THE FIBER REINFORCED CONCRETE STRESS BENDING BY TRANSVERSAL FORCES

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Abstract

The girders 220 cm dimension armored by 2% steel fiber of 10 x 20 cm cross section were tensed by transversal force.

The girders were loaded by two concentrated forces of different intensity which caused the cracks.

The first crack on the girder appeared as the reaction of the force acting from 2 x 12,8 kN and the next two forces the reaction of 2 x 15,31 kN which caused the fracture of the section of the girder.

The results shoved that stress fall for the exploitation load in the pressed concrete area was 13,97 % while it was increased 6,5% in the tensed armature.

The load, in time examination was applied gradually from 2 x 5,5kN through 2 x 6,5kN to 2 x 15,31kN. The aim of the my research is :

To show that my assumption for the estimate of the concrete girder reinforced with the steel fibers tensed to bending by transveryal forces , matches to the real behavior of the girders loaded to the fracture to accept the idealized diagram of the stress and dilatations as the real one .

My proposal for the diagram of the necessary safety coefficients to the concrete and to the armature tensed .

Key words: Steel fiber, armored concrete by the steel fiber, long time load.

1. Introduction

From the sake of this experiment made the concrete with three fractions:

0-2 mm, 2 - 4 mm, 8-16 mm, 35% of sand grain ”Moravac” from 0-2 mm, and 25% of aggregate from 2 - 4 mm, 40% of limestone aggregate from 8-16 mm, 0,55% of water cement ration of 300 kg/m^3 "Beočin" of Portland cement and the steel fibers ϕ 1,27 mm, 6-8 cm length whose the limit of tracking is 315 MPa making 2% concrete mixture.

Three series with two girders each were made with this prescription: All girders armored by 3ϕ8 mm (RA 400-500 -2) ribbed reinforcement placing on the lower area and by 2ϕ6 mm (GA 240/360) smooth steel placed on pressed area of the girders as well as constructive armature and with the steel fibers previously closed in the cement mixer.

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One series of the girders was made only with one stirrup on the span and with one stirrup each above supports of the girder.

The second series was with the stirrups on the area and.

The third was made with five stirrups on the area of the girder.

The girders were loaded by the concerted forces: 2x3,5 kN, 2x6,5kN, 2x7,5kN … 2x15,31kN.

Fig.1 The device for the measuring of the load on the girders

Another three test cubes were made of 15x15x15 cm to define the make of the concrete as well as three prisms of 10x10x10 cm to comparative testing of the shrinking and creeping of concrete.

The time deformation of the concrete: shrinking and creeping followed by the mechanical deformities in 28 days from the day of the fabrication of the prisms and the girders up to 12 months.

2. The experimental procedure

2.1 The tracking of dilatations caused by shrinking and creeping

The dilatations caused by the shrinking and the creeping of the concrete were followed by the comparative testing on the prisms and on the girders.

The prisms of 10x10x30 cm were placed on the top of the other. On the connecting surface between the prisms was placed the textile supports, so that the transporting of the force from the one to the other could be uniform.

The dilatations were measured from the very moment of the normal force application with mechanical deformities "Izmeron" of the Russian production 1/1000 accuracy, 11 cm of the base, placed on every side of the prism.

Fig. 2 The prism

Three cubes 15x15x15 cm were made (of this also concrete mixture) to determine the make of the concrete (cm) and three test prisms 10x10x30 cm were also made to follow the comparative time of determination of the creeping and the shrinking of concrete.

Fig. 3 The prisms with the deformeters

The measuring of the shrinking and creeping of the concrete was carried out with deformities "Izmeron" 1/1000 accuracy, 21 cm base on one aut of two test fiber reinforced concrete girders (MB 30) stressed to bending by the transversal forces in l/2 of the span with the simple lever.

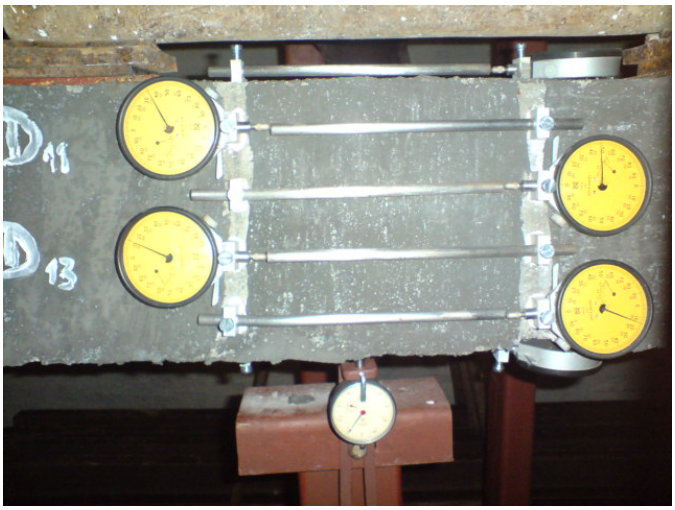

Fig. 4 The girder with the deformeters

The examing of the shrinking and the creeping of the concrete on the girder began after 28 days from the day of their fabrication and it lasted 12 months.

The girders were loaded by two concentrated forces of different intensity which caused the cracks.

The first crack on the girder appeared as the reaction of the force acting from 2x12,8 kN and the next two force as the reaction of 2x15,31 kN which caused the fracture of the section of the girder.

Fig. 5 The appeared of the first crack

Fig. 6 The developement of the cracks

The results got measuring on the prisms were identical with the results got measuring on the girders.

The results shoved that stress fall for the exploitation load in the pressed concrete area was 13,97 while it was increased 6,5% in the tensed armature. The projected long term load lasted 12 months.

Fig. 7 The fracture of the girder

3. The results analysis

Analyzing the results, got at the reinforced concrete girders by 2% steel fibers, I cun conclude:

- That the tested girders were dimensioned for the load with two concentrated forces from the operative load 2x5,5 kN.
- That the load, in time examination was applied gradually from 2x5,5 kN through 2x6,5kN, … to 2x12,8 kN.

- That the first crack appeared at the acting force 12,8 kN whose width 0,5 mm was expanding in the further load increase. The cracks furrowed the surface of the girder under every next load.
- That the load 2x15,31 kN caused the sudden increasing deflection and the fracture of the section in l/2 girder.
- That it is characteristic of the test girders, that the cracks, one to three were expanding at the limit load and the deflexions unlimitedly increased.
- That for the suggested diagram of the stress and the dilatations it is obtain the necessary coefficients of the safety to concrete γ_{bu} = 2,383 and the tensed armature γ_{au} = 2,21
- That the average values: the stress was increased to 6,5% at the stress decrease in the most pressed concrete part. It was 13,97 only because of the load.
- That the concrete make (MB 30) is defined on the concrete cubes armored the steel fiber and the concrete tensile strength at bending is defined on the concrete prisms armored with steel fibers.

4. Conclusions

The examing of the time deformation: the shrinking and the creeping of the concrete on the prisms and on the fiber reinforced girders long time load 8 months was the theme of this investigation[2].

The theme of many investigations remains the reinforced concrete from 19th century till these days.

By combination of differents materials in the production of concrete it come to the new knowledge about the exciting possibilities of this application in the building industry.

In this paper I examined the behavior of the girders armored next to the usual armature by the steel fibers with two percentage structure of the concrete mas (10x20x220 cm) loaded on longtime load (12 months) by transversal forces 2x5,5 kN.

- On the basis of the compareson of the previous and current results, I conclude:
- that in concrete (MB 30) of the reinforced concrete girders with the steel fibers tensed bending, as wellas in the high quality concrete (MB 80) also tensed bending, appeared the separation of neutral lines at the stress and the dilatations;
- that the stress decreased in the pressed concrete area for the exploitating load for 13,97% but the stress increased 6,5% in the tensed armature.
- My proposal for the diagram of the necessary safety coefficients to the concrete and to the armature tensed.

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