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FEATURES OF TRANSVERSE REINFORCEMENT OF COMPOSITE REINFORCED CONCRETE CONSTRUCTIONS IN BEARING ELEMENTS B.1.146.1-1.02 v.1

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Findings of investigation of deflected mode of regular sections in reinforced concrete beams with various types of transverse reinforcement to longitudinal axis are analyzed.

A construction of a composite bearing element B.1.146.1-1.02 v.1 consists of composite reinforced concrete beams with inclined bars of transverse reinforcement along the full length; hollow beams of light-weight concrete; in-situ concrete, placed on the site. Previous studies of reinforced concrete constructions reinforced with cross bars proved that reinforcement has a positive effect on constructions in bearing areas /1,3/, but its influence on strength, hardness and fracture strength of sections, regular to longitudinal axis was not studied.

To study the influence of cross bars on strength, hardness and fracture strength of constructions and to compare them with orthogonal ones two pairs of similar bars, 200*120*1830mm each (BO and BN), were manufactured. The beams are reinforced with fabricated frames; dot sealing was used for their manufacturing (Fig. 1). Two S400 bars 8mm in diameter were taken as a working tensile reinforcement; a compressive reinforcement - S 400 8 mm in diameter. S400 bars 5 mm in diameter were taken as a transverse reinforcement. The principle of equal consumption of metal per element was applied for beam reinforcement to compare the tested constructions with orthogonal and cross bars.

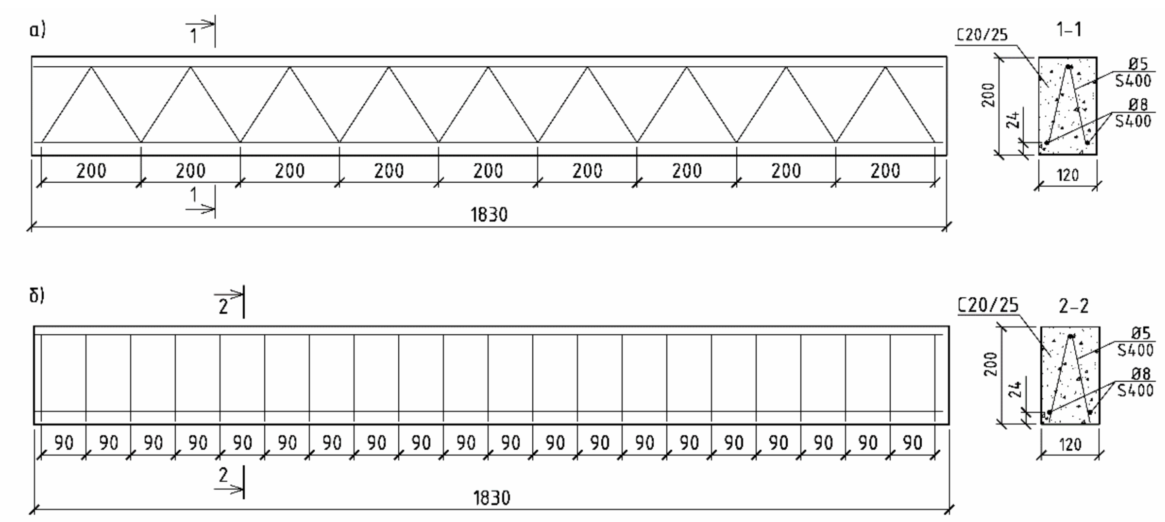

Fig. 1 Reinforcement of the tested samples : *a* – beams BN; *b* – beams BO

The samples were tested till gross fracture and with the application of two concentrated forces. The load was applied step by step; each step was no more than 1/10 of assumed bearing load and with 10 minutes of tenacity at a step. Compressive and stretching deformation of concrete, beam deflections, width of crack opening and their development along the depth of the beam till its fracture were measured. Concrete deformations of upwardmost and downwardmost fibres in a pure bending area were measured with an indicating gage with a grating period of 0,01 mm, the gauge was 100 mm. Relative compressive and stretching deformations up-to-reinforcement in the pure bending area were measured with an indicating gage of a grating period 0,01 mm, the gauge was 400 mm.

The fracture of beams was observed at regular sections in the pure bending area, meanwhile relative deformations of transverse reinforcement reached their maximum, corresponding to tension equal to yield strength; but relative concrete deformations of the most compressed face of the section have not reached ultimate compressibility by the time. Having reached the time, bends developed without the growth of load, cracks were opening and developing into the depth of the section, reducing the compression region. Having reached strengths in reinforcement, equal to the yield point, stretching deformations and bends of beams were increasing under an invariable load.

To analyze the obtained data a values-moment of deflection diagram was graphed: deflections (Fig. 2), width of crack opening (Fig.3), relative deformations of compressions and stretching. A flat cross-section hypothesis was used to obtain deformations at the level of the centre of gravity of a stretched reinforcement and a compressive face of a concrete section.

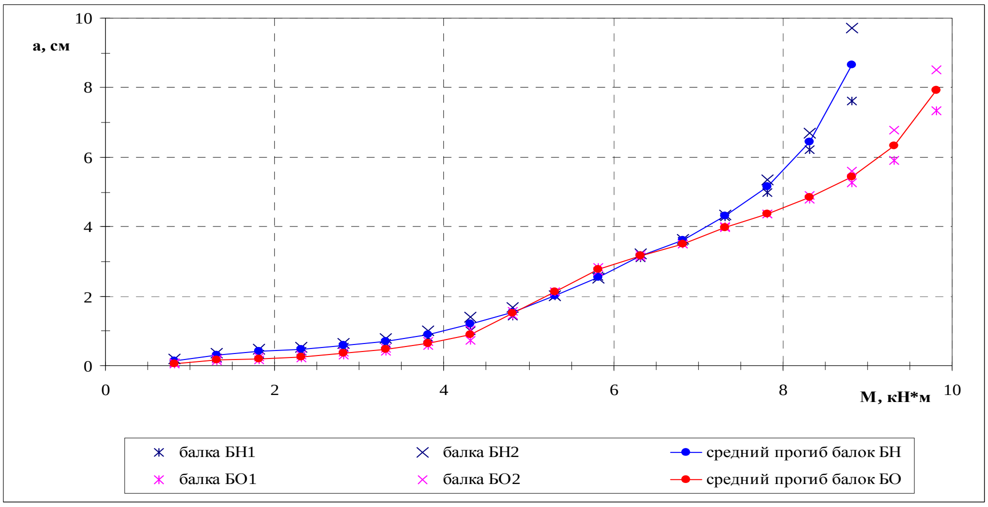

Fig. 2. Dependence of the beams tested on the bending moment

At the initial stages of loading (0-4,2 kN·m) deflections, in all the beams, had a proportionality to the moment of deflection and at the moment of first cracks were 12 mm for beams with transverse reinforcement, and 8 mm for beams with orthogonal reinforcement (Fig. 2). Redistribution of inner forces was observed after the appearance of cracks in the beams, the reinforcement became active and the rate of deflections in beams was increasing quite faster. At the intervals of loading from 4,2 to 6.4 kN·m graphic charts(curves) "*a*–M" for beams BN and BO coincided; and at the moment M=6.4 kN·m their deflection was about 32 mm. Further on, deflections of the tested beams became larger together with the bending moment , rapidly and disproportionally, up to their fracture. It should be mentioned that a slope of curve of "*a* - M" in beams BN is larger than that in BO beams, that is fixed in the diagram. At the point of destruction the deflection of beams BN was 65 mm, and 36 mm was in beams BO.

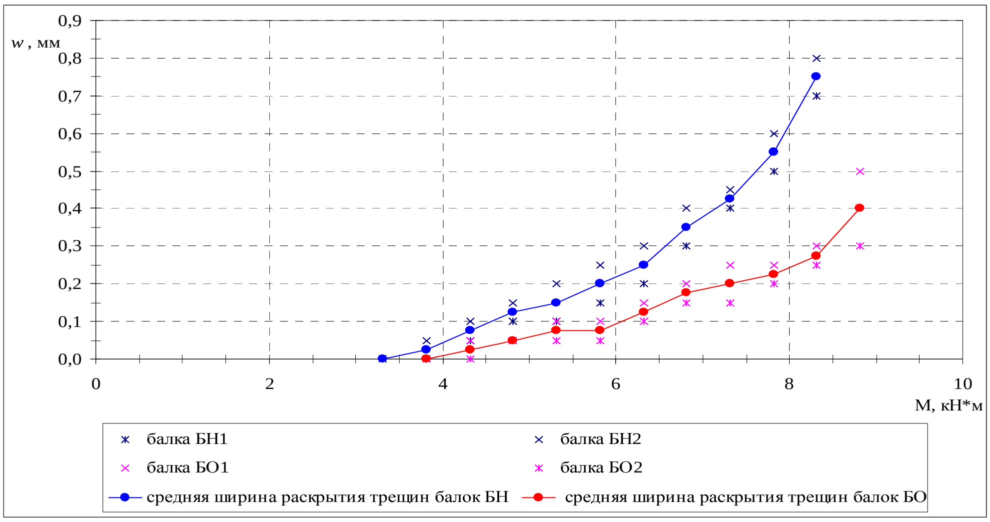

Fig. 3. Dependence of the width of the crack opening at the bending moment

The crack formation moment in beams BN1 and BN2 was fixed at the interval 3, 8…4,3 kN·m, and 4,3…4,8 kN·m for beams BO1 and BO2 (Fig. 2). The theoretical moment of crack formation, calculated according to the method /2/, was 3,4 kN·m. Further on, together with the growth of load, divergence of diagrams "*w*–M" for different types of beams was observed, and a slope of curve of the diagram for BN beams is larger than that for BO beams at that. Formulae for w_k calculations |2|, depending on a cracks step, prove the fact. The width of cracks opening of the tested samples was 0,75 mm for BN beams and 0,25 mm for BO beams at the destruction period of the tested samples.

Up to the fracturing stretching deformations in both types of beams were increasing proportionally to the bending moment and were not different. The load was increased to the yield strength in the reinforcement and stretching deformation in BO beams was 25…30 per cent higher than that in BN beams. The average deformation of outer compressive fabric (the gauge was 400 mm) almost did not differ in all the beams and at the destruction point of the samples they were not higher than the ultimate compressive index of concrete equal to 0,35 per cent. The fixed stretching deformations in sections with a crack were larger than in the section between cracks. The obtained results prove the Prof. V.I. Murashev's theory where index ψ_S, connecting average and ultimate deformations of reinforcement, was introduced. Tested indices for ψ_S were gained using tested results of average deformations of reinforcement (the gauge was 400mm) and ultimate gauged deformations fixed in the section with a crack, the gauge of 100mm:

$$\psi_S = \varepsilon_{sm}/\varepsilon_s, \quad (1)$$

ε_s – relative deformation of a stretching reinforcement in the section with a crack;
ε_{sm} – average relative deformation of a stretching reinforcement.
Theoretical values of ψ_S were gained using method /2/, formulae 2 and 3:

$$\psi_S = 1 - (\sigma_{sr}/\sigma_S)^2, \quad (2)$$

σ_{sr} – tension in stretched reinforcement for a section with a crack at the moment of crack formation, σ_S – tension in stretched reinforcement with a crack at the stage of loading.

$$\psi_S = 1 - (M_{cr}/M_d)^2, \quad (3)$$

M_{cr} – the bending moment corresponding to crack formation, Md –the bending moment corresponding to the loading step.

Having analyzed the results differences in tested and calculated values of ψ_S were found; the average of which is 0,74 (formula 1); 0,62 (formula 2); 0,96 (formula 3).

We came to the conclusions:

1) Fraction formation, regular to longitudinal axis of tested constructions with orthogonal and reversed bars were fixed under equal bending moments.

2) The rate of cracks opening, width and steps, varies considerably. With a larger length between cracks in beams with reversed bars, at the stages close to fraction, large, almost two times large, width characteristics were observed.

3) Deflection of beams with reversed bars under the loading was rather intensive.

4) The rates of average and ultimate deformations of stretched longitudinal reinforcement, which are important for ψ_S when hardness and fracture strength are calculated, turned out to be 1.3…1.5 times higher than those in samples with cross bars.

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WOOD CONCRETE BASED ON CRUSHED BAMBOO

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The test results of wood concrete based on various raw wood materials are analyzed. Wood concrete, used as a coarse aggregate of a crushed bamboo, is described in the article as well as technologies for wood concrete, based on bamboo of high physical and mechanical properties, production.

The use of waste pieces, saving of materials, development of building constructions are becoming urgent today. Gradual depletion of natural resources courses our interest in application of secondary products of proper quality and lower costs. From economical point of view it is important to produce such materials not far from the objects they will be used further on to minimize transport charges and use local raw materials in the production. Plant wastes can be used to get cheap and effective materials. Composite heat-insulating materials,