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ANALYSIS OF THERMAL COMFORT FOR STUDENT RESIDENTIAL IN IBS BUILDING (UNIVERSITY MALAYSIA PERLIS)

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Abstract: *Various efforts have been made to improve the level of the thermal comfort to each individual, especially thermal comforts in residential buildings. Thermal comfort level in residential buildings have a great impact on emotional and physical occupants. Perfect thermal comfort will result as a good quality of interior atmosphere. This is because a person's quality of life will be influenced by the level of thermal comfort felt. Comfortable temperatures in the home give a big impact on the level of one's self-esteem while the hot temperatures in the home can invite various problems such as sweating, tiredness, skin allergies and many more. The study of thermal comforts in the building of the Industrialized Building System (IBS) concept is aimed at identifying the comfort level of IBS residential building using a natural ventilation system. The main objective of the study is to find out the level of thermal comfort, and to define the effect of thermal discomfort study in IBS conceptual buildings as well as identifying the insulation level within the IBS conceptual building. This study is to identify the comfortable temperature at night in the student residential buildings of University Malaysia Perlis (UniMAP) in IBS concept in Perlis, Malaysia. Based on literature review, hourly weather data simulation in the existing residential building design was conducted to analyze indoor air temperature. The internal temperature is simulated much higher than the internal design conditions proposed in MS 1525: 2007 for the determination of thermal comfort. This finding discusses about the environment of potentially heat discomfort in different residential buildings in the city, in Malaysia. Adaptive Model of thermal comfort will be used in this study to determine the level of comfort of residential dwellers with reference to ASHRAE 55: 2013 standards. This study also helps researchers and academicians understand more clearly and* *in detail how the degree of thermal comfort in IBS conceptualized residential buildings is identified.*

Keywords: *Thermal Comfort Level, Quality of Life, Natural Ventilation, Industrialized Building System (IBS), Predict Mean Vote (PMV).*

Introduction

Thermal comfort can be defined as a situation in which a person feels comfortable in a space or an area. Thermal comfort in an individual space is very important not only for a good health but also affect the productivity of an individual or residential dweller. It relies on subjective parameters such as age, gender, health factors, and clothing (Nematchoua, Tchinda, & Orosa, 2014).

Thermal comfort levels in homes or buildings during the night are very important as it is a situation where residential dwellers rest with their families and sleep time after a hard day's work. Thermal comfort is a very important element in getting the best sleep quality. Field surveys on residential buildings concepted by industrialized building systems (IBS) are measured at night to determine the temperature obtained in comfortable thermal temperatures or vice versa. Referring to the previous study, adequate and comfortable sleep is a condition that can lower one's level of stress and also stabilize the body's energy and optimum rate throughout the day (Besedovsky, Lange, & Born, 2012). However, individuals or dwellers experiencing thermal discomfort such as hot air temperature in the living space can affect sleep time and this will negatively affect the quality of work the next day. One of the health problems that may occur due to thermal discomfort is insomnia (insufficient sleep). In addition, thermal comfort also affects the level and quality of residential dwellers because good thermal comforts are important to produce tranquility and happiness in a family. (Liu, Song, Wang, Wang, & Liu, 2014).

Industrial Building System (IBS) and their design procedures are considered as an opportunity to introduce sustainable features to the construction process and enhance construction sustainability into a more socially responsible, environmentally sustainable and economically variable to meet the current demand of the construction market. (Isa, 2016)

IBS concept of thermal comfort at IBS home is aimed at identifying how well IBS conceptual construction is able to produce a good thermal comfort level especially on the effect of indoor temperature at night. This study was conducted on IBS conceptual student residence building in September 2018 in Perlis state, north of Malaysia.

Literature Review

The housing sector in the city is rapidly growing due to the high demand and need of the population. However, profit-based development has contributed to the deterioration of building quality and affecting the population (Nicol & Roaf, 2017). In fact, the housing sector has now made significant improvements, which is a good effort to improve construction quality.

Detailed observations should be given to the design and installation of electrical devices to obtain optimum effect on thermal comfort. (Al-Obaidi, Ismail, & Abdul Rahman, 2014) states that IBS conceptual dwelling in Parcel 15-12B Putrajaya feels uncomfortable with the heat levels in three bedrooms. Considered that heat discomfort is the result of design orientation with inappropriate room position. Window aperture is inaccurate causing natural airflow to be blocked and unable to cater well. As the result, the help of mechanical tools will be needed to produce a comfortable temperature. Therefore, the use of internal energy depends on the combination of energy system and good structural design, as well as systematic operation and maintenance once the building is inhabited. It should also be understood that different climates may require design in different forms and equipment. Performance and value of technology components depend on the system used. Good thermal comfort level is influenced by the design of openings, windows and lighting controls. When increasing the efficiency of light, the lighting effect will reduce the internal heat. The heat released into the room will affect the heating of the building space.

Concept of Thermal Comfort

The concept of thermal comfort provided by the Chartered Institute Building Services (CIBSE, 2013) is a reflection of the overheating of the broader heating criteria introduced by CIBSE-TM52. Additional factors that affect extreme warming include the comfort of personal factors such as age, gender, health conditions and environmental factors such as areas, floor temperatures, heat disorders and other dimensional influences such as lighting that also affect thermal comfort levels. CIBSE also provides guidelines to inform the building designers to assess heat comfort and to determine or restrict overheating by applying a thermal comfort model.

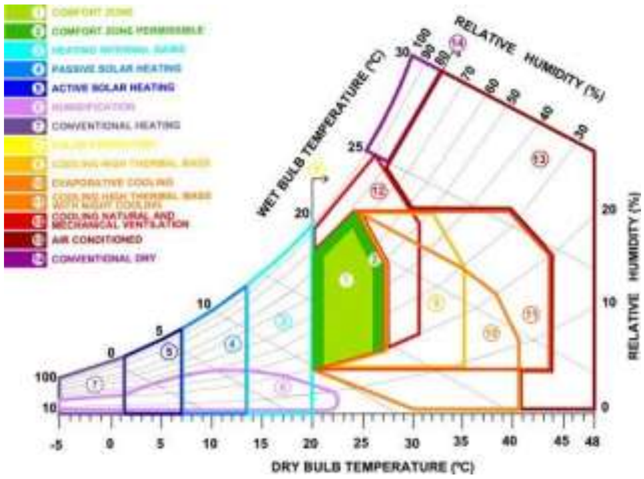


Figure 1: Determine the Level of Comfort of a Living Space Using the Psychometric Chart

Thermal comfort inside the house is strongly influenced by indoor space, building openings, landscape environment, indoor / hot indoor conditions and so on. This home is influenced by air temperature, air humidity, wind velocity and many other factors (Nematchoua, Tchinda, & Orosa, 2014).

Residents will not be able to carry out their daily activities efficiently and effectively if the living conditions are uncomfortable. Therefore, the best and practical building makes residents more comfortable doing daily activities. This is because the main purpose of a residential building is to ensure that people in it are happy and comfortable (not hot and not cold) (Harimi, Ming, & Kumaresan, 2012). In addition, relative humidity and air temperature are also key factors in determining the comfort level of residents living in hot and humid areas throughout the year. Optimal thermal comforts can affect the emotions of the residents to carry out their daily activities (Jamaludin, Khamidi, Wahab, & Klufallah, 2014).

Background of Study

There are some issues of heat discomfort that can affect the quality of life of building dwellers. However, this study only focuses on internal thermal comfort levels that only use natural ventilation. This study was conducted in the Units of Unicity student Unimap, located in the Padang Besar district and the student residence of Pauh Putra. Both locations are located in northern Perlis. The variables of the study to determine the degree of thermal comfort consist of air temperature, air velocity and relative humidity. In addition to temperature measurements, survey questions are also carried out to students who occupy the building to identify the thermal comfort level of the building.

The Location of The Study

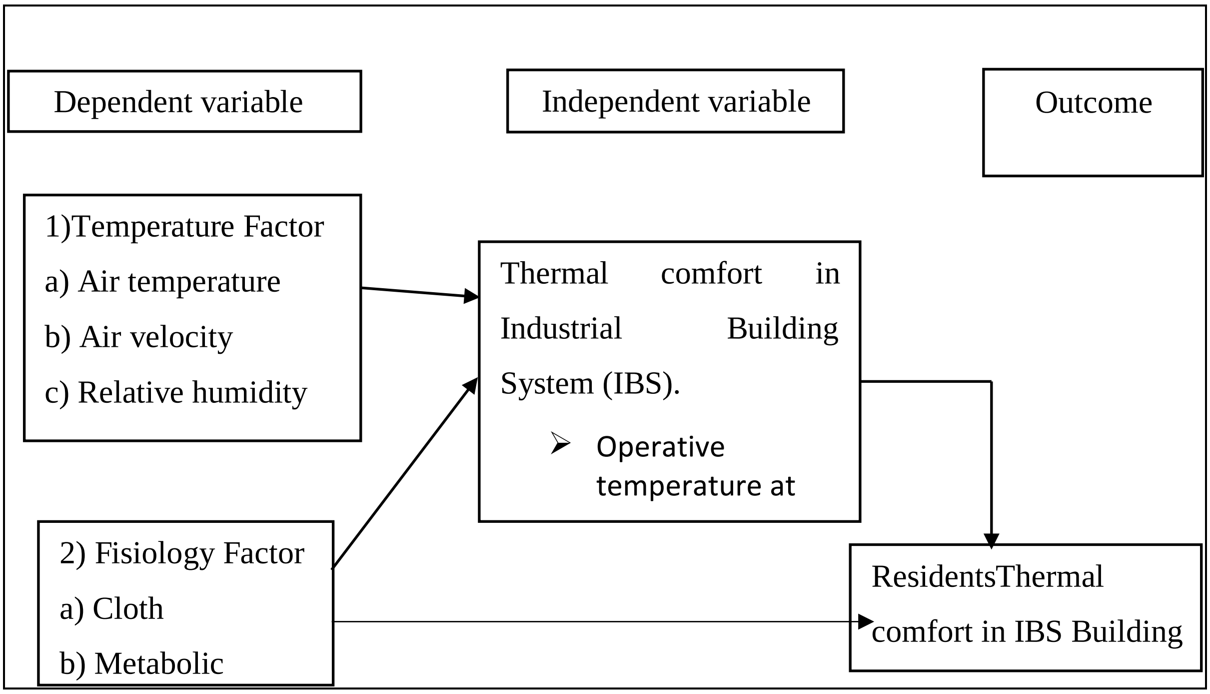
The location of the field study was in the residential building of Universiti Malaysia Perlis located at Pauh Putra and Uniciti Alam Campus. The coordinate position for the Campus Alam student residence, Pauh Putra is 6^{o}27'55 "N 100'11" 34 E and the coordinate position of student residence at Uniciti Alam, Padang Besar is 6^{o}38'58 "N 15'28" E.

Research Methodology

Research methodology involves several stages including temperature measurements in residential buildings using Annemometer. This tool is used to observe the air temperature, air velocity and relative humidity to determine the comfortable temperature in the home refer to the ASHRAE standard, 2013.

In this research, there are primary data on subjective assessment of internal thermal comfort that was collected through site measurement and subjective questionnaires. The monitored environmental parameters and data studied are subject to statistical analysis.

Besides that, the questionnaire was conducted on IBS concept dwellers. Question instrument refers to Krejcie & Morgan's schedule in determining the population and sampling of the study. The seven-point scale (ASHRAE, 2013) is also used, with each reaction rated numerically from -3 to +3 (-3 very cool, slightly cool -2, -1 cold, neutral 0, slightly hot +1, 2 and extremely hot +3), applied to respondents to assess the thermal sensation felt by the dwellers.



The Factor of Influence in IBS Thermal Comfort

Table 1: Framework of The Research

Research Analysis

A research study analysis that has been conducted on 164 respondents consisting of students. The time required to answer the question is between 5-10 minutes. The purpose of the analysis study was to find out the level of comfort of residential dwellers in SBB based student campus building located at Bumita, Pauh and UniCITI, Padang Besar, both building state in Perlis, Malaysia. The analysis was done using the SPSS program version 23.

Location	Gender		Age	Status
	Male	Female		
UniCITI, Padang Besar, Perlis	46	40	18 - 30	Students
BUMITA, Pauh, Perlis	71	7	18 - 30	Students

Table 2: Demographic Result

Thermal Sensation

The result of the analysis showed that 36.4% and 48.3% stated the temperature comfortable, 39% and 19.5% say the temperature is slightly warm, 9.1% and 20.7% states the temperature is hot and only 11.7% and 11.5% states that the temperature is very hot. The comparative study showed that 36.5% (Bumita building) and 48.3% (UniCITI building) of residential residents were comfortable and 69.8% (Bumita building) and 51.7% (UniCITI building) of the dwellers were in an uncomfortable situation (slightly hot, hot and very hot). Referring to the ASHRAE

2013 standard, comfortable temperatures are below 27°C, so the overall results show that the insulation material found on the IBS-based wall layers is still absorbed by the heat outside completely and does not reach the desired thermal comfort level. From the results of this pilot study, it proves that a detailed study to identify the comfortable temperature of the IBS-based residential building need to be continued.

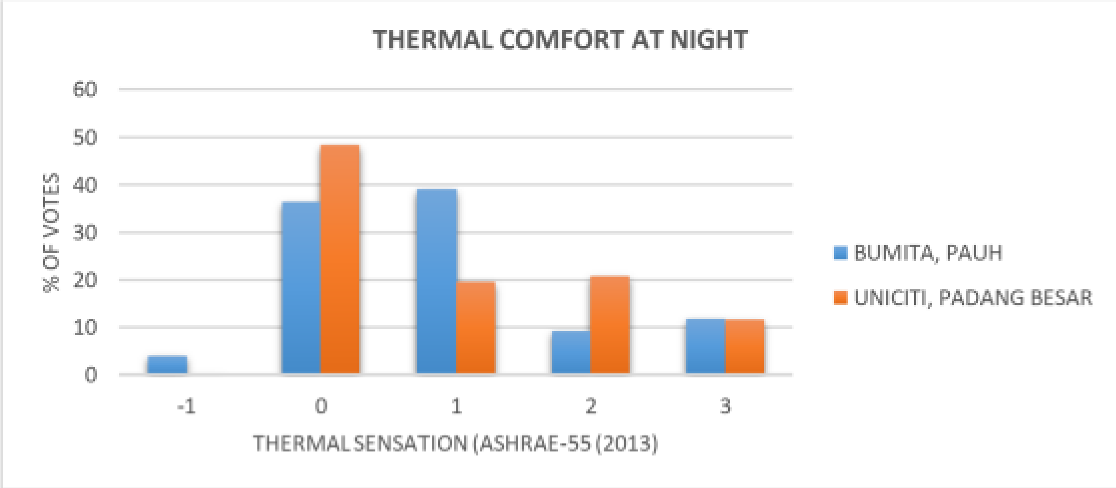


Figure 1: The Graph Shows the Thermal Comfort Vote and Effect of Thermal Comfort Rating of Students Living in The Student Residence at Bumita, Pauh And Uniciti Alam, University Malaysia Perlis, In the Countryside of Perlis.

Effect of Thermal Discomfort

Comfort is a subjective evaluation that is different depends on the individual perception. Referring to the ASHRAE 55 (2013) standards, the thermal discomfort come from different factors such as high humidity temperature, dry temperature, air movement, excessive sunlight inclusion, heat from appliances, and heat from window opening. To define the source of the thermal discomfort in this study, the view of the respondents is needed to determine the main factor of the discomfort. The analysis outcomes, that is used to identify the reason of the thermal discomfort at night in the residences, was obtained from the student residential building of UniMAP. The result of the analysis from residential building BUMITA, Pauh dan UniCITI, Padang Besar shows that 2.6% and 14.9% of the respondents are dissatisfied due the humidity temperature, 26% and 26.4% discomfort is caused by the dry temperature, 5.2% and 6.9% express their dissatisfaction because of the poor air movement, while 15.6% and 17.2% dissatisfied due to the little air movement. Besides,13% and 17.2% of the respondents stated that the thermal discomfort is due to inclusion of the light from the outside, and 5.2% of the respondents agreed that the heat from appliances also contribute to the discomfort of the internal space in BUMITA residential. Heat from the window opening and surfaces are also resulting to the thermal discomfort and was admitted by 29.9% and 2.6% respondents at BUMITA, and 13.8% and 3.4% respondents at UniCITI building.

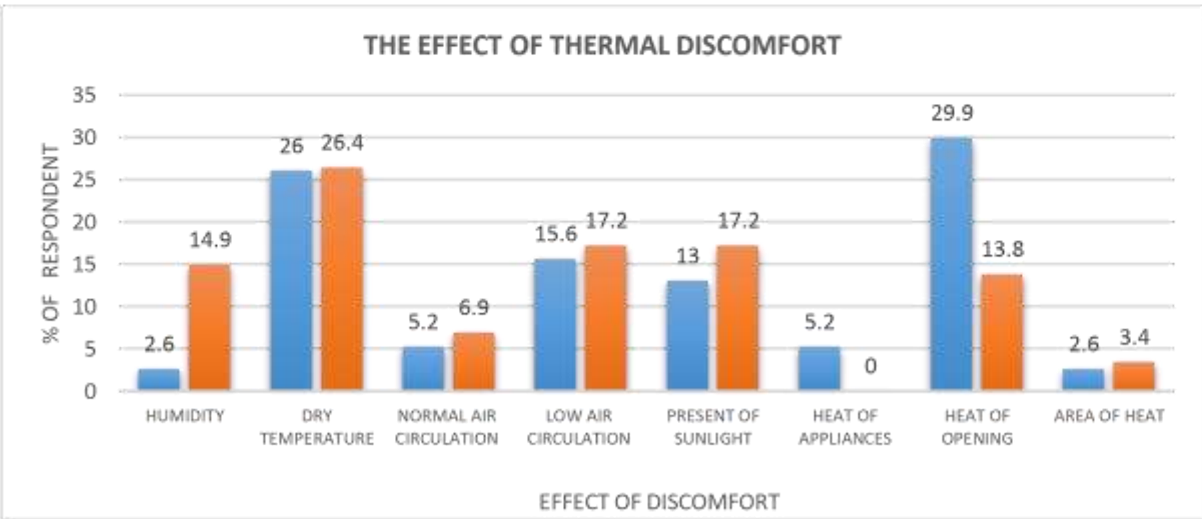


Figure 2: The Graph Shows the Effect of Thermal Discomfort Vote of Students Living in The Student Residence at Bumita, Pauh and Uniciti Alam, University Malaysia Perlis, In the Countryside of Perlis.

Conclusion

Previous studies show that there is a significant relationship between IBS residential homes and thermal comfort. Based on the thermal comfort scenario in Malaysia, it shows that the level of thermal comforts constructed by the IBS concept house should be made improvements. In addition, different weather conditions between states also affect thermal discomfort. Research studies have been conducted in Perlis, a state of Malaysia that receive the highest heat temperature reaching 40°C during the dry season. In conclusion, to achieve good thermal comfort to night dwellers, what needs to be done is to increase ventilation space in buildings, improvements to the existing insulation materials and use of air-conditioning. The results of this study will be recommended to the parties involved in the construction of the IBS concept building in Malaysia. The parties involved are Construction Industry Development Board (CIDB), IBS component producer and Local Government. The findings of this study are aimed at increasing the level of thermal comfort in IBS residential buildings and as a reference for future studies.

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