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# STUDY OF THE STATE OF DEFORMATION UNDER TENSION USING FIBER GLASS REINFORCEMENTS IN BEAMS

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**Annotation**
This master's thesis depicts an analysis of the results of research on the study of composite reinforcement elements widely used in the restoration of concrete structures of buildings and structures in the Republic of Uzbekistan and abroad.

**Keywords**: Composite reinforcement, concrete, load, bending moment, transverse force, consistency, deformation, deformation.

## Introduction

In many countries of the world in the field of construction, research is being conducted on the use of reinforcement made of composite materials, which are an alternative to reinforced concrete structures and steel reinforcement, and their results are used in construction practice. Examples include research and construction in Germany, Russia, China, Japan, USA, Canada and other countries.

At present, polymer-composite reinforcement is used at road and transport infrastructure facilities, strong electromagnetic fields, the chemical industry, water treatment and water treatment, land reclamation facilities, seaports and port facilities, urban engineering infrastructure, is effectively used in the construction of mines and subway tunnels, as well as in the construction, repair and reconstruction of load-bearing and enclosing structures of buildings and structures.

The use of polymer composite reinforcement instead of steel reinforcement of reinforced concrete structures, especially in aggressive environments, is a promising scientific direction.

In the development of the economy of the Republic of Uzbekistan, in the improvement of its material and technical base, it is important to bring into life, on the basis of theoretical and experimental studies, elements that have new design solutions and are economically profitable.

The study and analysis of existing studies shows that in the Republic of Uzbekistan, the performance of flexible reinforced concrete structures equipped with composite reinforcement under the action of force has not yet been sufficiently studied.

The best option is to conduct research on reinforcement from basalt fiber produced in the Republic of Uzbekistan and ordinary heavy concrete, which is used in the largest volume and in all types of building objects in construction practice. Therefore, it is advisable to conduct complex experimental and theoretical studies to determine the stress-strain state of flexible concrete structures equipped with basalt fiber composite reinforcement, the formation and development of cracks, brittleness, deformation forms and strength in them. To do this, it is necessary to experimentally study the resistance of flexible elements reinforced with basalt fiber rods from ordinary heavy concrete to the action of bending moments and transverse forces.

For experimental studies, prototype models of beams of rectangular section were made. Plain heavy concrete was used for the beams. Portland cement from the Turon cement plant in the Besharik district of the Fergana region with an activity of 42.5 MPa was used as a binder for concrete. Quartz river sand of the Akbarabad carer of the Kuva district of the Ferghana region with a fraction of crushed granite (sheben) 5-15 mm and a magnitude module of M2.25 was used as fillers. The composition of the concrete was selected in such a way that its bulk strength corresponded to the compressive strength of class B25. Granite crushed stone was sifted, washed in a special device and dried (table 1).

Along with beam samples, 10x10x10 cm cubes were also made from the same mixture. After 28 days of storage at normal temperature t = 20 ± 2 0 C and relative humidity at φ = 60-65%, the sample cubes were tested on a hydraulic test press until destruction when compressed. (Table 1)

**Table 1Conventional heavy concrete aggregates.**

| **Filler** | **Residue in % of sieve weight, hole size mm** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 20 | 15 | 10 | 5 | 1,25 | 0,63 | 0,315 | 0,14 | 0,07 |
| **Granite jackdaw** | 2-4 | 4-6 | 90-95 | 92-100 | - | - | - | - | - |
| **Quartz sand** | - | - | - | - | 1-2 | 4-5 | 12-15 | 45-50 | 90-100 |

**Table 1.The composition of 1 m 3 concrete mixture is shown in table 2. samples of beams of series I, II**

| **№** | **Naming** | **Quantity** | **Unit of measurement** |
|---|---|---|---|
| **1** | Fergana region Besharik region Cement plant "Turon" Portland cement M400 | 394 | кg |
| **2** | Sheben | 1197 | кg |
| **3** | Quartz sand | 495 | кg |
| **4** | Water | 212 | litr |
| **5** | Density of concrete: | 2298 | kg / m $^3$ |
| **6** | Concrete water/cement ratio (S/TS) | 0,54 | |

The materials were dosed to within ± 0.1 kg by weight. For this, high-precision electronic scales were used.

After the volumetric strength of concrete is determined, the corresponding prismatic strength is calculated by the expression $R_b = 0.75R$, and the tensile strength $R_{bt}=0.5\sqrt[3]{(R^2)}$ is calculated by the formula.

For experimental studies, beams were prepared, equipped with composite reinforcement, with a cross-sectional area of 12x24 cm and a length of 174 cm. The beams were made in wooden molds. The inner surface of the molds was covered with metal sheets. As working reinforcement, 2Ø12 ШКА to the elongated section 2Ø10ШКА to the compression section of the reinforcement Ø8ШКА were installed as clamps with a step of 7 cm. Composite reinforcement for clamps was woven and attached to the longitudinal reinforcement with mild steel wires. The fittings were installed and secured to molds at the site. Samples of beams are made of heavy concrete grade B25. Along with sample beams, 10x10x10 cm cubes were simultaneously made from the same concrete. Samples prepared for shrinkage and compression tests were made from 6 and 9 pieces.

Before the destruction of the samples, the deformations of concrete and reinforcement, the coolness of the beams, the cracking time (load) and the opening width were measured. The load value was recorded by the jack manometer. When the load reached the set value, the jack was closed and kept at this value for 15-20 minutes. After the readings of the instruments were recorded, they gave the load of the next stage. Thus, the tests continued, and the samples were kept until they collapsed.

At the end of the tests, the location of the cracks was determined, samples were taken and the height of the cracks, the distances between them, the protective layers of the working reinforcement were measured, and the working height was measured.

During the tests, the deformations of concrete and reinforcement, the time of formation of normal and oblique cracks and the magnitude of the load, the slope of the beam were measured and recorded.

The deformations at the base of 300 mm were measured with clock indicators with an accuracy of up to 0.01 mm, using a portable messura, at three points of the beam between the gaps and at the bases with the help of clock indicators with an accuracy of up to 0.01 mm. . The deformations of the tensile and compressive reinforcement, as well as the concrete compression area, were measured on a base of 300 mm at three given points along the cut height. During the experiment, the surfaces of the sample beams were carefully examined at each stage, and as soon as the first cracks appeared, they were immediately marked and fixed, and their width was also measured. At the same time, the cost of the cargo was determined. When the value of the delivered load reached approximately 85-90% of the breaking load, the gauges were removed and the sample was loaded until failure, while the nature of its destruction was controlled. In most cases, in sample beams, distortion occurred along inclined sections. During the experiment, the warping of the samples occurred at values close to the nominal loads; in all cases, it was noted that the experimental load differed from the nominal one by an average of 10-20%.

After the experiment, the samples were removed from the stand, placed in a separate place, and a map of cracks was compiled and photographed. It is noted that the location of cracks in the beams, their dimensions, the width of the openings are very similar and close to each other. In those cases where the failure was caused by elongated reinforcement, crushing of the concrete in the compressible zone was revealed. When curving along inclined sections, a situation arose that was close to curvature even in the region of pure bending. Achievement of the force value (0.9-0.95) Qult in most of the destroyed samples at the slope sections of the joints with longitudinal reinforcement was violated, and the beams were compressed, a shift was observed.

**Conclusions**

1. As a result of strength tests of composite reinforced concrete beams, reliable information is obtained on the stress-strain state of flexible reinforced concrete elements with fiberglass composite reinforcement, the appearance and development of normal and oblique cracks, the development of cracks, the nature and form of failure..

2. The physical and mechanical properties of concrete and basalt fiber reinforcement used for beam samples are carried out according to standard methods and quantitative values are determined. On their basis, all the main parameters of the tested samples were calculated in accordance with the requirements and rules of SNiP [4]

3. As a result of processing and analyzing the results of experiments, scientific conclusions were prepared based on the stress-strain state, crack resistance and brittleness of flexible concrete elements with composite reinforcement, and practical recommendations for calculation and design were developed.

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