

## **A Theoretical Study of and Phase Change Material Layered Roofs under Specific Climatic Regions in Turkey and the United Kingdom**

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**Abstract :** Roof influences considerably energy demand of buildings. In order to reduce this energy demand, various solutions have been proposed, such as roofs with variable thermal insulation, cool roofs, green roofs, heat exchangers and ventilated roofs, and phase change material (PCM) layered roofs. PCMs suffer from relatively low thermal conductivity despite of their promise of the energy-efficiency initiatives for thermal energy storage (TES). This study not only presents the thermal performance of the concrete roof with PCM layers but also evaluates the products with different design configurations and thicknesses under Central Anatolia Region, Turkey and Nottinghamshire, UK weather conditions. System design limitations and proposed prediction models are discussed in this study. A two-dimensional numerical model has been developed, and governing equations have been solved at each time step. Upper surfaces of the roofs have been modelled with heat flux conditions, while lower surfaces of the roofs with boundary conditions. In addition, suitable roofs have been modeled under symmetry boundary conditions. The results of the designed concrete roofs with PCM layers have been compared with common concrete roofs in Turkey. The UK and the numerical modeling results have been validated with the data given in the literature.

**Keywords :** phase change material, regional energy demand, roof layers, thermal energy storage

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