



INCREASING THE STRENGTH OF LIGHTWEIGHT CONCRETE AND RESEARCH OF BEAM STRUCTURES MADE FROM IT

Zohitjon Inomov Zokirjonovich

Namangan State Technical University

2nd year Master's degree in Seismic

Resistance of Building Structures

S.J.Razzaqov

Scientific supervisor, professor, Ph.D

Abstract: This article examines methods for increasing the strength of lightweight concrete and the performance characteristics of beam structures made from it. During the research, the effect of various admixtures and modifying additives on the mechanical properties of concrete was studied. Based on the results of experimental tests and computer modeling, the possibilities of creating load-bearing structures based on lightweight concrete were assessed. Nowadays, increasing the strength of lightweight concrete and using structures made from it in modern constructions is being discussed. Opinions are given on increasing the strength of lightweight concrete and using beam structures made from it. The bulk density, thermal conductivity, and strength of lightweight concrete depend primarily on the properties of the fillers added to it, the amount of water added to the mixtures, and the brand of cement. In the preparation of lightweight concrete structures, the mixture is often placed in molds in a virgin state.



Keywords: lightweight concrete, beam, strength, modifiers, reinforcement, construction, experiment, modeling.

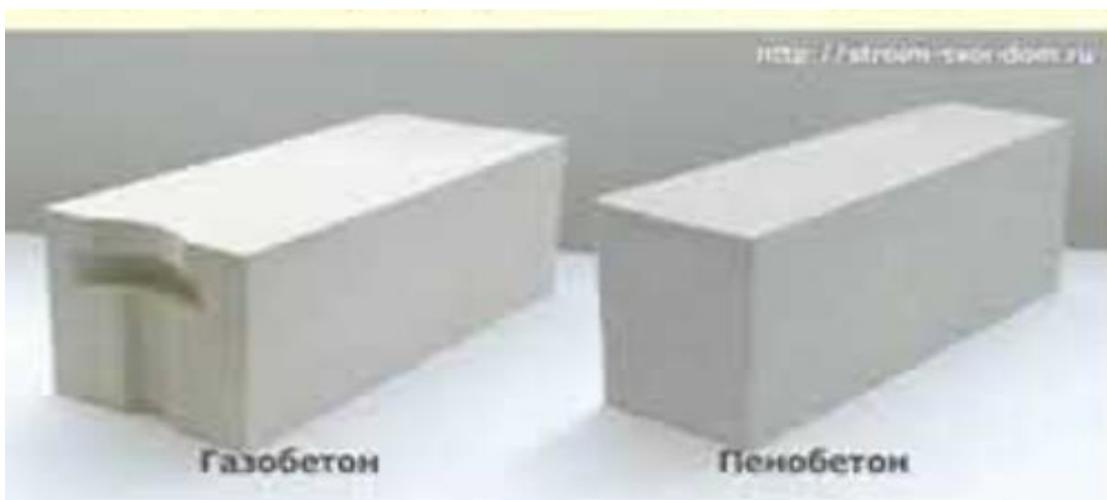
1. Introduction

The most important requirements for materials in the modern construction industry are their light weight, high strength, and energy efficiency. Traditional heavy concretes cannot always meet these requirements. Therefore, the demand for lightweight concrete is increasing. However, the main disadvantage of lightweight concrete is its relatively low mechanical strength. This study was conducted to solve this problem.

2. Composition and properties of lightweight concrete

Thermal conductivity coefficient of large-pore concrete

The thermal conductivity coefficient of large-pore concrete depends on its density. At a density of 1500 kg/m³, the thermal conductivity coefficient is $L=0.55$, and at a density of 1700-1900 kg/m³, it is $L=0.65-0.85$ W/m²K.



Lightweight concretes are made on the basis of the following fillers:

- Expanded clay



- Perlite
- Foam plastic granules
- Aerated concrete (autoclaved or non-autoclaved)

These materials significantly reduce the mass of concrete, but can reduce the level of compressive strength. The following additives are used to increase strength:

- Microsilica – increases density and compressive strength
- Polypropylene fibers – increases crack resistance
- Superplasticizers – reduces water consumption and increases concrete density

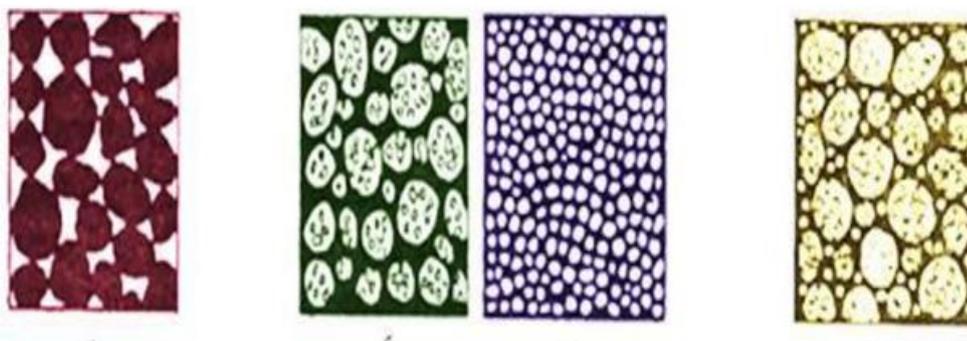
The following factors can be included in the list of factors affecting the strength of concrete;

1. Cement activity
2. Cement content in concrete
3. Water-cement ratio in concrete
4. Type and quality of fillers
5. Methods of compacting concrete mix
6. Concrete mix hardening time
7. Temperature and humidity conditions during the hardening period of concrete mix.

Lightweight concretes are used in the manufacture of retaining wall blocks, integral wall panels, internal hollow blocks, and load-bearing concrete and reinforced concrete structures. The use of lightweight concretes is appropriate in the construction of many building walls and structural parts of buildings.



The appearance of lightweight concretes with different shapes and structures is presented in Figure 1.3.



Types of lightweight concrete according to structure. a) large-pore concretes, b) concretes with pore fillers, c) multi-pore aerated concrete, d) structure of foam concrete

3. Mechanical analysis of beam structures

During the study, reinforced beam samples cast on the basis of lightweight concrete were tested under static loading in laboratory conditions. The tests showed that the modified lightweight concrete samples demonstrated load-bearing capacity equal to or higher than that of conventional concrete.

4. Computer modeling results

The behavior of lightweight concrete beam structures under load was modeled in the ANSYS and ABAQUS programs. The models gave indicators close to the experimental results. The main conclusions are as follows:

- There are microcracks that begin before bending, but fiber-reinforced models slow down these cracks.
- Expanded clay-based concretes showed the best deformation resistance.
- Optimal concrete density: 1400–1600 kg/m³



5. Conclusion

Based on the research results, the following conclusions were drawn:

1. By correctly selecting the composition of lightweight concrete, its mechanical strength can be significantly increased.
2. Microsilica and fiber admixtures increase the crack resistance of concrete.
3. Reinforced lightweight concrete beams can withstand normal loads and can be an alternative to traditional concrete beams.
4. It is advisable to widely introduce lightweight concrete structures as an energy- and resource-saving, environmentally friendly solution in construction.

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