

Study On Thermal Comfort In University Hostel Building Case Study At Universiti Tun Hussein Onn Malaysia (UTHM), Batu Pahat

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Abstract—A field study was conducted in a university hostel building at Universiti Tun Hussein Onn Malaysia (UTHM), Batu Pahat, Johor. The objectives of this study are to determine the level of thermal comfort in the hostel room and to identifying whether the thermal comfort of hostel building can be achieved through natural ventilation or not. The thermal comfort variables are measured between 11am to 5pm for five consecutive days using Thermal Comfort Meter Station (BABUC A). A total of 178 sets of questionnaires were distributed to respondents consisting of undergraduate university students. Average clothing insulation for residents was 0.43clo with activity 0.997met for seating relaxed. In terms of to conserve energy usage and to go for a sustainable environment, it is enough to achieved thermal comfort in UTHM Hostel Building by using the natural ventilation. Result from the analysis showed that occupants perceived their thermal conditions comfortable, but this condition is more effective with the aid of mechanical ventilation.

Keywords—*Thermal Comfort; Hostel building; Indoor Climate*

I. INTRODUCTION

Malaysia is located in a hot humid climate of temperature, 20°C to 32°C during daytime, and 21°C to 27°C during night time with relative humidity around 75% [1]. Buildings in the hot and humid climate usually account high energy usage for cooling, to provide a comfortable environment for its occupants [2][3]. Countries like Malaysia usually require air conditioning but for residential buildings, the dependence for thermal comfort through air conditioning may be minimized.

There is a need to conduct a study on residential building rise university hostels, especially in Malaysia because it is rarely done. One sample survey was carried out studies on residential buildings located at the Universiti Malaya (UM), Petaling Jaya and Universiti Putra Malaysia (UPM), Serdang. Issues that often arise, and often raised by

hostel residents are less comfortable with their environment inhabited building because of high temperatures in the building and ventilation is less effective. The problem arises mainly when noon. To fix this, mechanical ventilator should be used to reduce the increase in heat inside the hostel building. Therefore, it is necessary to know the thermal environment and thermal comfort in residential buildings for the university to know the comfort level of residents and the problems that can arise resolved in addition to saving energy costs.

The study of energy conservation potentials in buildings has to be based on criteria of human response to the thermal environment in building indoor environment. Human body response intelligently to different climate conditions by acclimatization and adaptation. The purposes of this study are to determine the level of thermal comfort in UTHM residential buildings where the building indoor comfort are using natural and mechanical ventilation and the building are 4 storeys.

The objectives of this study are:

- To determine the level of thermal comfort in the hostel room.
- To identifying whether the thermal comfort of hostel building can be achieved through natural ventilation.

II. METHODS AND MATERIALS

A. Field Measurement

Thermal Comfort Meter Station (BABUC A) is a portable instrument for the measurement of the entire various parameters for environment (Figure 1). It is a portable instrument for fast measurements with data logging and it was connected with several probes. The Thermal Comfort Station is easily transportable and can be set up on a tripod. It used to obtain reading of dry bulb temperature,

wet bulb temperature, radiant temperature, mean radiant temperature, relative humidity and air velocity. Environmental field measurements were done in five consecutive days between 11am to 5pm. The instrument was placed at the central part of the room area at “1.1m’ above floor level to represent the height of occupants’ body level.



Figure 1 Location of thermal comfort station on the floor

The collection of indoor environmental data, clothing thermal insulation and metabolic heat production had been analyzed using the software infoGAP. Thermal Environment Measurement Report was produced, also by using the stated software. The reports contained results of thermal environment indexes and mean values of environmental quantities, which are the operative temperature (t_o), predicted mean vote (PMV) and predicted percentage of dissatisfied (PPD). Three rooms were selected as below:

- Room 1: without occupants and only uses natural ventilation, acted as a control room.
- Room 2: with mechanical ventilation (ceiling fan) with female occupants.
- Room 3: with mechanical ventilation (ceiling fan) with male occupants.

B. Questionnaire

It was distributed to 178 respondents consisting of 103 female residents and 75 male residents currently occupying Tun Dr. Ismail residential college (KKTDI). The questionnaire consists of 3 sections:

- Section A: background information of respondent
- Section B: activity and type of cloth information of respondent
- Section C: indoor environment parameters

III. RESULT AND DISCUSSION

A. Measurement Result

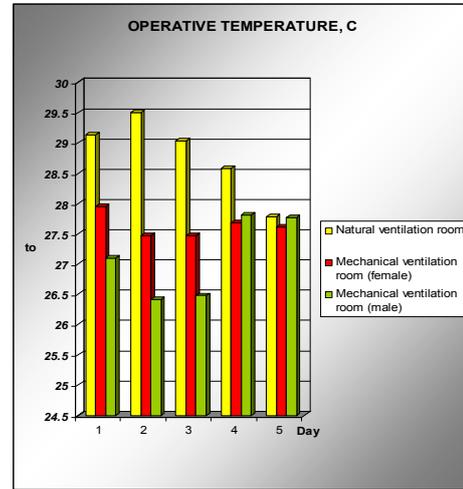


Figure 2 Operative Temperature Data for 5 consecutive days

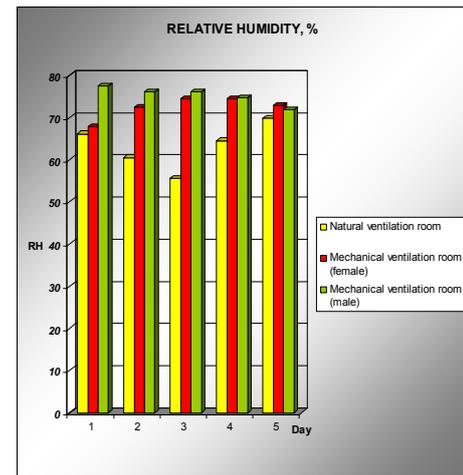


Figure 3 Relative Humidity Data for 5 consecutive days

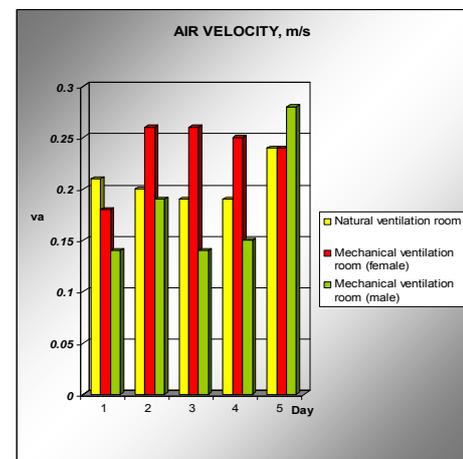


Figure 4 Air Velocity Data for 5 consecutive days

Fig. 2, Fig. 3 and Fig. 4 shows the environment conditions for room 1. The temperature in Room 1 was between 27.78 °C – 29.51 °C with relative humidity readings was between 55.58% - 69.9%, and surrounding air velocity of 0.19 m/s - 0.24 m/s.

Whereas for Room 2 which was aided by a mechanical ventilation, the temperature was recorded between 26.4 °C -

28 °C with relative humidity percentage of 67.8% - 77.6% and air speed of 0.14 m/s - 0.28 m/s.

Referring to the table below [4][5], we can understand that the temperature and relative humidity data for both rooms, are still in the comfort range listed by Sopian et. al., 2001. However air velocity in both of the rooms is seen insufficient and is not in the range noted by Sopian.

TABLE 1 COMFORT RANGE LIST BY VARIES RESEARCHER

Parameter	Room 1	Room 2	Sopian et. al	ASHRAE	ISO 7730 -7784
To, (°C)	27.78 - 29.51	26.40 - 28.00	26.00 - 29.50	23.0 - 26.0	23.00 - 26.00
RH, (%)	55.58 - 69.90	67.80 - 77.60	< 90	50.0	30.0 - 70.0
Va, (m/s)	0.19 - 0.24	0.14 - 0.28	0.5 - 1.0	< 0.15	< 0.4

B. Questionnaires Result

PIE CHART 4

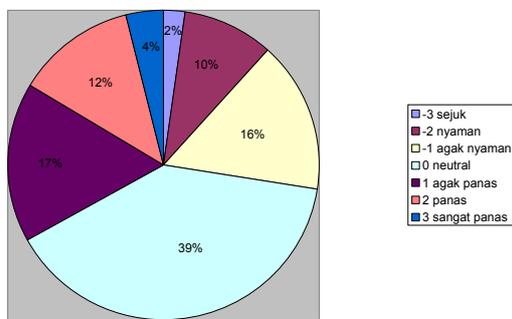


Figure 5

Fig. 5 shows that 94% of respondents were comfortable with a ceiling fan operating and windows closed. This can be said that mechanical ventilation plays a vital role in providing a comfortable condition at KKTDI hostel building.

PIE CHART 6

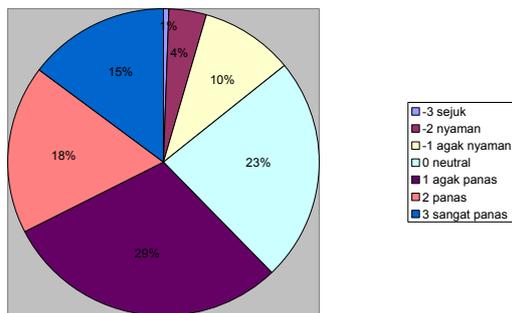


Figure 6

Fig. 6 shows that 16% of respondents felt their room is uncomfortable while another 84% of respondents were still feel comfort without ceiling

fans. Respondents react by opening the window to allow more air into their rooms. These results proved that the room which received air velocity of 0.19 m/s - 0.24 m/s was provided adequate air movement to maintain a comfortable indoor environment to its occupants.

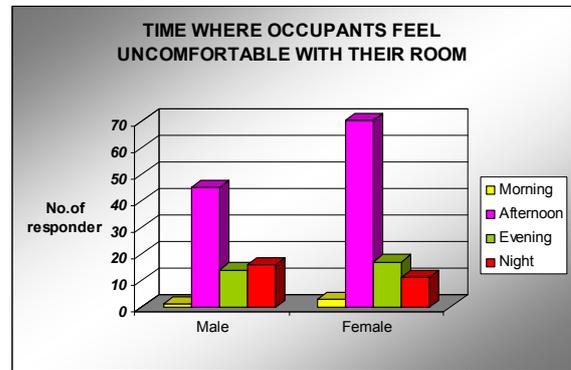


Figure 7

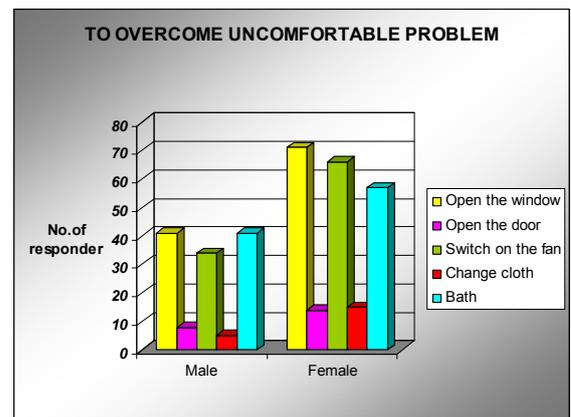


Figure 8

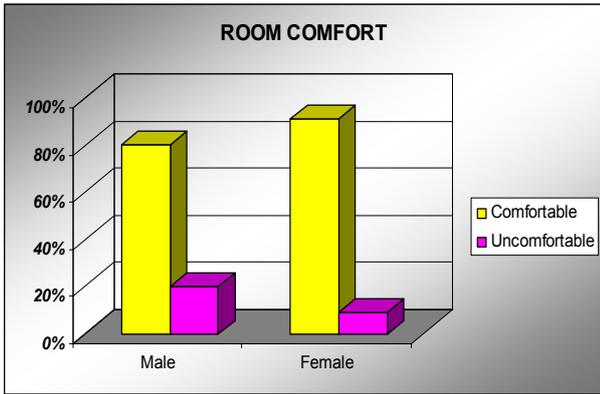


Figure 9

Further analysis of the questionnaire is stated in Fig. 7, Fig. 8 and Fig. 9. We found that 70% of the respondent answered that their room is hot and uncomfortable during the afternoon with the actual room temperature between 27.78 °C - 29.51 °C. The results showed that KKTDI's residents were not satisfied with the room temperature and did not feel comfortable with the room's indoor condition. Hence, the respondents take initiatives such as operating the ceiling fan, opening the doors and windows, to allow air flow through their rooms. The result showed 85% of the respondents felt more comfortable with their room after take the solution.

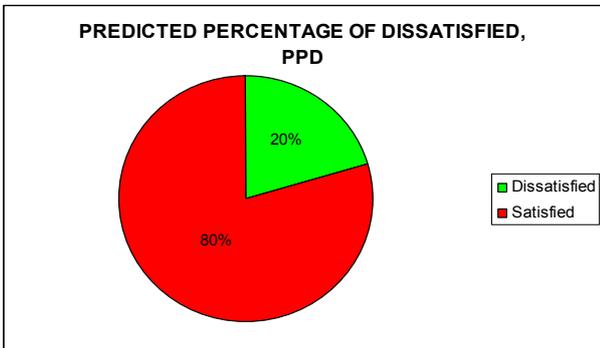


Figure 10 Predicted Percentage of Dissatisfied, PPD (natural ventilation room)

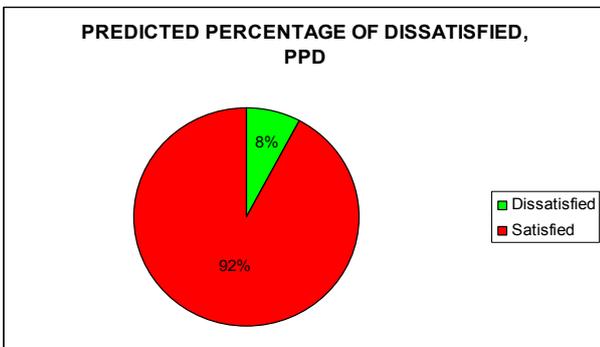


Figure 11 : Predicted Percentage of Dissatisfied, PPD (mechanical ventilation)

The following figure present results of the field measurement. Fig. 10 and Fig. 11 shows that the value for PPD is >20%. Both rooms are comfortable with more than 80% satisfied with the room's conditions. Respondents were satisfied with the natural ventilation rate at their hostel but respondents achieved more comfort level with the aid of a mechanical ventilation (ceiling fan).

IV. CONCLUSIONS

In order to achieve more comfortable, window openings and arrangements of furniture in room prevented adequate air movement in throughout the room spaces, thus contributing to less comfortable environment for the occupants through passive cooling compare to active cooling system. Wide of window opening and orientation also play an important role in passive design.

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REFERENCES

- [1] Paul Gut, and Dieter Ackerknecht, "Human requirements regarding indoor climate", *Climate Responsive Building*, 16(1993).
- [2] Fanger P.O, "Energy and building", *Climate Responsive Building*, (1985).
- [3] Olgyay Victor, "Design with Climate", *Climate Responsive Building*, (1963).
- [4] Abd Halid Abdullah (2007), "A Study on Thermal Environmental Performance in Atria in The Tropics with Special Reference to Malaysia". Unpublished PhD. Thesis, Heriot – Watt University, Edinburgh, Scotland.
- [5] ASHRAE Standard 55-1992. 1992. "Thermal Environmental Conditions for Human Occupancy". American Society of Heating, Refrigerating and Air-Conditioning Engineers, Atlanta.