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MODELLING OF EARLY-AGE COMPLEX CRACK PROPAGATION IN CEMENT-BASED MATERIALS USING PHASE FIELD METHOD

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A new multi-physics framework is proposed to model crack propagation in cement-based materials at early-age. The introduced model consists of coupling the most important hygro-chemo-thermo-mechanical processes to describe the temperature evolution, increasing hydration degree, and mechanical behaviour [1]. The changes of material properties are expressed as a function of hydration degree, to capture the age effects. These processes are then properly accommodated in the fracture analysis based on the phase field model in the framework of smeared crack models. The influences of cracks on hydration and thermal transfer are also considered. In addition, a stable and robust numerical algorithm to solve coupled problems using staggered scheme is proposed. The new method is applied to study the fracture phenomena at the macroscopic scale and mesoscopic scale, in which all microstructural heterogeneities of sand and cement matrix are explicitly accounted. Nucleation, initiation, and propagation of complex crack network are simulated in an efficient way demonstrating the potential of the proposed approaches to assess the early-age defects in concrete structures and materials.

REFERENCES

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