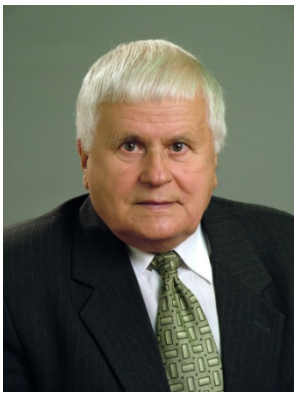
UDK 624

Experimental research of strain-stress state of ferrocement slabs of composite reinforced concrete structure elements



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Abstract

The results of experimental researches of ferrocement slabs of composite reinforced concrete structure elements as applied to metal mining industry are considered. Sequence and requirements for manufacturing of reinforcing bracings and concrete composition for slabs are described. The data concerning detector elements arrangement on the slab and the process of experimentation is given. The results of experimental researches of ferrocement slabs are provided and dependency diagrams of deformations on the load are constructed.

Key words: COMPOSITE REINFORCED CONCRETE, FERROCEMENT, CONSTRUCTION, SLAB.

Problem statement. In modern practice composite constructions, which combine various materials for mutual and effective work, are applied rather often. Application of armoured cement in bearing constructions significantly reduces its mass.

Assemblage rates, stiffness at small mass, small amount of unit sizes, easiness of transportation are important during building of an

object from built-up constructions. Composite reinforced concrete structural constructions fully conform to above mentioned requirements and that is why they should be analyzed and studied in a detailed way.

Analysis of the latest researches and publications. Composite reinforced concrete structural constructions have commonly used during building of industrial objects both of construction engineering sector and mining industry [1, 2]. Investigation of composite reinforced concrete structural constructions proves that they support great loads and herewith retain spatial stability [3]. At present the main researches are devoted to the study of constructions work in common [4].

Definition of unsettled parts of general problem. On the basis of analysis the latest researches there was determined a part of general problem – the absence of experimental researches of ferrocement slabs of composite reinforced concrete elements as applied to metal mining industry.

The aim of this work is experimental research of ferrocement slabs of separate elements of composite reinforced concrete structural constructions with determination of the character of their work under the influence of load, validation of accepted method of reinforcing and mutual work of steel and concrete.

Base material for research. Composite reinforced concrete structural construction combines steel and concrete and consists of slabs and cores, i.e. it is flat-core space system [1], which may be used in mining industry as the mount system of horizontal and vertical mine openings, ways, also as battering wall. In all cases all the load from the ground is taken by ferrocement slab. The slab distributes it on the core elements.

To confirm about maintenance reliability and possibility to use in metal mining industry such constructions it is necessary to research their strain-stress state and combined action of materials. There was an increased focus on the ferrocement slabs during development of methodology for experimental researches, because core elements are already investigated. To test the modes of operation of slabs of steel and concrete structures for bending and puncturing, there were produced engineering samples with the following dimensions $a \times b \times h = 1 \times 1 \times 2$ m, there are stiffening plates along the outline with the height 0.03 m and width 0.05 m. The sample included five steel welded fabrics made of wire with the diameter 0.9 mm and mesh width 12x12 mm. Fastening wire was applied to combine them. The distance between meshes for normal penetration of concrete and further coupling was provided through the spacers at a pitch of 0.1 m. The frame of each stiffening plate was made of two longitudinal and four cross rod Ø6 mm.

To form the slab there was used fine concrete of C25/30 class. Concrete composition: cement M500 (C), high-silica sand PK-020-3 (S), water (W). Proportion of the materials: C: S:W = 1:1.75:0.4. Solidification of samples coursed in laboratory conditions with observance of necessary temperature conditions and moisture load. Testing was fulfilled after 28 days. Detectors for measurements of relative strain were arranged pointwise (fig. 1,a). The load on the slab was applied in three points with the help of hydraulic ram through the crosspiece system (fig. 1, b). The load was applied in such a way to design concentrated forces affecting the slab at shots in ground layer. The load was fulfilled at a pitch of 1kN, i.e. at 0.25 kN on each load application point.

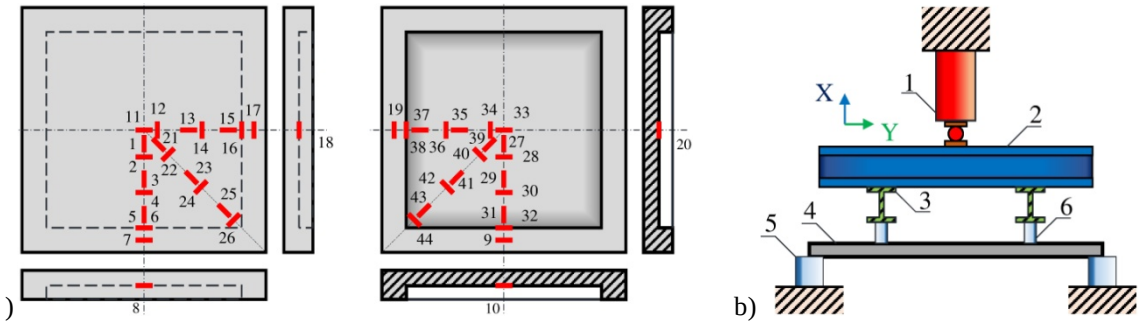

Figure 1. Scheme of detector arrangement (a) and load application (b) 1 - hydraulic ram; 2 - main-ram crosshead; 3 – secondary crosshead; 4 - composite reinforced concrete slab; 5 - bearing support; 6 – cylinder.

During experiment there marked significant moving inside the slab without appearing of cracks, which appeared mostly in supporting stiffening plates and gradually

developed inside. While destruction the inner part of the slab got minor failures in the places of load application in the form of flaking-off of concrete cover. Achieving the ultimate load, the destruction occurred along the knife edges, which were partially separated and moved due to shear forces. Obtained values of deformations from the action of load gave the opportunity to analyze the character of sample work (fig. 2).

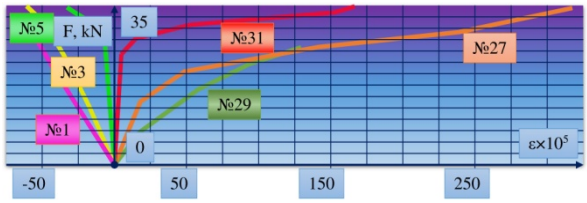

Figure 2. Load-strain diagram

Detectors No1, No 27, No 3 and No 29 were placed in the middle part of the slab and that is why they were swung into action. Lineal part on the graphs speaks for significant sample resistance in consequence of its re- reinforcing. On further stages of loading deformation developed more intensively and this was the reason of destruction. Detectors No5 and No31 showed small deformations, which speaks for late commissioning because of location of stiffening plate in their area, more intensive deformations in this place developed in normal direction.

Conclusions and perspectives of further development in this direction. During experimental researches of composite reinforced concrete slabs there determined their carrying capacity and deformability. On the basis of the results obtained there were built load-strain diagrams, analysis of which showed the effectiveness of accepted construction solution of the slab, way and coefficient of reinforcement, concrete class and its mechanical-and-physical properties.

Research results give the possibility to state about maintenance reliability and effective usage of composite reinforced concrete of elements in metal mining industry.

References

1. Gasii G.M. (2014). Technological and design features of flat-rod elements with usage of composite reinforced concrete [Electronic resource]. *Metallurgical and Mining Industry*. No9, p. 23–25.
2. Gasii G.M. Assemblage of structural-cable composite reinforced concrete covers. All Ukraine online-conference of young scientists and students. Problems of modern building industry. Poltava, 2012, p. 274-275.
3. Storozhenko L.I., Ermolenko D.A., Gasii G.M., Gladchenko Yu.L.(2012). Eksperimental'ne doslidzhennya modeley strukturno-vantovoi stalezalizobetonnoi konstruktsii. *[Experimental research of models of structural- cable composite reinforced concrete construction]*. Collected scientific papers of PoltNTU. No 3(33), p. 243–249.
4. Storozhenko L.I., Gasii G.M., Gapchenko S.A. Novi stalezalizobetonni strukturno-vantovi konstruktsii *[New composite reinforced concrete cable-stayed structures]*. Collected scientific papers of PoltNTU. No 1(40), p. 91–96.