THE BEHAVIOR OF MASONRY STIFFENING WALLS BASED ON THE FULL-SCALE RESEARCH

Abstract

The role of the masonry stiffening walls is to ensure the geometric invariability of the building, to limit the horizontal displacements and to ensure the overall comfort of use of the building. Stiffeners transfer horizontal loads acting in the plane of the wall. Lateral loads may be caused by wind and uneven ground subsidence or may result from the adverse effects of mining (shocks, ground deformations). Although the masonry stiffening walls is crucial from the design and use of buildings' point of view, there is no consistent study on the specificity of these elements.

This doctoral thesis contributes to the systematization of knowledge about masonry stiffeners of buildings. A thorough literature study was carried out, including domestic and foreign standard regulations and scientific publications, along with a critical analysis of the state of knowledge. Full-scale tests of single-storey masonry buildings made of masonry elements made of autoclaved aerated concrete (AAC) with different geometry of openings in the walls were carried out. These analyses made it possible to determine the behavior phases of the stiffening walls, specifying the range of elastic and non-linear behavior. Detailed damage propagation and crack morphology observations were made using digital image correlation (DIC) technology. The change in the vertical piers geometry and the effect of this phenomenon on the stiffness was demonstrated. Two methods of estimating the stiffness of stiffening walls have been proposed - the total stiffness method and the empirical method. In addition, a proposal for calculating the torsion center of the building based on the measurement of slab corner displacements has been presented. The values of internal forces were determined based on comparing theoretical and test results.

In addition, an original procedure for numerical homogenization of the masonry structure was developed based on standard tests and calibration of mechanical parameters. Appropriate full-scale numerical analyzes were performed based on an elastic-plastic material model with degradation. The impact of changes in the cracking energy and tensile strength of the wall on the results of numerical calculations was indicated. An engineering approach to the analysis of stiffening masonry walls using numerical elastic models with corrected stiffness of the walls was also proposed. Further research directions and theoretical work on the dissertation subject were also set.

Krzysztof Grzyb
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Marzena Gaura