Micromechanical modeling of restrained shrinkage cracking of heterogeneous materials considering moisture gradients

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Abstract

This study presents a recently developed finite element-based micromechanical model that simulates restrained concrete at early-age undergoing volumetric changes. In this model, the heterogeneous microstructure of concrete is explicitly modeled based on the statistical description of cementitious composites with aggregates. While an aging-viscoelastic constitutive model is employed to account for the time dependent behavior of the binder, microcracking due to drying shrinkage is modeled with a time dependent cohesive zone model (CZM). The effect of moisture gradients along concrete are considered as an input of the model based on experimental data.

This study aims to bridge the lower scales described before with the macroscale response of concrete using 3D macroscopic models. These results might contribute, for example, to predict the degradation of early age concrete pavement under cyclic loading conditions caused by movement of construction trucks once pavement is open to traffic. Cyclic loading on concrete at early ages might lead to static or fatigue cracks and therefore, aging effects as well as fracture properties evolution must be addressed properly to obtain accurate predictions. This bridge could be achieved by the use of a semi-concurrent method, based on FE2 multiscale concept.