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STRUCTURE OF SMALL-SCREET CONCRETE AND ITS INFLUENCE ON STRENGTH AND DEFORMATIVITY

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Abstract
The structure of concrete has a great influence on the strength and deformability of concrete. To clarify this issue, let's consider the scheme of the physicochemical process of concrete formation. When a mixture of aggregates and cement is mixed with water, a chemical reaction of cement minerals combining with water begins, resulting in the formation of a gel - a gelatinous porous mass with suspended cement particles and insignificant compounds in the form of crystals that have not yet entered into a chemical reaction. During the mixing process of the concrete mixture, the gel envelops individual aggregate grains, gradually solidifies, and the crystals merge over time into crystalline adherents. The hardening gel transforms into a cement stone that binds the grains of large and small aggregates into a monolithic solid concrete.

Keywords. Concrete structure, concrete essence, strength, deformability, process duration.

Introduction

A significant factor influencing the structure and strength of concrete is the amount of water used to prepare the concrete mixture, which is assessed by the water-cement ratio W/C, the ratio of the suspended amount of water to the amount of cement per unit volume of the concrete mixture. For the chemical bonding of water with cement, it is necessary that W/C 0.2 [1-2]. However, due to technological considerations, to achieve sufficient mobility and workability of the concrete mixture, the amount of water is taken with some excess, for example, mobile concrete mixtures that fill the form under the influence of flowability have W/C=0.5...0.6, while rigid concrete mixtures that fill the form under the influence of mechanical vibration have W/C=0.3...0.4 [3-4].

Excess chemically unbound water, partly, subsequently enters into a chemical compound with less active cement particles, and partly fills the numerous pores and capillaries in the cement stone and the cavities between the grains of the coarse aggregate, and then, gradually evaporating, releases them. According to research data, pores occupy about one-third of the cement stone volume; with a decrease in the water-cement ratio, the porosity of the cement stone decreases and the strength of the concrete increases. Therefore, in the factory production of reinforced concrete products, mainly rigid concrete mixtures with a lower W/C value are used, which also require less cement consumption and shorter shelf life for products in molds [5-6].

Thus, the structure of concrete turns out to be quite heterogeneous: it is formed as a spaced lattice of cement stone filled with grains of sand and gravel of various sizes and shapes, penetrated by a large number of microspores and capillaries, which contain chemically unbound water, water vapor, and air. Physically, concrete is a capillary-porous material in which the integrity of the mass is disrupted and all three phases - solid, liquid, and gaseous - are present. Cement stone also has a heterogeneous structure and consists of an elastic crystalline fusion and a viscous gel mass that fills it[7-8].

The prolonged processes occurring in concrete, the change in water balance, the decrease in the volume of the hardening gel, and the growth of elastic crystalline inclusions endow concrete with elastic-plastic properties. These properties are manifested in the nature of concrete deformation under load, in its interaction with the ambient temperature and humidity regime.

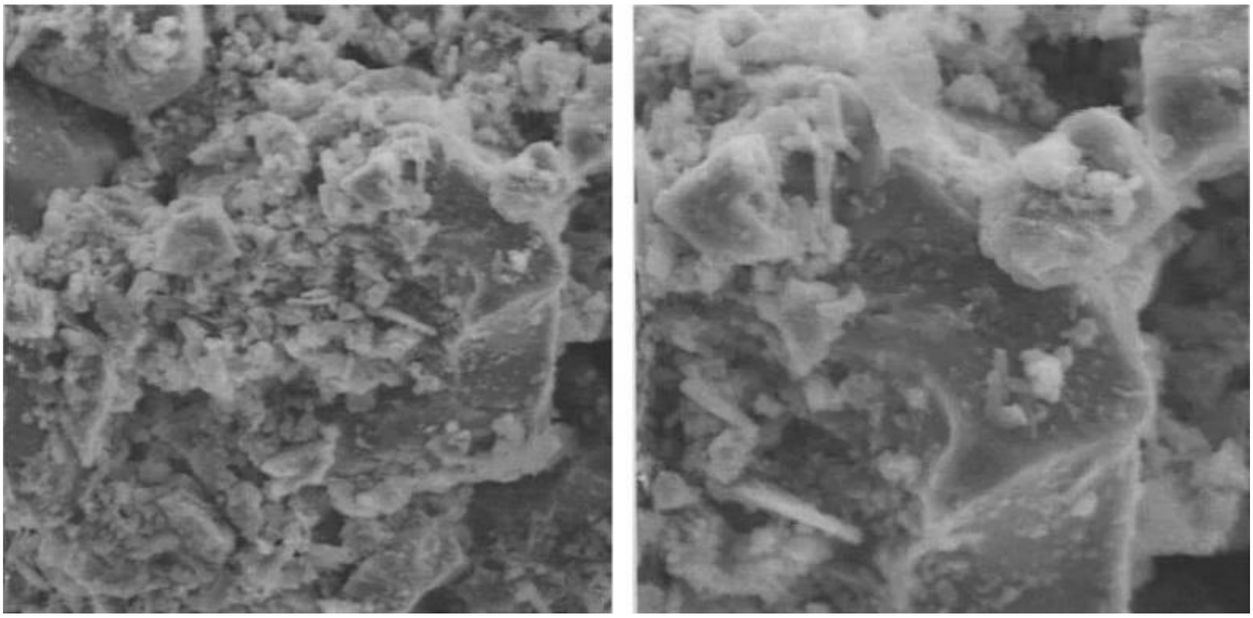

Figure 1. Cement stone under varying increase in the surface of low-gravel concrete

Studies have shown that existing known strength theories are inapplicable to concrete. The relationship between the composition, structure, strength, and deformation of concrete represents a problem that researchers solve for each type of concrete based on its characteristics (see above). Judgments about the strength and deformability of concrete are based on a large number of experiments conducted under laboratory conditions.

Physical and mechanical properties of low-gravel concrete

The greater the water absorption, the greater the number of interconnected capillary pores in the concrete. To reduce it, concrete is hydrophobized or steam and waterproofing of concrete structures are installed [9-10].

Frost resistance. The highest value is found in Portland cement concretes without mineral additives, with a C3A content of less than 5%. They are used for hydraulic structures in zones of variable water levels in harsh climatic conditions. Alumina cement concretes have even

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higher frost resistance. Low frost resistance in concretes based on SPC and PPC with active mineral additives of sedimentary origin (diatomites, opokas, trepels).

Table 1

Indicator list	Examples	
	Traditional composition of MZB	Proposed MSB composition
Sample density, kg/m^3	23:15.	2410.
Compressive strength at 7 days, R_1 MPa	15.0	12.5.
Compression strength after 28 days, R_3 MPa	B22.5 (26.9)	22.5 (27.4)
Water absorption capacity, %	5.5.	3.7.
Frost resistance, cycles F	150.	150.

Frost resistance is increased by:

By reducing the water-cement ratio by introducing surfactants: LST, soapwort, GKJ-10, GKJ-11 and others, which form short-circuited pores. Using hard concrete mixtures that are intensively compacted during laying. Hydrophobization (volumetric or surface), which reduces the water absorption of concrete. Application of frost-resistant aggregates: high-grade PCs of finer grinding with C3A less than 5% or alumina cement. Frost resistance grades: from F50 to F1000. They are selected based on climatic conditions and the number of water horizon changes during the winter on the concrete surface being washed. The concrete for bridges and roads is branded as VHP F50, F100, F200. For hydraulic concrete - up to F500. Water resistance. Pores up to 0.001 mm in diameter are practically waterproof. Material with large communicating pores is water-permeable. Water resistance is characterized by the highest water pressure (MPa) under which it does not seep through concrete that has hardened for 180 days. Water resistance grades: W0.2, W0.4, W0.6, W0.8, W1, W1.2, W1.4, W1.6, W1.8, W2.

Conclusion

The importance of concrete as a building material cannot be overestimated. Currently, the vast majority of industrial, residential, public, cultural, sports, trade, and other facilities worldwide are built using it. Undoubtedly, in the future, it will retain its role as the main building and structural material.

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