TENSILE FRACTURE ANALYSIS of FIBER-REINFORCED CEMENTITIOUS COMPOSITES with REINFORCING BARS focusing on BRIDGING FORCES

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Meso-scale tensile fracture analysis with discretized short fibers is used to investigate fiber-reinforced cementitious composites (FRCC) with reinforcing bars. In this numerical analysis, the effects of fiber volume fraction, steel reinforcement ratio, steel-FRCC bond characteristics, and fiber distribution on tensile fracturing are investigated. The results show that there are cases in which localized cracking occurs in the post-yield range of the reinforcing bars. The localization mechanism is numerically explained and a method of inhibiting localization is developed by focusing on the bridging forces carried by fibers and steel bars. It is also clarified that, in strain-hardening cementitious composites (SHCC), steel reinforcement is an effective means of enhancing strain capacity.

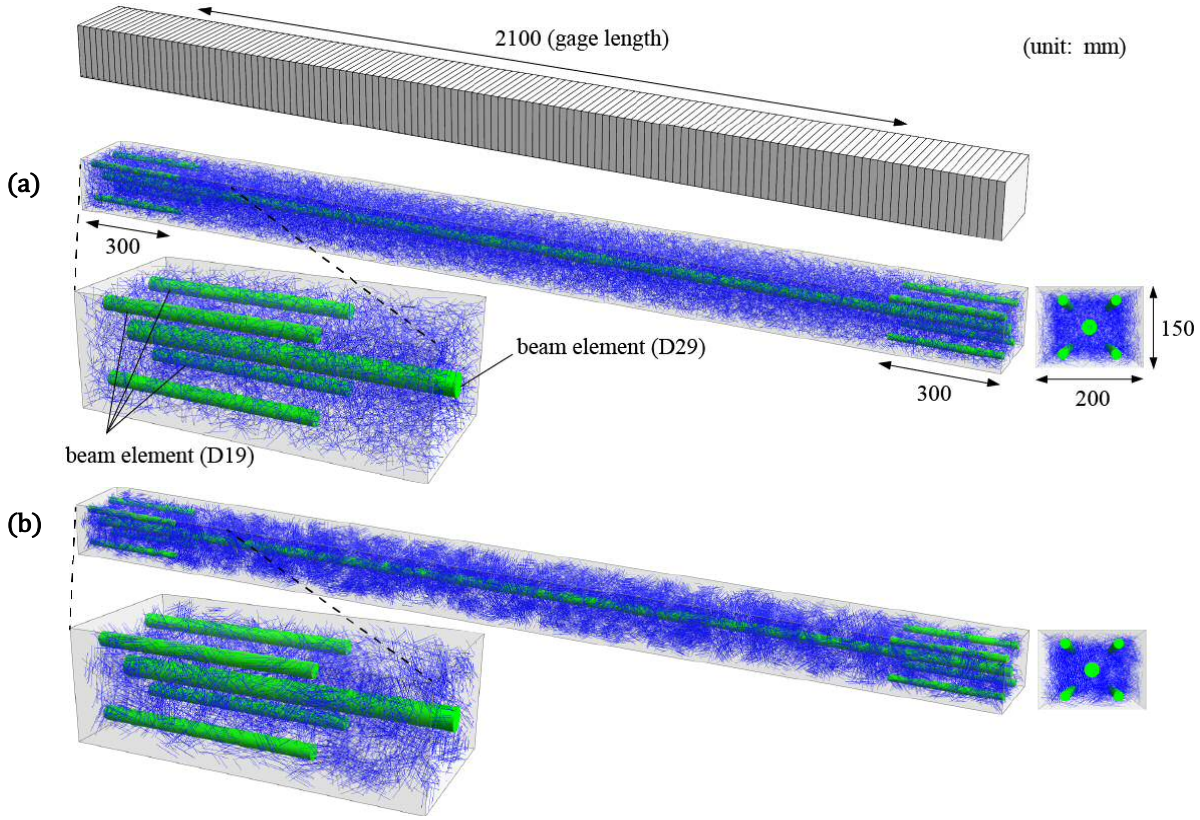

Fig. 1 Discretized cement matrix, steel bars, and fibers (V_f=0.5%): **(a)** uniform distribution model; **(b)** nonuniform distribution model

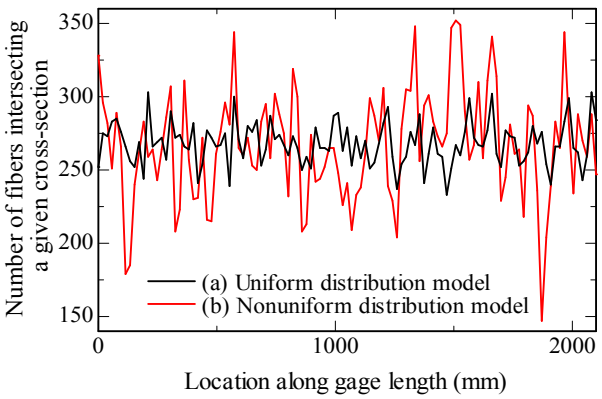

Fig. 2 Number of fibers intersecting a given cross-section

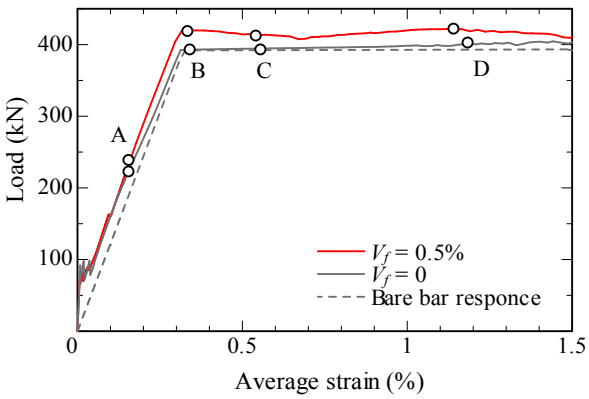

Fig. 3 Tensile load-average strain curves

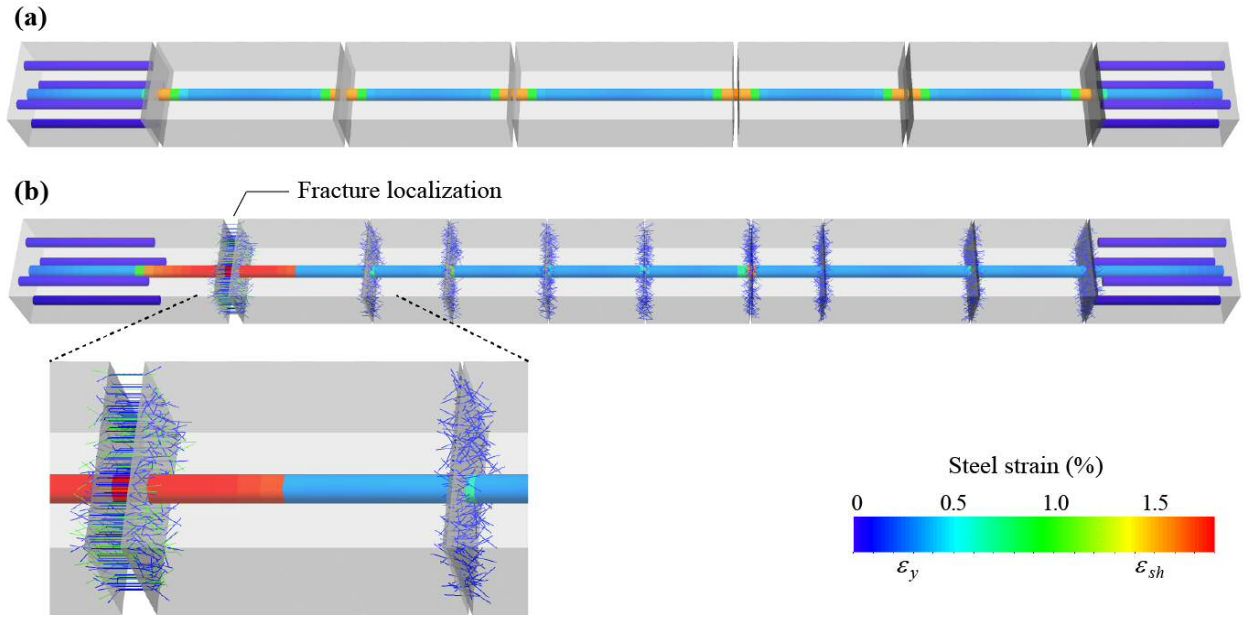

Fig. 4 Simulated crack patterns and fibers that bridge crack faces at 0.57% strain: **(a)** V_f=0; **(b)** V_f=0.5%

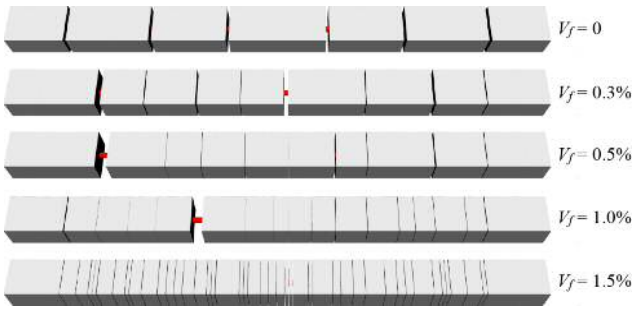

Fig. 5 Simulated crack patterns at 1.2% strain

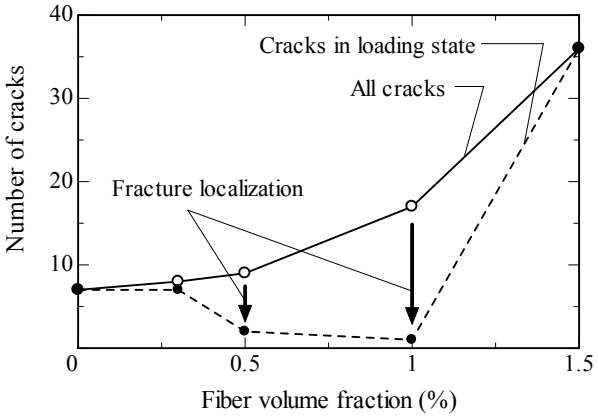

Fig. 6 Number of cracks as a function of fiber volume fraction at 1.2% strain

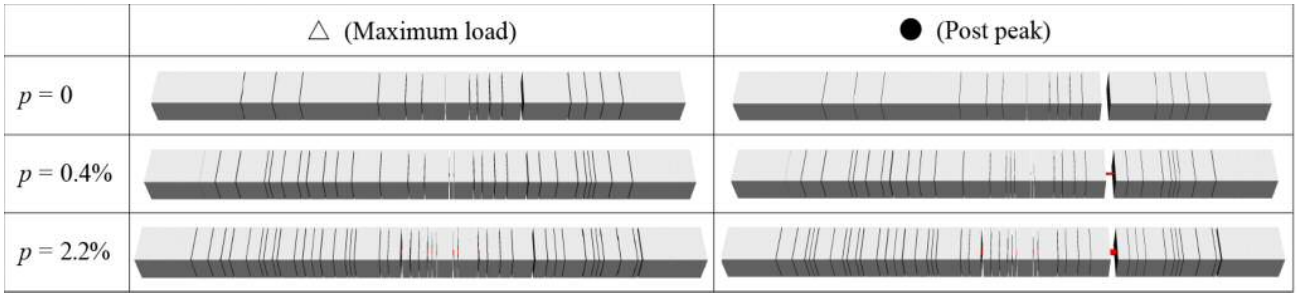

Fig. 7 Simulated crack patterns (V_f=1.5% – uniform distribution model)

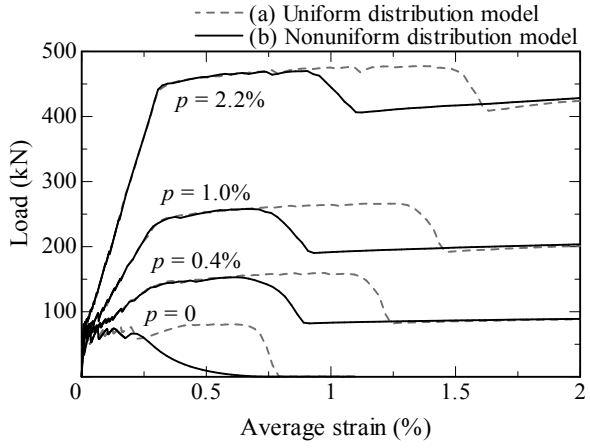

Fig. 8 Tensile load-average strain curves (V_f=1.5%)

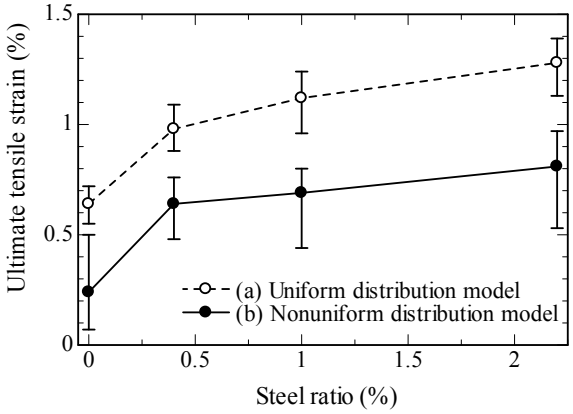

Fig. 9 Ultimate tensile strain as a function of steel ratio