Thermo-mechanical assessment of concrete microcracking damage due to early-age temperature rise

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Abstract

The pursuit of high early-age strength concrete has led to mixtures with higher heat of hydration rates at early ages which produces higher temperatures and an overall increased risk of cracking. This study uses a two-phase micromechanical model to compute thermal stresses based on both coefficient of thermal expansion (CTE) and elastic Young's modulus (*E*) mismatches between aggregates and the cementitious matrix. Concrete specimens were prepared using four types of coarse aggregates (different CTE and *E*), and subjected to temperature cycles to generate thermal cracking. Fluorescence microscopy, compressive strength, dynamic elastic Young's modulus, and electrical resistivity were used to characterize the effect of this induced thermal cracking. Experimental results were in agreement with the two-phase model and it was concluded that the interaction pressure (*P*) between phases could be used to estimate the impact on the mechanical and transportation properties of a temperature gradient at early age.