Assessing and understanding the interaction between mechanical and thermal properties in concrete for developing a structural and insulating material

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Abstract

Highly thermal insulated building envelopes are the base of energy efficient buildings worldwide, however, concrete show poor thermal insulation properties. Developing a structural and thermal insulating concrete is challenging because improving thermal properties undermines mechanical properties. This study aims to understand the interactions between thermal and mechanical properties of concrete (conductivity-to-strength efficiency), when modifying the matrix and aggregate phases by adding fly ash (FA) and coarse and fine lightweight aggregates (LWAs). Based on the ratio fc/ λ , the highest efficiency was given by the addition of LWAs (0.017 [W/mK]/MPa) in comparison with the addition of FA (0.008 [W/mK]/MPa). Nevertheless, those efficiencies are highly dependent on the interaction between the aggregate and matrix phases. The optimization of one phase only is not enough to obtain a structural insulating concrete because the thermal conductivity-to-strength efficiency is governed by both, the aggregate and the matrix.

Keywords: Lightweight aggregates||Fly ashCompressive strength||Structural concrete||Two-phase models
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