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Abstract of doctoral dissertation:

"Analysis of masonry behavior in complex stress state"

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Masonry structures are still an important part of building structures. Nowadays, greater demands for strength, physical and serviceability properties are put to them. At the time, tools and theories to conduct more accurate analyzes of these structures are being developed thanks to which the structures can meet the requirements. The most important issue is formulation of a boundary surface of the material. It allows to perform numerical analysis and, thanks to that, prepare more accurate documentation of the internal forces occurring in the whole object or its fragments.

Formulation of the strength criterion for masonry structures, which would be practical and corresponding with experimental data, is difficult because of the structure of this material. Masonry is a combination of masonry units (bricks, hollows, etc.) and mortar, so the properties of these materials and phenomena in contact between them should be taken into account. Moreover, each of masonry components has isotropic properties but in combination give a new material with anisotropic properties. This situation causes additional difficulties.

Primary objective of this dissertation was to formulate the material model for masonry based on the boundary surface modified by the author. This model should take into account masonry behavior as a substitute homogenous material with some unified properties. It should also allow to capture orthotropic behavior of the masonry.

Dissertation includes within its scope:

- A review of the state-of-the-art literature targeted on experimental test on masonry structures and a review of material models formulated for masonry.
- Modification of the strength model taken from the literature, which includes change of the method for determination of the meridians of the boundary surface, limitation of necessary laboratory tests and change of the shape of the meridians of the cap closing the boundary surface from the tensile stresses side.
- Results of laboratory tests conducted on mortar and brick specimens with the use of the triaxial compression device. Results of the tests are compared with similar tests described in the literature.
- Numerical analysis with an objective to verify and calibrate the proposed material model.

Attempts to formulate a masonry model which includes orthotropic properties of the masonry have begun from adaptation of the three-parameter William-Warnke model proposed by L. Szojda. In the course of work the way of determination of the boundary surface meridians has been modified. Thanks to that uniaxial compression, uniaxial tension and biaxial compression strength values are enough to determine the boundary surface. In that way necessity to conduct tests on mortar and brick specimens using the triaxial compression device has been eliminated. Additionally parabolic cap which is closing the boundary surface from tensile stresses side has been modified. Orthotropic masonry behavior was included in the proposed model by introduction of a coefficient that modifies the size of the boundary surface depending on the angle between the minimal principal stress and the plain of horizontal joints.

The conducted triaxial compression tests allowed to determine a couple of points lying on the meridians of the boundary surfaces for mortar and brick. Based on the results of the tests and data taken from the literature, a proposal for a form of a compressive meridian has been made. It has also been proven that the proposed form of the boundary surface meridians is close enough to the test results.

During the procedure of calibration of the material model a function that determines the value of the reduction coefficient of the boundary surface has been determined. Verification of the masonry model based on the data taken from the literature has been carried out, too. On its basis the accuracy limit has been set.

Dissertation is divided into six chapters. The first chapter contains introduction and the thesis of the dissertation. The second chapter is an analysis of the topic literature. Chapter three focuses on the proposed boundary surface of the masonry. Chapter four contains experimental data obtained during laboratory tests and retrieved from the literature. In chapter five the results of calibration and verification of the proposed model has been presented. Chapter six contains the summary and conclusions from the dissertation.