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USE OF FIBER MATERIALS TO IMPROVE THE DURABILITY OF ROAD STRUCTURAL CONCRETE

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Summary. *Durability is an important property of concrete, and in road projects in cold regions of Belarus, often freeze-thaw cycles and salt erosion and other multiple factors act together to cause concrete damage. This paper focuses on the effect of using mineral admixtures and fibrous materials on improving the frost resistance of concrete.*

Concrete is a compound of a variety of materials, its structure and performance changes with time and environmental changes, its durability is a major scientific and technological issues and economic problems in the world today. Since its introduction, concrete has experienced the development of low strength, medium strength, high strength and even ultra-high strength, and at first people are always happy to pursue higher strength. But the past four or five decades, concrete structures due to material deterioration caused by premature failure and collapse of damage accidents at home and abroad are common, and there is a growing trend. The premature destruction of concrete projects, the main reason is not due to insufficient strength but poor durability of concrete. 50 years of concrete durability in the world, Professor P. K. Metha concluded that, today, if the factors affecting the durability of concrete in decreasing order of importance, then they are reinforcement corrosion, freeze-thaw damage, the physical and chemical effects of aggressive environments, alkali aggregate reaction, etc. alkali-aggregate reactions, etc. Data shows that the cost of maintaining and repairing concrete road surfaces at airports is about $4 billion per $100 billion in the United States. Of course, Belarus, located in the cold zone, also faces the same problem. Therefore, the solution to the current frost resistance of road concrete is an urgent scientific problem in the Republic of Belarus.

The addition and application of non-metallic fibers as well as metallic fibers. SaraIbn-ElHaj, Soumia Mounir, et al. conducted a series of experimental studies by combining reeds with white cement to measure the thermal conductivity of reeds in construction. The thermal conductivity of reeds in construction was measured. The results showed that the addition of reed helped to enhance the thermal insulation of white cement and its thermal conductivity and density decreased from λcement=0.75Wm. The thermal conductivity of white cement containing reed fibers was reduced by 25 %, which clearly indicates the improved thermal insulation of white cement with reed. It is well demonstrated that cementitious materials rich in reed fibers can be used in large quantities in construction and it has excellent properties of thermal insulation and heat preservation. Zainab Z. Ismail, Ali J. Jaeel applied giant reed ash (GRA) in concrete mixes The main conclusion that can be drawn from this study is that the use of 7.5 % of reed ash (GRA) as a replacement of sand in concrete mixtures is optimal for producing maximum compressive and flexural strength values ratio. The slump test values of the GRA modified concrete decreased as the percentage of giant reed ash (GRA) increased to 12.5 %. Despite the decrease in slump values, the GRA concrete mixture was considered viable. Thus, reeds can also replace some natural fine aggregates after crushing, thus highlighting their renewable and environmental properties. Secondly, steel fiber concrete belongs to a composite material and the incorporation of steel fibers enhances the mechanical properties of cement concrete. Laminated steel fiber concrete is applied in road concrete, and this material is more advantageous, especially in terms of crack resistance and rutting resistance. For this reason, after Chinese scholars Zhu Changkui and Li Jinhui found that the application of steel fiber road concrete can not only enhance the crack resistance of road concrete, but also improve the high temperature rutting resistance of road concrete mixes.

The tests were conducted in accordance with the characteristics of high performance concrete and road concrete was formulated to meet the heavy traffic class. A comparative test with a single fiber additive was conducted to study the effect of adding 1 %, 2 % and 3 % of steel fiber,

reed fiber and composite admixture on the frost resistance of concrete, and the tensile and compressive tests were conducted according to the concrete mechanical properties test. Further, the relevant test findings were analyzed to determine which fiber admixture can better improve the frost resistance of concrete and is economical and practical. As well as the optimum amount and percentage of the admixture to be added.

Table 1 – The experimental results

№	Cement	Sand	Gravel			Water	Reed fiber	Steel Fiber	Water Reducer	28d anti-fold	28d of stress resistance
			5–10	10–20	16–31.5						
1	400	730	110	550	440	180	50	7.75	4.0	3.5	33.1
2	400	730	110	550	440	180	50	15.5	4.0	4.2	42.6
3	400	730	110	550	440	180	50	23.25	4.0	3.8	38.3
4	400	730	110	550	440	180	100	7.75	4.0	4.1	35.1
5	400	730	110	550	440	180	100	15.5	4.0	4.5	43.2
6	400	730	110	550	440	180	100	23.25	4.0	4.4	42.7
7	400	730	110	550	440	180	150	7.75	4.0	4.2	36.6
8	400	730	110	550	440	180	150	15.5	4.0	4.8	44.5
9	400	730	110	550	440	180	150	23.25	4.0	4.5	45.6

Figure 1 – Specimen tensile test

Figure 2 – Specimen compressive test

Conclusions. This thesis focuses on the use of fiber admixtures in concrete with original mineral admixtures to improve the tensile, compressive and frost resistance and wear resistance of road concrete. The article uses a single admixture approach for concrete design tests, adding reed fibers and steel fibers to the mineral admixtures (fly ash, silica fume, and composite admixture fly ash + silica fume). Under the condition of standard curing age of 28 days, the following conclusions were drawn from the tests. (1) A reasonable amount of fiber admixture can improve the compressive strength and flexural strength of road concrete. Research shows that under the condition of 28 days, 1 %, 2 %, 3 % of steel fiber and reed fiber can effectively improve the compressive strength and flexural strength of concrete. However, the fiber content of 2 % additive makes the tensile, flexural and frost resistance better. (2) The durability test was conducted again on reed concrete with 1 % by volume and steel fiber concrete with 1 % by volume, and the study showed that the water penetration resistance of concrete became better after adding reed, and the heat preservation performance was better. The reed fiber can effectively improve the wear resistance of concrete. While steel fiber cannot.