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Analysis of Thermal Comfort SNI-6390 in the Lanting (Floating House), Banjarmasin-Indonesia

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Abstract. Lanting house is floating house type which is found in South Kalimantan, especially in Banjarmasin. Today, the floating houses decreased in quantity and quality. To preserve the cultural products, it is necessary to do research on floating houses. The research raises thermal comfort in floating houses by following the standard SNI-6390. The measurement results humidity indoor and outdoor of the floating house is high. The indoor air temperature is almost always higher than outdoors. The indoor temperature increases rapidly after sunrise. Indoor thermal comfort in floating houses for longer uncomfortable. The outdoor temperature in a comfort zone is only about 5 hours a day. However, overall the comfort zones only concerned with the dry bulb temperature, it still has weaknesses. These results conclude that the need for a more comprehensive study. Humidity and wind must also be considered in calculating the thermal comfort. Collaboration dry bulb temperature, humidity and wind called the effective temperature.

Keyword: lanting, thermal comfort.

1. Introduction

Thermal comfort is influenced by many factors such as: activity, clothing and the environment. [1]. This paper discusses the influence of environment on thermal comfort. The Indonesian Standardization Board (BSN) issued a national standard ventilation system and energy conservation [2], [3]. The thermal comfort standard required to help the designer to provide a comfortable building [4]. Indonesia is a country with a humid tropical climate, characteristics: high solar radiation, high air temperatures, high humidity and high rainfall, and the state of the cloudy sky [5], [6].

Lanting house is floating house type which is found in South Kalimantan, especially in Banjarmasin. It is a product architecture of Banjarmasin culture [7]. Today, the floating houses decreased in quantity and quality. To preserve the cultural products, it is necessary to do research on floating houses. The research raises thermal comfort in floating houses by following the standard SNI-6390. Optimal comfort in SNI-6390 is a temperature between 24°C-27°C for indoor and 27°C-30°C for outdoor [3].

2. Research Methods

2.1. Description of Location and Places of Research

Indonesia is located at 6°NL to 11°SL. Banjarmasin city is the capital of South Kalimantan province, as well as the largest and the most populous city in Kalimantan. Banjarmasin city located on the 3° 15' to 3° 22' SL and 114° 32' EL, ground altitude is at 0.16 m below sea level and almost the whole area is flooded at high tide. It is located in the east of the river of the Barito and cleaved by the river of Martapura tipped in Meratus Mountain. The river has become a major point of community activity [8]. The research was conducted in places: Sasirangan Village, Kelurahan Seberang Mesjid-Banjarmasin (Figure 1).

2.2. Measurement Procedure

The purpose of this study was to determine the thermal comfort in floating houses in the city of Banjarmasin. For that reason, the independent variable research is housing around the river, while the dependent variable is the thermal condition. While the thermal performance assessed between indoor and outdoor. The control variables are comfort zone standards of SNI 6390 on thermal comfort. Field measurements performed in Sasirangan village from 18th - 21th September 2016. Measurement period and instruments, can be seen in Table 1 and Figure 2. Measurements were performed at the indoor and outdoor the floating house. Outdoor measurement of the building measuring devices is protected from direct sunlight. The air velocity measurement is done from all directions and the highest value taken. High measuring instruments from the floor is 150 cm.

Fig. 1: Places of Research (Foto by drone Ziro explorer camera)

Table 1: Measurement period and instruments

Measurement items	Temperature, humidity, and air velocity
Measuring instruments	Data logger-4HC for temperature, humidity Extech AN100 for air velocity and drone Ziro explorer camera
	  
Measurement period	18th - 21th September 2016 Time: 06:00 am to 05:00 am (every hour/24 hours)
Number of houses measured	4 floating houses
High measuring instruments from the floor	150 cm
Number of measuring points	480 points

3. Result and Discussion

The measurement results show Figure 2 the indoor and outdoor humidity in floating house is high, between 50%-90%. The highest humidity in floating houses occurs at night until morning, the average humidity 75%-90% and lowest humidity is 50%. The first day of measurement was raining around 1 PM. Air humidity increases rapidly when it rains. Humidity difference between rain and bright conditions around 20%-30%. The indoor air temperature is almost always higher than outdoors. The highest difference indoor and outdoor temperatures during the day about 2 ^{o}C. The highest indoor temperature during the day can reach 36^{o}C. Indoor and outdoor temperature down 2^{o}C-3^{o}C when it rains. Humidity is inversely proportional to the temperature, The minimum temperature occurs when the maximum moisture content and the maximum

temperature occurs when the minimum humidity. The houses located on the river, has humid environmental conditions. The wind speed in outdoor ranges from 1 m/s – 2,5 m/s. The highest wind speeds occur during the day and lower at night. The wind speed at indoor around 0.1 m/s, this condition affect the indoor temperature is higher than outdoors.

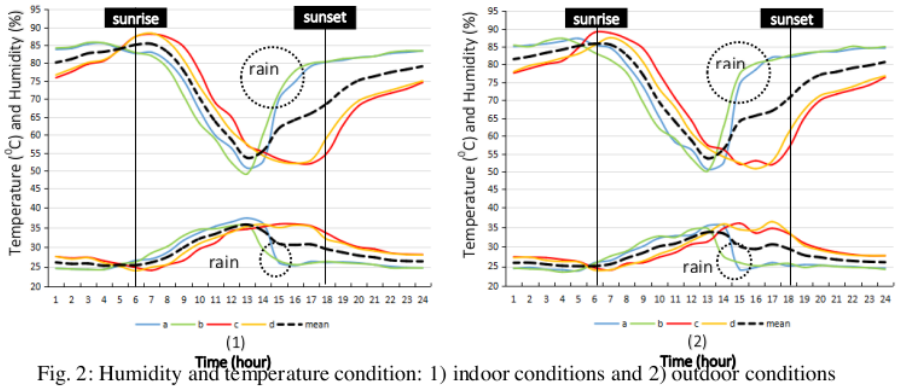

Fig. 2: Humidity and temperature condition: 1) indoor conditions and 2) outdoor conditions

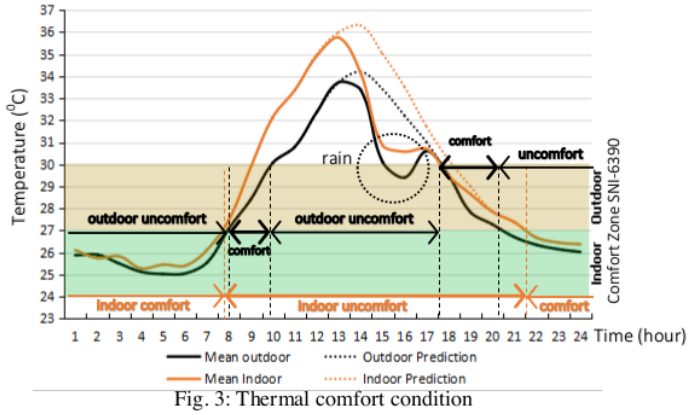

Fig. 3: Thermal comfort condition

Thermal comfort conditions in the floating house can be seen in Figure 3. Based on the SNI-6390 standard, Indoor thermal comfort for longer uncomfortable about 13 hours, this condition occurs from 8AM - 9PM. The indoor temperature increases rapidly after sunrise, up to a peak at around 2PM. Indoor temperatures increased by an average of 1.57 °C / hours. Outdoor optimal thermal comfort based on the standard of SNI-6390 is 27 °C-30 °C. Outdoor temperature in the comfort zone occurs in the morning, from 8AM-10AM and in the evening from 5.30PM-8.30PM. Outdoor temperature in comfort zone only about 5 hours a day. Outdoor temperature in uncomfort zone about 7 hours during day and 12 hours at night. At night, the outdoor temperature is lower than the minimum value of thermal comfort SNI-6390. This suggests that environmental conditions around the river is relatively cool to cold. At the time of rain, the temperature drops rapidly, especially the outdoor temperature. Outdoor temperature after the rain up some time ago and then down, while the indoor temperature constant while ago and then down.

From the results of the standard comfort zone above SNI-6390, thermal comfort conditions in a floating house tend to be uncomfortable. The SNI-6390 in determining the comfort zone just pay attention to the dry bulb temperature. Several studies conducted in Indonesia are still many uses of dry bulb temperature, as shown in Table 2. The results of the research conducted is also not much different from the standard SNI-6390. The results showed a range of thermal comfort the Indonesian people between 24.1°C to 27.7°C in the dry bulb temperature unit. Outdoor minimum temperature for thermal comfort in SNI-6390 is 27°C. Values 27°C is still quite high, because the Indonesian people are still comfortable at 24°C.

However, overall the comfort zones only concerned with the dry bulb temperature, still has weaknesses. The weakness of the comfort zone is a factor of humidity and wind have not been included in the calculation or consideration. Determining the comfort factor would be more comprehensive if taking into account the temperature, humidity and wind. Collaboration dry bulb temperature, humidity and wind called the effective temperature.

Table 2: Research on thermal comfort in Indonesia

No.	Year of Study	Principal Researcher	Location	Type of Building	Type of Subject	Comfort Vote	Comfort Temp. (°C)
1	1937	Mom [9]	Bandung, Indonesia	Climate Chamber	University Members	20	26
2	1993	Karyono [10]	Jakarta, Indonesia	Offices	Office workers	596	26.4
3	2000	Karyono [11]	Jakarta, Indonesia	Offices	Office workers	596	26.7
4	2004	Feriady [12]	Yogya, Indonesia	House	Local People	525	26
5	2005	Karyono [13]	Bandung, Indonesia	Classroom	Students	200	24.7
6	2013	Karyono [14]	Jakarta, Indonesia	Classroom	Students	468	24.1
7	2013	Karyono [14]	Jakarta, Indonesia	Classroom	Students	432	24.9
8	2015	Karyono [15]	Jakarta, Indonesia	Cathedral, Bank, Market	Local People	219	27.3-27.7
9	2015	Siti Aisyah [16]	Bandung, Indonesia	Campus, office	Students, workers	400	24.7-27.5

4. Conclusion

Based on the SNI-6390 standard, Indoor thermal comfort in floating houses for longer uncomfortable. Comfortable indoor conditions only 11 hours a day, between the hours of 9 PM-8AM. Outdoor conditions more inconveniences. Outdoor comfortable only at 8AM-10AM and 6PM-8PM. These results conclude that the need for a more comprehensive study. Determination of the comfort zone is not only seen from a dry bulb temperature, but also pay attention to humidity and wind. Further research is needed to pay attention to three factors commonly called the effective temperature.

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