Available online at www.sciencedirect.com

ScienceDirect

Procedia Engineering 205 (2017) 410–414

Procedia Engineering

www.elsevier.com/locate/procedia

10th International Symposium on Heating, Ventilation and Air Conditioning, ISHVAC2017, 19-22 October 2017, Jinan, China

Qualitative Experimental research on thermal response of interior finishing material under air-conditioning intermittent running

Zihan Deng[a] , Naisheng Cu[a], Xi Meng[a,*], Qian Zeng[a] Hanfei He[a], Ling Li[a], Yaoyao Wang[a]

[a] *College of Architecture and Urban-Rural Planning, Sichuan Agricultural University, Dujiangyan, China*

Abstract

The response rate of indoor thermal environment is a main factor affecting indoor comfort level greatly under air-conditioning intermittent operation. Interior finishing material can affect inner surface temperature response rate directly as the layer closest to indoor air. According to this situation, in order to explore the thermal response of the different interior finishing material under air-conditioning intermittent running, a experiment is built to analyze the effect of the interior finishing material property on inner surface temperature. Results show that interior finishing property has an significant influence on the thermal response on inner surface temperature. The porous interior finishing material has 20% higher thermal response rate of inner surface temperature than the homogeneous dense materials. Integrating with EPS or rubber sponge in the interior finishing material can improve the thermal response rate of inner surface temperature and the increased response rate can be up to 17.7%~29.6%.

Peer-review under responsibility of the scientific committee of the 10th International Symposium on Heating, Ventilation and Air Conditioning.

Keywords: Thermal response; Interior finishing material; Intermittent operation

1. Introduction

In China, building energy consumption accounts for more than 30% of the social energy consumption and becomes the largest terminal part [1, 2], so building energy conservation is a long-term national policy. However, in the present research and practice on building energy conservation, more attention is focused on the air-conditioning continuous operation in the whole building to simplify the energy conservation design. However, the air-conditioning intermittent operation, which accords with the occupant's daily habits, is widely used in the buildings.

* Corresponding author.
E-mail address: mengxihvac@163.com

1877-7058
Peer-review under responsibility of the scientific committee of the 10th International Symposium on Heating, Ventilation and Air Conditioning.
10.1016/j.proeng.2017.10.391

So the corresponding norms, standards or regulations on building energy conservation are inconsistent with the actual operation situation of air-conditioning, which leads to the large difference between actual value and design value of building energy consumption [3].

As the heat transfer loss in building envelopes accounts 60~80% of the building total heat transfer loss[4]., it is of vital importance to create a good indoor environment and decrease building energy consumption by bettering the thermal performance of the building external envelopes [5,6]. Under the air-conditioning continuous operation, wall energy conservation optimization has been matured under the different climatic conditions and detailed review studies were reported by Kaynakli[7], Sadineni et al.[8], and Shekarchian et al.[9]. However, there is few academic research on the air-conditioning intermittent operation in the partial space of the whole buildings[10,11]. Moreover, Tsilingiris []has numerically analyzed the effect of the wall structure on the wall dynamic thermal response rate under the step change of the indoor air temperature and the internal thermal insulation layer is in favour of the wall thermal response rate, but his indoor air temperature case is a ideal one, which ignored the effect of indoor furniture and occupants and is not obtained in the actual buildings. In fact, interior finishing material is closest to indoor air, so its thermal response can affect inner surface temperature more directly. According to the above problem, a comparative experiment was carried on to analyze inner surface thermal response for the different interior finishing material under air-conditioning intermittent running

2. Methods

In this study, wall dynamic thermal measurement platform as shown in figure 1(a) was used and experimental wall was the interior wall. Figure 1(b) shows the interior wall section. From outer side to inner side, the interior wall consists of one layer of cement plaster of 5 mm, one layer of foamed concrete of 90 mm and one layer of cement plaster of 5 mm. Three group of interior finishing material were considered as shown in figure 2. Figure 2(a) shows the experimental diagram of aluminium, wood and gypsum board, which are the typical homogeneous dense materials, Figure 2(b) shows the experimental diagram of wallpaper, wall cloth and blanket, which are the typical porous materials, and Figure 2(c) shows the experimental diagram of wall cloth, EPS + wall cloth and rubber sponge + wall cloth, which are the typical soft roll interior finishing materials. Meanwhile, inner surface temperature is also measured without any additional layer. Table 1 shows the thermophysical properties of wall materials.

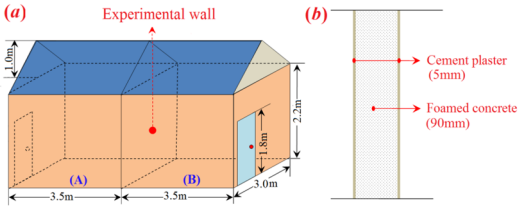

Fig. 1. (a) Experimental building and wall and (b)the experimental wall section

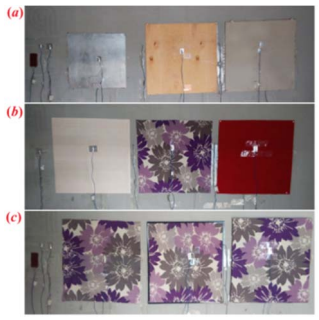

Fig.2 (a) Group I: aluminum, wood and gypsum board, (b) Group II: wallpaper, wall cloth and blanket and (c) Group III: wall cloth, EPS + wall cloth and rubber sponge + wall cloth