Stress Distribution along the Crack in Cracked Fiberconcrete Beam Subjected to Bending

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Usually fibers are homogeneously distributed in concrete body having arbitrary spatial orientations [1, 2]. Macro crack propagation in mechanically loaded steel fiber reinforced concrete is characterized by fibers bridging the crack, providing resistance to its opening. Suppose about homogeneous distribution of spatially arbitrary oriented fibers in a volume is leading to homogeneous spatially arbitrary distributed fibers orientation on the surface of the crack. At the same time is obvious, when macro crack is cutting bended beam orthogonal crossection, fibers located close to a neutral axis are loaded very weak or not loaded at all (stretching stress is equal to zero on the neutral axis and is maximal on the outer surface of the beam). Each single fiber, depending on its location on the crack surface, crack opening, fiber orientation and its geometrical form is carrying different tensile load. Important is where is neutral axis position, in beam's crossection with macro crack, depending on crack size and opening. Because the single fiber pull-out curve is non-linear, must exists optimal fibers distribution along the crack, depending on the crack opening [3]. For this purpose an experimental program was realized. Three groups of 10x10x40 cm fiberconcrete prisms were prepared. Each prism contained the same amount of small (6mm long straight steel fibers distributed in all samples chaotically in the volume) and long (end hooked 35 mm long (Dramix)) fibers.

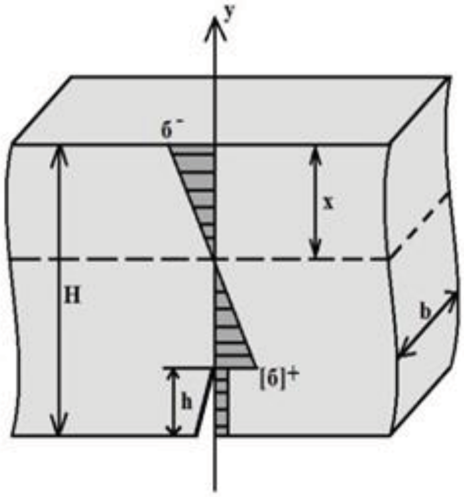

Fig.1. Tensile stress distribution in the beam with a growing crack if beam has homogeneous fibers distribution in the beam's volume.

In first group both small and long fibers were chaotically distributed. In second group chaotically distributed in the volume were only small fibers, all long fibers were concentrated in each prism bottom layer (two layers prisms). In third group long fibers were concentrated in upper and bottom layers (three layers prisms). Fibers distributions were controlled experimentally by X-ray method. Two mathematical models were used (exploiting Monte-Carlo method): a) macro crack growth model (based on loads equilibrium) and b) stable macro crack opening model.

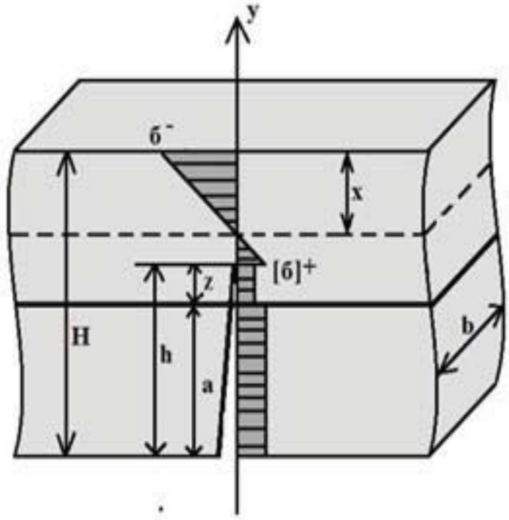

Fig.2. Tensile stress distribution in the beam with a growing crack if beam is consisting out of two layers with different fibers concentrations.

Neutral axis position in fiberconcrete beams with growing crack is shown in Fig.1 and Fig.2. Numerical simulations were recognized optimal fibers distribution in the beam volume depending on macro crack size and opening. Models predictions were validated by experiments.

References

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