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Compressive properties of a novel slurry-infiltrated fiber concrete reinforced with arc-shaped steel fibers

Key words:

Slurry-infiltrated fiber concrete; Arc-shaped steel fiber; Quasi-static compressive properties; Spilt Hopkinson pressure bar; Dynamic compressive properties

Potential bridging mechanisms of arc-shaped steel fibers in SIFCON

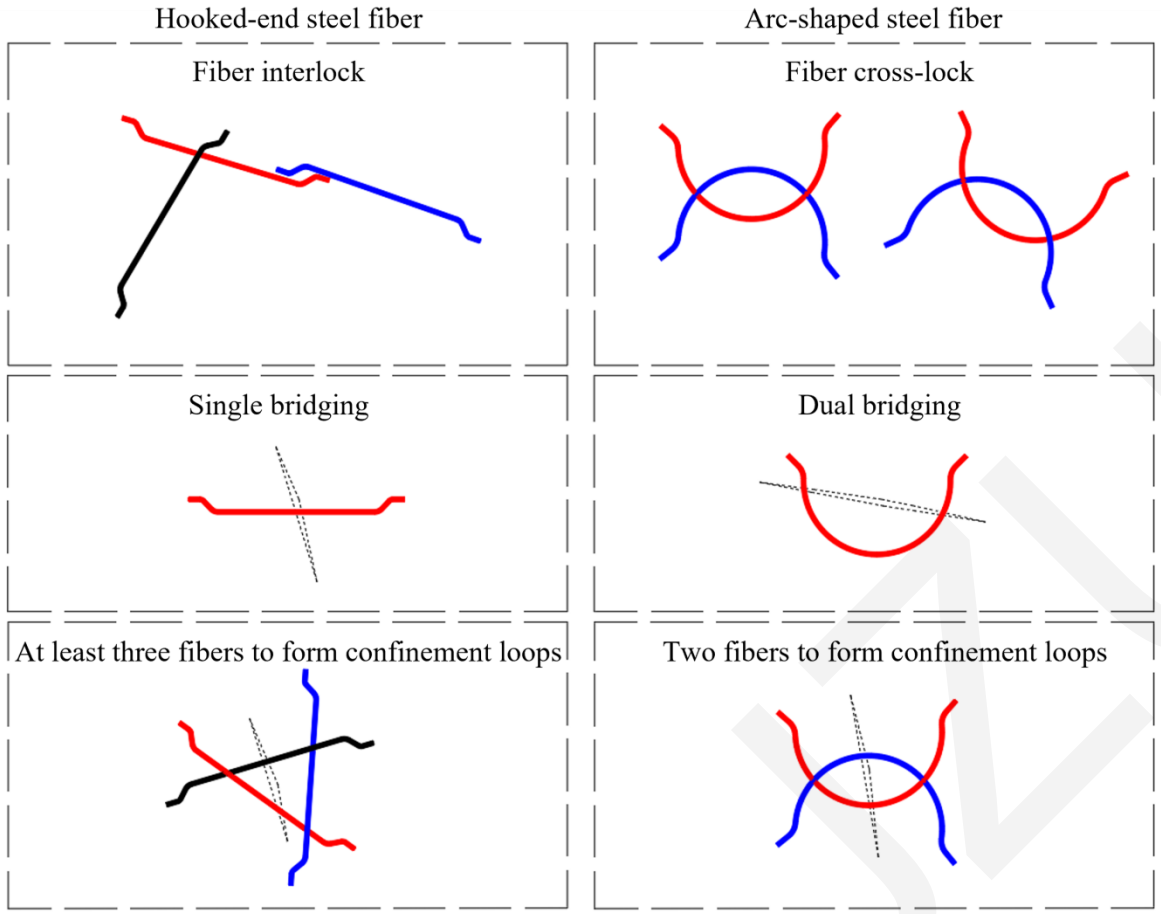
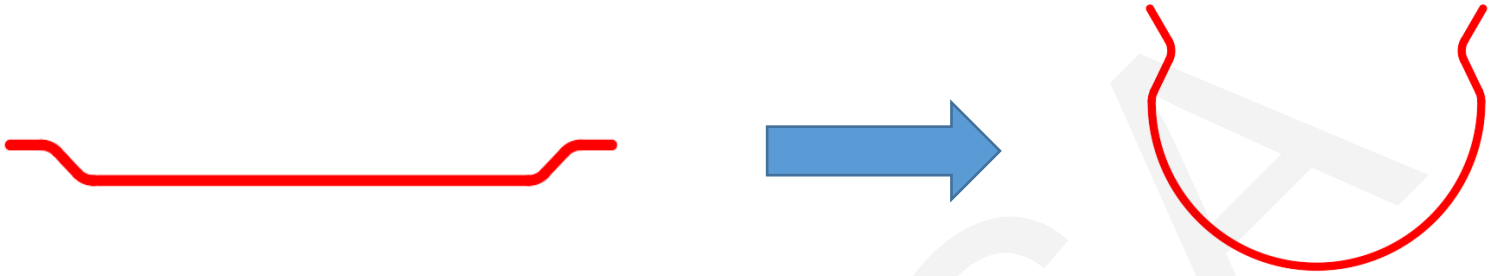


Fig. 1 Comparison of the bridging mechanisms of hooked-end steel fibers and arc-shaped steel fibers

The "fiber cross-lock" mechanism, "dual bridging" over crack surfaces, and formation of "confinement loops" by a minimum of two fibers for arc-shaped steel fibers in SIFCON can effectively improve the compression properties.

Steel fibers



Quasi one-dimensional

Two-dimensional

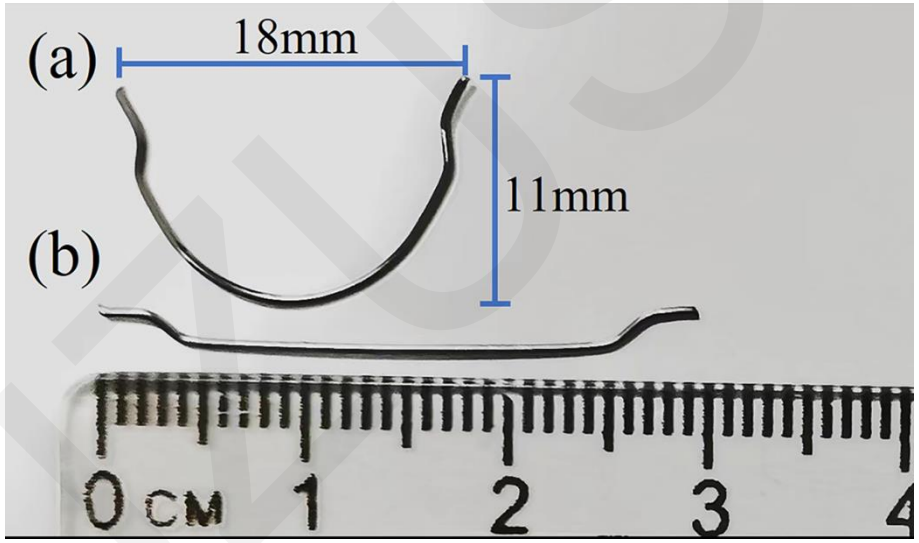


Fig. 2 Steel fibers used: (a) arc-shaped steel fiber, (b) hooked-end steel fiber

Arc-shaped steel fibers were used to produce a new class of SIFCON.

Quasi-static compressive properties

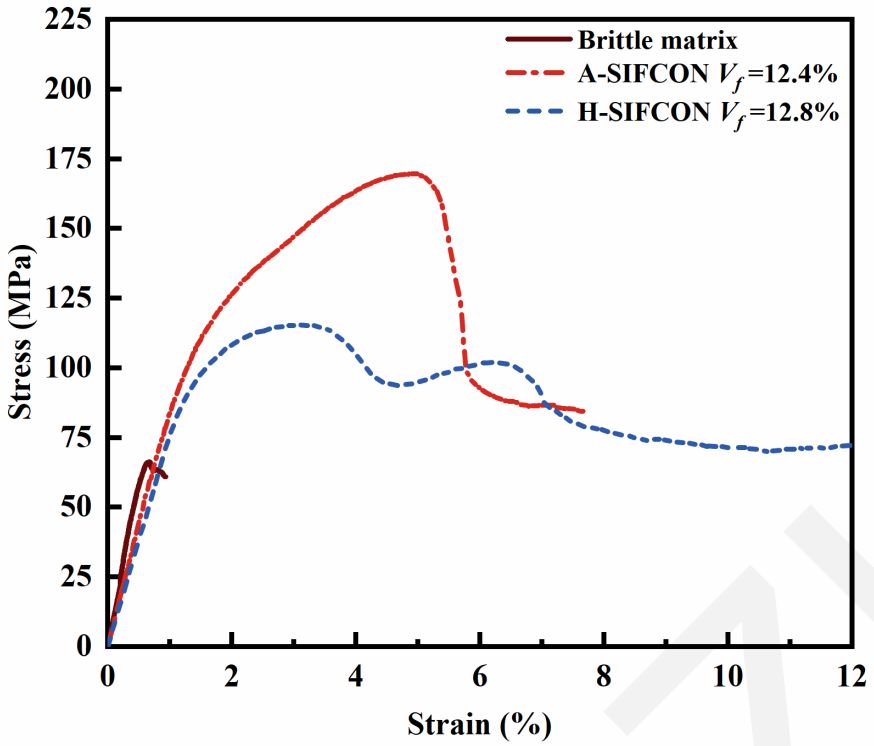


Fig. 3 Quasi-static compressive stress-strain curves of SIFCONs incorporating different steel fibers made from the same steel wires

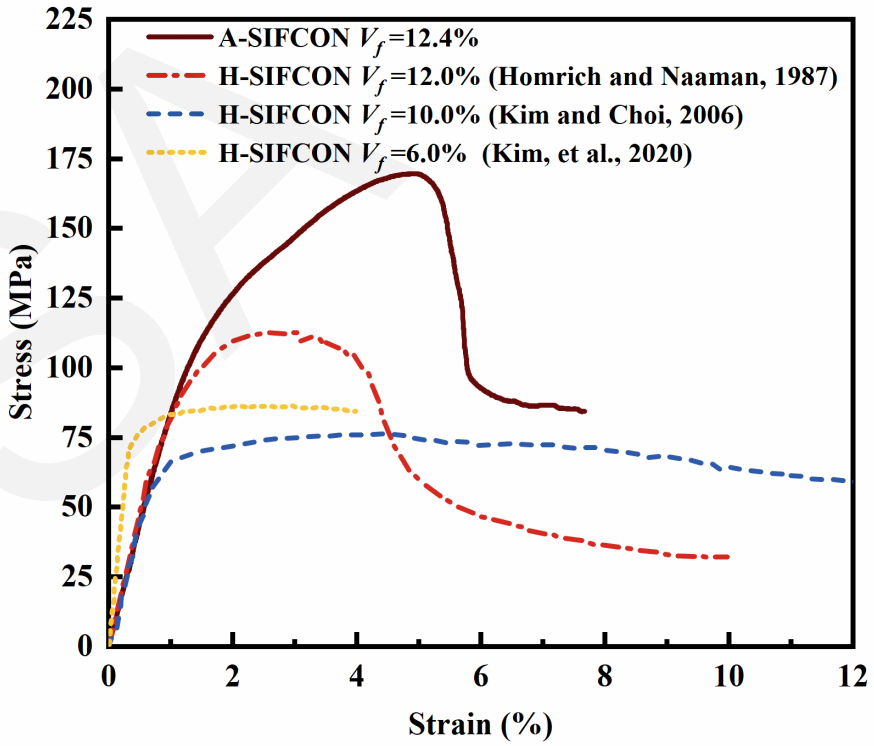
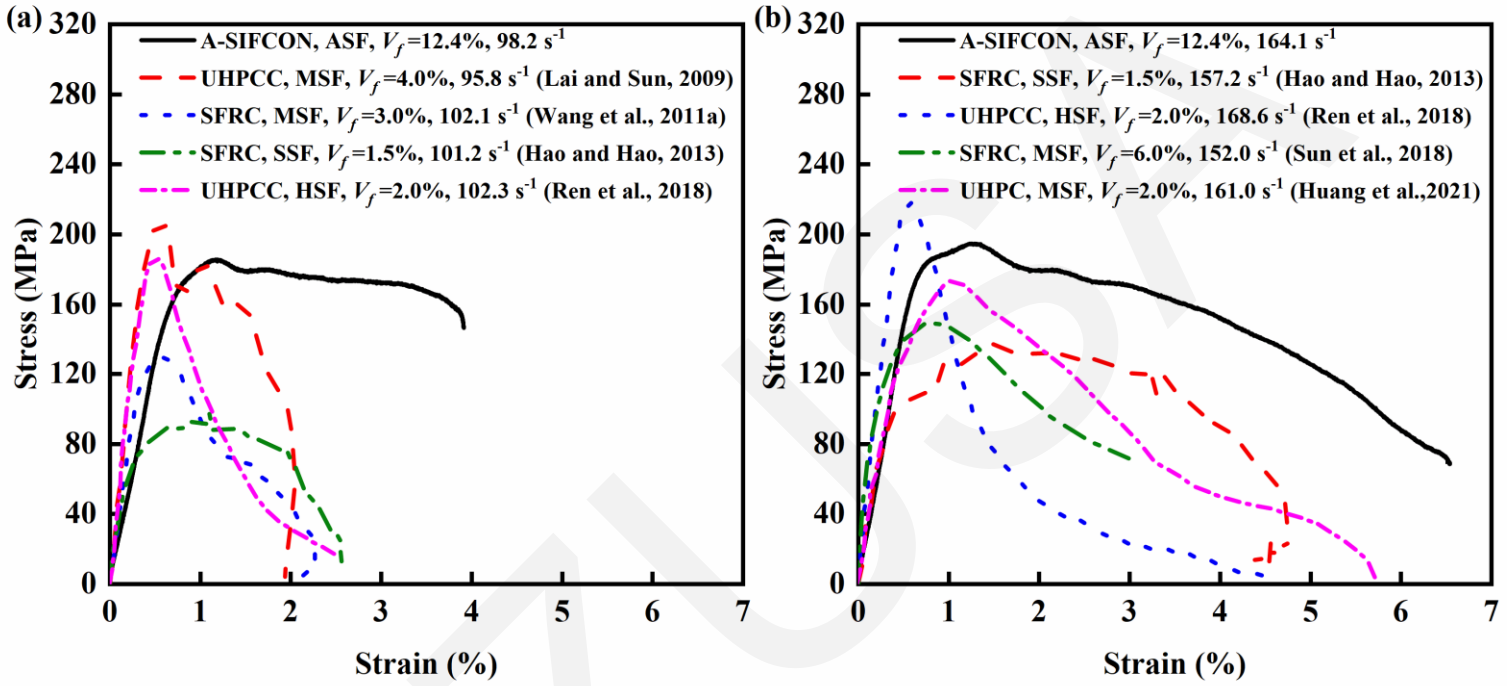


Fig. 4 Comparison of quasi-static compressive stress-strain curves between A-SIFCON and reported H-SIFCONs

The quasi-static compressive performance of SIFCON can be significantly improved by using arc-shaped steel fibers in lieu of ordinary hooked-end steel fibers at a similar fiber volume fraction and the same fiber aspect ratio.

Dynamic compressive properties



Notes: ASF: Arc-shaped steel fiber; MSF: Micro steel fiber; SSF: Spiral steel fiber; HSF: Hooked-end steel fiber.

Fig. 5 Dynamic compressive stress-strain curves of different concretes at comparable strain rates

Compared with other fiber reinforced concretes, the arc-shaped steel fiber SIFCON had greater deformation and energy absorption capabilities at similar strain rates.

Dynamic compression test specimens

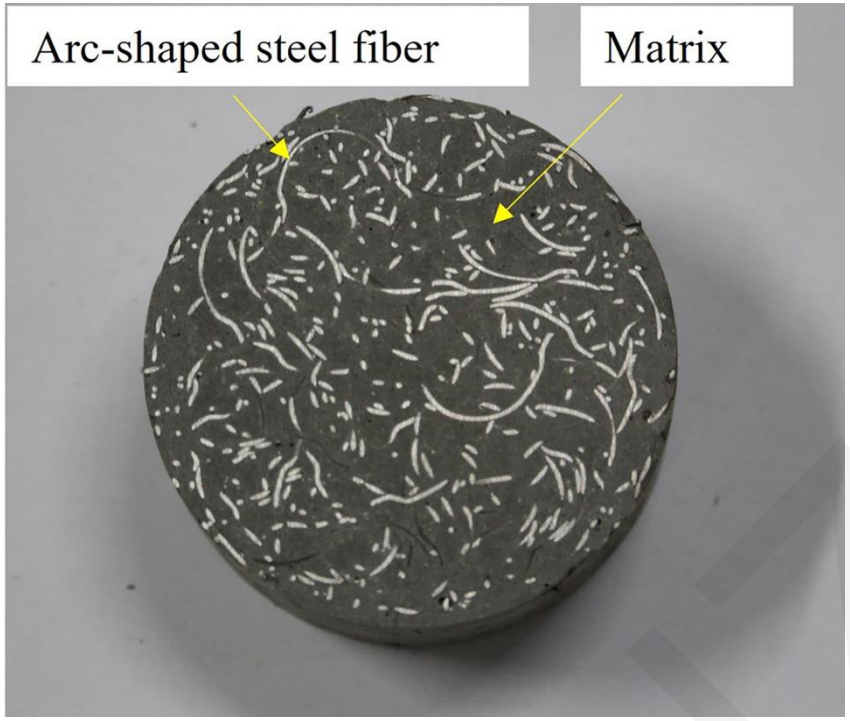


Fig. 6 An A-SIFCON dynamic compression test specimen

The dynamic compression specimen was prepared by cutting Φ68-136-mm-high cylinders. Therefore, the arc-shaped steel fibers may have been partially distorted or damaged during the specimen cutting process. The cutting process led to a potential diminishing of the "fiber cross-lock" mechanism, which might have limited the improvement of dynamic compression properties.

We recommend further research to adopt a better dynamic compression test method to fully reflect the contributions of the arc-shaped steel fibers.