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SOI: 1.1/TAS DOI: 10.15863/TAS

International Scientific Journal

Theoretical & Applied Science

p-ISSN: 2308-4944 (print) **e-ISSN:** 2409-0085 (online)

Year: 2024 **Issue:** 01 **Volume:** 129

Published: 11.01.2024 **http://T-Science.org**

Issue Article

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INVESTIGATION OF THE STRENGTH OF A BRICK WALL OF A BUILDING UNDER THE ACTION OF STATIC LOAD

Abstract: *The results of the stress and strain state of the structural elements of the building under the action of static load on the wall were demonstrated in the article. According to the predicted values, the deflection of the wall, the contact pressure in the brickwork and the safety factor of all structural elements of the building were determined.*

Key words: *brick wall, load, stress, strain, building.*

Language: *English*

Citation: Chemezov, D., et al. (2024). Investigation of the strength of a brick wall of a building under the action of static load. *ISJ Theoretical & Applied Science, 01 (129),* 236-239.

Soi: http://s-o-i.org/1.1/TAS-01-129-20 ***Doi***: crossref https://dx.doi.org/10.15863/TAS.2024.01.129.20

Scopus ASCC: *2206.*

Introduction

When designing buildings, engineers are guided by the fundamentals of the strength of materials. Carrying out theoretical calculations and experimental tests for strength, rigidity and stability of structures of buildings makes it possible to obtain reliable and

economically justified dimensions of elements at the design stage.

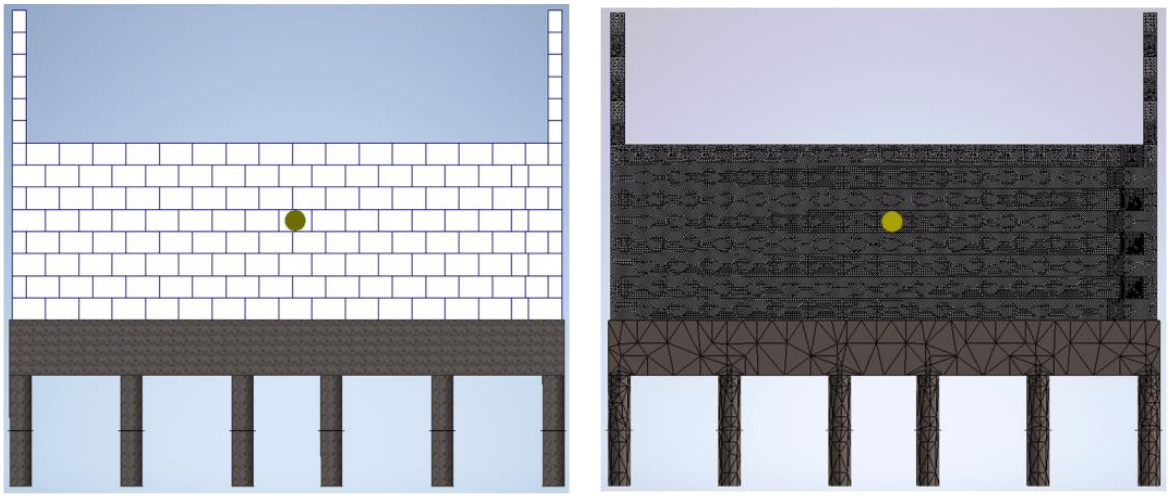
During operation, constant and temporary loads are applied to buildings (including residential ones). Constant loads do not change for a long time, i.e. they are static. Temporary loads change over time in magnitude and direction, i.e. they are dynamic. In addition to traditional calculations and experiments [1-10], special computer programs of engineering analysis are used to visualize the state of a loaded object.

The impact on the structure from the outside, statically or dynamically, will make it possible to predict possible destruction of elements. Without taking into account the loads acting on the structural elements due to the mass of other elements, consider the static loading of a brick wall of the building in a direction perpendicular to the force plane of the brickwork.

Materials and methods

The study of the strength of the brick wall of the building model was performed in the Autodesk Inventor computer program. To do this, a 3D model of the building with a foundation was built. The physical properties of the building model were: weight – 121338 kg, area – 673119000 mm^2, volume – 5.04039×10^3 mm^3, center of mass – x = 2382.45 mm, y = 5037.88 mm and z = -361.409 mm. The wall consisted of bricks connected to each other. The following properties were adopted for the brick model: mass density – 2.40731 g/cm^3, yield strength – 2.41329 MPa, final tensile strength – 2.41329 MPa, Young's modulus – 23.25 GPa, Poisson's ratio – 0.167, shear modulus – 9.96144 GPa. A static load of 15 kN was applied to the brick wall of the building.

The finite element grid on the building model was configured as follows: the average size of the element (fractional value of the diameter of the model) – 0.1, the minimum element size (fractional value of the average size) – 0.2, the coefficient of heterogeneity – 1.5, max. angle of rotation – 60 degrees. This allowed us to obtain satisfactory simulation results. The conditions for the experiment are presented in the Fig. 1.



A ***B***

Figure 1 – Experimental conditions: *A* – application of the load on the wall of the building model and *B* – the grid on the building model.

Results and discussion

The results of the computer calculation are presented in the Fig. 2. The color contours on the model of the building depict the intensity of displacement, von Mises stress, equivalent strain and contact pressure of the wall elements. Also, the value of safety factor of the building under the action of the applied load was calculated.

The contour color characterizes the intensity of the stress and strain state of the structural elements of the building. It is noted that the effect of concentrated force on one brick of the wall leads to the displacement of several closely spaced rows of bricks. The greatest displacement of the wall occurs above the point of application of the load, due to the lack of fixation of the last row of bricks. The smallest displacement of the wall occurs below the point of application of the load. However, the intensity of stress and strain prevails at the place of application of the load, near the foundation and at the junction of the piles. The contact pressure was determined at the joints between the bricks above the applied load. The most loaded elements are the foundation and the piles connected to it.

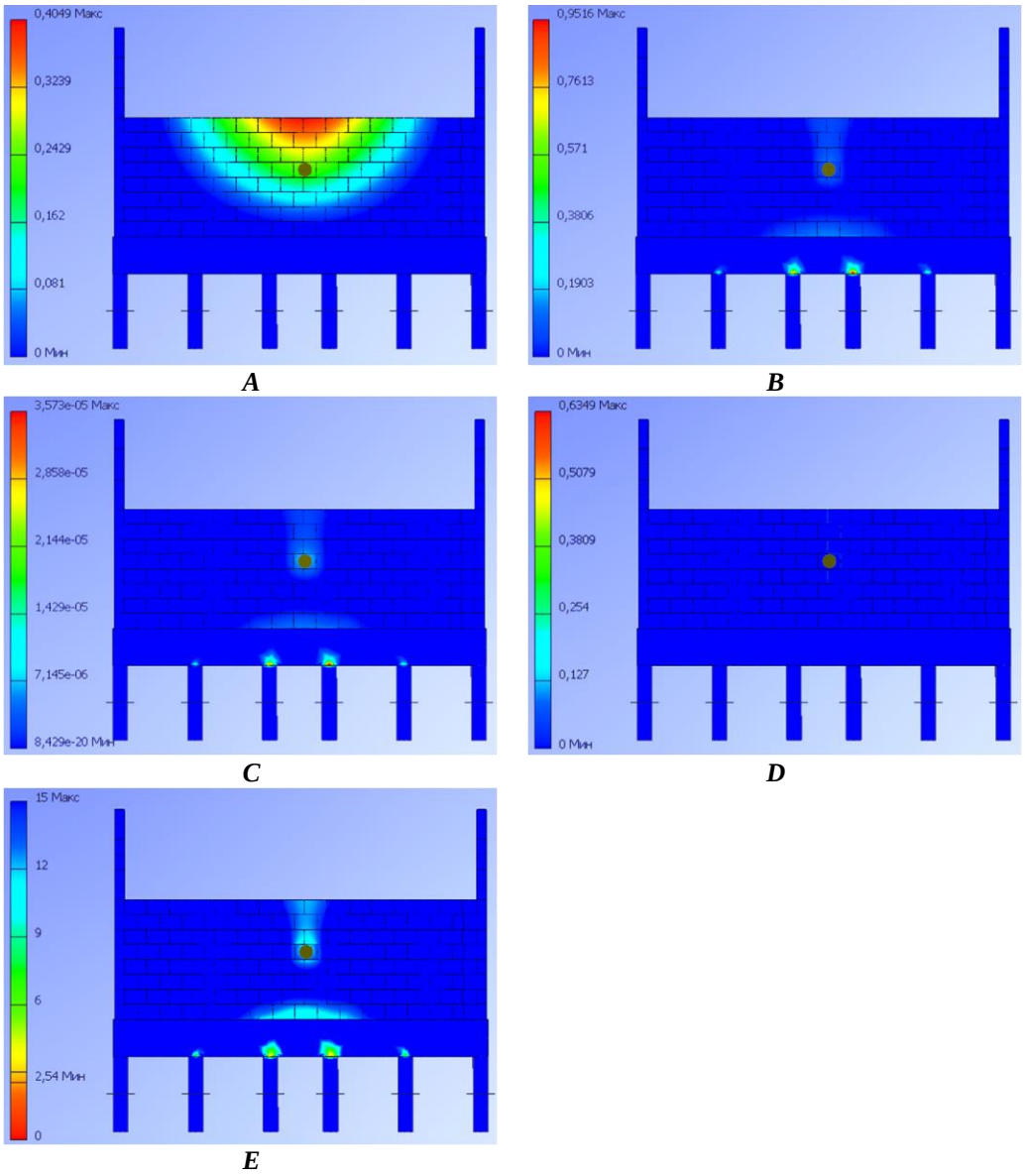


Figure 2 – Computer calculation results: *A* – displacement (mm), *B* – von Mises stress (MPa), *C* – equivalent strain, *D* – contact pressure (MPa), *E* – safety factor.

Conclusion

According to the results of computer modeling, the loaded sections of the brick wall of the building were identified when exposed to a concentrated load. In particular, the foundation and the piles connected to it are subjected to significant deformations. This is confirmed by the small value of the safety factor at the junctions of these elements.

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