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FEATURES OF USING FIBER CONCRETE FOR PARAPET-TYPE RESTRAINING TRANSPORT SYSTEMS

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According to the Ministry of Reconstruction, 25,400 km of roads were destroyed as a result of hostilities in Ukraine, and according to experts, their reconstruction will take from 5 to 20 years, depending on the facility. Therefore, the issue of large-scale restoration and reconstruction of highways in Ukraine is relevant [1].

The highway is a zone of increased danger – a significant percentage of road accidents are associated with a car driving into the oncoming lane or outside the carriageway. An important role in the construction of highways is played by technical means of traffic organization, including restraining transport systems, which ensure a reduction in the risk of emergency situations when a vehicle exits a dangerous zone and reduce their consequences [2, 3].

The restraining system can be represented by parapet-type road barriers, including stationary road barriers intended for installation on the side of the road – lateral, on the carriageway, on the dividing strip – central (two-sided) [4].

The use of barrier road fences (bumpers) using concrete products with a trapezoidal cross-section («New-Jersey» profile) is relevant. Concrete blocks for road fences are barrier fences that are used on accident-prone sections of the road, where there is a risk of vehicles crossing into the oncoming lane. The shape of the bumper is designed so that in a tangential collision it practically does not damage the car. Compared to other types of road fences, prefabricated concrete bumpers are characterized by a relatively low cost, simple manufacturing technology, do not require constant maintenance, but are strong enough and durable [5].

The advantages of concrete road barriers in the form of a bumper are that it is not damaged in minor accidents, is easily installed after major accidents, has a service life of about 50 years, and does not require the use of special tools and mounting parts during installation.

Concrete blocks can have different overall dimensions and restraining ability, which primarily depends on the mass of the product. There are the following groups of barriers that can withstand an impact with the appropriate restraining ability: road group - 400 or 600 kJ, as well as "mobile protection" in the form of portable blocks – can withstand an impact with an energy of up to 130 kJ [5, 6].

The main requirements for concrete fences are the following: durability, ability to work in extreme conditions – not only under certain types of loads (withstand an impact with a restraining ability of 400...600 kJ), but also withstand the effects of changes in humidity, temperature changes, and the aggressive action of salts [7].

The possibility of obtaining such products can be ensured by using concrete with a tensile strength at bending not lower than $B_{tb}4.0$ with frost resistance F200, with a concrete class for compressive strength C32/C40 [7]. The retaining capacity significantly depends not only on the concrete class for compressive and bending strength, but is also determined by the density of the concrete and its crack resistance.

The work is devoted to establishing the possibility of obtaining special concretes with increased crack resistance and bending strength to ensure the necessary restraining capacity of products based on them.

To obtain such concretes, Portland cement PC I-500N, quartz sand with a particle size modulus 1.25, granite aggregate with a maximum grain size of 20 mm, as well as the superplasticizer MC-PowerFlow 3196, which contributes to high-quality mixing of the concrete mixture and their stabilization at high plasticity classes, and also has a high water-reducing effect with the provision of the necessary thixotropic properties at low water consumption, were used. This is important when obtaining products of complex configuration by the method of casting with vibration compaction.

To increase the bending strength of concrete, polypropylene monofilament fiber with a diameter of 20 μm of different lengths (12 and 18 mm) was introduced into their composition, which does not exceed the size of granite aggregate and contributes to the creation of an elastic multidimensional mesh [8].

The introduction of polypropylene fiber into the concrete composition reduces shrinkage cracking, as well as internal stresses that arise in the composition both during concrete hardening (including increasing the resistance of the concrete mixture to water separation) and during its operation due to increased impact resistance, bending and tensile strength [8-9].

Dispersed reinforcement of concrete with fiber in the amount of 0.9…1 kg/m^3 together with the use of the optimal amount of superplasticizer allows to increase the tensile strength of the stone by approximately 28%, and in compression – by 19%. The coefficient of crack resistance for modified concrete compared to the control without additives increases by 25%, while the bending strength during hardening in natural conditions increases by 2 times, in compression – by 1.2 times, providing the required indicators of concrete strength in compression – class C32/C40 and bending B_{tb}4.0. The frost resistance grade of such concrete exceeds the required indicator – F200.

To ensure increased bending strength and minimal concrete porosity, and therefore its density, the optimal coefficient of aggregate grain displacement was calculated, which is 1.32 when the sand : granite aggregate ratio is 1:2.1. It should be noted that the quality of coarse aggregate, namely the content of plate-shaped particles in it, significantly affects the provision of concrete bending strength. The number of such particles should not exceed 10%, since an increase in the content of such particles is accompanied by a decrease in strength by 15%.

Typically, the production and use of fiber concretes involves an increase in the cost of materials due to the use of additional expensive components, as well as a possible complication of the process of obtaining a concrete mixture. However, it should be noted that due to the increase in operational properties and durability of products based on them, the number of scheduled repairs is reduced and frequent renewal of concrete fences is not required.

The results presented confirm the possibility of using fiber-reinforced concretes of optimal composition, reinforced with polypropylene fiber, which are characterized by increased bending strength and crack resistance, to create reliable and durable parapet-type restraining road structures. Such materials and products based on them can be useful for the restoration and reconstruction of highways in Ukraine, including for ensuring the reduction of the risk of emergency situations and road safety.

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ВПЛИВ КОНЦЕНТРАЦІЇ ВОЛЬФРАМУ НА КОРОЗІЙНУ СТІЙКІСТЬ КОМПОЗИЦІЙНИХ МАТЕРІАЛІВ Cu-W

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Композиційні матеріали на основі міді та вольфраму привертають значну увагу завдяки їхнім унікальним властивостям, таким як висока електропровідність, термічна стабільність і зносостійкість. Проте одним із ключових факторів, що визначають їхню експлуатаційну придатність, є корозійна стійкість, яка залежить від хімічного складу, мікроструктури та умов експлуатації. Мідь і вольфрам не утворюють твердих розчинів або хімічних сполук, що робить їхні композити гетерогенними системами, в яких фазовий склад суттєво впливає на корозійні процеси.

У роботі досліджено зміну хімічного складу мідно-вольфрамових конденсатів, отриманих методом електронно-променевого випаровування з двох тиглів на стаціонарну підкладку [1]. Встановлено, що у напрямку від мідного до вольфрамового тигля концентрація вольфраму в конденсаті закономірно зростає від 0,64 до 32,98 мас.%, що супроводжується зменшенням товщини від 4,9 мм до 0,82 мм. Аналіз хімічного складу методом мікрорентгеноспектрального аналізу підтвердив, що в місцях, де розміщено мідний тигель, спостерігається мінімальний вміст вольфраму (0,64 мас.%), а в зоні над вольфрамовим тиглем – максимальний (32,98 мас.%).