TESTS FOR MISALIGNMENT OF WIDE WALLS AND WALL JOINTS OF MUTUALLY PERPENDICULAR DIRECTIONS

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ABSTRACT

The aim of the work is to study the features of deformation of brickwork materials under static and dynamic loading. Modeling of the stress-strain state of brickwork and calculations were carried out by the finite element method using the calculation complex AWP. A fragment of brickwork with dimensions in plan was examined: for L-shaped and T-shaped sections, they are equal to 140x140 cm and 140-240 cm.

The main purpose of the tests was to assess the nature of the work of the mates in the case when the walls of one direction remain not skewed, while other walls are skewed.

In prototypes with unequal dimensions, the sections were skewed in the plane of large walls.

KEYWORDS. Testing, misalignment, diagonal cracks, loads, pier, deformation, power stand

INTRODUCTION

Earlier, B. B. Otovchits and G. G. Shorokhov (Chisinau Polytechnic Institute) carried out tests and presented the results on the skewing of narrow walls made of cellular concrete blocks with a width of no more than 140 cm. the walls, while the inner walls are characterized by wider piers. Therefore, the main series of samples we took piers with a width of l = 190,240,360,480 cm. at a height of h = 240 cm. from unreinforced block masonry.

The tests were carried out on a power stand simulating statically deformations of the building walls under seismic horizontal impact.

The stand is a four-hinged rectangular frame with adjustable uprights so that when the frame is skewed with the sample, the stands ensure the parallelism of the horizontal movement of the crossbars and do not interfere with their vertical movements. [1]

During the tests, the growth of horizontal displacements of the crossbar and the growth of deformations of the compressible diagonal of the sample were monitored. The samples were made from six rows of grade 75 aerated concrete blocks with block sizes of 39 x 39 x 105 (138) cm on grade 50 mortar. Tests of the main first series showed that the nature of diagonal cracks, which are the cause of the destruction of the walls, varies from stone splitting in narrow walls to stratification of mortar joints (diagonal zone) in wide walls.

MAIN PART

In addition to diagonal cracks at the top and bottom of the walls, horizontal cracks can occur, originating at the ends of a diagonal stretched when skewed. The moment of formation and the degree of opening of these cracks depends on the ratio of vertical - N and horizontal load - S.

With a vertical load that is approximately three times greater than its value determined from the condition of overturning the wall, according to the formula $Ne \geq Sh$, horizontal cracks are formed shortly before the diagonal ones and thus a small opening is obtained. At lower values of the vertical load, the formation of these cracks occurs earlier, and the opening turns out to be large, which, with a significant lack of vertical load, leads to the loss of the system's resistance to the formation of a diagonal crack in the wall, i.e. to overturn the pier. [2]

After testing the walls in one direction, they were turned and tested in the other. The bearing capacity in the latter case decreased by about 1.5 times.

It can be assumed that the diagonal delamination of the walls occurs only due to the shear of the horizontal seams, since prior to the delamination, the previous formation of cracks in the vertical seams is already observed. [3]

The second series of experiments was carried out on samples with a width of 360 and 480 cm, the masonry solution of which was carried out with vibration through the above-stacked block. The purpose of these experiments was to evaluate such a technological measure from the point of view of adhesion in the seams and filling the seams with mortar. As a result of tests for aerated concrete blocks, vibration almost does not increase adhesion, but significantly increases the degree of filling the joints with mortar, which, in comparison with conventional masonry, leads to an increase in the bearing capacity when skewed by almost 1.7 times.

In the third gray, there were samples 240, 360 and 480 cm wide, having continuous reinforcement in horizontal seams with meshes with 4 longitudinal rods made of steel of class A-1. Tests have shown that horizontal reinforcement is an effective means of increasing the strength of the diagonal sections of the walls. If we consider the skew as diagonal compression, and use the allowance for indirect reinforcement adopted for compressed reinforced-stone elements by increasing the resistance of the masonry, then a satisfactory description of the experimental data is given by the formula

$$R_{ак} = R_{к} + 0{,}02R_{а}\sqrt{\text{p}}Sin\varphi$$

Where: $R_{ак}$ - resistance of reinforced masonry;

$R_{к}$ - resistance of masonry without reinforcement

$R_{а}$ - reinforcement resistance

p - coefficient of volumetric reinforcement of masonry;

φ - angle of inclination (acute) of the diagonal to the horizontal

Experiments have shown that in this case, 5 mm should be taken as the maximum diameter of the rods (with a grid step of 40 cm), since a further increase in the diameter gives a slight increase in the strength of the walls. After the formation of a diagonal crack in one direction, testing the walls in the opposite direction showed that with horizontal reinforcement of the joints, the bearing capacity in both directions is almost the same. In this case, the process of diagonal cracking is smooth, i.e. after the formation of cracks, the walls continue to perceive almost the same load, only with greater compliance. This property is useful not only because of vibrations during one earthquake, but also from the point of view of the perception of repeated earthquakes. [4]

The fourth series of specimens is represented by walls 245, 350 and 490 cm wide, which were made without blocking the blocks and therefore, as it were, consisted of separate block-walls, monolithic between themselves with vertical mortar joints. With a width of 245 cm, the piers were composed of 2 blocks-piers 105 and 138 cm wide.With a specimen width of 350 cm, from 3 blocks-piers 105, 138 and 105 cm wide and with a width of 430 cm piers from four blocks-piers 105, 105 wide, 105 and 138 cm. Some of the samples had continuous horizontal reinforcement, and some of the samples were made not from pillar blocks, but from vibroblocks per storey high, made in horizontal molds with vibration of the grout and framing the end faces.

Tests have shown that such samples at the beginning of loading work as a single wall, then they are divided along vertical seams into blocks-walls (vibration blocks), after which diagonal cracks are formed in wider and then in narrow blocks-walls (vibration blocks). Thus, it can be considered that a pier (wall) of such a design in the limiting state works as a sum of separate blocks-walls (vibration blocks). [5]

Compared to ordinary (tied) masonry, such (cut) masonry makes it possible to increase the bearing capacity of the walls when skewed by 5 times, which is explained by the different nature of the destruction of these masonry, namely, the delamination of the seams in the first and the splitting of the stone of the block-piers in the second.

In addition to flat specimens, spatial specimens were tested having L-shaped, T-shaped and cruciform sections, the first two types of specimens reflecting the case of abutment, and the third - the case of intersection of walls of mutually perpendicular directions.

Specimens with a height of 240 cm were made of unreinforced masonry with a dressing at the junctions of the blocks of the longitudinal and transverse directions of the walls. Two options for dimensions in the plan were adopted: for L-shaped and T-shaped sections they are equal to 140 x 140 cm and 140 x 240 cm, and for cruciform - 240 x 260 cm and 240 x 360 cm.The purpose of the tests was to assess the nature of the work of the mates in the case when the walls of one direction are not skewed, and the other walls are skewed.

In the experiments, samples with unequal cross-sectional dimensions were tilted in the plane of large walls. To reflect the cases of self-supporting and load-bearing walls of the building, the walls of the samples that were not subject to distortion were tested both without and with vertical loading. Tests have shown that with a horizontal load equal to (approximately) 0.8 load corresponding to the formation of diagonal cracks in the skewed walls, the spatial work of the walls is disturbed due to the formation of vertical cracks in the skewed walls, separating these walls from the skewed ones. In this case, the bearing capacity of the skewed walls is the same as in flat walls.

CONCLUSIONS

The calculation of fragments of brickwork for the action of static and dynamic loads has been performed. The resulting computer model of a brickwork fragment allows a detailed study of the stress-strain state of brickwork, taking into account the real properties of the brick, mortar and structure of the brickwork. The nature of the destruction of masonry samples from the action of static forces. The calculation results showed that the first crack at the central point of the masonry is formed in the mortar joint and is caused in these experiments by the main tensile stresses across the compressed diagonal.

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