UDC691.32

TRENDS IN THE IMPROVEMENT OF ROAD CONSTRUCTION AND DESIGN

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The development of economical cement-concrete road pavements, which possess high operational qualities and indicators of the modern technical level is an urgent task for road construction in the Republic of Belarus.

The strength of the foundation has a significant influence on the performance of road covering. The strengthening of foundation soils is carried out by binding materials, including production wastes that have astringent properties. The effective raw materials used in strengthening the foundations are spent casting mixtures of the foundry industry and cupola slag. With the optimal combination of prescription and technological factors the compressive strength of the mixture for the road foundation can be achieved immediately after compaction of 1,02 MPa [1].

One type of construction of rigid road coverings in the construction of cement concrete covers includes an intermediate layer of heavy concrete, which in turn lies on a sandy base [2, 3]. With this variant of coating, the middle layer perceives most of the loads.

A promising method of increasing the strength of a concrete base is reinforcement [4, 5]. Reinforcement allows to redistribute the stresses arising from the action of the transport load on a large area, and thereby contribute to the stable operation of pavement even in adverse climatic conditions [6].

The research object in this work is cement slabs reinforced with waste alkali-resistant glass mesh GMP-160(100)-1800/1800OJSC «Polotsksteklovolokno» (fig. 1). The main characteristics of the grid: fiber length – 20-25 mm; nominal weight – 160 g/m^2; breaking load – 1800H; chemical resistance – very high. The research subject is the strength of concrete for pressing on an elastic base.

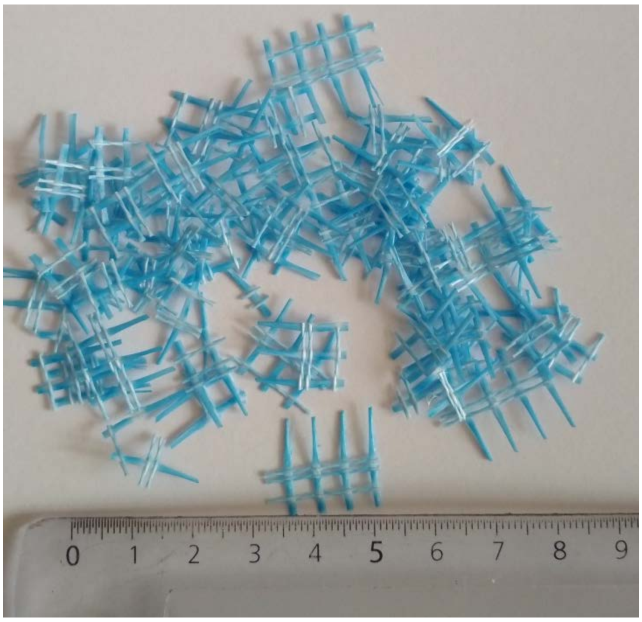

Fig. 1.Waste alkali-resistant glass mesh

For the study samples of four species with different percentage of fiber from the mass of cement were molded: without fiber, 10%, 20% and 30%. Sample sizes: length – 140 mm, width – 120 mm, thickness – 30 mm. In all compositions the water-cement ratio was 0,4, cement consumption – 1000 kg/m^3, cement CEMI42,5H. After molding the samples underwent heat and moisture treatment.

The finished samples were tested for pressing on a hydraulic press HCP-1000MG4. The plate was laid on a hard base, a metal round die with a diameter of 60 mm.

The data obtained during the test are presented below (table 1). The main indicators are the force and deformation of the samples.

Table 1. – Test results data

№ Sample	Cement consumption, kg/m^3	Water flow rate, kg/m^3	W/C	Fiber content, %	Load P,kH	Deformations L, mm
1	1000	400	0,4	0	1,01	2,764
2	1000	400	0,4	10	0,11	0,012
2	1000	400	0,4	10	0,21	0,164
2	1000	400	0,4	10	0,33	0,302
2	1000	400	0,4	10	0,44	0,395
2	1000	400	0,4	10	0,54	0,469
2	1000	400	0,4	10	0,95	0,748
2	1000	400	0,4	10	1,22	0,829
2	1000	400	0,4	10	1,45	0,973
2	1000	400	0,4	10	1,74	1,117
3	1000	400	0,4	20	0,1	0,014
3	1000	400	0,4	20	1,06	2,007
4	1000	400	0,4	30	0,56	0,499
4	1000	400	0,4	30	1,27	1,207

According to the obtained data, a combined graph is constructed that reflects the load and the corresponding deformations of all the samples (Fig. 2).

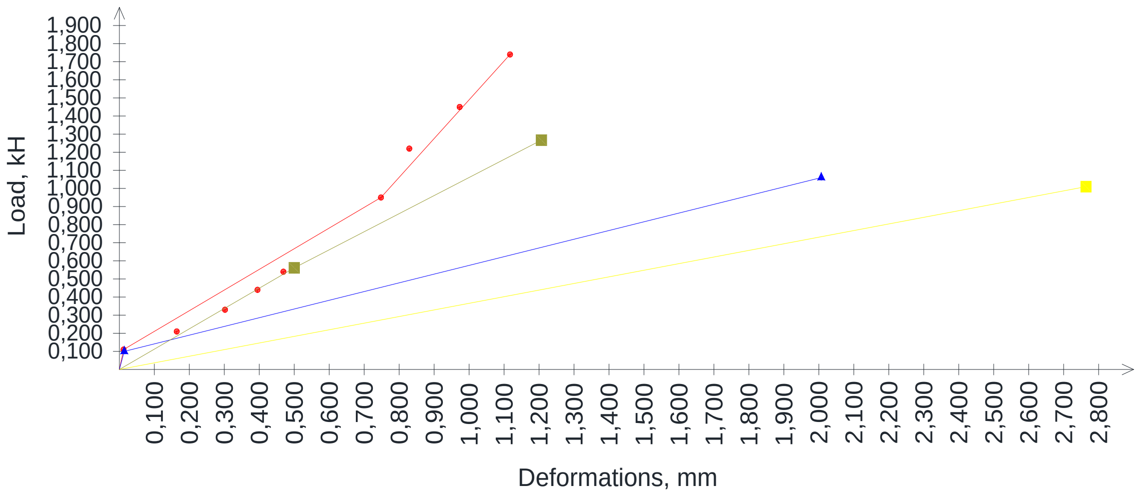

Fig. 2. Graph of load and deformation of the samples:
yellow – without fiber, red – 10% fibers, blue – 20% fibers, green – 30% fibers

Then the samples were loaded before the beginning of the cracking. Separately, the forces in which cracks in the samples are revealed are tabulated (table 2).

Table 2. – Efforts and displacements during crack opening

№ Sample	Fiber content, %	Load P, kH	Deformations L, mm
1	0	1,01	2,764
2	10	210,88	1,778
3	20	284,96	7,189
4	30	89,58	3,263

By the nature of the sample destruction it can be seen that without fiber fracture is brittle. The added fiber binds the sample from inside, which in turn prevents brittle fracture and does not scatter the sample under load. Even after opening the cracks the sample keeps its shape without breaking apart.

Analyzing table1, it can be noted that the most optimal is the second sample, where the reinforcement is 10% of the cement mass. In sample number two, with the greatest load being equal to 1,74 kH – the least deformation, which is 1,117 mm.

According to table 2, it can be concluded that the second sample is also optimal, in which the cracking begins at a load 210,88 kH, and the deformation at this instant is 1,778 mm. It should be noted that in sample 3 cracking begins when crocheting 284,96 kH, which is higher than in the second sample, but with this load the deformation is several times higher and is 7,189 mm.

Thus, according to the data obtained during the test, it can be concluded that with the use of alkaline-wool glass wool as a reinforcing fiber it is possible to create the main middle layer in a multilayer road. Due to its application the force at which the destruction takes place increases and movements are significantly reduced. It is also worth noting that the use of fiber changes the nature of destruction, which is also important for concrete. The destruction ceases to be brittle, and after the opening of the cracks the sample is not destroyed due to the binding action of the fiber. Based on the test results it is advisable to mold products with the content of fiber as in the second sample, 10% of the fiber from the mass of the cement. This percentage of reinforcement gives the most optimal indicators of force, displacement and maximum force at which crack opening occurs.

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