Available online at www.sciencedirect.com

ScienceDirect

Procedia - Social and Behavioral Sciences 204 (2015) 19 – 28

Procedia
Social and Behavioral Sciences

4th World Congress on Technical and Vocational Education and Training (WoCTVET), 5th–6th November 2014, Malaysia

Architectural evaluation of thermal comfort: Sick building syndrome symptoms in engineering education laboratories

Nor Dina Md Amin[a]*, Zainal Abidin Akasah[b], Wahid Razzaly[c]

[a]*Department of Engineering Education, Faculty of Technical and Vocational Education, UTHM, 86400 Parit Raja, Malaysia*
[b]*Department of Design Engineering and Architecture, Faculty of Civil and Environmental Engineering, U THM, 86400 Parit Raja, Malaysia*
[c]*Department of Professional Education, Faculty of Technical and Vocational Education, UTHM, 86400 Parit Raja, Malaysia*

Abstract

Providing comfortable and healthy learning environment in tertiary institutions is beneficial to the teaching and learning process. However, uncomfortable and unhealthy indoor conditions may increase the risk of sick building syndrome (SBS) symptoms, discomfort and illness among building occupants. This study was conducted to investigate thermal conditions and SBS symptoms in three air-conditioned engineering education laboratories (EEL) located at Universiti Tun Hussein Onn Malaysia (UTHM). Building-related factors (such as space layout and adequacy, seating, furniture layout, surfaces' colors, windows, architecture aesthetic value and windows/ opening) of the lab were also evaluated and rated as good in terms of overall quality (range between 3.71, SD= 0.48 and 3.93, SD= 0.36). Objective measurement was conducted for thermal variables; mean radiant temperature (tr), relative humidity, and air velocity. Results shows that the mean radiant temperature (tr) were not within recommended range (minimum 17.8^{0}C in EEL3 and maximum 22.42^{0}C in EEL1). Subjective measurement with questionnaire surveys was distributed to 71 undergraduate and postgraduate students. Investigations were made with a particular focus at SBS symptoms and thermal sensation votes. Results show that most students in each lab have experienced all the SBS symptoms. Among the symptoms, dry skin received the highest percentage (40.85%), followed by runny nose (31%), dry eyes (29.58%), blocked/ stuffy nose (28.17%), tiredness (26.76%) and flu-like symptoms (21.13%) with unacceptable thermal conditions among the respondents in all laboratories. Based on the results, centralized air conditioned in engineering education laboratories should be designed adequately. Without a proper functioning control system, it is impossible to sustain a comfortable indoor environment for student occupants.

Peer-review under responsibility of Faculty of Technical and Vocational Education, University of Tun Hussein Onn Malaysia.

* Corresponding author. Tel.: +6-07-4564179.
E-mail address: dina@uthm.edu.my

Peer-review under responsibility of Faculty of Technical and Vocational Education, University of Tun Hussein Onn Malaysia.
doi:10.1016/j.sbspro.2015.08.105

Keywords: architectural space features; engineering education laboratories; sick building syndrome; thermal comfort

1. Introduction

The World Health Organization (WHO) emphasizes that indoor environmental conditions influence health and well-being of building occupants. These are true since poor indoor environmental conditions affects occupants' satisfaction and comfort perception (WHO, 1990). Several studies in commercial and residential buildings have been conducted to better understand these issues. Moreover, the increase of concern over the quality of the indoor environment improves the standard of livings in society, while failure to provide satisfactory condition has resulted in discomfort and illness (Cheong et al., 2003; Kruger & Zannin, 2004). Discomfort and illness among building occupants is commonly discussed in terms of "sick building syndrome" (SBS). SBS appear due to the association of time spent in building however no specific illness or cause can be identified.

Nomenclature

AV	air velocity
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
EEL	engineering education laboratory
FTVE	Faculty of Technical and Vocational Education
FCEE	Faculty of Civil and Environmental Engineering
tr	mean radiant temperature
RH	relative humidity
SBS	sick building syndrome
TSS	thermal sensation scale
TSV	thermal sensation vote
WHO	World Health Organization

1.1. Research background

The term SBS is used to describe situations in which building occupants experience acute health and comfort effects. Some of the investigated symptoms were dry eyes, eye strain, watering eyes, blocked or stuffy nose, runny nose, dry or irritated throat, flu-like symptoms, and difficulty in breathing, headache, tiredness as well as dry skin. Other scholars have emphasized the association between SBS and indoor environment. For example, thermal environment has direct/indirect impact on human's health. A recent clinical study has been conducted regarding both direct and indirect effects of humidity and temperature on human health in air-conditioned buildings in Thailand (Sookchaiya, Monyakul, & Thepa, 2010). It was found that medical experts agreed temperature and RH are most likely factors that cause disease and worsen the symptoms of patients. Too high RH is associated with the growth and spreading of bacteria, virus, house dust mite (small insect that can bite and case irrigation to human) and fungi especially in air-conditioned rooms with poor ventilation system. Furthermore, RH has potential to increase the intensity of chemical pollutants in the air by changing the distribution rate of gas from materials used inside the buildings and the reaction between water and chemicals. A control system for temperature and RH in air-conditioned rooms was proposed to improve health and comfort of occupants, however these variables were difficult to control in hospital buildings (Sookchaiya et al., 2010).

1.2. Significance of the study

In the built learning environment, scholars provide evidence that thermal conditions influence students' behavior (Cash, 1993), attitudes (Weinstein, 1979), preferences and comfort (Corgnati, Filippi, & Viazzo, 2007), personality