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AN ASSESSMENT OF THERMAL COMFORT IN NATURALLY VENTILATED ARCHITECTURAL STUDIO IN ABIA STATE UNIVERSITY, UTURU

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Abstract
Indoor thermal comfort is the way individuals respond to increase and decrease in temperature within enclosures such as buildings. Architectural studios are enclosures and observations revealed that most architectural students in Abia State University Uturu employ hand fans as palliatives, for cooling their body temperatures, anytime electricity supply is removed. This paper presented the result of thermal measurements in 400 level architectural studio in Abia State university uturu. The aim was to determine the thermal character of the studio and indoor thermal perception of the students. The study measured thermal comfort variables of air temperature and relative humidity. The test was conducted during the first semester from 3rd October to 7th November, 2016. The measurement lasted between the hours of 8 am to 4 pm. Analysis of the data revealed that the studio did not fall within ASHRAE 55 Comfort Zone. The result revealed also that the environmental conditions of the studio ranged from warm to hot in 7-point ASHRAE scale. The linear regression between predicted mean vote and operative temperature showed the maximum acceptable temperature to be 26.5^{0C}

Keywords: *Thermal Comfort, studio, Field Survey, PPD and PMV*

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Background to the Study

Thermal comfort is very important in every architectural studio and environment. ASHRAE 55 (2004) defined thermal comfort as the express condition of the thermal environment, in which at least 80% of the sedentary or slightly active persons find their environment thermal acceptable. The evaluation of thermal comfort is subjective and is affected by the environment under survey, as well as individual factors influencing heat movement. However, Fanger (1970) noted that psychological factors influencing the minds condition directly is also very vital.

Kamaruzzaman and Tazilan (2009), pointed out that thermal comfort factors could be affected by physiological behavioral and psychological adaptation, therefore thermal comfort remains a pivot to the quality of indoors environment. Environmental elements; such asheat from electrical lighting, lack of adequate ventilation, high humidity and poor performance building envelopes can enable inability in indoor spaces to attain acceptable thermal comfort.

Researchers have shown that thermal comfort affects productivity. (Hoof, Mazej, and Heusen 2010, Li and Yao 2012), Nguyeni, et al (2012) in their investigations gave credence to this. Other scholars like Zailani, Hamidon, Hussin, Hamzas and Hadi (2012), Hussein and Rahman (2009), Teli, Jeutsch and James (2012) and ANSI / ASHRAE (2010) narrowed down the relationship between thermal comfort and productivity to be the same.

Students perception of thermal comfort is affected by air temperature and relative humidity in the studio, the clothing, physical activities, mean radiant temperature, such as the temperature of the walls, floor and windows.

The mean radiant temperature is a significant factor, especially in buildings whose envelopes are exposed to strong solar radiation, as cold walls or windows may cause feeling of coldness, even when the surrounding air provides comfort. In same manner, warm surfaces may create warmer feeling in individuals than the surrounding air temperature would indicate.

According to Kamanzzaman et al (2009), field studies in tropical environmental conditions and occupants comfort carried out in two architecture studios in hot humid environments revealed that 80% of the respondents found their indoor thermal conditions acceptable even though the Thermal Sensation Votes (TSV) exceeded that specified by ASHRAE standard 55.The neutral temperature and comfort range were obtained by linear regression analysis of TVS and in the Fangers PMV model.

From the subjective assessment, it was found that the occupants can accept the thermal range beyond the ASHRAE comfort zone, this indicated that the occupants in tropic environment have higher heat tolerance and can adapt to environment (Hussien and Rahman 2009).

In another study conducted to evaluate the comfort level of an air-conditioned studio using objective measurement, and subjective assessment, the results showed that measured temperature and relative humidity were within the standard comfort condition by ISO EN7730 (1994), while air velocity exceeded the standard limit. The overall comfort votes, Predicted Mean Vote (PMV) and Predicted Percentage Dissatisfied (PPD) indices showed that occupants are comfortable and satisfied with the studio comfort level (Zailaniet, al 2012).

The primary objective of this study was to explore the indoor climate in a naturally ventilated 400 level architectural studio in Abia State University Uturu and to investigate its occupant's level of indoor thermal comfort.

Methodology

The study measured thermal comfort variables of air temperature and relative humidity in the studios. Data logger which took both measurements, at the same time was calibrated to read off the variable values at every 30 minutes. The data was collected for 25 studio days Mondays to Fridays. 3rd October - 7th November 2016. The data logger was hung at the rear, at a height of 1.5 metres above floor level. All windows were kept open during the period of measurement to make sure air flow is maintained. Questionnaires based on the 7-point ASHRAE scale was used to determine student's perception of their thermal environment.

Data Collection

The primary data for the indoor environment of the studio were measured by the Thermal Comfort Equipment (Data logger).The equipment measured ambient temperature, radiant mean temperature, and relative humidity.

Clothing Insulation Value and Activity Rate

Clothing insulation is the thermal insulation provided by clothing. The insulation of clothes are often measured with the unit "Clo", where 1 Clo = 0.155 m2K/W, based on the ASHRAE Standard 55. By observing the occupants in the studio, the clothing and metabolic rate were estimated. The study established the clothing insulation of student at 0.6Clo. Cotton shirts and trousers were worn by both female and male students. Some female students also wore skirts, and blouses.

Table 1. Estimated clothing insulation value and activity rate

	Clo	Met
Estimated value based on ASHRAE	0.6	1.3

400 Level Architectural Studio

The field study was carried out in 400 level architecture studio. The building was designed for natural ventilation and the studio is also mechanically ventilated by four ceiling fans. The measuring instruments were hang at 1.5 meters above the floor and were set at the back of the studio in order to prevent interference. The studio is equipped with wooden tables and chairs, and sat sixty-five students in an area of 70m^2. Each drawing table measured 1.2×1 meter and took most of the floor area. The students were squeezed.

Results and Discussions

The environmental data was collected for 5 hours daily for 25 days, from Mondays to Fridays for five weeks. The PMV in all days were above 2 and according to the 7- point ASHRAE scale, the environment of the studio is from "warm" to "hot" while 80% to 100% of occupants felt dissatisfied.

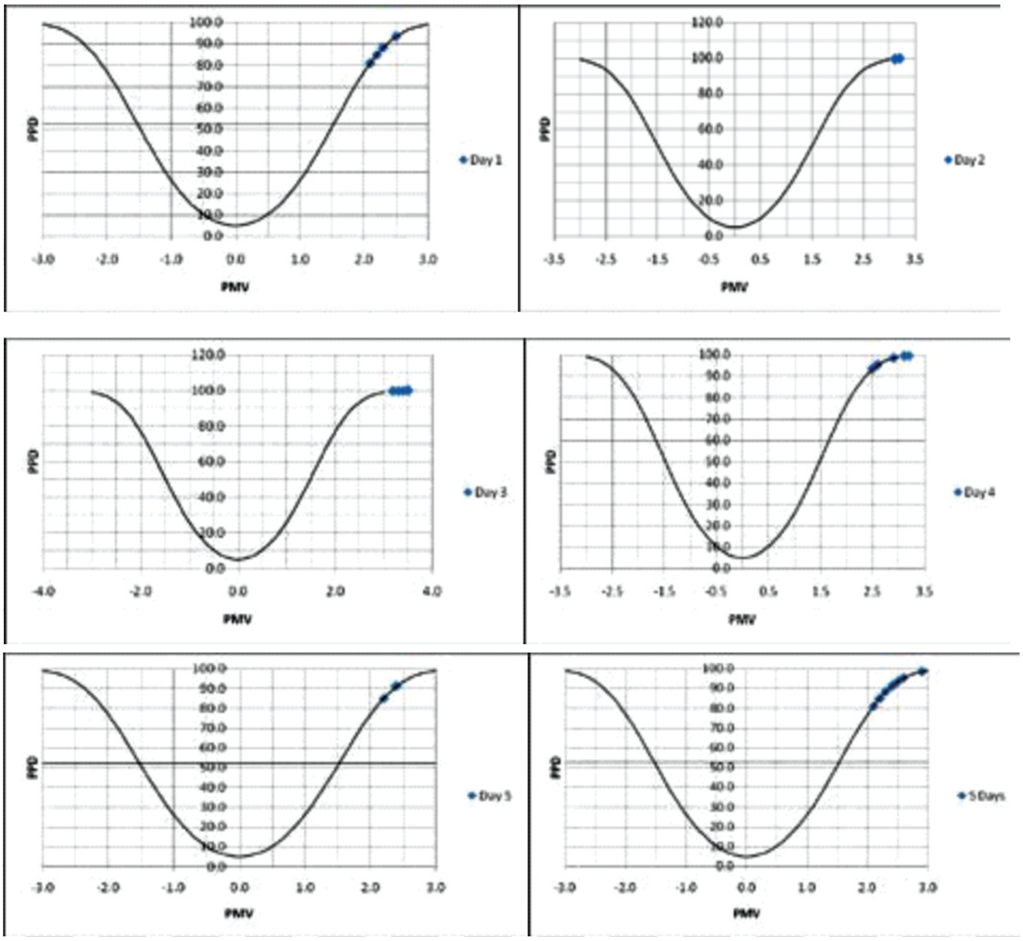

Fig 1: PPD vs PMV

Fig. 1 shows the trend of PMV versus Operative Temperatures (OP). The maximum acceptable temperature is 26.5^{0}C where the PMV is 1.

Conclusions

According to the direct measurement of thermal comfort, the studios do not provide thermal comfort environment for staff and students. The survey concluded that the 400 level architecture studio environment registered "warm" to "hot" in the 7-point ASHRAE scale. Hence, there is need to improve on its thermal environment. The air ventilation systems of the studio need to be improved. The number of seats and students number should be reduced, since the space is fixed. It was recommended that each studio seats fifteen students against the present 65, as human body provides heat transfer or heat loss. If the seats are too close or too near with each other, the pupils will feel more discomfort or hot.

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