Phase-field modeling of steel fiber reinforced high performance concrete considering failure

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ABSTRACT

In the recent decades great research effort has been carried out which result to new innovative concrete types such as high performance concrete (HPC). In HPC steel fibers are obligatory to provide sufficient ductility. During fracture the stresses in concrete are transmitted from matrix to the fibers. These fibers restrain the further growth of the crack and contribute to the energy absorption capacity of the concrete, compare [1, 2]. This holds true not only for static but also for cyclic loading. For example [3] shows that steel fibers affect the deterioration characteristics in cyclic compression. The effects of fibers are even more pronounced in cyclic flexural tests [1]. In this contribution, experimental series of fiber pullout tests are described focusing on the dependency of compressive strength as basis for numerical analysis. The pullout behavior of straight and anchored steel fibers embedded in concrete at various orientation is investigated in [4]. The aim is to examine the pullout behavior of a single steel fiber and its influence on the overall material behavior of HPCs. A continuum phase-field model based on the variational formulation of fracture in elasto-plastic material is implemented in view of the description of the aforementioned phenomena, compare [5]. For brittle to ductile failure criteria for crack propagation proposed by [6] is followed. The predictive capability of the above mentioned model is analyzed in detail by simulating steel fiber reinforced HPC and compared against experimental data.

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