INFLUENCE OF FIBER REINFORCEMENT VOLUME IN CONCRETE MEMBER ON CRACK DEVELOPMENT AND CRACK WIDTH

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Abstract

Often we have good idea about ideal behaviour of concrete under different loads but we need verify it by tests and we would like have comparable results with clear influences of single input. The testing of concrete specimens under tensile load brings many problems which have to be solved for expected results receive. Mainly is necessary choose convenient shape of specimen and way how we will distribute tensile force to it. We tried develop such a specimen focused on a testing influence of fiber on crack development and crack width.

Keywords: crack; fibers; development; specimens;

1 Introduction

Test of concrete members reinforced with fibers and steel bars have no basis in current standards now. There is some reference in RILEM guideline but only for steel fiber concrete. Purpose of IGS 2006 project was to design the test examining crack development, crack width and bond. The aim of the project was a selection of convenient shape of specimens, suitable for wide range of concrete mixtures with different dosage and types of fibers. For this test accessible laboratory equipment should be used in Department of Concrete and Masonry Structures. Next step was to design repeatedly used forms for production of specimens. The objective of the project was verification of possible production of specimens and implementation of designed test into laboratory practice after evaluation of results.

2 Application of tensile force

The basic problem with tensile test of concrete is an application of tensile force. Common used specimens are sensitive on precision of production and mainly during own testing. The greater problem is to take hold jaw of the machine producing tensile force and concrete specimen without an eccentricity. This problem is often solved by specimens shaped as a bone with enlargement on the ends or with gluing. Results could be influenced by the size of the test elements too, as it is difficult to choose between good manipulation and proper

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size of specimens. Larger size minimizes influence of local hardening or softening and material characteristics reach smaller values than in case of smaller specimens where aggregate and reinforcement have normal size. When the dimensions are too small, orientation and position of fibers is affected by closeness of member surface.

2.1 First type of specimens

Next possibility is to use an inbuilt steel bar for application of tensile force. The force is taken into the member linearly and the coated part of bar is damaged on whole length. In this test the tensile strength is not the main attribute to be observed but it is width of cracks and theirs spacing. Is expected that concrete without fiber reinforcement will show less wider cracks than concrete with added conventional reinforcement. Crack width should decrease and number of cracks increase with greater dosage of fibers in the mixture.

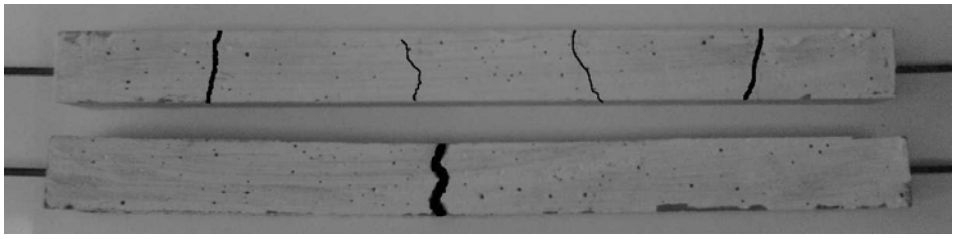

Fig. 1 First type of specimens made of plane concrete

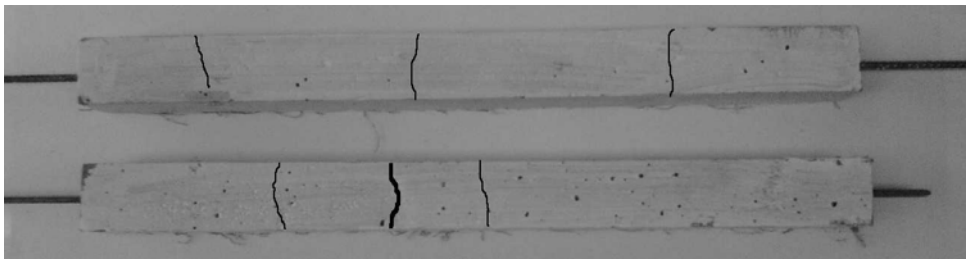

Fig. 2 First type of specimens with 0,5% dosage of synthetic fibers

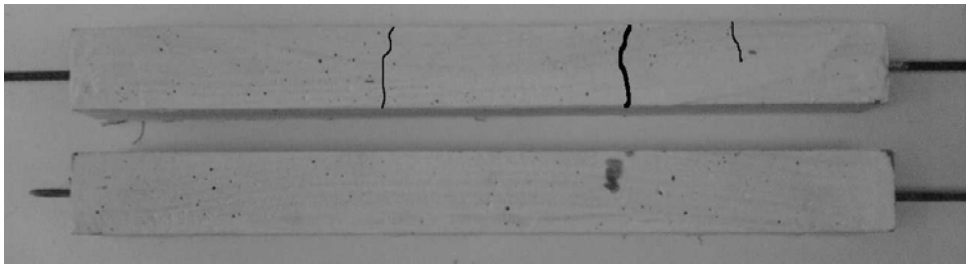

Fig. 3 First type of specimens with 0,5% dosage of steel fibers

The first specimens made for pilot testing had dimensions of 50x50x500mm and were made in six modifications, from plane concrete, fibre concrete with addition of steel and synthetic fibers. Inbuilt bars were of two steel grades (10 505 and 10 206) with diameter of 6mm. All of these specimens were tested on machine for tensile testing of steel

bars. The results had shown unsuitable selected dimensions and chosen steel rods. In cases of fiber reinforcement concrete the steel bars from 10 206 were broken outside of the coated part without concrete failure so the grade of steel is not suitable for the next testing. The others were close to the expected results but occurrence of crack could be affected by shortness of coated part. Anchor length could be comparable with the whole length of the specimens or their essential part what means that cracks appear less than it is necessary for good influence of fibers.

2.2 Final specimens

The following specimens had dimensions of 75x75x800mm what should ensure better appearance of cracks and take note of concrete coverage. For the second test a new form was designed which made possible to produce four specimens at a time. This solution is eliminating problems with close surface of the member related to the length of fibers. Mixture of concrete was C25/30 in three modifications: Plane concrete, concrete with admixture of 0,5% steel fibers and concrete with admixture of 0,5% synthetic fibers. Steel bars were only of 10505 grades this time and two diameters 6 mm and 12 mm. Twelve specimens were concreted. It was necessary to cut a concrete member into single specimens by saw before testing, this was made after 15 days.

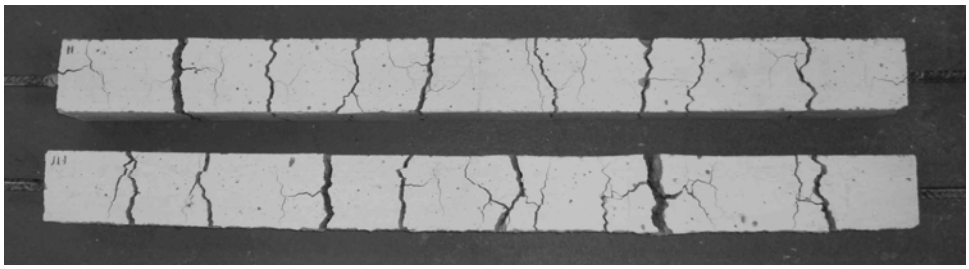

Fig. 4 The final specimens made of plane concrete

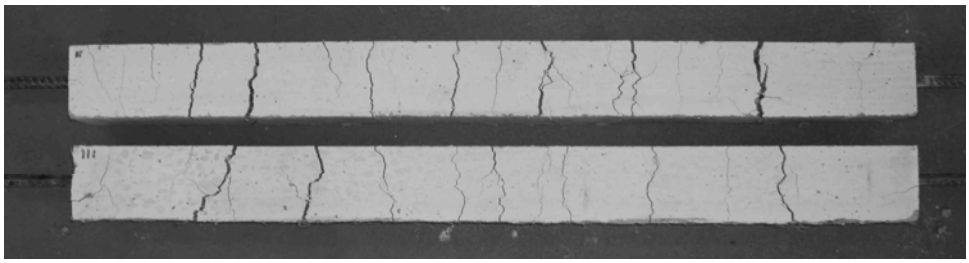

Fig. 5 The final type of specimens with 0,5% dosage of synthetic fibers

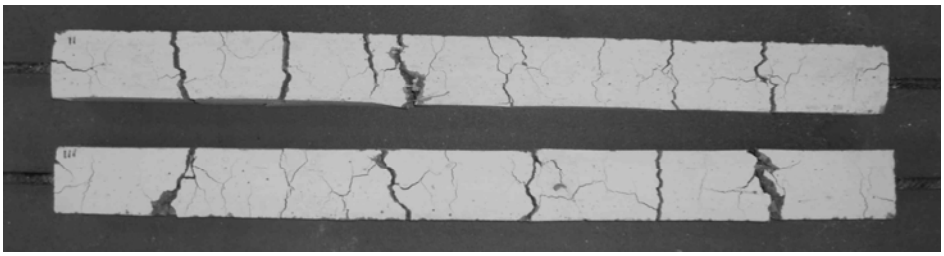

Fig. 6 The final type of specimens with 0,5% dosage of steel fibers

2.3 Testing

Own test was made after 28 days. Specimens were painted with white colour for better visibility of the cracks. The test was performed on the HACKERT machine for tensile testing of steel bars.
First members with 12mm steel bars were tested, these members have very good behaviour and the positive influence of admixture of fibers was evident. Then members with 6mm steel bars were tested, this set has showed the same problems as in case of the first type of specimens with 10 206 grade steel. Steel bars were broken outside of coated part and concrete shows only a few cracks not corresponded with expectations.

3 Conclusions

The designed form and used method of testing is capable to tell us more about influence of fiber reinforcement on concrete behaviour. For the precision of results it will be necessary to carry out more tests for statistical evaluation of the results.

Aknowledgements

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References

[1] Vistr, T. – Kohoutková, a.: *Influence of fiber reinforcement volume in concrete member on crack development and crack width* Securkon, September 2006, 4. Konference speciální betony