A REVIEW ON THERMAL COMFORT ASSESSMENT FOR INDUSTRIALISED BUILDING SYSTEM (IBS) HOUSES.

Norain Ali
Faculty of Engineering Technology
University Malaysia Perlis, 01000 Kangar, Perlis, Malaysia
Email:7376norain@gmail.com

U.Kassim
Faculty of Engineering Technology
University Malaysia Perlis, 01000 Kangar, Perlis, Malaysia
Email : umar@unimap.edu.my,

ABSTRACT

Technological advances are now more emphasize on the comfort level in a daily life. Various ways have been made to provide the perfect level of thermal comfort individually, especially the thermal comfort in the house. The thermal comfort level in the house has a great impact on emotion and physical. It will also produce a better quality of work by the individuals. This is because their quality of life will be influenced by the degree of thermal comfort in the house or residential institution. Thermal comfort study in the IBS concept house (Industrialized Building System) enhances understanding of the importance of thermal comfort level in a residential house especially during the summer months and the effect on the house temperature at night. This study focuses on the latest review of the thermal comfort rating in summer of the northern states of Kedah and Perlis in Malaysia. Based on literature review, a simulation of the hourly weather data in existing residential building design was carried out to analyse the indoor air temperatures. Indoor temperatures simulated are higher than indoor design conditions recommended in MS 1525:2007 for thermal comfort. The findings address the potential thermal discomfort environment in residential building at different urban climates in Malaysia. The negligence of climatic design approach in residential building design could lead to uncomfortable indoor thermal conditions affect people productivity, health and quality of life. A theoretical adaptive model based on the thermal comfort is adaptive Predicted Mean Vote (aPMV) using the "black box" theory will be used. The results of the thermal comfort level assessment from previous researchers were also discussed. This study will help researchers, academics and practitioners to understand more clearly and in detail about how the degree of thermal comfort in IBS conceptualized living space plays an important role in improving the quality of life for every individual and family institution in Malaysia.

Key Words — Thermal comfort level, IBS (Industrial building system), neutral ventilation, life quality, Predict Mean Vote (PMV)

1.0 INTRODUCTION

Thermal comfort can be defined as the situation in which a person feels neither cold nor warm in a given atmosphere. Thermal comfort in a living environment is very important not only for good health but also for factors like productivity of an individual or an occupant. It depends on the subjective parameters such as age, sex, health, origin of an individual, and clothing (Nematchoua, Tchinda, & Orosa, 2014b).

Beside that the level of thermal comfort in natural ventilation at night was very important for the residential building since it is the time to sleep and rest. Surely, thermal comfort is a very essential element to get the best quality of sleep. The field study was measure at night to obtain the optimum level of thermal comfort in IBS residential building. Referring to a review study, sleeping is a reversible tranquillization phenomenon controlled by the circadian rhythms in order to stabilize the energy and alertness of the human body throughout the day, also to maintain their optimal body health (Besedovsky, Lange, & Born, 2012). However, people in our society experienced sleep curtailment and disruption due to their work, caregiving, uncomfortable thermal or lifestyle. Health disorders resulting from insomnia or chronic sleep disorders should be delineated to raise public awareness on this matter. The thermal environment deeply influences sleep thermal comfort and sleep quality as the environment with the best thermal comfort is crucial to shorten sleep latency and lengthen the duration of quality sleep. (Liu, Song, Wang, Wang, & Liu, 2014)

1.1 Concept of Thermal Comfort

The concept of thermal comfort is provided by (CIBSE, 2013) is an overheating reflection of the criteria for the broader heating 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 area, floor temperature, heat aggravation and other dimensional influences such as lighting that also affect thermal comfort level. CIBSE also provides guidelines to inform the building designers to evaluate heat comfort and to determine or limit overheating by applying the adaptation of the thermal comfort model.

Thermal comfort in a house is greatly influenced by the interior space, building openings, landscape environment, hot/cold indoor temperature conditions and so on. Thermal attachment relates to the level of human body comfort and the living environment. The condition of the dwelling is influenced by air temperature, air humidity, wind velocity and various other factors (Nematchoua, Tchinda, & Orosa, 2014a). Residential dwellers will not be able to carry out their daily activities efficiently and effectively if housing condition is uncomfortable. Therefore, a proper and practical building makes people more comfortable to do daily activities. This is because the main purpose of the building is to ensure that people inside them are happy and comfortable (not hot and not cold) (Harimi, Ming, & Kumaresan, 2012)

In addition, relative humidity and air temperature is also a major factor in determining the comfort level of the occupants who live in hot and humid buildings throughout the year. Optimal thermal comfort can provide stable emotion to the occupants to carry out their daily activities (Jamaludin, Khamidi, Wahab, & Klufallah, 2014)

Thermal comfort study in the IBS conceptual house (Industrialised Building System) enhances understanding of the importance of the thermal comfort level issue in a residential house especially during summer season and its effect to house temperature at night. This paper focuses on the latest review of thermal comfort rating in summer of the northern states of Kedah and Perlis in Malaysia

2.0 REVIEW OF THERMAL COMFORT STUDY

According to (Roslan, Ibrahim, Affandi, Mohd Nawi, & Baharun, 2016) the study of thermal comforts made on library building using IBS-based system construction shows that thermal comfort does not reach a comfortable temperature according to the standard temperature index (CET) standard, as well as to achieve thermal comfort level the IBS building needs to be installed with air conditioner.

(Cui, Cao, Park, Ouyang, & Zhu, 2013) reported an epidemiological investigation conducted in August 2000 in Shanghai and in south eastern China's Jiangsu Province in August 2001 that focused mainly on the factors that determine the prevalence of sick building syndrome (SBS). The respondents were selected randomly among employees of enterprises, hotels, and restaurants in these areas. In total, 2,595 of them returned complete questionnaires. The respondents were divided into two groups according to whether their living and working environments had air-conditioning or not. The main aim of this study was to determine the extent to which people experienced discomfort in any of 12 different categories. Significantly positive relationships were found between long periods of time in air-conditioned environments and SBS in 10 of the 12 categories; category 2 (nasal dryness, itching, congestion, discharge, or bleeding) and category 6 (skin dryness with systemic or regional itching) were the only exceptions. The results showed that the discomfort included physiological effects that affected the nervous system, the digestive system, and the respiratory system, as well as irritation to skin and mucous membranes due to exposure to conditioned air. The frequency of such feelings of discomfort was higher for subjects who were acclimated to air-conditioned spaces than it was for people who were not accustomed to air-conditioning. Thus, air-conditioning can be a cause of discomfort and can affect people's health.

Most people believe that the main reason for SBS caused by air-conditioning is poor indoor air quality. Indeed, SBS has been rarely associated with stable thermal environments. In order to understand the relationship between acclimation to air-conditioned environments and health, a climate chamber experiment was conducted with a group of Chinese subjects acclimated to air-conditioned (AC) environments and a control group acclimated to naturally ventilated (NV) environments (Yu, Cao, Cui, Ouyang, & Zhu, 2013).

2.1 Thermal Comfort in IBS Residential Building

According to (Kassim & Walid, 2013) , the development of IBS construction is now growing up, but despite that, there are some problems arise among them about the non-thermal comfort in the IBS construction. Thermal comfort plays an important role in our daily life.One of the problems that arise in IBS construction is thermal discomfort, especially at night. Interviews and discussion between the researcher and most students of Unimap (Pauh and Unicity Campus, Perlis, Malaysia) residents and IBS residents in South Laka, Kedah, Malaysia, where the residential buildings use IBS innovation concept, the IBS foam and IBS block, complained that the building temperature at night is quite high and uncomfortable.

In addition, there are some thermal discomfort issues that can affect the quality of life in the city population. However, this research focuses only on indoor comfort with natural ventilation issues as this issue can affect the building occupant's life quality. The housing sector in the city is growing rapidly with the supply and demand of the population. Nevertheless, profit-based development has contributed to the deterioration of the population's quality of life (Nicol & Roaf, 2017). In reality, the housing sector nowadays has abandoned an important component, which is the prosperous and perfect empowerment effort in improving the urban life. Detailed observation should be given to the design and devices installation in order to acquire the optimum effect to thermal comfort.

(Al-Obaidi, Ismail, & Abdul Rahman, 2014) states that residents of the conceptualized building system (IBS) Parcel 15-12B Putrajaya expressed dissatisfaction on the heat levels in three bedrooms. It was assumed that the thermal discomfort is a result of the design orientation with inappropriate room position. It will disrupt natural airflow and require mechanical support 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 different designs and equipment. The performance and value of any component technology depend on the system being used. Refer to good thermal comfort level depends on the performance of the electricity converter device, as well as window design, window and window cover controls and other lighting controls. As light efficiency increases, lighting controls will reduce the impact on consumption. The heat that was released into rooms will affect the heating of the building

The main focus of this study is to get an idea about the IBS conceptual houses with comfortable night temperature without the use of air conditioner. To acquire the range of comfortable temperature, temperature measurements, the insulation type of the house and house construction, and the difference of the temperature between IBS conceptual houses and regular construction, must be done and figured. 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. Thermal comfort models using the adaptive Predict Mean Vote (PMV) method and thermal discomfort (DI) are used to study the characteristics of indoor thermal environments in IBS conceptual dwellings in the northern states of Kedah and Perlis, Malaysia

3.0 CONCLUSION

The review on previous studies showed that there is a significant relation between IBS residential house and human thermal comfort. Based on the thermal comfort scenario in Malaysia, it shows that the awareness level on thermal comfort in IBS residential house is moderate. There are insufficient researches on thermal comfort in the residential in north Malaysia. In developed country, the managements and municipalities are paying more attention and priority to the thermal comfort of IBS residential house. In conclusion, it is necessary to conduct more researches on the thermal comfort, especially in IBS residential house to raise the comfort level in IBS residential house in Malaysia. The result of this study will be developed by the parties involved in the construction of IBS building in Malaysia. The involved parties are Construction Industrial Development Board (CIDB) and Housing and Local Government. Findings of this research will pull out and improve proposals of thermal comfort level in IBS residential building. These proposals will be evolved by the CIDB. This party was responsible in controlling the construction industry in Malaysia. Besides, these proposals will be submitted to the Housing and Local Government, as the lawmaker, and they will standardize the construction laws in Malaysia under Local Government Act 1976. From this research, we believe that the stated parties will take an appropriate action regarding to this matter to overcome the thermal discomfort in residential buildings at night during summer in Kedah and Perlis.

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