Application of COMSOL Multiphysics® Software to Model Temperature Changes in Buildings with PCM Incorporated in Their Elements

N. P. Sharifi[1], A. A. N. Shaikh[1], A. R. Sakulich[1]

[1]Department of Civil and Environmental Engineering, Worcester Polytechnic Institute, Worcester, MA, USA

Abstract

Reducing HVAC energy consumption in buildings has provoked a lot of thought and has, subsequently, drawn a lot of attention. Out of the several methods that have been introduced to achieve this goal, the usage of Phase Change Materials (PCMs) in the structural components is one of the very effective ones. However, to find the optimum melting temperature and percentage of PCM for different climates and buildings, the changes in temperature in the buildings should be analyzed when real temperature changes of each cite are applied to the structural elements as the thermal load.

Since laboratory experiments are expensive, time-consuming, and not always practical, a COMSOL Multiphysics® software model is generated to precisely simulate temperature changes in structural elements while taking the effects of the PCM into consideration. The accuracy of the COMSOL model is validated by a laboratory experiment. Various models are generated regarding different percentages of PCM, different locations and walls with different components. As the results show, the COMSOL software model can accurately calculate changes in buildings' temperature and precisely take the effects of changing in PCM's phases into account. Also, incorporation of PCM into buildings increases occupant comfort and brings down energy consumption by modifying and smoothing temperature change profiles in buildings.

Figures used in the abstract

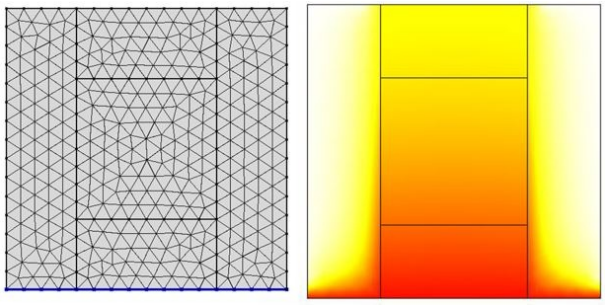

Figure 1: COMSOL model mesh (left) and simulation results (right).

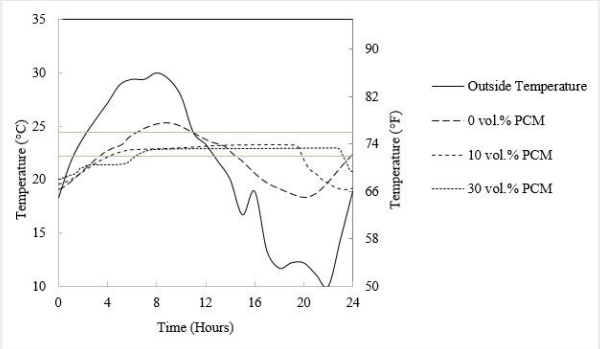

Figure 2: Plot showing temperature changes.