RHEOLOGICAL AND MECHANICAL PROPERTIES OF STEEL FIBRE REINFORCED SELF-COMPACTING CONCRETE IN PRECAST SLABS

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Abstract

In the paper the basic influence trends of different composition and properties of steel fibres on fresh mixture and mechanical properties (compressive and flexural strength researching in different length of precast beams) of Self-Compacting Concrete (SCC).

Keywords: steel fibre; self-compacting concrete; rheology; workability; Bingham model

1. Introduction

The main objective of this study was to determine distribution and orientation of steel fibres in tested SFRSCC for a chosen structural model and its effect on mechanical properties. The aim of presented research was to determine the distribution of steel fibres in SFRSCC in specific case of the corner beam concreting of the structural element and the effect of the fibres on concrete’s mechanical properties. Beam structural elements are specific but commonly performed concrete structures, hence the authors’ proposal to analyze SFRSCC properties in suggested elements in terms of selected technological factors.

2. Research methodology

As a structural model, concrete beams with dimensions 1800×150×150 mm and 1200×150×150 mm were chosen, where concrete mixture was introduced to the form in one of the edge points. After hardening, elements were cut into two or three samples with dimensions 600×150×150 mm. Two types of steel fibres were considered on three levels of volume ratio.

3. The results and discussion

The results of tests for beams formed in various distances from the point of formation. Obtained results allowed to test the effect of the distance from the point of formation of SFRSCC on the distribution of fibres in matrix and mechanical parameters of beams.

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The orientation of fibers connected with the direction of the SFRSCCs mix flow during moulding was confirmed. Proved as well was the uniform distribution of fiber in the produced concrete element. For the formed elements, cut from beams of 1800×150×150 mm, the effect of SW50 fibres content on tensile strength in bending of tested SFRSCC, is illustrated on Fig. 1. It has also been shown the increase in bending force with the increase of SW50 fibres content in SFRSCC.

Additionally, there was the increase in bending force for beams II and I with the increase of SW50 fibres content in tested SFRSCC. For SW50 fibres content of 120 kg/m$^3$ in SFRSCC, there was the increase of bending force in beam III (furthest one) by 65% in relation to bending force in beam I (closest one). For SW50 fibres content of 80 kg/m$^3$ in SFRSCC, there was no difference between bending forces in beams I, II and III.

![Fig. 1 The effect of steel fibres SW50 on tensile strength in bending of beams I, II and III](image-url)

**4. Conclusions**

This phenomenon intensifies in elements with longer fibers (SW50) and with the increase of their volume ratio in the mixture. However, such orientation of fibres caused the improvement of strength in bending of beams with the addition of longer fibres (SW50). The increase in flexural strength was even up to 80% in beam II in case of SW50 fibres content of 120 kg/m$^3$, in relation to beam I, cut from the element of 1200×150×150 mm.

The results of image analyses show that even when high volume of long fibres are used fibres in the self compacting concrete can be dispersed homogeneously without clumping, which results in enhancement in toughness of concretes. The long fibres are mostly oriented parallel to the flowability direction, vertically to the loading direction, and hence, they can operate efficiently under flexural loading. It was also observed that a low yield stress concrete leads to a good alignment of the fibres. The fibres are sufficiently oriented and connected together to ensure a longitudinal transfer loading. It was also shown that using the rheological properties of matrix with the content and geometry of fibre it is possible to predict the flexural strength of SFRSCCs. The orientation of fibers connected with the direction of the SFRSCCs mix flow during moulding was confirmed. Proven as well was the uniform distribution of fiber in the produced concrete element.

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