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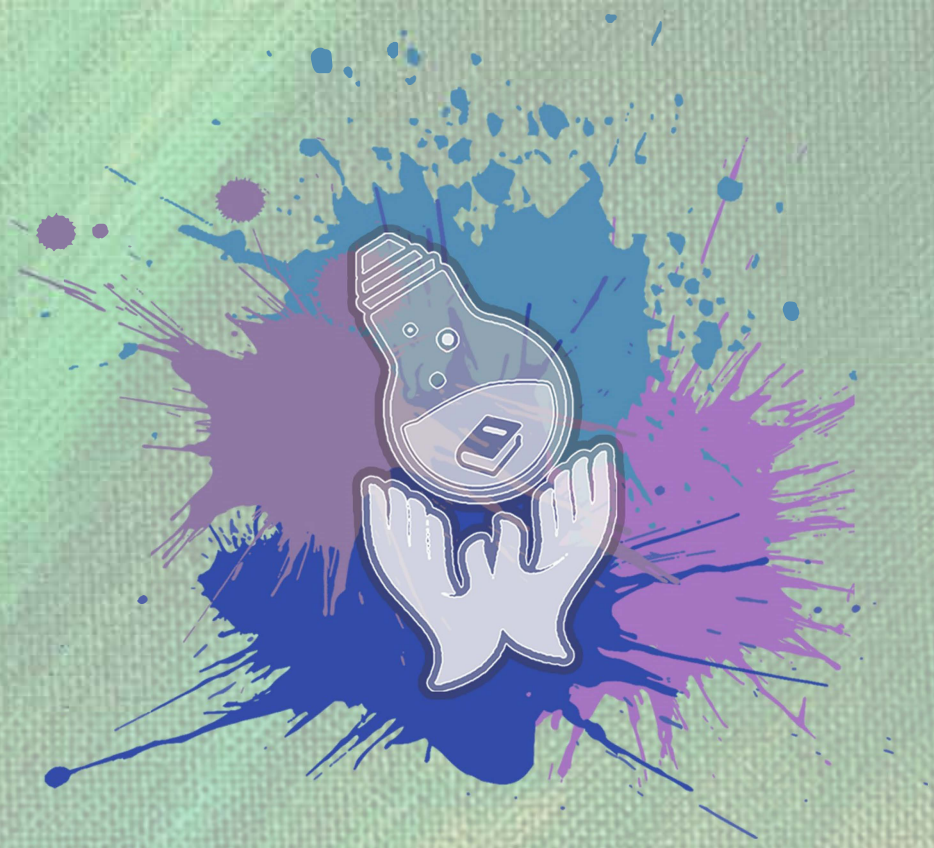

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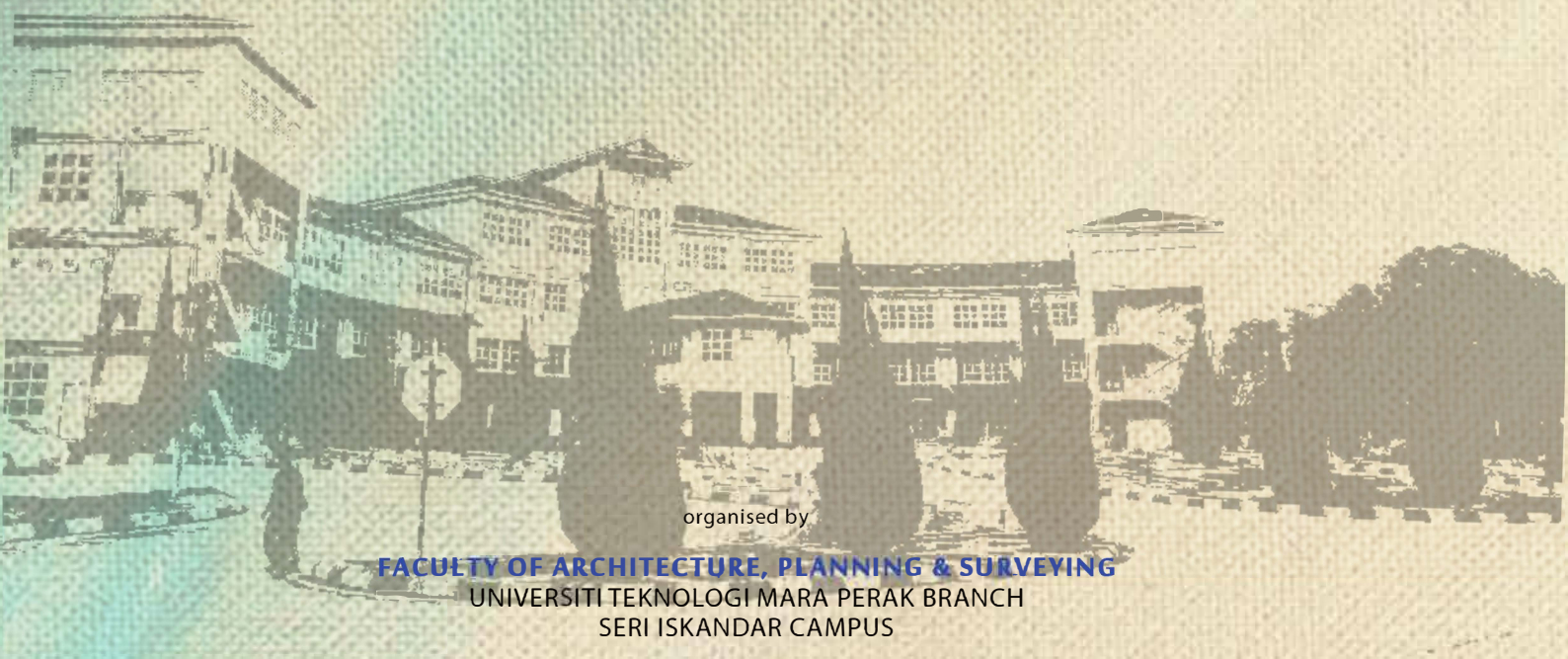

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MULTIPLE LINEAR REGRESSION ANALYSIS BETWEEN THERMAL COMFORT AND WORSHIPPERS' SATISFACTION IN MALAYSIAN MOSQUE

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Abstract:
Human thermal comfort is the paramount target to achieve the satisfaction of the occupation and users of the building. However, in Malaysia daily climate with high air temperature and relative humidity and inconsistent air movement throughout the day affect the thermal comfort for the building. Inappropriate thermal comfort in mosque buildings will lead to the unsuitable thermal environment for the worshippers and the function held inside of the building. Therefore, the objective of this paper is to determine worshippers' satisfaction level toward thermal comfort condition in Malaysia mosques. This study used a quantitative method in research methodology by a measure of the questionnaire survey and was conducted in Kelantan Darul Naim Malaysian Mosque. Then, the survey evaluated by using SPSS Version 23.0. Based on data, the most dominant factor that influences worshippers' satisfaction is air movement in mosques building. From this study, it is hoped that this study will give benefit in term of the worshipper's satisfaction towards thermal comfort in mosques building.

Keywords:
Thermal Comfort; Worshippers' Satisfaction; Malaysian Mosques

1.0 INTRODUCTION

The term "mosque" originates from the Arabic "masjid" mean verbatim the location of prostration or sujud (Al Jarah, 2017). The mosque is an important physical symbol of Islam and the centre of Muslim activity. Kassim et al., (2012) mosque is a building venue where the followers of Islam can worship, attending to the religious dialogue, argument, and learning and like thing which related to Allah (S.W.T). Mosques has their unique physical and intermittent operational characteristics. Religious spaces require special function and operation treatments as the indoor environment necessitates thermal comforts to the occupancy. Worshippers' satisfaction on thermal comfort are important to make sure they feel more comfortable, relaxed to attain of tranquility and concentrate in daily prayers. Offering good indoor building environment on thermal comfort can influence worshippers' activities not only a congregational place for worship but also for other social cultural activities.

2.0 LITERATURE REVIEW

The variation in the building design must be consider the climate of the country especially in the hot and humid area to make sure the occupation was satisfied with thermal comfort environment in building. The understanding of the factor affecting thermal comfort and the influences on the building design is necessary in producing an effective building function to occupants.

2.1 Thermal Comfort

According to ASHRAE Standard 55 (2013) the thermal comfort is the condition of mind that expresses satisfaction with the thermal environment. The six factors affecting thermal comfort are both environmental and personal. The first four factors define conditions of the surrounding environment while the latter two represent personal factors. These factors may be independent of each other, but together contribute to a thermal comfort.

2.1.1 Temperature

The temperature is a measure of how hot or cold the air is where it is the most commonly measured weather parameter. The previous studies showed that the air temperature has been considered as the main factor among others that influences the occupants thermal comfort level. Maarof (2014) the temperature has been considered the major influencing factor to the thermal comfort and many of the indexes produced are mainly focusing to the determination of the comfort temperature. Norman, Kamsah & Mohamad Kamar (2016) stated that the air temperature that ranges from 24°C to 29°C of the building is the best rate that suits Malaysia climatic condition that to achieve good thermal comfort.

2.1.2 Humidity

Humidity is the mass of water vapour in a volume of air divided by the mass of dry air. If water is heated and it evaporates to the surrounding environment, the resulting amount of water in the air will provide humidity. For tropical countries especially in the hot and humid regions, high relative humidity is one of the biggest obstacles to tackle besides high air and mean radiant temperature (Maarof, 2014). The higher the relative humidity, the less heat a person is able to lose heat through the evaporation of moisture on the skin, and so the hotter they will feel. The previous studies stated that the relative humidity from 30% to 70% is good to achieve good thermal comfort.

2.1.3 Air Movement

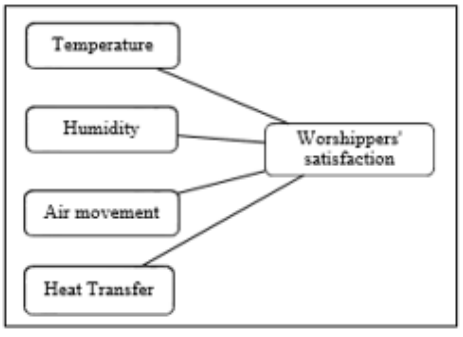
Indoor air velocities also affect the thermal comfort of people within spaces because of the greater of air velocity in indoor building, the greater will be the heat exchange between people in a space and the air around them. In some circumstances a higher air velocity may be desirable, for example, a fan might be turned on during hot weather to increase the rate at which the body is able to lose heat to its surroundings. Abdul Malik & Rodzi-Ismail (2006) stated that the passive design in tropical climate is not enough to reach to the occupants comfort satisfaction without the aid of active systems introducing the mechanical.

2.1.4 Mean Radiant Temperature (Heat Transfer)

Together with air temperature, mean radiant temperature is the factor that most affects the sensation of warmth because the radiation that falls on the skin stimulates the skin‘s sensory organs. The radiant temperature is related to the amount of radiant heat transferred from a surface, and it depends on the material's ability to absorb or emit heat. Increasing numbers of the hard surface building material which absorb and release the heat gain from the solar radiation will affecting the building indoor environment and the thermal comfort of the occupants.

2.2 Framework and Hypothesis

Table 1: The Relationship between factor affecting thermal comfort and worshippers' satisfaction



Hypothesis 1: There is a relationship between temperature and worshippers satisfaction.

Hypothesis 2: There is a relationship between humidity and worshippers satisfaction.

Hypothesis 3: There is a relationship between air movement and worshippers satisfaction.

Hypothesis 4: There is a relationship between heat transfer and worshippers satisfaction.

(Adapted from Tharim, Samad & Ismail, 2018)

3.0 METHODOLOGY

In studying the worshipper's satisfaction level in thermal comfort of mosques building, four mosques were selected as the case study and conducted in Kelantan Darul Naim. The mosques that use the air conditioning system was not selected since the mechanical system can control the thermal condition

and comfort level inside a space. To acquire the satisfaction of the worshippers' of the selected mosques on the thermal comfort and their preferences thermal comfort according to the condition experienced in the mosque, the respondents have contacted by the researcher personally in distributing the survey. The 476 surveys have been given out, and a total of 173 of the survey have achieved, which is about 36% of the questionnaire have received. After that, the data obtained have been inserted the SPSS software version 23.0 to received demographic analysis for demographic profile and multiple linear regression for hypothesis tests.

4.0 ANALYSIS AND FINDINGS

The following results derived from data analysis by SPSS Version 23.0

4.1 Demographic Profile

The worshippers' demographic information included the worshippers' gender, age and type preference of mosque building. The gender of respondents was male (25.1%) and female (74.9%). Their age range from 30 years old or under (52%) followed by the 31 to 50 years (14%), and over 50 years old (33.9%). The most preferences type of mosque building is concrete mosque (55.6%) while timber mosque (44.4%) which is lower than concrete mosque.

4.2 Multiple Linear Regression analysis

Table 2: Coefficients statistics on the agreed factors

Hypothesis	t	Sig	Beta	Hypothesis Finding
H1.Temperature- satisfaction	6.150	.000	.428	Supported
H2.Humidity-satisfaction	.613	.540	.058	Not Supported
H3.Air movement-satisfaction	7.916	.000	.721	Supported
H4.Heat Transfer-satisfaction	4.200	.000	.212	Supported

*R^2 adjusted value 0.457 (model)

*P value >0.05/t. >1.96

a) 45.7% (model) worshippers satisfaction is influenced by model variables. Thus 54.3% is from external factor.

b) Table 1 indicated that temperature, air movement, heat transfer has positive relationship with worshippers satisfaction (Hypothesis 1, 3 and 4 was supported).

c) From beta value, the most dominant variables are air movement followed by temperature and heat transfer.

5.0 CONCLUSION

From the analysis of multiple linear regression, it can be concluded that the model of thermal comfort is 75% fit to predict the worshippers' satisfaction in mosque building.

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