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DEVELOPMENT OF COMPOSITE REINFORCEMENTS AND CONCRETE DEFORMATIONS IN BASALT REINFORCED CONCRETE BEAMS

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Abstract
This article describes the analysis of the results of the research carried out on the study of the work of composite reinforced elements, which are widely used in the restoration of concrete structures in the buildings and structures currently being built in the Republic of Uzbekistan and in foreign countries.
The article includes the types of composite reinforcements, the physical and mechanical properties of composite reinforcements, and the proposed practical recommendations for ensuring their strength, uniformity and seam resistance.

Keywords: composite, basalt, concrete, flexibility, strength, messura, polymer, deformation, compression, stretch.

Introduction

Currently, polymer composite fittings are used in road transport infrastructure facilities, in areas where high electromagnetic fields are generated, in the chemical industry, water treatment and purification, land reclamation facilities, in the construction of seaports and pre-port facilities, in urban engineering infrastructure facilities, mines and metros. It is effectively used in the construction of tunnels, as well as in the construction, repair and reconstruction of load-bearing and barrier structures of buildings and structures.
The use of polymer composite reinforcements instead of steel reinforcements of reinforced concrete structures working in especially corrosive 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 put into practice the elements that have new constructive solutions and are economically effective based on theoretical and experimental research.[1]
In recent years, the President of the Republic of Uzbekistan and the Cabinet of Ministers have been making important decisions to raise the standard of living of the population and improve living conditions. In the implementation of these decisions, it is necessary to create economically inexpensive construction structures with high strength, uniqueness, and their practical application in the construction of production enterprises, residential buildings, and engineering structures, which are necessary for the economy. The issues raised in this direction include the use of composite materials, which are relevant today. The use of

composite materials in construction increases the overall reliability and technical economic efficiency of industrial, residential, public buildings and engineering structures in accepting permanent, temporary and earthquake stresses.
Year by year, the volume of construction and improvement works is increasing in the Republic of Uzbekistan. In order to successfully implement the planned large-scale construction works, extensive use of new innovative technologies is required. The introduction of polymer composite reinforcements into the construction practice in the conditions of Uzbekistan requires their research in the conditions of our country. Therefore, conducting research in the direction of reinforcement of concrete structures with polymer composite reinforcements is an urgent problem of social and economic importance.[2]

Main Part:
To conduct experimental studies, test models-sample beams with a rectangular cross-section were prepared. Ordinary heavy concrete was used for the beams. Portland cement of Turon cement plant in Beshariq district of Fergana region with activity of 42.5 MPa was used as a binder for concrete. As fillers, quartz river sand from Akbarabad quarry, Kuva district, Fergana region, with a fraction of 5-15 mm and a bulk modulus of M2.25 was used. The composition of the concrete was chosen so that its cubic strength would have a compressive strength corresponding to the class B20 and B35. Granite limestone was sieved, washed in a special device and then dried (Table 1).

Granulation composition of ordinary heavy concrete aggregates. Table 1

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

The consumption of materials for 1 m3 concrete mixture of class B20 is given in table 2.

Concrete composition for sample beams. Table 2.

T/R №	Naming	Amount	O‘lchov birligi
1	Farg‘ona viloyati Beshariq tuman “Turon” sement zavodining portland sementi M400	300	kg
2	Sheben	1220	kg
3	Kvars qumi	720	kg
4	Suv	150	litr
	Betonning zichligi:	2390	kg/m^3
	Betonning suv / sement nisbati (S/S)	0,50	

The materials were dosed with an accuracy of ±0.1 kg by weight. An electronic scale with high accuracy was used for this purpose. The results of the cube tests are presented in Table 3.

Test results of cubes made of sample beam concrete. Table 3.

№	Beam cipher	Age of concrete (days)	Edge of sample cubes, cm	Compressive strength of concrete, MPa	Strength of concrete		
					R_b, MPa	R_{bt}, MPa	E_b*10^{-3} MPa
1	2	3	4	5	6	7	8
1	BKPA -1	30	10	26,35	14,3	1,33	30,1
2	BKPA -2	30	10	25,42	13,9	1,30	29,6

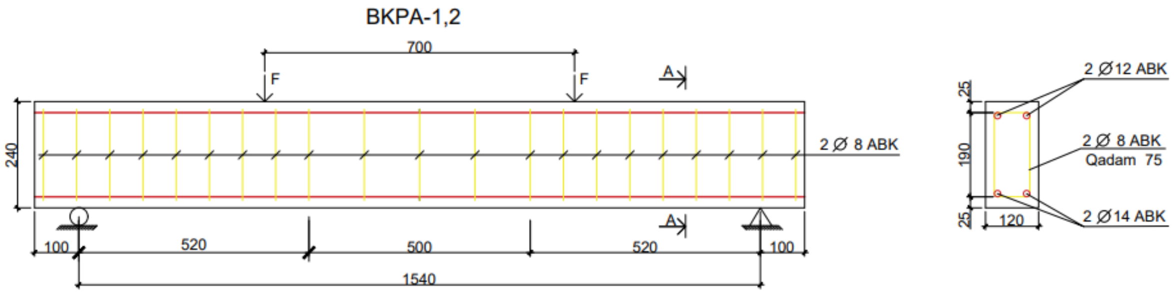

Figure 1. Schemes of reinforcement and loading of sample beams.

Research Results:

Deformations increase proportionally with the increase in load until cracks appear in the longitudinal reinforcement. In this case, the values of deformations in the field of pure bending were slightly higher than those in the range of shearing caused by transverse forces. After the formation of cracks normal to the longitudinal axis of the cross-section in the stretching areas of the beams, the deformations in the longitudinal reinforcements began to increase faster. This situation was especially evident in the places where the cracks cross the reinforcement. Before the formation of normal cracks, the deformations in the longitudinal reinforcements in the area of pure bending were 2-3 times larger than in the area of shearing.[3]

In BKPA-1,2 sample beams, before the formation of normal cracks in the area of pure bending, the deformations of the longitudinal working reinforcements were e_f=(56-62)·〖10〗^(-5), and deformations in reinforcements during shearing were equal to e_f=(52-58)·〖10〗^(-5).

After the formation of cracks normal to the longitudinal axis of the BKPA-1,2 sample beams, the deformations of the longitudinal working reinforcements in the pure bending area are (182-188)·10-5, and in the shear areas (110-190)· increased to values of 10-5.[9]

The subsequent increase in loads led to a certain "flattening" - equalization of the deformations of the longitudinal working fittings along the length of the beams. In this way, as the loads increased, the deformations in the longitudinal working reinforcements also increased. It was found that when the amount of loads is in the range of (0.8-0.9) Kult, the deformations of the longitudinal working reinforcements reach up to (500-600)·10-5.

According to the results of the measurements, before the formation of cracks, stresses of (100-140) MPa appear in the longitudinal reinforcements. The average relative deformations of tensile working reinforcements in the field of pure bending continuously increase according to the curvilinear regularity as the amount of load increases, especially at high values of the load, it was observed to increase more rapidly (Fig. 1.).[4]

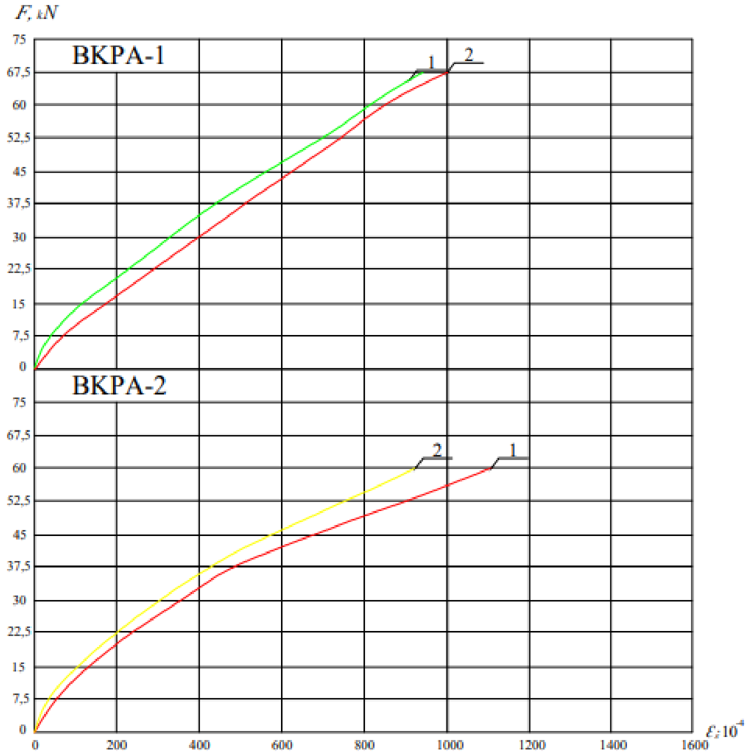

Figure 2. Average relative deformations of sample beam reinforcements:

It was observed that when the BKPA-1.2 load is close to the breaking forces, the deformations in the reinforcements reach values of (800-900)·10-4. From the graph, it can be determined that in such cases the tensile stresses in the fittings are 420-480 MPa. e· 〖10〗^(-4)[8]

Deformations of the beams in the longitudinal reinforcement in the shear range were 1.2-1.5 times less than in the pure bending areas. In these reinforcements, only when the largest loads are applied, that is, before the limit state occurs in the beam, a sharp increase in deformations was observed, and the beams approached the deformations of the reinforcement in the areas of pure bending. [7]

During the preparation of all the sample beams, it was possible to measure the longitudinal compression deformations of concrete on a 30 cm base on 3 levels in the concrete compression zone of the pure bending zone using a PMB-30 portable measuring device.[6-26]

Longitudinal compressive deformations of concrete do not have large values when the applied force is up to 20 kN, and their change increases almost in a straight line. When the force in the sample beams reached 20 kN, the concrete compressive deformations reached the values of 70·10-5, 90·10-5, 120·10-5, respectively, at the levels located 60, 90, 120 mm below the most compressible axis. (Figure 2.).

The increase of the loads in the subsequent stages led to an intensive increase in the longitudinal compressive deformations of concrete. It was observed that when the stage load value approaches the breaking load in the sample beams, the value of the largest compressive deformations Q=(0.85-095)Kult reaches (160-190)·10-5. At the last stage of loading, it was found that the longitudinal compressive deformations of concrete reached (200-230)·10-5, and the stresses in concrete reached the limits of its compressive strength. In this case, after the level load reached 35-40% of the breaking load, the accumulation of inelastic deformations occurred in the concrete in the compression area.[5]

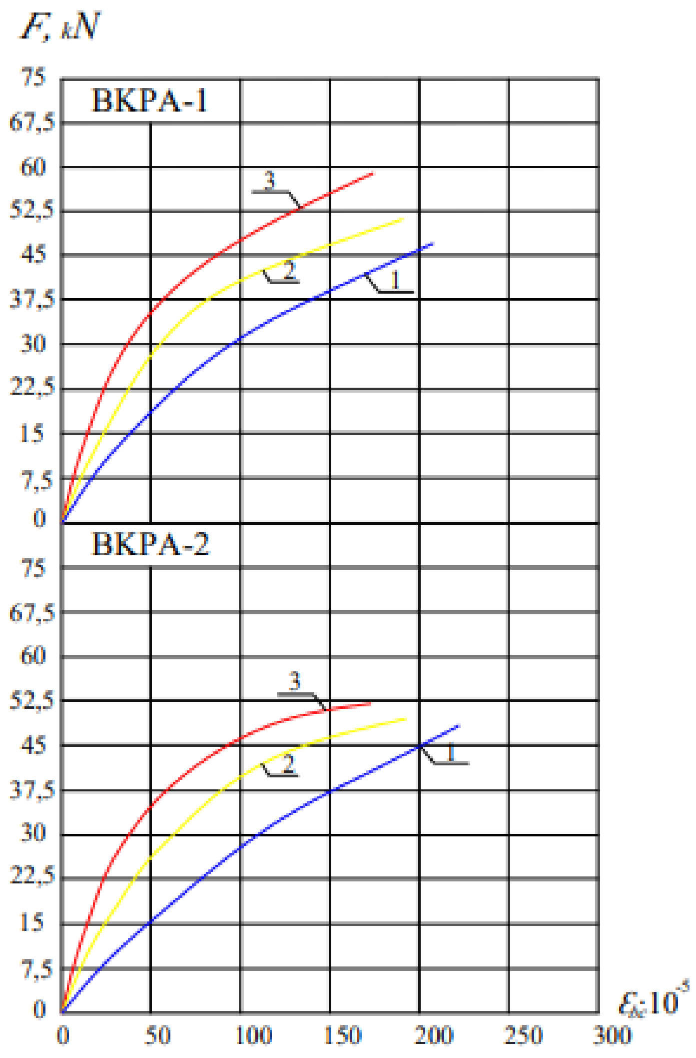

Figure 3. 1,2,3,4,5,6- average relative compressive deformations of the concrete of sample beams in the area of pure bending: 1- at the level located 30 mm from the most compressible side; 2nd at the level located 60 mm from the most compressible side; At the level located 90 mm from the 3rd most compressible side.

Conclusions:

At small values of the loads, that is, when s_bt<R_bt in the stretching area, mainly elastic deformations and stresses are formed in the beams, the elements work without cracks. After reaching the values s_bt→R_bt in the tensile zone, initially cracks normal to the longitudinal

axis of the cross-section were formed in the pure bending zone of the beams, and then, as the load increased, they were inclined in the shear spans where Q and M acted together. cracks were also formed. The opening width of the initially formed normal and oblique cracks (a_crc) was 0.05-0.1 mm.

After the occurrence of limit states, the failure of the sample beams occurred due to a small increase in the loads or keeping them at the level of the stage load. The failure of the elements reinforced with basalt plastic reinforcements in most cases was caused by the breaking of the beams along the oblique sections as a result of the pulling out of the couplings due to the weak connection of the couplings with the longitudinal reinforcements. It should be noted that the element was in the limit state both in the inclined section and in the normal section in the pure bending area before the failure occurred. Sample beams with a/h_0 =2.59 broke relatively quietly, at rest. The damage of the elements reinforced with metal reinforcements occurred due to the breakdown of the concrete in the compressible part of the element area. It is worth noting that in the elements with a high class of concrete, the damage was relatively quiet and peaceful.

The maximum deformations formed in the longitudinal tensile reinforcements indicate that the tensile stresses in the amounts reaching the design resistance of the composite reinforcements have been generated in them.

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