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Evaluation of PCMs as passive thermal regulators of indoor spaces in a temperate climate

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Statement of the Problem: The purpose of this study is to evaluate phase changing materials (PCMs) as passive thermal regulators for indoor spaces with no mechanical thermal conditioning within a temperate climate. Today, in the building construction area, there is a need to increase the use of light weighted construction systems due to less installation time, and reduce energy consumption due to mechanical thermal conditioning. However, light weighted construction systems implemented in buildings within temperate climates imply the need of mechanical thermal conditioning. Vernacular building construction in temperate climates has included materials with thermal mass properties to condition by passive means; however, these materials are heavy. Therefore, there is the necessity to implement materials with thermal mass properties, but weighting less than thermal mass conventional materials. PCMs, lighter than thermal mass conventional materials, are an alternative for this purpose, as these change of phase at ambient temperatures with the advantage that absorb and release latent heat besides of sensible heat. Methodology of the study: The thermal performance in relation to inertia effects of five case scenarios of construction systems combining commercial organic PCMs and conventional materials was compared to that of five construction systems of only conventional materials. Mono dimensional dynamic thermal simulations using a finite difference condition algorithm were performed. Conclusion & Significance: The results showed that PCMs greatly reduce indoor temperature oscillations and increase the number of hours these remain within the thermally acceptable temperature range, even if no mechanical conditioning is used. Also, when implemented in a temperate climate and have a fusion temperature close to the upper limit of the thermally acceptable temperature range, thermal damping is mostly present, although thermal lag is reduced. The significance of this work lies on PCMs applicability as passive thermal regulators within a temperate climate if strategically combined with other construction materials.

Biography

Adriana Lira-Oliver obtained a Doctor in Design (DDes) degree from the Harvard University Graduate School of Design in 2006. Her recent work has focused on the study of new materials with higher energy efficiency than conventional materials to thermally regulate indoor spaces by passive means in many temperate climates. Her recent research projects include dynamic building envelopes with changing thermal and optical properties applied to different climates in Mexico, and smart systems to increase building operation energy efficiency.

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