Identification of Good Opening Area During the Pandemic Classroom at the Faculty of Engineering Khairun University in Ternate

Muhammad Tayeb[1*] and *Sayyid* Quraisy[2]

[1,2] Architecture Study Program, Faculty of Engineering, Khairun University, Ternate 97719, Indonesia

Abstract. Good air distribution in the building should provide comfort and health for the wearer. This can be achieved through the design of more specific architectural sections or forms with the aim of maximizing the distribution of cool air. The target of this research is the Faculty of Engineering lecture hall which located on the Khairun Campus and is a new building with 3 floors. For this new normal period, lectures have reached 100 percent of students entering the room, so supporting facilities are needed that meet the requirements of thermal comfort and health protocols. This study aims to analyze good natural ventilation during endemic times in the lecture hall. This rese arch was conducted using quantitative – qualitative descriptive methods in analyzing the data. The results showed that lecture hall have an average temperature of 31.84 °C, with dampness of 68.47 percent and wind speed of 0.12 m/s. Thing This indicates that the thermal conditions in the lecture hall does not meet the standard of thermal comfort has a temperature exceeding 27.1°C, and a dampness level of more than 70 percent and must have a wind speed of 0.2m/s – 2m/s. With this condition, the lecture hall has not yet met the standards of good natural good air distribution during the pandemic and has natural air that is not good for health the wearer

Keywords: Temperature, Wind Speed, Thermal Comfort.

1 Introduction

Climate is closely related to thermal at a location and thermal plays a role in the comfort of a building. Through BMKG observation data starting from 1981 to 2018. Temperature fluctuations in Indonesia in general, the temperature in Indonesia, both the minimum, average, and reached maximum temperatures have an increasing value that varies by 0.03 °C each year. It can be calculated that the air temperature continues to increase by 0.03 °C every year so that in 30 years it has increased by 0.9 °C.

According to (1), thermal comfort is influenced by 2 factors, namely psychology or from a human perspective and climatic factors. As for the human factor, it is divided into body metabolism, clothes that you wear used, and the activities carried out. while the climatic factors are radiation, wind speed, dampness, and air temperature.

Wind speed is a natural ventilation in room and is one of the factors that affect thermal comfort in room. The speed of the wind entering and leaving the room requires appropriate openings so that air circulation can run and is not left behind in the room. (2) and (3), is a standard for measure thermal comfort in part countries, especially in America and Europe. Where this standard is used for rooms that use artificial conditioning (AC). According to (4), (2), and (5), cannot be used in room with natural conditioning.

In the study room, thermal comfort is the most necessary thing because it supports the realization of a conducive learning process and produces satisfaction for room users.(6), there are studies shows a positive relationship between learner achievement and quality in the edifice (room) (including thermal conditions).

Previous research by (7), at Sudirman Elementary School in Makassar that the openings of class 4 to class 6 are a total of 107,506 m², on the east and west sides. on the east side the opening area is 55,206 m², while for the west side it is 52.3 m². The average indoor temperature from 010.30 WITA to 11.00 WITA is 29.82 °C. The lowest temperature in class IV-B averaged 29.36 °C. (8), states that the temperature and dampness conditions outside the room do not provide thermal comfort in the room every day.

Research by (9), (10), shows that informant are more likely to be tolerant of heat in a lecture room with natural ventilation with a temperature of 31 °C.

Determining the base temperature or reference temperature, this study refers to the Indonesian thermal comfort equal SNI/T/14/1993/03 there are three views in the following table:

* Corresponding author: m.tayebmustamin@unkhair.ac.id

Table 1. Indonesian thermal comfort standard

Temp.	Value-Limit	Dampness	Value-Limit	Wind-Velocity
Cool-comfortably	20.5 °C to 22.8 °C	Relative-dampness	50% to 80%	0.2 Average m/s.
Comfortable-optimal	22.8 °C to 25.8 °C	Relative-dampness	70% to 80%	0.2 Average m/s.
Almost-comfortable	25.8 °C to 27.1°C	Relative-dampness	60% to 70%	0.2 Average m/s.

The results of the questionnaire conducted on April 18, 25, 09, and May 23, 2022 to students in the T-11 and T13 classrooms for four weeks in the room showed that the classrooms were not comfortable to use from a thermal comfort perspective, so that it would reduce students' concentration in the learning process due to feel hot.

The results of interviews with students as respondents as well as measurements of fluctuations in room temperature data, dampness and indoor wind speed. The data was collected in the T-11 and T-13 classrooms from 13.00 to 16.00 WITA.

2 Research Methods

2.1 Site

The research location is in the lecture hall of the Faculty of Engineering, Khairun University. The lecture hall is a new building on the 3rd floor. The research points are located on the 2rd floor of rooms T11 and T13.

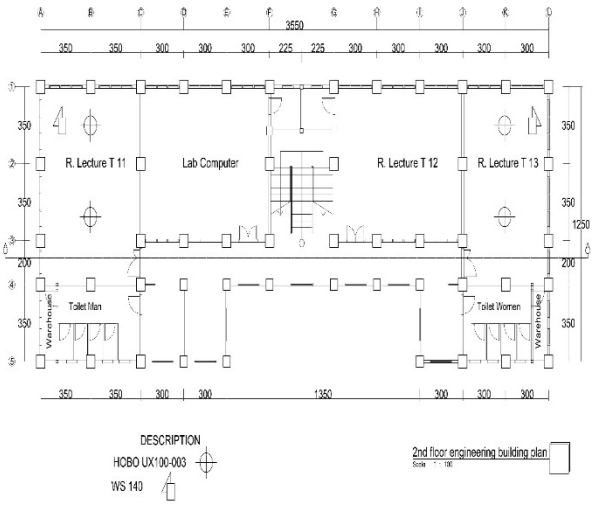

Fig. 1. A figure schematic of the building on the 2nd floor

The tools used are HOBO UX100-003. The HOBO UX100-003 Temperature/Relative Dampness data logger records temperature and relative dampness (within 3.5% accuracy) in indoor environments with its integrated sensors

2.2 Method of Collecting Data

The lecture room on the 2nd floor has rooms T11, T12 and T13 as classrooms and 1 shared computer laboratory. Each classroom T11 and T12 has an area of 63 m^2 and there are 20 students per class. The openings for the T11 class room are in the south and west in the form of a 15,988 m^2 window and a door facing north with an area of 3,458 m^2. while the classrooms at T13 have openings in the south and west in the form of windows of 15,988 m^2 and the door of the room facing south with an area of 3,458 m^2.

Data collection was carried out for 4 weeks every Monday at 13.00 WITA until 16.00 WITA. The room used is the 2nd floor with a predetermined measurement point. For each class, 2 measurement points are used, namely the measurement of temperature (Ta) and dampness (RH) in front and behind. While the measurement of wind speed (Va) is behind as can be seen in Figure 1.

The respondents involved were 20 students in each class. Each class has 8 women and 12 men, so the total respondents amounted to 160 respondents. The clothes used on average are the same, namely wearing a shirt and long pants. Data was collected by measuring the room and direct observation to obtain primary data. The research was carried out using natural ventilation without the help of air conditioning.

The measurement standard is based on ASHRAE standard 55 with the use of a 7-point scale to measure the thermal sensation vote (TSV). The list can be seen in table 2.

Table 2. 7-point scale on ASHRAE standard55

Question to Responden	Scale	Thermal-sensation	Sensation-vote
How do you feel about the thermal environment in this classroom	+3	(hot)	
	+2	(warm)	
	+1	(slightlywarm)	
	0	(neutral)	
	-1	(slightlycool)	
	-2	(cool)	
	-3	(cold)	

The technique of collecting data on respondents was through several questions with details of the thermal comfort problems of each student as a questionnaire method. The data obtained from the HOBO/UX100-003 tool as primary data is then described into a graph using the statistical method.

The results of the graph from the data of air temperature, dampness, wind speed and the number of respondents can be seen their influence on thermal comfort. The research instrument is as follows; Questionnaire for each student, in order to obtain thermal psychology, and personal information, measuring tools for measuring the area of the room and the opening of each room.

3 Result and Discussion

3.1 Temperature

The results of measuring room temperature there are quite far differences between the T11 and T13 lecture rooms. The difference is greatly influenced by the speed of the wind entering the room.

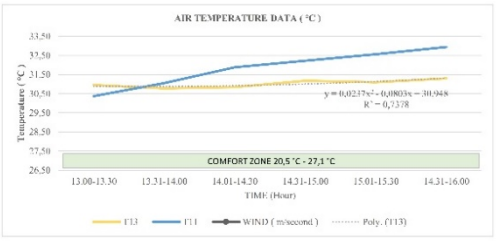

Fig. 2. The difference in temperature of the lecture room T-11 and T-13

It can be seen in table 3 that room T-13 tends to be more stagnant or fluctuating in temperature, Meanwhile, room T-11 has a higher temperature. It can be seen in fig 2 that room T13 tends to be more stagnant or fluctuates in temperature, while room T11 has a higher temperature.

The highest visible difference occurred on April 23, as shown in table 3 at 13.00 – 13.30, not much difference between each room. At 13.31 to 16.00 the difference occurred almost close to 2 degrees.

3.2 Dampness

The dampness in the lecture hall from the measurement results for T-11 fluctuates between 60% - 63%. While the fluctuations in the T-13 lecture room vary slightly, where from 13.00 to 13.00 the dampness reaches 72.06%. Then it fell at 13.31 to 16.00 reaching 69.46%. The difference in maximum dampness in rooms T-11 and T-13 is from 13.00 to 13.30 reaching 11.58%. There is no dampness equation on the same day during measurements and data collection.

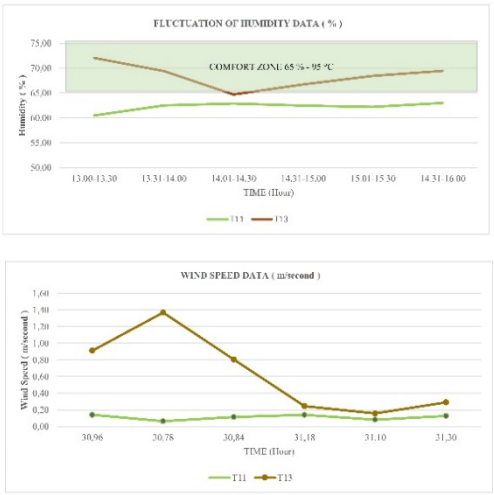

Fig. 3. (a) Dampness chart in room T-11 and T-13 (b) Wind speed chart in lecture hall

3.3 Wind

Calculation of wind speed that occurs in each room is very different. This is due to several factors, including the location of the openings and the direction of the wind in the building. Calculation of wind speed that occurs in each room is very different. This is due to several factors, including the location of the openings and the direction of the wind in the building.

In the lecture hall T-11, the wind speed at 13.00 – 13.30 averaged 0.31 m/second. Likewise, at 14.31-14.30 and 14.31-16.00 the average indoor wind speed reaches 0.23 m/s. Both times have exceeded the required 2 m/s. Classroom T-13, based on the required wind speed measurement, it has exceeded 0.2 m/second so that with the south and west openings, it maximizes the entry of wind into the room.

4 Conclusion

From the results of the analysis above, it can be concluded:

1. The lecture room that has the highest temperature is the T-11 lecture room where the average temperature is 31.84 °C, the dampness reaches 62.26%, and the wind speed is 0.11 m/sec.
2. The influence of the location of the opening is very influential to reduce the temperature in the room which can reach an average of 0.81 °C.
3. Thermal comfort in the lecture hall was not achieved in terms of measurements and questionnaires from respondents who stated that the room was hot (+3) in the 7-point scale on ASHRAE standard 55 and not good for health the wearer.

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