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Summary of the doctoral thesis
„Load capacity and deformability of monotonically sheared AAC walls confined with reinforced concrete"

Insufficient resistance of unreinforced masonry walls to seismic and paraseismic influences is increased by using confined with reinforced concrete elements, consisting in a permanent connection of the wall with concrete vertical and horizontal elements cooperating in one plane. The issue is crucial in stiffening walls made of autoclaved aerated concrete (AAC) characterized by susceptibility to damage and low stiffness. Numerous tests of cyclically loaded walls confirm that the ideal solution to minimize the unfavorable degradation of stiffness and the development of cracks is the use of confinement. However, the literature lacks adequate research on the behavior of confined walls subjected to monotonic loads, where confinement is used only to improve load capacity and deformability. The current standards (EC-6) are limited only to information on the construction of confined walls, but there are no guidelines on the design method. The thesis attempts to answer two key questions: (1) what impact will the confinement placed along the perimeter of the wall and along the vertical edges of the openings have on the behavior of walls without openings and with openings subjected to horizontal shear? (2) will the use of confinemets along the vertical edges of openings with an area of 1.5 m^2 in accordance with the EC-6 standard have a positive effect on the mechanical parameters of the wall subjected to horizontal shear? Little recognition of the phenomenon of shearing of constrained walls subjected to monotonic shear allowed to formulate the main goal of the work, which was: experimental and theoretical analysis and determination of the influence of confinements on the bearing capacity and deformation of constrained masonry walls subjected to horizontal shear. The analysis of available research and theoretical considerations allowed for the following theses of the work:

1. The use of confinements has a positive effect on the crack resistance, load capacity and deformability of masonry walls subjected to horizontal shearing.
2 The factor determining the state of stresses and deformations are the initial compressive stresses.
3. Confinement causes changes in the morphology of cracks and the mechanism of failure compared to horizontally sheared unconstrained walls.
4. Numerical analysis allows for a fairly good representation of the behavior of the confined wall and to explain the impact of confinement on the state of stresses and deformations as well as the morphology of cracks in the wall subjected to horizontal shear.

The layout of the work reflects the scope resulting from the set goal and theses. Chapters one and two present an introduction and give the purpose, scope and theses of the work. The third chapter presents an analysis of the current state of knowledge in the field of testing reinforced, infilled and

confined walls as well as standard provisions, which allowed to determine the scope and program of basic research and formulate theses of the work. The fourth chapter presents the results of the basic tests of 16 confined walls without openings and with openings subjected to horizontal shear. The main tests of the walls were divided into three series: walls without openings confined along the vertical and horizontal edges (circumferential confinement), walls with a window opening (area A = 1.5 m^2) located in the middle part of the wall with circumferential confinement, and walls with an opening window (A = 1.5 m^2) located in the central part of the wall with additional (apart from the circumferential) confinement along the vertical edges of the opening. The fifth chapter is devoted to the analysis of the obtained test results with the use of a numerical FEM model using an elastic-plastic-brittle model of masonry and concrete with contact elements used in bed joints, head joints and at the contact with cinfined elements. In the sixth chapter, the analysis of confined walls was performed using a bilinear analytical model. The model was defined by the stiffness at the time of cracking, the maximum displacement and the dissipated energy. The seventh chapter presents a summary and the resulting conclusions from the study research, experimental research as well as numerical and analytical calculations. At the end, directions for further research in the field of shearing were proposed.

The study analyses, experimental research and numerical calculations carried out in the work in the field of the questions and theses of the work allowed to draw the following final conclusions:

- confinement in models without openings did not significantly affect the values of cracking stresses in relation to unconfined models, an increase in shear strains at the time of cracking and the angles of shear deformations at the time of failure was observed,
- in walls with openings and circumferential confinements, a significant increase in cracking stresses was shown in relation to unconfined models, an increase in strains and shear deformations was also visible,
- the introduction of reinforced concrete confinements elements along the vertical edges of the openings eliminated early cracks in the tensioned corners of the openings, which resulted in a significant increase in the stiffness of the walls,
- confinements increased the value of plastic displacements uy by 17% on average, and the value of maximum displacements umax by 18%,
- the morphology of the cracks in the confined walls without openings and those with openings and circumferential confinements did not differ significantly from the cracks in the walls without restraints. The cracks were formed in the tensioned corners of the openings and then in the lower corners of the window pillars. Clear differences were observed in models with openings, in which confinements running along the vertical edges of the openings were used, because the first cracks were made in the lower corners of the window pillars,

- using the methodology of empirical homogenization in numerical micromodels of wall models and contact finite elements replacing bed and head joints, it is possible to predict the morphology of cracks and selected mechanical parameters of confined walls with satisfactory consistency,
- the proposed bilinear model of the behavior of the shear wall made it possible to show that in confined models, the increase in the value of initial compressive stresses resulted in a significant increase in the value of dissipated energy in relation to unconfined models (68-77%),
- in confined walls, an increase in wall ductility was observed in relation to unconfined walls (7–26%).

The conducted research, calculations and analysis of the results do not exhaust the subject of constrained masonry walls subjected to horizontal shear. They can be treated as a basis for the validation of one's own theoretical models.

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