Role of applying PCMs on thermal behavior of innovative unit roof enclosure	
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Abstract: As a technical approach, using Phase Change Materials (PCM) can be an effective method to prevent energy losses through building enclosures. In the present paper, different roof structures containing PCM have been examined to analyze their thermal behavior. The governing equations were developed and solved for a sample unit extracted from a typical roof. The control volume based finite element method has been applied for solving coupled equations governing heat transfer through the roof and flow of melted PCM. The effect of key parameters including thermal diffusivity of the PCM and the wall, Prandtl number (Pr), Rayleigh number (Ra) and solid wall thickness to total thickness has been examined. The main results indicate an enhancement of heat transfer through the increase of the thermal diffusivity of the PCM with respect to the building material. Increasing the thermal diffusivity ratio from 1 to 25 doubles the heat transfer rate and decreases the full melting time by 80% for high Rayleigh. Pr affects the mode of heat transfer but has little impact on PCM melting rate. Raising Ra improves heat transfer under the condition of high thermal diffusivity in the PCM. Increasing Rayleigh number from 104 to 106 doubles the heat transfer rate and reduces the melting by 67% for high thermal diffusivity ratio. Finally, increasing the size of the wall thickness does not affect the fraction of melted PCM but reduces the heat transfer rate. The heat transfer rate can be increased by up to 75% when the non-dimensional thickness of the solid layer is reduced from 0.5 to 0.005.