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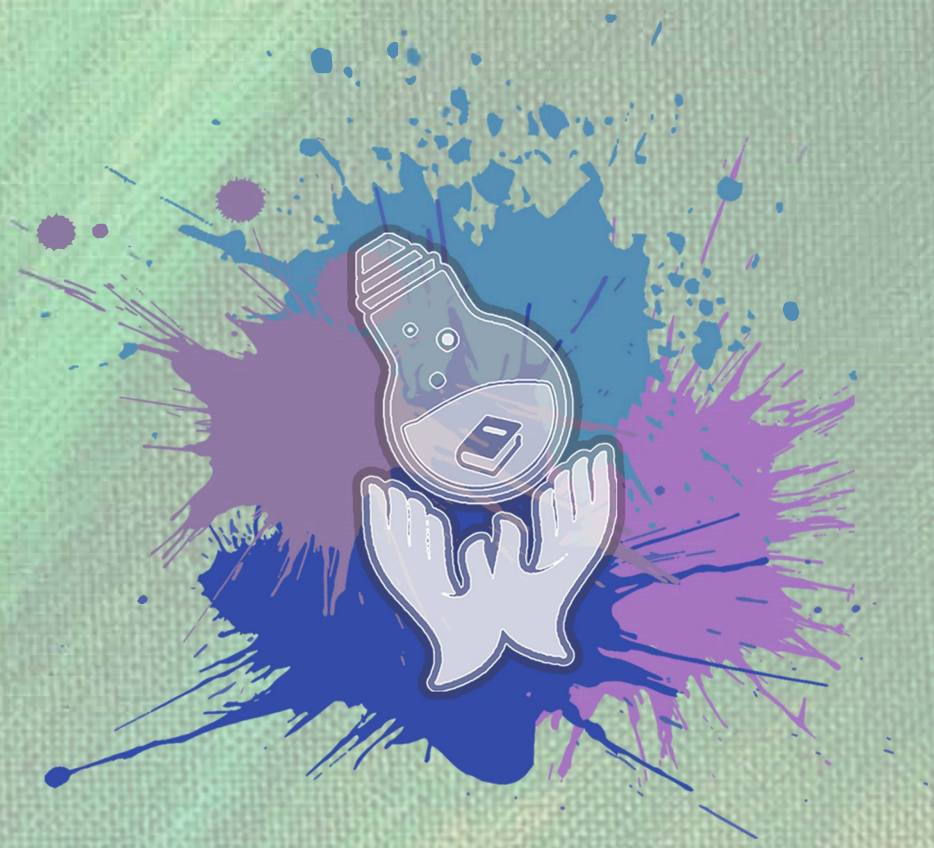

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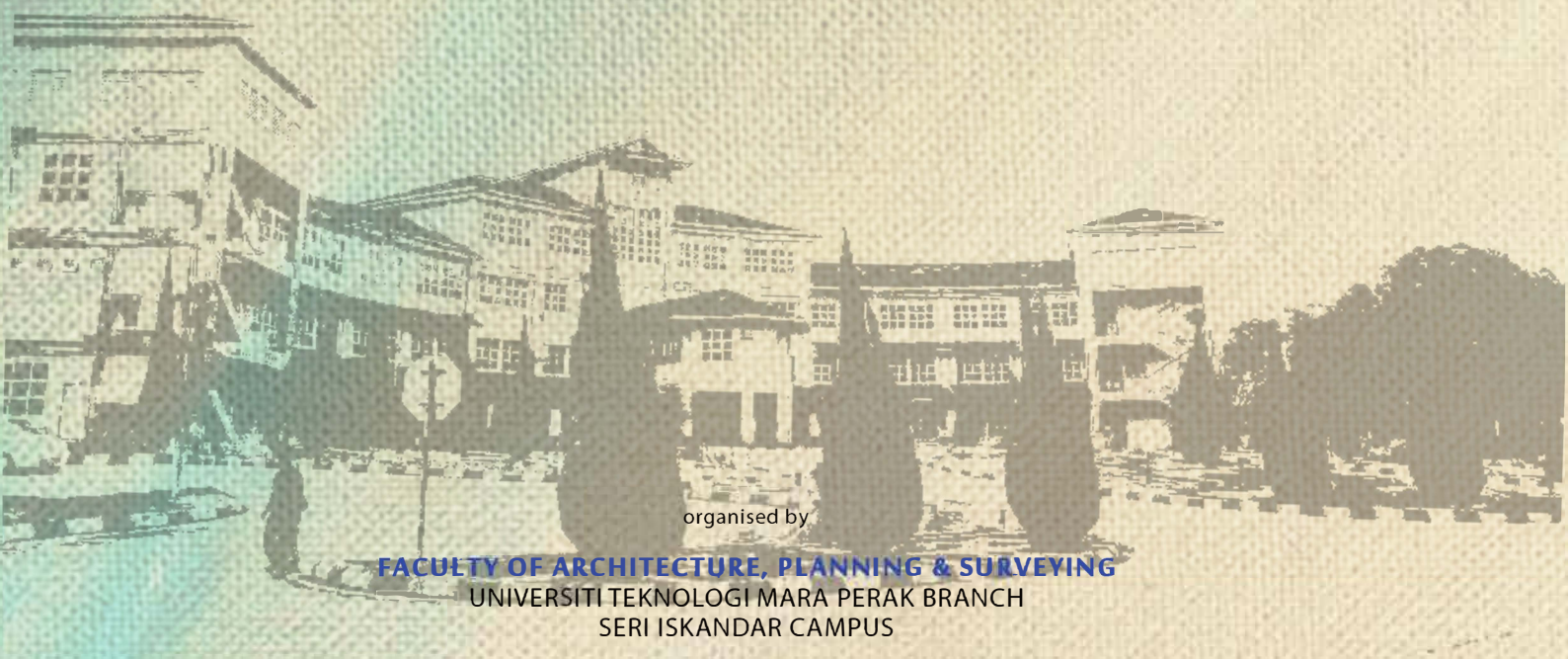

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INFLUENCING FACTOR ON THE EFFECTIVENESS OF THERMAL COMFORT IN THE MOSQUE

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Abstract:
In hot-humid climate especially in the Malaysian situations, many mosques should be provided with acceptable level of thermal comfort in order to focus for worship. They are partially or fully occupied five times a day and the maximum occupancy is expected to occur on Friday prayers. As buildings with intermittent occupancy may not perform the same thermally as typical commercial and residential. This paper presents the results of satisfaction user during prayers in mosque order to assess thermal comfort conditions. The purpose of this study is to investigate the influence factors on the effectiveness of thermal comfort in the mosque. Have 2 mosque was selected as a test building and thermal condition were monitored during Friday prayers. Air temperature, relative humidity and air velocity were collected as a data and a questionnaire were calculated and evaluated using ASHREA 55-2010 standard and Malaysian standard 1525. A comparison is provided to highlight the difference between the calculated and perceived satisfaction of occupants.

Keywords:
Hot-Humid climate; Mosque; Thermal comfort; User satisfaction.

1.0 INTRODUCTION

Thermal comfort is a key factor that might affect comfort, health, and occupants (Centers et al. 2013). It is influenced by a range of environmental and individual factors, both objective and subjective, including air temperature, the temperature of the surrounding surfaces, the air movement, the relative humidity, and the rate of air exchange (Ormandy et al. n.d. and Sugini, Fitriani, & Anggoman, (2017)) mentioned that nice building design and types of element that been used were also can give more comfort to user. The main objective for this research is to identify the problem that affects satisfaction user in the mosque and to analyses the level of thermal comfort in mosques.

2.0 LITERATURE REVIEW

Malaysia is experiencing tropical climate which is hot and humid throughout the year, the recommended indoor design temperature and relative humidity by ASHRAE 55 is not quite accurate. Indoor comforts in the building depend on the weather conditions of change and subjective factors (Sugini et al. 2017). According to Efeoma & Uduku, (2014) have factors that contributed to thermal comfort such as environment factors and personal factors. After that, have seven factor that will affect the thermal conditions in the building which is, air temperature, ventilation, lighting, layout and size of room, space usage, cleanliness and performance fan. Furthermore, Efeoma & Uduku, (2014) mentioned the basic factor will affecting thermal comfort from environmental factor is air temperature, mean radiant temperature, air velocity and humidity and personal factor is from metabolic rate or activity level and clothing insulation. Next, according to Al-Homoud, Abdou, & Budaiwi, (2009) basic requirement design and element of mosque also important to improve comfortable to users.

3.0 METHODOLOGY

In order data collection methods were used: (1) a physical measurement of certain parameters that influence the thermal comfort conditions and (2) a questionnaire as the subjective measurement. The case study that been chosen is mosque (A) Masjid Toh Puan Besar Hatijah, Batu gajah and mosque (B) is Masjid Nurul Hidayah, Manjung. First, for physical measurement it was taken every prayers time at a height of 5 m with every floor and get the reading in every 5 points in one space. The data been collected is temperature (Ta), relative humidity (RH) and air velocity were measured via 4 in 1 meter.

For the subjective measurement, collecting data via questionnaires which were prepared. The questionnaire was developed to gauge how participants feel towards their thermal environment. A total of 60 responses were collected and all of the responses were included in the analysis.

4.0 ANALYSIS AND FINDINGS

4.1 Analysis of indoor environment condition

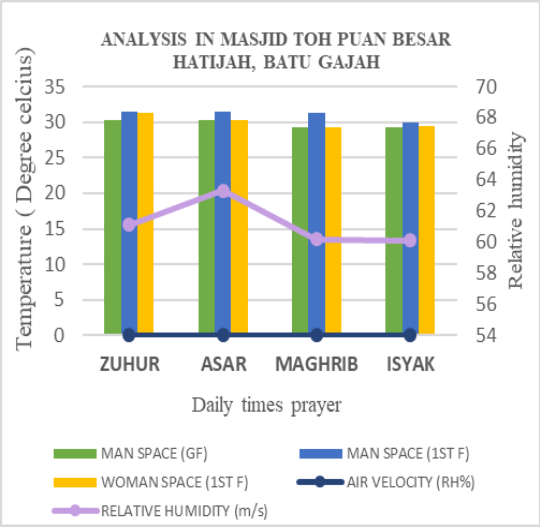

Figure 1: Analysis in Masjid Toh Puan Besar Hatijah, Batu Gajah

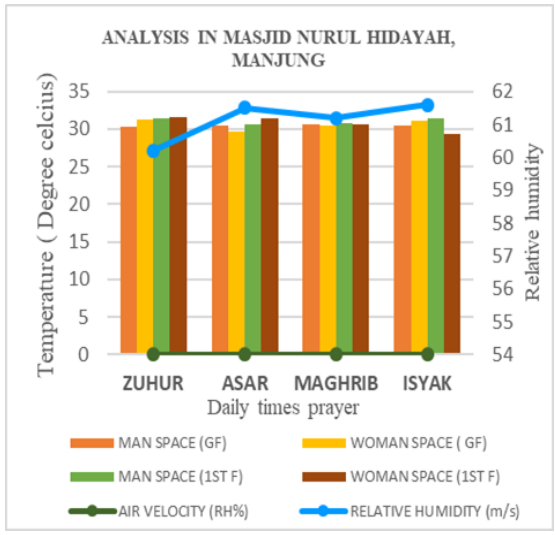

Figure 2: Analysis in Masjid Nurul Hidayah, Manjung

Figure 1 and 2 present the analysis of summaries of indoor measurement in Masjid Toh Puan Besar Hatijah, Batu Gajah and Masjid Nurul Hidayah, Manjung. Indoor temperature values ranged between 29.0 °C and 31.9°C. In case study of Masjid Toh Puan Besar Hatijah, Batu Gajah (mosque A) higher range air temperature is 30.0°C and 30.3°C. Then, for Masjid Nurul Hidayah, Manjung (mosque B) the higher range of air temperature based on the prayers time is 30.0°C and 30.6°C. For the relative humidity range between 60.0 m/s and 64.0 m/s. For relative humidity both of mosque have higher reading in Asar prayers time with 63.3 m/s (mosque A) and 61.6 m/s (mosque B). The air velocity for this both mosque is do not have any reading with 0.00 RH%. The reading that been collected in both mosques are achieved with the ASHRAE standard 55-2010 and Malaysian Standard.

4.2 Analysis of participants thermal preference

Sixty occupants participated in the study during Friday prayer respectively. The participate were (15%) woman and (15%) males with range 35-70. Table 1 presents thermal preference of respondents in both mosque based on the satisfaction level of user in mosque. As can be seen the lower mean is level user satisfaction of air temperature and ventilation with Masjid Batu Gajah was getting mean air temperature is 2.60 means and ventilation is 2.50 means while masjid Manjung the air temperature is 2.80 means and ventilation is 2.90 mean. From the data collected the satisfaction of user are not achieved towards feeling participants.

Table 3: Means of satisfaction level of user in mosque based on questioners

Satisfaction level of the user in the mosque	Person	Mean Masjid Batu Gajah	Mean Masjid Manjung
Level of user's satisfaction of air temperature per person	60	2.60	2.80
Level of user's satisfaction of ventilation per person	60	2.50	2.90
Level of user's satisfaction of lighting per person	60	3.07	2.97
Level of user's satisfaction of clothing per person	60	2.43	3.13
Level of user's satisfaction of size of room per person	60	3.03	3.03

Level of user's satisfaction of space usage per person	60	3.07	3.30
Level of user's satisfaction of cleanliness per person	60	2.83	3.20

5.0 CONCLUSION

The main objective for this research is to identify the problem that affects satisfaction user in the mosque and to analyses the level of thermal comfort in mosques. The results show that 38% occupants are not satisfied with the temperature and ventilation during daily prayers time. And from the collected via data loggers and questionnaire participants, data via loggers are still followed the standard temperature is range 29.0°C and 31.0°C, while based on participants feeling the temperature condition in the building are not achieved with their comfortable. Besides, people might tolerate and need higher indoor temperature in hot and humid climates. Future studied focusing on the perception of occupants during heating season are necessary to support this conclusion.

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