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NUMERICAL MODEL OF THE TESTED MASONRY SAMPLE

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Abstract: *The article describes the scheme and structure of a numerically finite element model of the tested samples for analysis and study of the deformation mechanism, as well as for analytical numerical verification of the data obtained as a result of the tests.*

ЧИСЛЕННАЯ МОДЕЛЬ ИСПЫТЫВАЕМОГО ОБРАЗЦА ИЗ КАМЕННОЙ КЛАДКИ

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Аннотация: *В статье изложены схема и структура численно конечноэлементной модели испытываемых образцов для анализа и изучения механизма деформирования, а также для аналитической численной верификации данных, полученных в результате испытаний.*

СЫНАЛЫП ЖАТКАН КИРПИЧ ҮЛГҮСҮНҮН САНДЫК МОДЕЛИ

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Аннотация: *Макалада деформация механизмин талдоо жана изилдөө, ошондой эле сыноолордон алынган маалыматтарды аналитикалык сандык текшерүү үчүн сыналган үлгүлөрдүн сандык терминалдык элементардык моделинин схемасы жана түзүмү баяндалган.*

In the previous works [1, 2 and 3] of the author, experimental studies of masonry samples on the effect of static and multi-cycle loads were carried out. Samples of 8 series of masonry with a total of 25 samples were presented for static load testing. And samples of 4 series with a total of 8 pieces were presented for testing with a multi-cycle load . The description of the series of samples, the test scheme and design solutions for reinforcement are described in detail in [1, 2 and 3]. The samples were a rectangular fragment of brickwork with dimensions of 1060x1060mm, 250 mm thick with a chain bonding in accordance with Fig.1.

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Figure 1 – Samples of brickwork

For additional confirmation of the obtained results of the physical study, as well as for a more detailed analysis of the test, a numerical study is necessary. The Lira-SAPR software package [4] was used for numerical analysis of the stress-strain state of experimental samples. The following types of elements are included in the calculation scheme:

Type 10. Universal spatial rod Finite Element.

Type 41. Universal rectangular Finite Element of the shell.

Type 42. Universal triangular finite element of the shell.

Based on the existing experience in calculating brickwork using the finite element method, the methods of modeling and assigning the stiffness characteristics of brickwork were analyzed. To solve the problem of modeling experimental studies, it was proposed to use finite elements in the form of a plate.

This technique is effective when considering a local problem for studying the behavior of experimental samples. To calculate a real building, brickwork modeling is recommended to be carried out on the basis of data from previous studies and the results obtained in this work according to the following scheme:

– we model the masonry with plate elements, (Samples made for performing physical experiments in works [1, 2 and 3] are taken as the basis for the development of calculation models.);

– we take the grid splitting step 5x5 cm, further grid splitting, as calculations show, does not lead to the refinement of stress diagrams.;

– the modulus of elasticity of the masonry material is assigned according to the data obtained as a result of the survey and tests carried out.

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Modeling of the support and loading device is carried out taking into account the dimensions of the structures used in physical experiments. The stiffness parameters of the support and load devices are taken as close to "perfectly rigid body".

The application of the proposed step of splitting the finite element grid is due to the need to smooth out the deviations of the boundaries of the stress isofields when modeling with plates compared to the method of modeling with volumetric elements. A general view of the picture of the isofields of tensile stresses when modeling with plate elements is shown in Figure 2. Using this method allows you to save the values of internal stresses and the picture of their distribution. We apply both static and dynamic loads in accordance with the loading scheme in previously performed physical experimental studies [3 and 4].

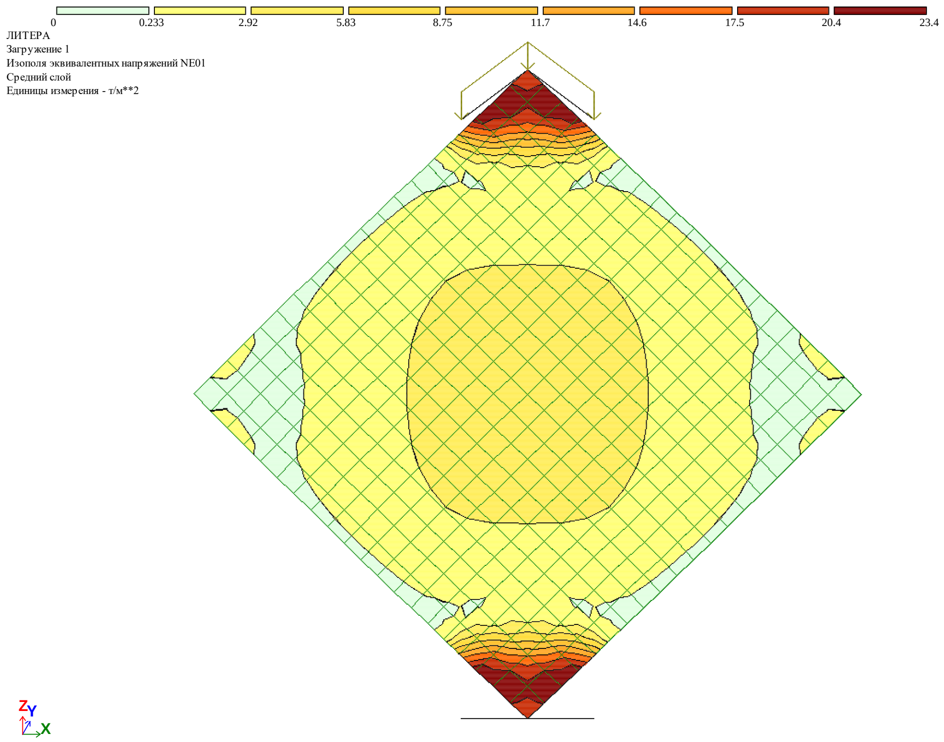

Figure 2 – A picture of the isofields of tensile stresses, when modeling with plates

External reinforcement using carbon fiber fabric is recommended to be modeled with plate elements, combining the wall and reinforcement elements with joint nodes on the entire contact area at the same time:

– when modeling reinforcement elements, we use triangulation with splitting the contour into a grid in 5 cm increments;

– we accept the rigidity of the reinforcement elements in accordance with the technical parameters of the carbon fiber specified by the manufacturer. A general view of the modeling of a masonry sample is shown in Figure 3.

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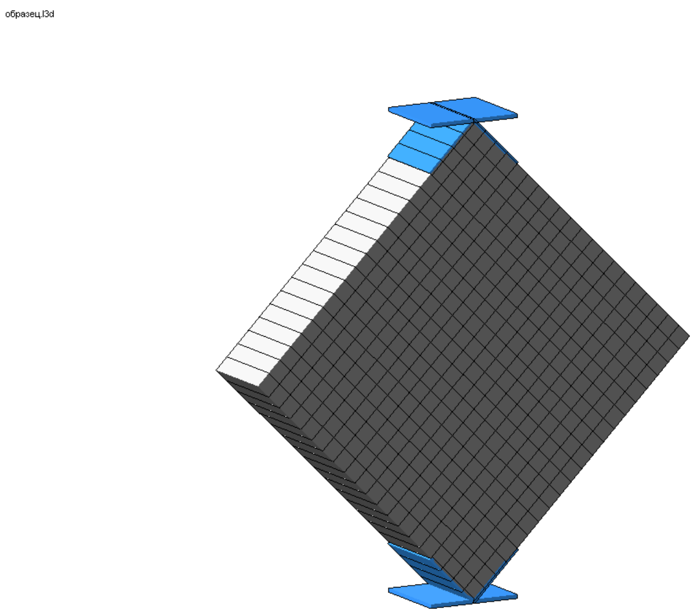

Figure 3 - General view of the finite element model of the masonry sample

Conclusion

The proposed numerical model will help verification by comparing the results of a numerical experiment and the data of a physical experiment performed in [1, 2 and 3].

The calculation model of masonry as a composite material from the standpoint of mechanics is considered on the basis of two different concepts:

a) composite as a continuous homogeneous material;

b) composite as a structure (discrete model) consisting of separate internal homogeneous basic elements, as well as elements providing connections between the basic elements of the composite.

Additional research is needed to analyze and compare numerical studies of the discrete model.

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