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Functional Characteristics and Energy Intensity of Concretes

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Abstract: The development of the national economy is realized mainly through capacity building activities. In turn, the level and effectiveness of the construction directly related to the production of construction materials, depending on their quality. Among the building materials in the last century the leading place in the world held the concrete. In addition to the functionality of the concrete is now all the more important characteristic is the energy intensity of production. A comparison of standard functional characteristics, energy consumption and the market value of concrete, makes it possible to identify the most effective ones in terms of the prospects for the further development of the industry of concrete and reinforced concrete structures.

Key words:

INTRODUCTION

Among the building materials in the last century the leading place in the world held the concrete. In the twentieth century, only in Russia has been used more than 21 billion cubic meters of concrete and reinforced concrete. To manufacture it took more than 70% of the total cement production and 30% of non-metallic building materials. In terms of value for concrete and reinforced concrete accounts for about 60% of the value of all the materials used in the construction of [1, 11].

In the XXI century, concrete is a major material for construction. Today apply more than one hundred different types of concrete - from extra light with a density of 200 kg/m3 - to especially strong with the strength of more than 100 MPa and a variety of special concrete complexes with different properties [2, 11].

The relative simplicity and accessibility of concrete technology, ample opportunity to use local and man-made industrial raw materials, reasonable price and wide opportunity in the incarnation of different architectural solutions - all of this is a guarantee of widespread use of concrete in construction.

Today, the term "concrete" refers to a wide range of different composite construction hydration and other types of hardening. Here and normal-weight concrete and lightweight cellular concrete and concrete with porous aggregates, solutions, pastes and concretes and special concretes, including the use of polymer components and various binders. Diverse in its functional characteristics, they are designed for a variety of applications [3, 12].

In addition to the functionality of the concrete is now all the more important characteristic is the energy intensity of production. This figure is not only an indicator of environmental technologies, but also has a great influence on the cost of production and, consequently, its competitiveness in the market.

MATERIALS AND METHODS

The main functional characteristics of concretes of a various type of regulated standards. A comparison of standard functional characteristics, energy consumption and the market value of concrete, using a point scoring system that allows to bring all of these indicators in a comparable form, makes it possible to identify the most effective ones in terms of the prospects for the further development of the industry of concrete and reinforced concrete structures.

The Main Part: The strength characteristics of the three types of concrete, regulated of state standard, [4, 5, 6] are presented in Figure 1.

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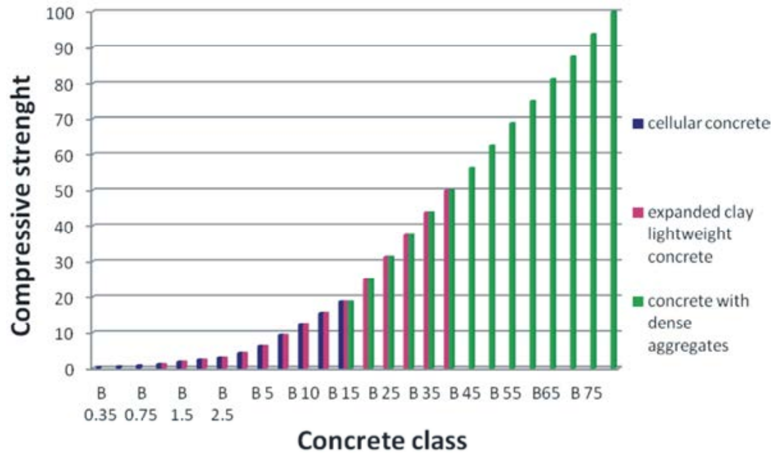

Fig. 1: Compressive strength of concretes of different types and classes

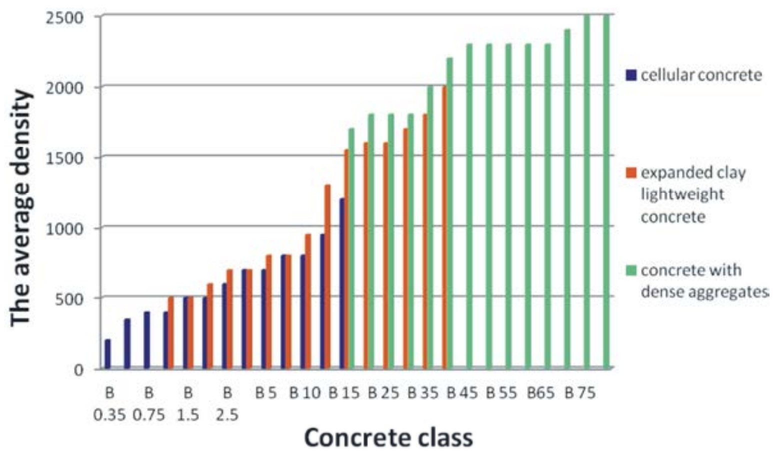

Fig. 2: The ratio of the average density of different types of concretes and their strength [4, 5, 6]

The same class of concrete can be assigned to a cellular and lightweight aggregate concrete. The same can be noted in the analysis of concrete classes for dense and porous aggregates. This means that the concrete with porous aggregates in the construction industry can practically be replaced by cellular and concrete on the dense aggregates.

Many indicators of concrete properties depend on its average density, which affect the value of the average density of cement stone, type of aggregate and concrete structure [2].

Concretes having a different structure, composition and the strength class can have the same average density. The average density of the concrete with porous aggregates are slightly higher than those of similar classes of cellular concrete for strength. Priorities in this situation is also quite obvious. Concrete permeability caused characteristics of its structure, namely the presence of a large number of pores. This does not mean that an increase in the number of pores increases water permeability of concrete. It depends not only on the number, but largely on the shape and nature of □pores.

Found that the diameter of the capillaries to 0.3 microns is waterproof. Water resistance of concrete depends on the amount and type of pore ratio of the starting materials, the selection of the composition of the concrete mixture and the nature of its placement [2].

Great impact on the water resistance of concrete have aggregates. Concrete mix for making watertight structures have to be prepared from aggregates of dense rock. They require less water and mixing well packed in concrete.

Figure 3 shows the change in water resistance of concrete of different types depending on the strength class [4, 5, 6].

Water resistance of porous concrete with the more perfect nature of the pore structure is slightly higher than that of lightweight aggregate concrete of the same classes.

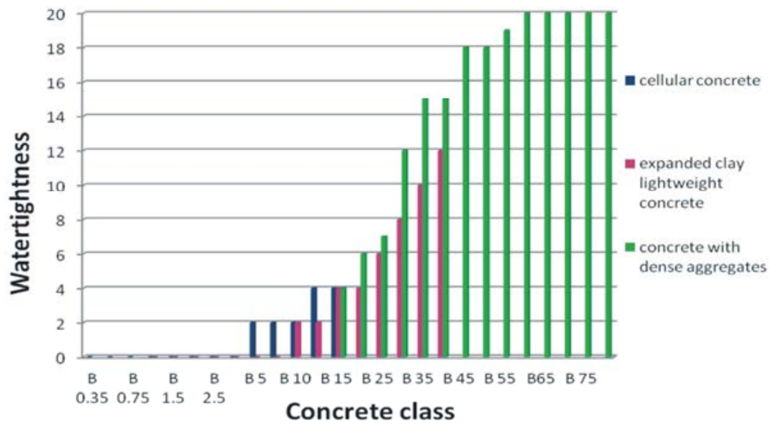

Fig. 3: Water-resistant of concretes of different types and classes

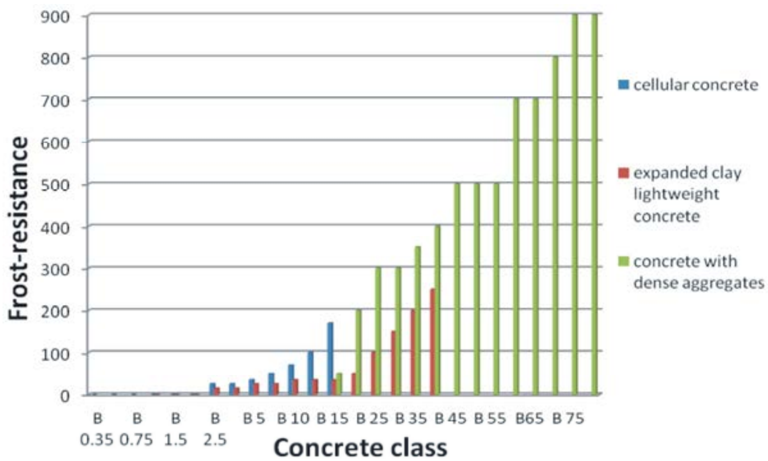

Fig. 4: Frost resistance of concretes of different types and classes

Frost resistance of concrete is also determined mainly by the nature of porosity in determining the amount of ice and its distribution in the structure of the concrete. Porosity depends on the nature of the value of the stresses in the concrete and the speed of the processes of destruction of the structure.

The micropores of concrete have little effect on its frost resistance, as related to water are usually never goes into ice even at extremely low temperatures, greater the effect of the volume and structure of macropores.

Figure shows that cellular concrete frost slightly higher than keramsit low classes because of improved porousstructure, more uniformity of material.

Thermal conductivity - one of the most important property of the concrete. The easier it is concrete, so as a rule, less than the thermal conductivity, since the decrease in the density of concrete due to the increase of porosity, that is, with involvement in the concrete volume of air, which is an excellent heat insulator in small pores.

Figure 5 showing the thermal conductivity of different concrete classes and types [4, 5, 6].

According to the diagram thermal conductivity of cellular concrete is much lower than that of concrete with porous aggregates. For Class B 15 - B45 structural concrete indicators of thermal conductivity is generally not important.

The cost increases with concrete strength class. This is due to increased consumption of energy-intensive and expensive binder.

Also on the cost of the concrete affects appearance and consumption of other components: sand, coarse aggregate and additives. One of the biggest cost items are the direct and indirect production costs.

Figure 6 shows a diagram of the concrete value of different types and classes

The diagram shows that the cost of cellular and heavy concrete slightly lower cost of similar expanded clay concrete classes.

Energy intensity of concrete and concrete products can vary within a large enough and determined by the composition of concrete and production technology.

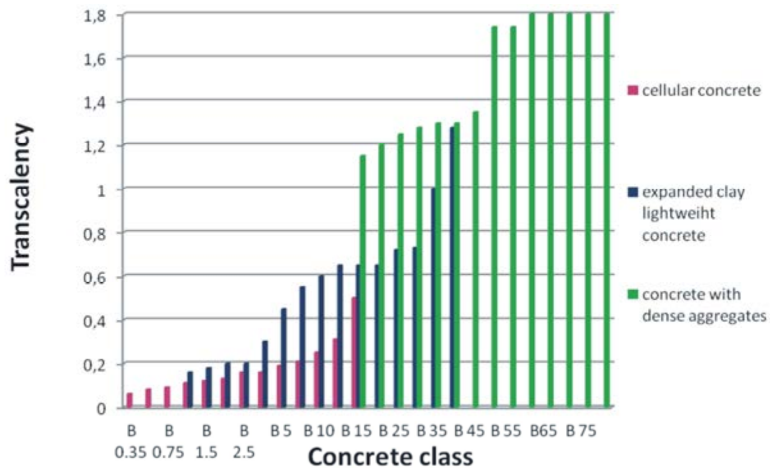

Fig. 5: Transcalency of concretes of different types and classes

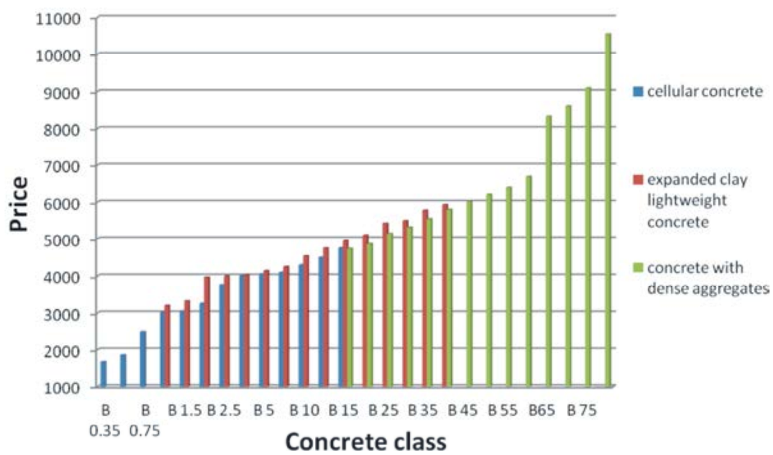

Fig. 6: Price of concretes of different types and classes [7]

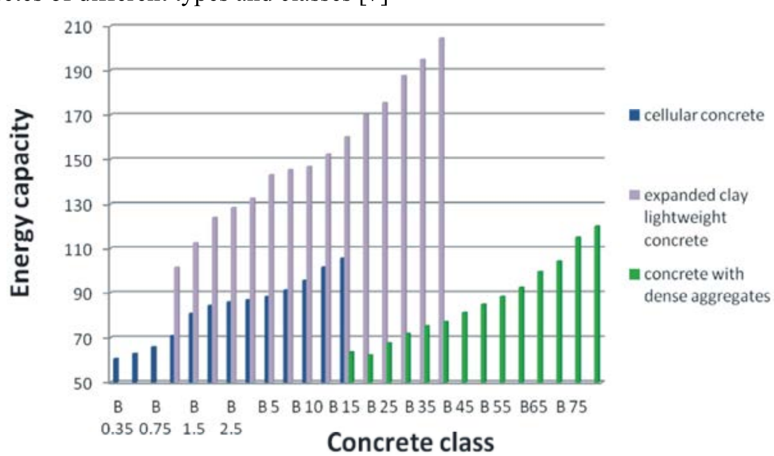

Fig. 7: Indirect energy consumption of different classes of concretes

The share of indirect and direct costs of thermal power accounts for about 90% and electricity - 10%.

Growth of indirect energy heavy concrete with increasing its class mainly caused increased flow of Portland cement, as the most energy-intensive part of concrete.

Energy intensity of small and coarse aggregate insignificant compared to the energy content of cement.

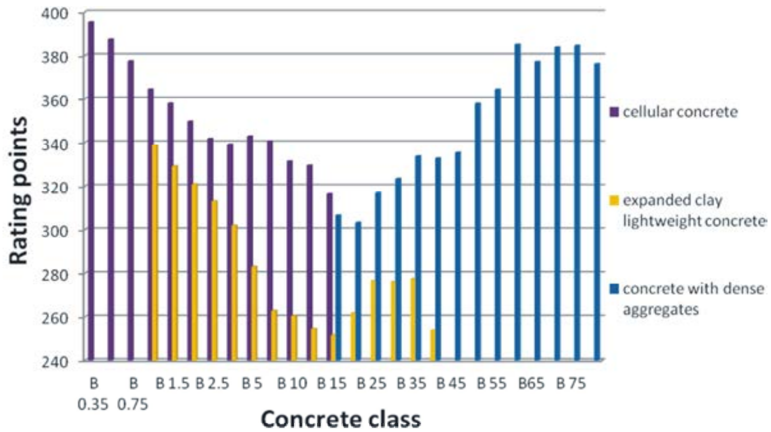

Fig. 8: Rating points of concretes of different types and classes

Concretes with porous aggregates have more energy capacity than the concrete on the dense aggregates. This fact is caused that energy capacity of synthetic porous aggregates is 10-30 times higher than the energy capacity of dense aggregates [9].

Indirect energy capacity of expanded clay concrete in 1.5-2 times higher than the energy capacity of cellular concrete and dense aggregates concrete because of the use of aggregate with a large energy capacity.

Conclude. All of the functional characteristics of concretes were scored with the rating points. This allowed the sum them and to present the final results in a diagram in Figure 8.

CONCLUSIONS

The highest scores were low-classes cellular concrete and concrete with the dense aggregates on solid high-class strength. The use of concrete in buildings is most effective in terms of bearing capacity of structures, efficient thermal protection, low material. The practice of modern construction confirms these calculations.

Expanded clay concrete on all counts inferior cellular and dense aggregates concrete of similar classes. It is the most energy-intensive concrete. This makes it possible to conclude that the prospects for industrial development of concrete with porous aggregates is very questionable.

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