Explicit modelling of fracture in fiber-reinforced cementitious composites

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Abstract

The incorporation of fibers in a cement-based matrix considerably improves its ductility and durability. In this work, the fracture of fiber-reinforced concrete is researched where FRC is explicitly simulated as a two-phase material. By means of pre-inserted cohesive elements, FRC with potential cracks is represented using a fictitious crack model. Fibers are regarded as truss elements which intersect with one of even several crack elements, thus additional intersection points are calculated and saved. Randomly distributed, fibers lie at arbitrary angles to the crack faces. According to different intersection and inclination, a single fiber is cut into several smaller *subfibers* whose pullout performances are dependent on the single fiber pullout response. After embedded in cementitious matrix, fiber elements can work as bridging ligaments. The effects of material properties including matrix strength, fiber strength and fiber distribution on the crack propagation processes and load-carrying capacities are all explored. The developed model provides a simple but effective tool for assessment of structural performance and sheds light on the tailoring of FRC composites.

Keywords: Fiber-reinforced concrete, Cohesive model, Fracture