BEHAVIOR OF STEEL FIBERS IN CONCRETE REINFORCED WITH VARIOUS TYPES OF FIBERS

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Abstract:

The article informs about the results of an experiment which tried to compare behavior of three kinds of steel fibers in various types of fiberconcrete. We monitored the influence of the Twincone 1/54, HE 1/60 and Tabix 1/60 fibers (Fig.1). Their behavior was monitored in the environment of plain concrete as well as concrete reinforced with polypropylene, glass, cord, carbon and steel fibers.

Keywords: fiber, fiberconcrete, stress-strain diagram,

1 Introduction

Reinforcing with more than one kind of fiber is one of the current tendencies applied when developing fiberconcrete. Usually, a combination of fibers with different geometric qualities made of identical material is used for the reinforcement. The experiment described therein focused on comparison of behavior of steel fibers in concrete reinforced with various kinds of fibers. Fibers which report a high homogeneity of reinforcement that is fibers with a high number of pieces in a volume unit were chosen for the experiment.

2 Behavior of fibers in concrete

The behavior of steel fibers in the structure of concrete is influenced by the qualities of fibers and the surrounding concrete. Among the key qualities of fibers there are its strength and its modulus of elasticity and also its geometric shape. The three monitored fibers (Twincone 1/54, HE 1/60 a Tabix 1/60) are made of steel of identical quality. Their length is also almost identical – approximately 60 mms. The fibers differ dramatically what concerns their geometric shape which essentially influences the way in which the fibers anchored in the concrete and the cooperation of the fibers with the concrete. Twincone 1/54 reported the best anchorage (extended head at both ends of the fiber). The shape of the fiber enables full utilization of physical-mechanical qualities of steel practically throughout the whole length of fiber. This fiber is destroyed by tearing. HE 1/60 fiber is bent twice at both its ends (Fig. 1) which provides a pretty good however not ideal anchorage of the fiber. Contribution to cohesion in the central area of the fiber is not negligible but it is rather small. The typical way of destroying the fiber is its gradual disengagement from the concrete. Tabix 1/60 is a fiber with a wavy axis. Its behavior in

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concrete may be described as a combination of disengagement and straightening of its axis. Presence of gravel in the place of anchorage of the fibers influences significantly all three kinds of fibers. The behavior of fibers was monitored in concrete with sufficient volume of 8 – 16 mms gravel. Also occurrence of mikrocracks in the concrete composition is another factor influencing the behavior of fibers.

Fig. 1 Used kinds of fibers (top down: Twincone 1/54, HE 1/60, Tabix 1/60

3 Experiment procedure

The behavior of steel fibers in the structure of concrete was monitored using test specimens the shape of which is described below (see Fig. 2).

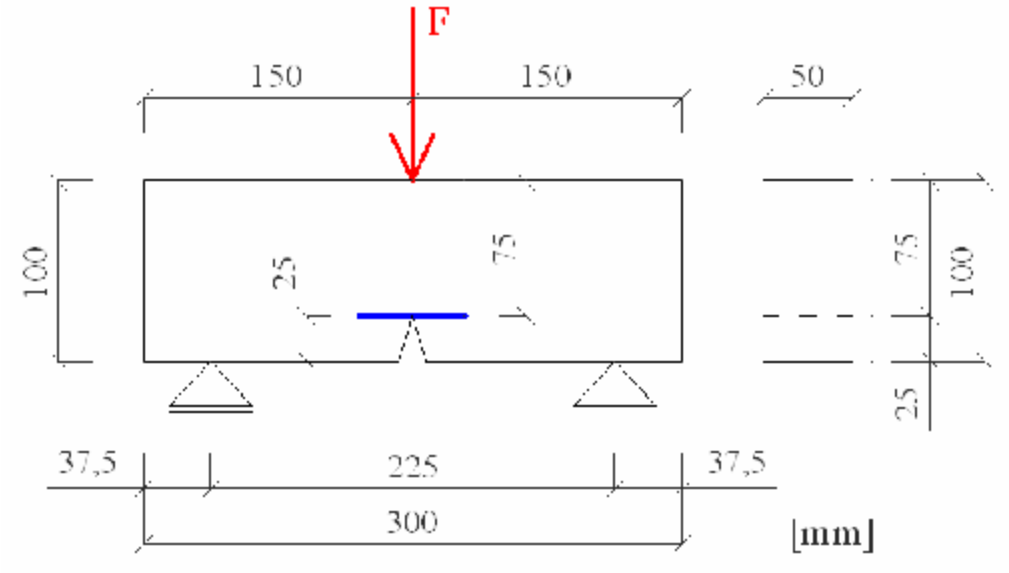

Fig. 2 Test specimen with marked place of indention and the position of the tested fiber

The test specimens included one and only piece of the selected type of fiber. The experiment ended when deflection reached 3 mms (fibers HE 1/60 and Tabix 1/60) or when the fiber tore (Twincone 1/54).

4 Evaluation of the experiment

We evaluated the behavior of single kinds of fibers in concrete with various kinds of reinforcement based on the size of the area marked below (Fig. 3). The area defines the benefit of the fibers in the surrounding concrete on the behavior of the only steel fiber. The interval of deflection between 0.5 and 1 mm was chosen for the evaluation in the post peak part of the diagram. We thus evaluated the ability of the steel fiber to resist to stress in the moment of the experiment when tensile strength of the concrete is completely excluded and the dowel effect of the gravel is excluded to a great extend as well. In respect to the relatively low number of test specimens, we used a standardized version of results.

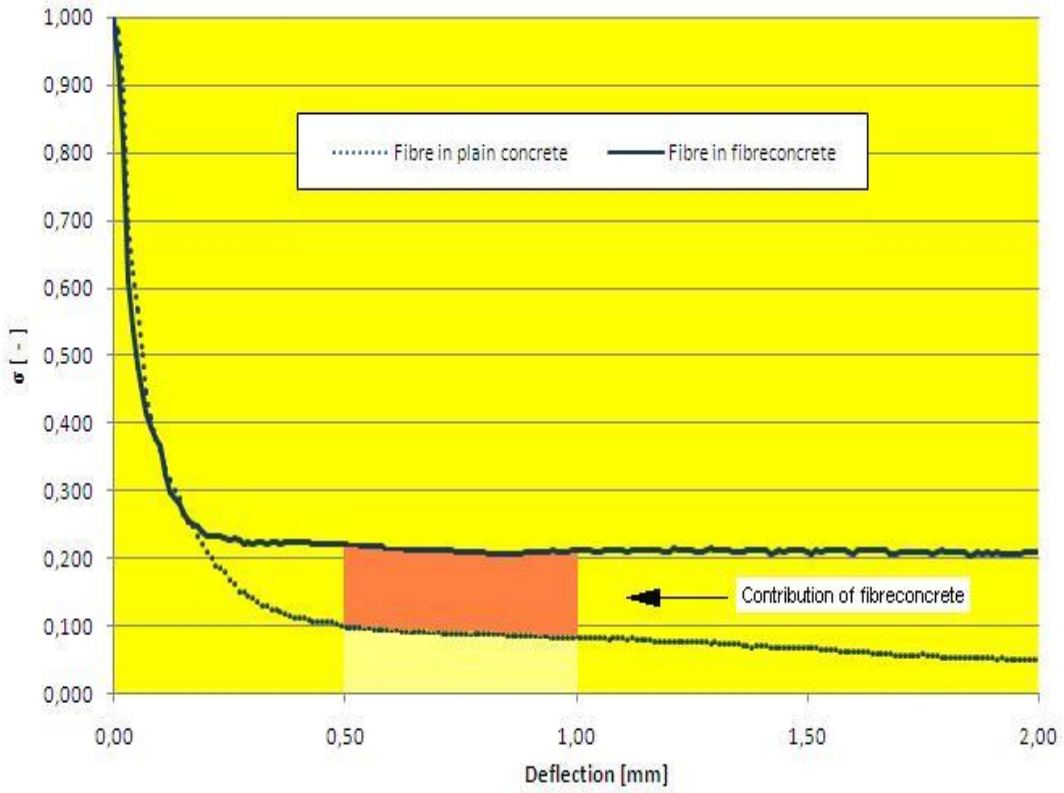

Fig. 3 The principal of the experiment evaluation (the upper curve describes the behavior of a selected fiber in the fiberconcrete, the lower curve the behavior of the same fibre in plain concrete)

5 Results

The results of the experiment are summarized in the Table 1. The results are divided into three parts in accordance with the examined type of fiber. The figures are percentages while the base is the efficiency of the observed fiber in plain concrete.

Tab. 1: Influence of various fibers reinforcement of concrete on the efficiency of the three selected types of steel fibers ("no" means no positive influence, - no test for this combination)

fibers in concrete	steel fiber		
	Twincone 1/54	HE 1/60	Tabix 1/60
polypropylene fibers (6 mm)	51	no	no
alkaliresistant glass fiber (12 mm)	25	110	80
carbon fibers (2 mm)	10	-	-
carbon fibers (6 mm)	8	-	-
cord fibers (12,5 mm)	53	24	no
steel fibers (12,5 mm)	48	no	no

6 Conclusions

In respect to the limited number of results of the experiment, we may preliminarily make the following conclusions:

- reinforcing the concrete with fine fibers increases the efficiency of the steel fibers, especially when it is effectively anchored.

- among the selected kinds of fine fibers, the alkaliresistant, glass, cord and steel fibers proved efficient.

- carbon fibers reported rather low efficiency; the fact that we carefully worked out the production process of this kind of fibreconcrete may be considered a great contribution of the experiment.

- the conclusions are significantly influenced by the amount of used fibers. We used amounts which may be considered as usual which is however not necessarily optimal.

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