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## **STEEL FIBER CONCRETE – EFFECTIVE MATERIAL IN ROAD BUILDING**

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The article describes the characteristics of fiber concrete, their research and manufacture steel fiber concrete. Posted prospects for its use in road construction. Submitted experience placement rigid type pavements in the developed world. The scope of work for the repair and rehabilitation of existing and construction of new roads is enormous. Therefore, the use of strong, durable and cost effective material in road construction is very actual problem today.

Advantages and disadvantages of asphalt-concrete and cement-concrete pavement roads are presented. Described perspective of rigid pavement designs using steel fiber concrete. Posted experience of steel fiber concrete in road construction in our country and abroad.

**Keywords:** fiber concrete, fiber, steel fiber, road-transport facilities, road building

In road construction the final product is a road intended for making secure freight and passenger traffic during its service life. These consumer properties of roads is provided by one of its most important constituents of pavement structures the required strength.

Ensuring the strength of the pavement reglamentary regulations for the design of rigid and non-rigid types. These documents combine the collection of source data, designing and calculation of designs of road clothes, and also efficient selection of the most rational designs for each individual object.

Road pavement can be rigid and non-rigid type. Choosing of the type of pavement, the cost of which is up to 60% of the total cost of the road is an important and responsible decision. The higher technical road category, the higher the requirements for strength and capital of the pavement. From the impact effects that arise during the movement of the vehicles and climate factors on the surface of the pavement of non-rigid road pavement (asphalt pavement) created the destruction (potholes,

cracks, husking, etc.) and deformation of different types (rut, influx, comb).

According to the regulations, cement concrete pavement on the roads uses at road types I-a, I-b and II classes with high intensity movement of the vehicles – more than 3000 vehicles per day.

Concrete pavement is arranged on the road in the form of monolithic solid plates which is divided into parcels of different lengths with expansion joints or as precast coating prepared from the plant plates of different dimensions. Despite of some advantages of this kind of pavement, such as the increase length of season, construction, precast concrete pavement on major roads is not used. This is due to major deficiencies that significantly impair their vehicle operating quality.

In concrete pavements tensile stresses partially or fully receives the reinforcement. In such pavements applied reinforcement in the form of a metal mesh or steel rods with consumption 2...5 kg/m<sup>2</sup>. Also another types of reinforcement used in concrete pavements.

Cement concrete pavement is placed with the same type thickness across the entire width of the roadway in one or two layers. Two-layer pavement applied for using when the bottom layer has less durable stone materials. The thickness of the upper layer in a double layered coating must not be less than 6 cm.

Concrete is also used for base under asphalt pavement on roads with intensive and heavy traffic.

It can be considered that the road is an engineering complex, the functioning of which needs must be done appropriate conditions and which includes not only the roadbed and road pavement, but also a significant number of road-transport structures (RTS) with the given functional purpose. In Ukraine, the public roads network includes 169,5 thousand km of roads. The throughput of an individual roads of Ukraine even exceeds these standards – in particular the road Kyiv-Boryspil has a throughput of 40 thousand vehicles per day. Huge traffic pass through the cross-section of roads of this class and create significant dynamic vibration oscillations, which act on RTS. These include: drainage trays and pipes, bridges and viaducts, tunnels, retaining walls, galleries, balconies, tubing, rectangular pipe for a cattle drive, and so on. (Fig. 1). They are very important elements of the road. Their price on flat roads is up to 10 % of the cost of the entire road, and on the roads in the mountainous areas, the cost of road construction can reach 30 % or more of the total construction cost.



**Fig. 1.** Road traffic facilities:

- 1, 2 – retaining walls along the highway; 3 – ring pipe; 4 – double peephole pipe in an earth embankment;  
5 – rectangular pipe for a cattle drive; 6 – tubing

Today in Ukraine the most difficult situation with the road condition is in the Western regions, as well as in Mykolaiv, Odesa and Kharkiv regions. Over 50 thousand km of roads in need of repair in a country. In addition, 1,740 km of roads coating is completely absent, so the repair of these roads can be done only comprehensively [1]. To improve the life support system of a multifunctional economy of our country is needed as soon as possible build a large number of new trunk roads and repair of

existing. If the condition of regional and state roads is the internal affair case, international routes which in Ukraine more than 8 thousand km is the issue of reputation at the international level.

The development of road infrastructure in terms of annual increasing traffic, involves the construction of modern highways with high traffic-use-their characteristics and is a very urgent task for Ukraine's integration into the European community.

In comparison with asphalt road pavement of rigid type has higher strength, evenness, and at the same time, sufficient adhesion of car tires with the surface coating. Technology of cement-concrete pavement works execution is almost completely mechanized. It represents slabs of concrete, arranged in a strong and sustainable basis.

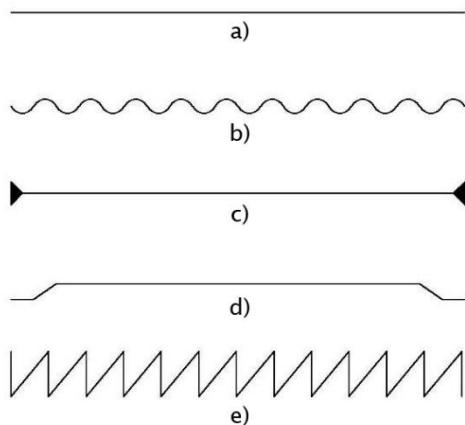
Currently on the territory of Ukraine are building the road with asphalt. For comparison, according to statistics in developed countries the length of cement-concrete road is: USA – 60 %, Austria – 46%, Germany – 38 %. And in Ukraine – up 3 %. The service life before repairs of concrete pavement in the United States, Germany, the Netherlands and Austria often exceeds 30 to 40 years, which is more in 2... 3 times than the overhaul service life of asphalt pavement.

It should be noted that most of the traffic structures relates to structural elements, that perceive shock, dynamic and thermal effects, in which the direction of the main tensile stress and formation of plastic hinges is unknown or may vary during operation. Therefore, using of concrete and the conditions of his work in structures poses the problem of how to improve the crack resistance, impact strength, frost resistance and other characteristics, which in turn depend on the strength of the material in tension.

Analysis of internal and international researches shows that one of the promising directions in the field of road construction is using as a base layer of roads of dispersed-reinforced concrete and especially steel fiber reinforced concrete [2]. Dispersion-reinforced concrete, which are a kind of a wide class of composite materials are increasingly used in various fields of construction today.

The main admixtures for making fiber reinforced concrete are: 1) steel, 2) glass, 3) synthetic, and 4) basalt fibers. The steel fiber is the most used in civil engineering and is commonly found in construction elements of bridges and road pavements to enhance the deck toughness and ductility. It is typically added at higher dosage amount ranging between 1% and 2% by volume to improve toughness, fatigue and in

controlling crack width of concrete [3]. Application of the steel fiber reinforced concrete constructions instead of standard reinforced concrete allows (after a detailed justification) reduce the consumption of construction and as a consequence - their weight, to reduce labor costs of its manufacture, and significantly increase the durability of the structure.



**Fig 2.** Shapes of steel fibers:

- a) Straight fiber; b) Crimped fiber; c) Stranded fiber; d) Hooked fiber; e) Crinkled fiber



**Fig 3.** Steel fibers in concrete mixture

Specifications of steel fiber reinforced concrete in comparison with classic concrete is:

- high tensile and breaking strength (Fibers aligned in the direction of the tensile stress may bring about very large increases in direct tensile strength);
- ductility (the ability of concrete to undergo maximum elastic deformation before collapse);
- increased modulus of elasticity;
- resistance to chemical agents and weathering;
- frost and fire resistance;
- no shrinkage;
- crack resistance (it measures the energy absorption capacity of material under static or dynamic or impact load);
- water resistant;
- resistance to abrasion;
- high impact resistance and ductility.

Steel fiber reinforced concrete as an effective material should be used for the manufacture of road constructions in general or their separate structural elements in particular.

Given the above – a study of traffic structures and their structural elements which is made of steel fiber concrete at various load is an urgent task.

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