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NUMERICAL INVESTIGATION OF BUILDING WALL STRUCTURE FOR A MEDITERRANEAN CITY

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ABSTRACT

Buildings are recognized as among the most energy-consuming systems, accounting for about 30% of the world's energy consumption and sources of greenhouse gas emissions. Improving building energy efficiency while maintaining occupant comfort has become increasingly important worldwide, as reflected in the growing stringency of building regulations. One significant passive energy control strategy is using insulation materials with low thermal conductivity. In this work, the thermal analysis of building wall structure is analyzed numerically by using the explicit finite difference technique. This conference paper examined the thermal performance of building multilayer walls composed of four layers: inner plaster, Hollow brick, insulation material (silica aerogel), and outer plaster, which concurrently provides better insulation. The outer layer of the building wall is subjected to combined convection and radiation. The inner building wall is exposed to the convection heat transfer. This analysis was carried out using actual weather data for 4 days in a city with a Mediterranean climate during summertime in Türkiye. The energy balance equations are written for each layer of the multilayer wall and discretized for each nodal point using the explicit finite difference method. The interface conductivity is calculated using the harmonic mean technique. The examined model is coded in the computer programming language MATLAB. This current research work determines the time-wise temperature variation and thermal performance of the building. The developed 1D numerical heat transfer model was validated with the published data. Moreover, the effect of the insulation material thickness on the thermal performance of the building wall is investigated. The results showed that the silica aerogel material has a substantial role in order to diminish energy consumption in the buildings.

Keywords Building wall, Explicit finite difference, Insulation material

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