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Properties of Non-Autoclaved Cellular Concrete under Pure Shear Conditions

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Abstract. The results are presented and the analysis experimentally established that the shear modulus of non-autoclaved aerated concrete, established by experiments under pure shear conditions, is 1200 MPa, which is GB=0.41EB. The strength of non-autoclaved aerated concrete with biaxial "compression-compression" increases. The largest increase is 20% with the ratio of the main compressive stresses of 0.4-0.6, and with uniform compression this increase is 8 - 10%. It was experimentally established that the strength of non-autoclaved non-autoclaved aerated concrete with biaxial "compression-tension" is 13.5 % lower than with axial tension.

Key words: tests, load, non-autoclave, values, aerated concrete, experiment, strength.

Non-autoclaved cellular concrete in construction is mainly used for the production of fencing structures as a structural and heat-insulating material. The main types of non-autoclaved cellular concrete products are as follows: small wall blocks, reinforced and non-reinforced large wall blocks, reinforced wall panels, reinforced roof and attic floor slabs, heat-insulating slabs.

However, despite the existing experience in the production and use of non-autoclaved cellular concrete, their scope in construction remains limited. One of the reasons hindering wide application is the insufficiency of the conducted studies.

In this regard, the Research Institute of Concrete and Reinforced Concrete carried out complex experimental and theoretical studies of the operation of the based varieties of non-autoclaved cellular concrete, both under short-term and long-term compressive loads, as well as under a biaxial stress state.

Tests of non-autoclaved aerated concrete samples with dimensions of 15x15x15 cm were carried out 162 days from the date of their manufacture under conditions of a biaxial stress state “compression-tension”, equivalent to pure shear

$G_1 = - G_2 = \tau_{XY}$ (1)

According to [1,2,3], when a “compression-tension” load is applied to the test sample, with equal in magnitude and opposite in sign of the main stresses G1 and G2, an element isolated inside with sides located at an angle of 45° to the main axes of the sample will be be in pure shear conditions, i.e. only tangential stresses τxy will act on the faces of this element.

The measure of deformation caused by shear stresses is characterized by the shear angle or simply shear deformation γ, which is related to the shear modulus GB and the magnitude of shear stresses τxy by the following relation

$G_B = \tau_{xy} / \gamma$ (2)

where γ is the shear angle, which is defined as twice the elongation strains of the diagonals of the element, along the edges of which shear stresses act in the zone of elastic operation of non-autoclaved aerated concrete. In order to avoid the influence of the presence of shrinkage cracks in cubes, shortening deformations were not taken into account.

When testing tensile and compressive strains, the readings were measured with wire strain gauges with a base of 50 mm using an AID-IM strain gauge. For the purpose of mutual control, strain gauges were glued symmetrically on opposite faces of the sample, free from loading, and their direction would coincide with the diagonals of the sample element, along the faces of which shear stresses act.

Before testing in biaxial “tension-compression”, in order to identify the effect of friction on the strength in uniaxial compression and tension, some of the prototypes were tested on the same installation with the elimination of friction.

The results of these tests are shown in table 1 and in fig. 1 a, b. Note: in the table, the value of ρ is given in a naturally humid state.

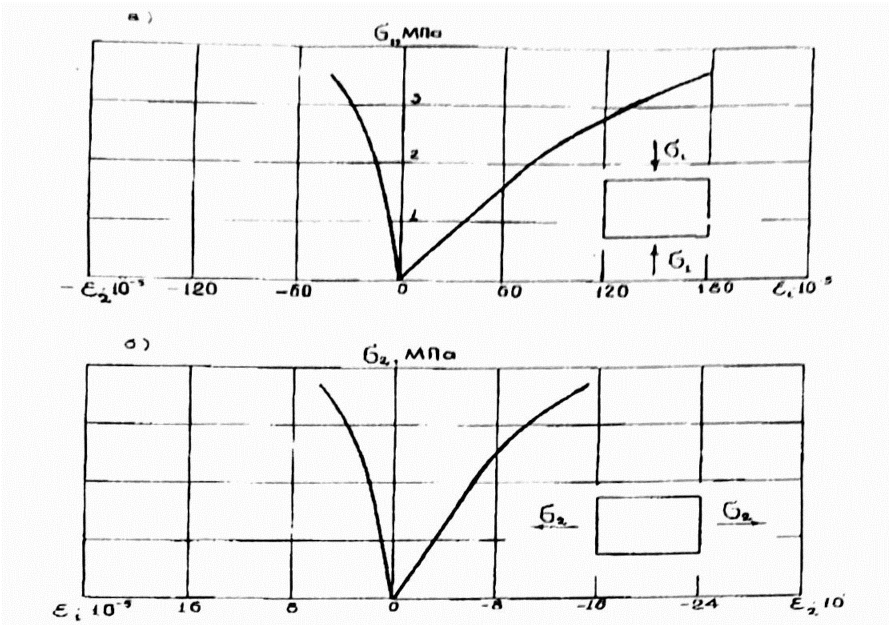
The results of comparison of experimental data obtained in uniaxial compression and tension with friction elimination with experimental data obtained under the same loads without friction elimination (see Ch. 2.4, Table 2.3) show that the elimination of friction in the bearing surfaces led to a decrease in strength when compressed by an average of 12%. And the tensile strength, determined using self-centering grippers, decreased by 6.5%. The results obtained are consistent with the previously obtained experimental data on other types of concrete, in [4,5,6].

Table 1 Results of tests in uniaxial compression and tension with the elimination of friction.

Series number (according to table 2.1; 2.2 and 2.3)	Type of test	ρ, kg/m^3	R, Mpa	Deformation at the moment Blending 10 – 5
IX	under axial compression.	1191	3,55	177,5
	With axial tension	1124	0,37	15,25

The destruction of the samples tested with the elimination of friction in axial compression occurs due to longitudinal cracks parallel to the action of the compressive force. And with axial tension, their destruction occurs along a plane perpendicular to the action of tensile stresses.

In tests for biaxial “tension-compression” (in pure shear), it was found that redistribution stresses are 13.5% lower than in axial tension, i.e. is 0.32 MPa.



Drawing. 1. The nature of the change in the relative deformations of non-autoclaved aerated concrete (on non-ground sand, series IX) under central compression - a and tension - b) (with the elimination of the effect of friction).

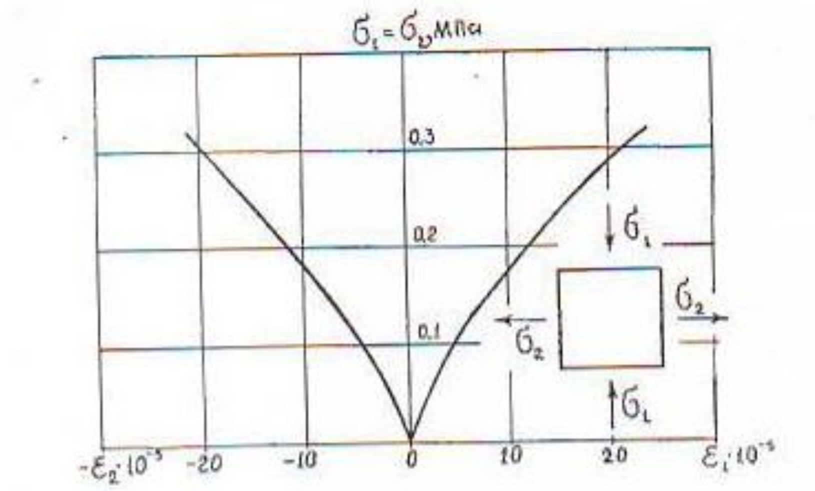
Similar results were obtained in [7, 8]. The results of measurement of relative deformations are presented in fig. 2. From fig. 2 it can be seen that the nature of the change in the relative deformations of shortening and elongation is almost the same. However, to calculate the shear modulus using formula (2), elongation deformations were taken into account. At the same time, it was determined that the values of the shear modulus of non-autoclaved aerated concrete is 1200 MPa, which is equal to 0.414 of its initial compressive modulus.

Also, according to the results of tests of 6 prisms with a size of 15x15x60 cm under axial compression without eliminating friction, the shear modulus of non-autoclaved aerated concrete was determined using the well-known formula:

$G_B = E_B / 2(1+\mu)$ (3)

Where: $E_B = 2900$ MPa, μ=0,21.

The value of the shear modulus according to formula (3) is 1198 MPa, т.е. 0,413* E_B.



Drawing. 2. Changes in relative deformations of non-autoclaved aerated concrete under pure shear conditions.

Conclusion

1. Thus, it was experimentally established that the shear modulus of non-autoclaved aerated concrete, established by experiments under pure shear conditions, is 1200 MPa, which is the value G_B=0,41E_B.
2. The strength of non-autoclaved aerated concrete with biaxial "compression-compression" increases. The largest increase is 20% with the ratio of the main compressive stresses 0.4 - 0.6, and with uniform compression this increase is 8 - 10%.
3. It was experimentally established that the strength of non-autoclaved aerated concrete in biaxial "compression-tension" is 13.5% lower than in axial tension.

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