Final Report Summary - ESECMASE (Enhanced Safety and Efficient Construction of Masonry Structures in Europe)

Within the European research project ESECMASE static-cyclic and pseudo-dynamic shear wall tests were carried out at Kassel University (Germany), at Pavia University (Italy) and at the Technical University of Munich (Germany). Furthermore, shaking table tests and pseudodynamic full scale tests were executed at the technical University of Athens (Greece) and the JRC in Ispra (Italy). These tests followed the aim to extend the knowledge about the shear bearing capacity and the deformation capacity of masonry walls made of different kind of units and mortar. For different kinds of masonry walls and for different boundary conditions, a new design model for the shear resistance could be developed and verified by the tests. Finally, a proposal for a new design procedure for the coming European code has been developed including a proposal for realistic behaviour factors for masonry structures.

The aim of the ESECMASE project was to develop a better understanding of the stress states in typical masonry structures, the identification of the relevant material parameters and suitable test methods.
improvement of existing design models for shear loaded masonry, and the optimisation of masonry unit properties. The shear bearing capacity and the deformation capacity of masonry structures was analysed by static-cyclic and pseudodynamic wall tests as well as in shaking table tests and pseudodynamic full scale tests. A proposal for a new design procedure for the coming European code was evaluated in. Proposals for the optimisation of masonry units have been elaborated for both clay and calcium silicate units. Comparative tests showed, that an improvement of the material properties (the material of which the webs and shells consist of) can be achieved using optimised raw materials or admixing selected aggregates.

In order to model the stress states in typical masonry houses and to identify the expected failure modes, two common cases have been studied. These are typical terraced houses and multi-storey apartment houses, for which three-dimensional (3D) finite element models have been made. These models consider the most important nonlinearities which have to be expected due to the inelastic behaviour of masonry especially due to combined shear / tension loading (horizontal joint opening). By parametric studies, configurations with different values of the length (in ground plan) of the main shear walls have been investigated. With respect to the relevant current design code provisions, the ultimate lateral loads could be determined in dependency of the actual wall length.

It could be shown that the new integral approach reduced the scatter of the predictions considerably. After calibration of the unit tensile strength specific to the different masonry types, a quite uniform safety level could be reached. Thus, the model could be validated also for the different combinations of loading parameters and geometry as used in the ESECMASE tests.

In conclusion, the project has shown the complex behaviour of masonry walls under in plane loading. The new approach for a design model could be validated by the great number of tests in this research project.

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