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Modification effects of nanosilica on the interfacial transition zone in concrete: a multiscale approach

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Abstract

The effects of colloidal nanosilica on the interfacial transition zone (ITZ) in concrete at three days are studied. Mechanical properties are investigated at macro-scale, followed by nanoindentation characterization at micro-scale. A top-down and a bottom-up modelling are carried out, respectively, at macro- and micro-scales. Macro-mechanical results show that nanosilica addition is especially beneficial for the improvement of ITZ performance. Estimates from statistical nanoindentation provide evidence, suggesting that the hydration acceleration effect of nanosilica dominates in the modification of ITZ in an early age. It is revealed by modelling at both scale levels that the ratio of the Young's modulus of ITZ to that of bulk paste increases from around 50% to 80% if nanosilica is incorporated. This work further confirms that a substantial improvement on ITZ can be obtained by ultra-fine nanosilica modification.

Keywords: Interfacial transition zone; C-S-H; Nanoindentation; Nanosilica

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