place.

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