Advanced Science and Technology Letters
Vol.69 (Architecture and Civil Engineering 2014), pp.47-50
http://dx.doi.org/10.14257/astl.2014.69.12

A preliminary Study on Indoor Temperature Changes according to the Thermal Storage Wall System applied with Phase Change Materials during Winter Season

Kyu-young Lee[1.1], BeomDong Seo[1.2], Yongseong Kim[1.3]

[1] Graduate School of Techno Design Kookmin University,
77 Jeongneung-ro, Seongbuk-gu, Seoul, Korea
marine290@hanmail.net[1.1], raintiger7@naver.com[1.2], yongkim@kookmin.ac.kr[1.3]

Abstract. In this study, the scale model experiment was carried out in order to verify the possibility to install the thermal storage wall system applied with phase change materials and save heating energy during winter season. The scale model experiment was carried out for two types of structures including the structure of thermal storage wall system applied with phase change materials. The comparative analysis result showed that the structure of thermal storage wall system applied with phase change materials showed less indoor temperature changes below proper temperature than the previous balcony structure during winter season. It is judged that this could be effective for reducing the heating energy consumption during winter season.

Keywords: Passive Solar System, Thermal Storage Wall, Energy Saving, Phase Change Material

1 Introduction

According to the survey conducted by the Ministry of Environment, the domestic construction sector accounts for approximately 20 % of total national energy consumption and approximately 50 % of carbon dioxide production[1]. Due to the promotion of green growth policies since 2008, efforts on the distribution of eco-friendly buildings to reduce the greenhouse gas exhaustion have been made in the construction sector, and according to the road map announced by the government, zero energy will be made compulsory for all buildings from 2025[2]. In order to reduce cooling, heating energy and electric power consumed in buildings, eco-friendly systems using natural energy have been applied actively. The thermal storage wall system which is the typical indirect acquisition method among natural solar heat systems is the system which accumulates solar energy during daytime and uses the accumulated solar energy for buildings at night to save heating energy[3]. The previous thermal storage wall system accumulates solar energy using the sensible heat but the thermal storage wall system applied with phase change materials stores solar energy using latent heat to accumulate more energy[4].

ISSN: 2287-1233 ASTL

2 Scale model experiment and result analysis

Two types of scale model prototype unit were produced at the reduction ratio of 1/6 for comparative evaluation according to the installation of thermal storage wall system applied with phase change materials. The first model was the previous balcony type (TYPE A) and the second model was the type of thermal storage wall system applied with phase change materials and internal windows removed (TYPE B), and the summary of prototype units is as shown in Table 1. The prototype units of actual measurement were installed on the rooftop of K University (37° 36′ latitude, 127° 00′ east longitude) on December 19, 2013. [5]

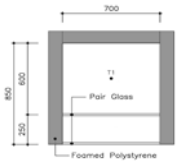
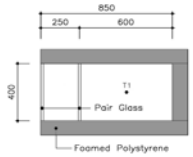
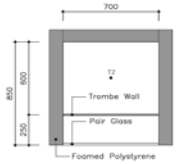
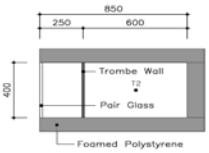
TYPE	Floor Plan	Section Plan
Type A		
Type B		

Table 1. Overview of Specimen by Types (T1 : Temperature/Humidity Sensor)

3 Result of Performance Evaluation

3.1 Weather data during the experiment period

The experiment result is data obtained for 3 days from 12 AM of December 20, 2013 to 11:59 PM of December 22, 2013. The weather data for 3 days during the experiment period is as shown in Figure 1.

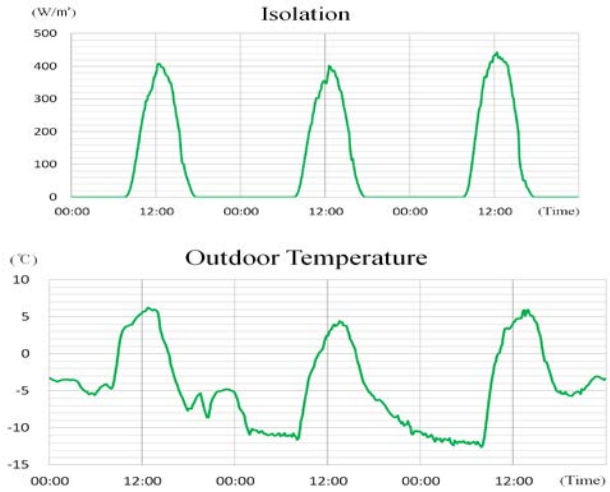


Fig. 1. Weather Data during Test Period

3.2 Result of prototype units

The indoor temperature of 2 prototype units including TYPE A (basic type) and TYPE B (thermal storage wall applied with phase change materials) during the experiment period was as shown in Figure 2, and TYPE B showed less deviation than TYPE A so that it could be more advantageous for saving energy.

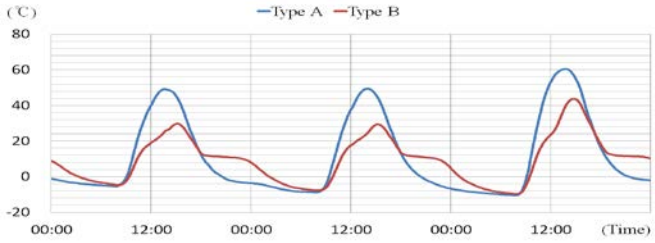


Fig. 2. Test Results(Indoor Temperature)

4 Conclusion

In this study, the experiment was carried out separately for the previous balcony structure and the structure of thermal storage wall system applied with phase change materials in order to verify the possibility to install the thermal storage wall system

applied with phase change materials and save heating energy during winter season, and the result is as follows.

First, the indoor temperature of previous balcony structure was greatly influenced by the amount of solar radiation and external temperature so that it tended to decrease rapidly from the point of time when the amount of solar radiation decreased.

Second, it was confirmed from the comparison of indoor temperature changes measured for 3 days through the experiment using a scale model, the structure of the storage wall system applied with phase change materials showed significantly less temperature changes than the previous balcony structure. This could be effective for improving the comfort of occupants.

This study has its significance as the preliminary study regarding indoor temperature changes according to the thermal storage wall applied with phase change materials, and the precise evaluation of performance should be carried out through the analysis of temperature changes at various indoor locations including the balcony in future.

References

1. Ministry of Environment , http://www.me.go.kr
2. Committee on Green Growth, http://www.greengrowth.go.kr
3. Yoon, J.H., Baek, N.C., Shin, U.C. : Experimental Study on Thermal Performance of Passive Trombe Wall System, Journal of the Korea Solar Energy Society, vol.28 no.1 pp.75-82 (2008)
4. Lee, K.Y., Ryu, R., Seo, J.H., Kim, Y.S. : Study on PCM Applied Thermal Storage Wall System to Reduce Cooling Energy, The Society of Air-Conditioning and Refrigerating Engineers of Korea, vol.26 no.6 pp.247-256 (2014)
5. Lee, K.Y., Seo, J.H., Kim, Y.S. : Study of Room Temperature Changes resulted from Thermal Storage Wall applied with Phase Change Material : Focused on Cooling Period of Apartment, An International Interdisciplinary Journal, vol.17 no.7 pp.3193-3198 (2014)
6. Korean Meteorological Administration, http://www.kma.go.kr

