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COMPREHENSIVE EVALUATION OF THERMAL PERFORMANCE AND TIME-LAG IN RESIDENTIAL APARTMENTS: A NUMERICAL SIMULATION STUDY ON PHASE CHANGE MATERIAL WITH MYCELIUM INTEGRATION IN AMMAN

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Abstract

This study explores the feasibility of enhancing energy efficiency in residential buildings within the climatic conditions of Amman, Jordan, by introducing a novel material termed "Phase Change Material with Mycelium Integration (PCMMI)." Utilizing numerical simulations via Autodesk-Revit, the thermal performance of a typical residential building was evaluated, comparing conventional construction materials with PCMMI. The investigation focused on three crucial components: external walls (W.01), roof (R.01), and ground floor slab (S.01), all of which initially failed to meet prescribed thermal transmittance codes. Integration of PCMMI successfully improved the building envelope's thermal performance, aligning with Jordanian regulations for thermal insulation.

Additionally, a parametric analysis assessed the time-lag of materials in the residential envelope, revealing an average delay of approximately 8 hours. This delay implies that, with the addition of the PCMMI layer, the envelope requires 8 hours to transmit outdoor temperatures (e.g., 30°C) to the interior's peak temperature, thereby showcasing the material's potential in mitigating energy demand.

Keywords

Thermal Performance, Parametric Analysis, Time Lag, Ground Albido, The Decrement Factor, Thermal Transmittance, High-Lands Climatic Zone