SJIF Impact Factor (2023): 8.574| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 8 | Issue: 4 | April 2023 - Peer Reviewed Journal

ADAPTABILITY OF THE PHYSICAL AND MECHANICAL PROPERTIES OF SELF-COMPACTING EXPANDED CLAY CONCRETE FOR USE IN MULTILAYER STRUCTURES

Yunusaliyev E.M.[1], Usmonov S.B.[2]
[1]*Candidate of Technical Sciences, Fergana Polytechnic Institute*
[2]*Master Student, Group M 1-21, CBS*

ABSTRACT
The article reveals an analysis of the physical and mechanical properties of self-compacting expanded clay concrete and the relevance of its use in multilayer structures (reinforced concrete floors). The ratios of the bending and shear strengths of expanded clay concrete are determined, and on the basis of the analysis, data on the parameters of the "stress and strain" diagram are obtained.
KEY WORDS: *Self-compacting expanded clay concrete, reinforced concrete floor, tensile strength, tension and compression, concrete mixture, deformation*

INTRODUCTION
For the first time, the principles of designing reinforced concrete elements with layers from concretes of different densities were developed in the early thirties of the last century. Such structures are promising due to the combination of a number of necessary functions in them - load-bearing, heat and sound insulating. The most widely used in construction are two- and three-layer structures, which are used as floor and ceiling slabs, wall fencing panels, etc. [1]. In recent years, new types of multilayer structures have been used in construction practice - load-bearing three-layer wall panels of one-story industrial buildings. The use of the latter makes it possible to exclude columns and foundation beams, and to reduce labor costs for installation.

EXPANDED CLAY CONCRETE IN MULTILAYER STRUCTURES
The use of lightweight concrete on porous aggregates makes it possible to create efficient structures, their advantage in relatively low weight opens up wide opportunities in the field of improving the load-bearing and enclosing structures of buildings and structures. The introduction of studies of lightweight concrete is actively used in modern construction [2]. When developing multilayer structures, the use of highly mobile, including self-compacting concrete mixes, is of particular importance, providing high productivity and quality of work by eliminating the need for vibrocompacting machines and mechanisms [3]. In turn, the technology for manufacturing self-compacting lightweight concrete mixtures is more complicated than the technology for manufacturing concrete mixtures on dense aggregates, since there is a special specificity of mass transfer processes in self-compacting concrete mixtures made on porous aggregate.

According to GOST 25820, structural lightweight concretes must have an average density grade not higher than D2000, a compressive strength class not lower than B12.5. Of all lightweight concretes on porous aggregates widely used in construction, expanded clay concrete is the most common. According to GOST 25820, structural expanded clay concrete is divided into strength classes B12.5 - B40 and grades by average density D1100 - D2000.
In SP 63.13330, lightweight concrete of strength classes from B12.5 to B40 and a grade of average density from D1100 to D2000 are characterized by an axial tensile strength class from Bt 1.2 to Bt 3.2, an initial modulus of elasticity E0 from 10.0 to 23.5 MPa.

Any special conditions for lightweight concretes obtained from self-compacting concrete mixtures are not specified in the standards.

Of particular importance is the relevance of scientific research into the influence of recipe-technological factors on the properties of self-compacting mixtures and concretes made on porous aggregates. Numerous works are devoted to the study of the issues of structure formation and the interdependence of the properties of expanded clay concrete with its composition and structure, in connection with the numerous advantages of expanded clay concrete, research continues at the present time. High-strength lightweight concretes have already been developed with a compressive strength of 40 to 60 MPa at an average density of 1300–1500 kg/m3. Lightweight concretes with a compressive strength class up to B115 have been described. However, there are practically no data on the experience of using lightweight self-compacting concretes, especially on the structural properties of these concretes.

SJIF Impact Factor (2023): 8.574| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 8 | Issue: 4 | April 2023 - Peer Reviewed Journal

In [5], information is given on the properties of concretes obtained from self-compacting concrete mixtures with a cone flow diameter of 85 to 97 cm, made on natural porous aggregates of Kabardino-Balkaria. The concretes obtained in [5] with a grade of average density D1800 are characterized by a compressive strength from 31 to 57 MPa (B20 - B45), a prism strength coefficient from 0.83 to 0.96, a ratio of tensile strengths from 0.04 to 0, 05 for tensile splitting and compression; ratio of flexural and compressive strengths from 0.09 to 0.11, Poisson's ratio from 0.128 to 0.15, initial modulus of elasticity from 15.7 to 23.4 MPa, shrinkage value up to 0.86 mm/m, creep measure from 9.43·10-5 to 15.23·10-5 MPa-1, adhesion strength of reinforcement of periodic profile A400 with light self-compacting tuff concretes of class B20 - B45 from 10.75 to 11.55 MPa. There are no data on deformation and strength properties of structural self-compacting expanded clay concrete in [5]

Calculations on the dependencies that establish the relationship between the strength and deformation properties of concrete, taking into account their average density [6,8], show that expanded clay concrete of strength classes B12.5 - B25 - B40 grades for average density D1100 - D1600 - D2000 can have the values of the initial modulus of elasticity of concrete are about 8.2 - 18.2 - 30 GPa. It should be noted that in [6,8] it is not specified whether it is possible to apply these dependencies for self-compacting concretes. It should be borne in mind that, according to, self-compacting concretes, due to a higher concentration of the mortar component, have some differences in the values of deformation properties, when compared with traditional vibration-compacted concretes.

In particular, in relation to structural expanded clay concrete, it follows from this that self-compacting expanded clay concrete on dense sand will have elastic modulus values intermediate between fine-grained and expanded clay concretes of vibration compaction. In the case of porous sand, the forecast is complicated by the fact that, due to the lower modulus of elasticity of fine aggregate, a lower value of the modulus of elasticity of concrete is expected. But due to the need to achieve the required class of concrete to provide a higher strength, and, consequently, a higher modulus of elasticity of the cement stone, in this case the resulting effect becomes difficult to predict. The possibility of applying formulas relating the value of the modulus of elasticity of concrete with the concentration and deformation properties of its macrostructure elements is limited due to the lack of reliable information on the quantitative values of the deformation characteristics of structural elements (cement stone, porous filler). The same can be attributed to the possibility of predicting both shrinkage deformations and creep deformations [4] of self-compacting structural expanded clay concrete.

As is known, the adhesion of concrete to reinforcement and the adhesion of concrete to previously laid concrete is determined, among other things, by the tensile strength of concrete by stretching. Expanded clay concrete, in contrast to heavy concrete, with equal compressive strength, has lower values of tensile strength. The peculiarity of the destruction of expanded clay concrete in axial tension is that the destruction occurs due to the rupture of the mortar component and the porous filler, a rupture in the contact zone is usually not observed [4,7]. Heavy concrete of medium classes is characterized by a gap in the solution component and in the contact zone. When analyzing the adhesion of expanded clay concrete with reinforcement or with previously laid concrete, it should be borne in mind that these types of adhesion, especially the adhesion of "old" and "new" concrete, will be determined by the adhesion of cement stone and the tensile strength of cement stone. Cement stone of expanded clay concrete of equal strength with heavy concrete is characterized by a lower value of (W / C) ist and, consequently, higher strength, incl. to axial tension, in connection with which one can expect high values of the considered parameters.

Due to the urgency of the problem of reducing the mass of buildings, it is obvious that it is expedient to use lightweight concrete or combined structures, for example, in reinforced concrete floors [4], but the use of lightweight concrete due to the reduced value of its initial modulus of elasticity can cause a floor stiffening problem. In multi-layer or combined floor structures containing layers of heavy concrete - providing rigidity and lightweight concrete- providing weight reduction, there may be a problem of adhesion of different-modulus concretes, insufficient in magnitude for the perception of stresses at the contact of the layers.

The nature of the possible destruction of the multilayer structure of the ceiling will be determined by the ratio of the ultimate strength of concrete for shear and bending.

The shear strength of concrete is determined by the well-known Mersch formula

$$R_{cut} = 0.5 * \sqrt{R * R_t} \qquad \_\_\_\_\_\_ \quad (1.1)$$

where R, Rt are the compressive and axial tensile strengths of concrete, respectively, MPa,
The ultimate strength of concrete for axial tension and compression are related by the following relationship

$$R_t = a * R^{0.6} \quad (1.2)$$

in which the coefficient α for heavy concrete and light concrete on porous aggregates is 0.29 and 0.27, respectively.

SJIF Impact Factor (2023): 8.574| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 8 | Issue: 4 | April 2023 - Peer Reviewed Journal

The tensile strength of concrete in bending and the compressive strength are related by the following relationship

$$R_f = 0.29 * R^{0.74} \qquad (1.3)$$

Determining the ratio of bending and shear strengths depending on the class and type of concrete is an urgent task today.
Based on the performed analysis, it is necessary to obtain data on the parameters of the "stress-strain" diagram during short-term central axial compression of structural expanded clay concrete obtained from self-compacting concrete mixtures and to investigate the adhesion of this concrete to heavy concrete of various ages.

CONCLUSION

One of the promising types of concrete for the middle layer of three-layer floors is self-compacting expanded clay concrete, which, when laid over a layer of heavy concrete, does not violate its structure formed during the manufacturing process.

REFERENCES

1. *Akopov, V.G. Bearing capacity of three-layer reinforced concrete floor slabs // Problems of intensification and improvement of production culture. - Rostov n / a: SKNTS VSh, 1987.*
2. *Belyaev, A.V. To the definition of shear stresses in bending layered reinforced concrete elements / A.V. Belyaev, D.R. Mailyan, G.V. Nesvetaev // Industrial and civil construction. - 2017. - No. 1.*
3. *Bazhenov, Yu.M., Korol, E.A., Erofeev, V.T. Enclosing structures using low thermal conductivity concretes. Fundamentals of theory, methods of calculation and technological design. - M: DIA, 2008 ..4.Давидюк, А.Н., Маилян, Д.Р., Несветаев, Г.В.*
4. *Self-compacting high-strength and lightweight concretes based on porous aggregates for effective structures // Tekhnologii betonov. - 2011. - No. 1-2*
5. *Bychkov, M.V. Composition, structure and properties of light structural self-compacting tuff concretes: Abstract of the thesis. dis. ... cand. tech. Sciences. - Rostov n / a, 2013.*
6. *https://core.ac.uk/download/pdf/82315081.*
7. *https://www.mdpi.com/2076-3417/11/16/7634/htm*
8. *https://vestt.com.ua/en/news/foam-concrete-blocks/*