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EXPERIMENTAL STUDIES OF EXPANDED CLAY LIGHTWAY CONCRETE MODELS WITH THE USE OF REINFORCED KEYS WITH A CLAMP

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Formulation of the problem.

The most acute problem at present is the moral and physical deterioration of the blocks of flats belonging to the first mass series. Further reconstruction of the existing blocks of flats is often possible only in those situations where the reinforcement of the existing support structures is in place.

In large-panelled construction the interface nodes of the external wall panels connected together, as well as with the interior panels and the slabs of the intermediate floors,and are the most difficult, because there is a possibility of corrosion of the embedded parts.

Butt joints of the panels are the most crucial elements of the support system in the panelled building, and, above all, their connections by the metal embedded parts, which are often subject to corrosion. Strength and spatial stiffness of the structures and buildings in general is being reduced due to corrosion damages of the structural elements, thermo technical performance worsens due to the deterioration of the enclosing structures' material

The purpose of the research is the experimental tests of B10 light expanded clay lightway concrete models on the shift with the use of the reinforced keys with the clamp, and comparison of the experimental results with the results of the numerical experiment.

Testing

12 testing models- the prisms made from class B10 light expanded clay lightway concrete, each with the dimensions of 30 x 30 x 40 cm, were made for the experimental studies in January 2012 that were carried out in the laboratory of the Reinforced Concrete and Stone Structures Department of Prydniprovska State Academy of Civil Engineering and Architecture. The models were prepared in three stages, 4 models made during each stage. One stage consisted of 2 batches, each giving 2 models. Special indents for devising of the embedded parts were foreseen in each models-a reinforcing bar (clamp) with a diameter of 12 mm. The indents in the models were performed along the middle of the side of 40 cm, with the help of "Г"-shaped embedded liners made from form polystyrene slabs with the cross section of 4 x 4 cm and 19 cm in length from the edge of the model, 8 cm in height, placed in a formwork form before the process of concreting (Pic. 1).

Expanded clay lightway concrete of the following composition was used for the preparation of the testing models:

1. Concrete *ПЦ 11/Б-Ш-400 (ДСТУ Б В.2.7-46-96)* - 380 kg / m 3
2. Sand, gradation factor 1,5 (*ДСТУ Б В*.2.7-32-95) - 415 kg / m 3

3. Expanded clay, fraction 5-10 mm (ДСТУ Б В 2.7-14-94) - 470 kg/m3
4. Water - 220 l/m3

Pic.1. The formwork form with the liner made from form polystyrene.

The strength of the expanded clay lightway concrete compression was determined by the concrete sampling from each batch to manufacture 3 prisms with the dimension of 15 x 15 x 15 cm each.

All models were 28 days old at the time of the experiment. The models were connected to each other with the help of the reinforced key with the clamp.

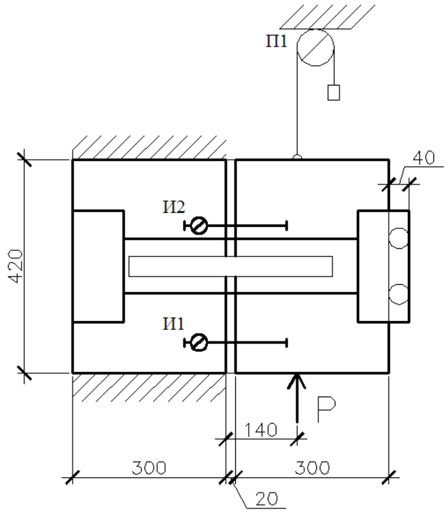
The docked models were tested for a shift in the vertical position. One part of the model was tightly pinched by the hydraulic press *ИПС*-500, whereas shear force was transmitted to the other part with the help of the oil station and the *ДГ*-10 jack.

The model was additionally tightened with the special metal holder to prevent the reciprocal transfer of the model's parts relative to each other before the beginning of testing the modelling of the conditions of the real stress-strain state in the joint of the wall panels (Pic. 2). To reduce the effect of friction force between the holder and the model occurred during the deformation, two metal cylinders with a diameter of 40 mm were placed under the corners of the free parts of the model.

Shifting force was applied to the lower edge of the free part of the model at a distance of 140 mm from the place of the pinch. The load on the model was increased in stages - 169.56 *кгс* in one stage.

The reciprocal vertical shifting of the prisms' models in the joints and the deformation of the concrete were measured with the help of the watch type indicator *ИЧ*-10 with a scale division of 0.01 mm on the basis of 200 mm, 6-*ПАО* deflectometer with the scale division of 0.01 mm and a ruler with the scale division of 1 mm. Countdown in accordance with the devices was carried out after each stage of the loading. The moment of the formation of the cracks in the testing models was determined visually. The testing scheme of the models is shown in Pic. 3.

Pic.2. The design of the testing model



Pic.3 The scheme of conducting the testing

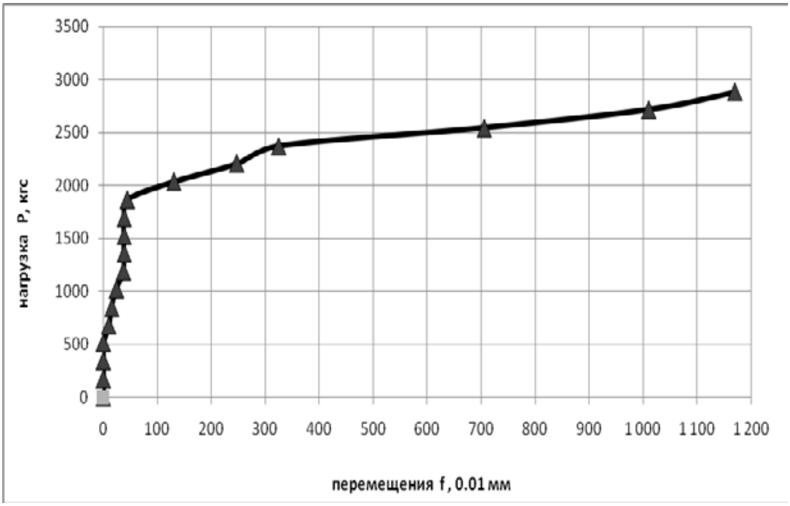
The destruction of the docked prism models made from light expanded clay lightway concrete took place as a result of sectioning the concrete under load of 2.8 *кН*. With the load of 0.8-0.9 of the destruction, the formation of the cracks was noticed along the contact of the mortar joint with the concrete model (Pic.4), whereas where the load was over 0.9 of the destruction, there was the formation and the development of the cracks in the concrete prisms, and ,simultaneously, the formation as a result of the shift of the vertical hairline cracks in reinforced with key clip (Pic. 5).

Pic.4. The formation of the cracks along the contact of the mortar joint

As can be seen from Pic. 6, the deformations of the models were elastic and insignificant in size before the load representing 60% of the destruction, whereas with the increase in the load they were of elastic-plastic nature.

The pressures in the repair part of the key and the parts of the concrete adjacent to it spread unevenly along the length of the key. The highest concentration of the pressures was focused at the site of the shifting forces in the join, at the same time the different magnitude of the pressures in the mortar on the left and on the right of the joint can be explained by the different pressure state of the docked prisms in the adopted scheme of the tests on the shift.

Pic.5. The formation of the cracks in the concrete prisms



Pic.6. The formation of the cracks along the contact of the mortar joint

Comparison of the results of the experimental testing and the numerical modeling

The forces emerging in the external wall panels of the large-panelled residential building series 1-480 were modelled in the programme complex SCAD Office 11.3. As a result of the numerical modelling it was concluded that to reinforce the locations of the embedded parts of the wall panels from the first to the fourth floor inclusive, for the perception of the operative forces, it is enough to install one reinforcing bar with the diameter of 12 *A400C* in each key. To reinforce the embedded parts of the fifth floor, where the maximum forces arise, 1Ø12 *A400C* will be sufficient only where the corrosion of the embedded part is 30%. Where corrosion is 50% and 70%,the reinforcement 1Ø20 *A400C* and *A400C* 1Ø25 needs to be performed respectively. The reinforced keys were located above and below the wall panel from the external part only, in the locations of the embedded parts. The forces arising in the embedded part of the reinforcement of the 5th floor were 1.37 m with 30% corrosion of the embedded part.

In carrying out experimental research the models were connected with the help of the reinforced keys with one reinforcing bar Ø12 *A400C*, i.e the presence of the corroded embedded parts in the panels was not taken into account. The reinforcing joint of the models made from 1bar Ø 12 *A400C* took the maximum shifting force equal to 2.88 tonnes, which is higher than the significance of the force in the embedded parts of the reinforcement, obtained by the analytical calculations. During the tests shutdown of the work of the steel framework was not observed, there was a destruction of the models on the border of the concrete and the reinforced key.

Thus, it can be concluded that the option of reinforcing the joints of the wall panels in the large-panelled residential building series 1-480 with the help of the reinforced key with the clamp, where the corrosion of the embedded parts is up to 30%, is possible and will have a positive effect.

Findings

1. Experimental tests of the reinforced keys with the clamp on the shift functioning were completed based on the theoretical calculations and the numerical modelling. Joint work at the shifting of the complex structure of the reinforced keys with the concrete has been studied, i.e the distribution of the forces in the concrete, the deformation of the joint, the character of the destruction of the key connection.

2. It was found that the reinforced joint of the models made from 1 bar Ø 12 mm took the maximum force equal to 2.88 tonnes, which is higher that the force equal to 1.37 m in the embedded part of the force obtained as a result of the analytical calculations. Thus, the load-bearing capacity of the joints of the wall panels in the large-panelled residential building series 1-480 is guaranteed after reinforcing with the reinforced key with the clamp .

LIST OF APPLIED SOURCES

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