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Phase-Field Modeling of Fracture in Steel Fiber Reinforced High-Performance Concrete During Low-Cycle Fatigue

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Extended Abstract

Fiber-reinforced high-performance concrete (HPC) shows a pseudo-ductile material behavior during failure, mainly characterized by complex fiber-matrix interactions. We propose a phenomenological material model to discuss the influence of reinforced fibers, represented by orientation distribution functions (ODF), on the failure process of HPC. Therein, an additive type macroscopic energy function is formulated, superimposing the models of one-dimensional elastoplasticity for the steel fibers and an elasto-plastic phase-field fracture model, cf. [1], which can predict the nonlinear behavior of high-performance concrete (HPC) during low-cycle fatigue. We apply the pressure-sensitive Drucker-Prager yield criterion as a basis for pure concrete behavior. A phase field model is used to regularize the softening behavior of the material; otherwise, we can expect a pathological response in the finite element method. Two different data-driven degradation functions are calibrated to model the asymmetric tension-compression behavior of HPC, see [2]. Three-point bending experimental tests at low-cycle using notched beams are performed, and the experimental load-CMOD (crack mouth opening displacement) curves are used to calibrate the proposed numerical model. ODFs approximate different distributions and orientations of reinforced fibers, see [3]. The accuracy of the proposed numerical model is verified by comparing the degradation of stiffness in numerical and experimental results.

References

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