Analysis of masonry shear walls and non-load-bearing inner walls with the aid of the finite element method (FEM)

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Abstract

In order to analyse the load bearing behaviour of masonry shear walls and non-load-bearing inner walls finite element simulations were carried out with the program DIANA 9. A micro modeling of the walls considering the brick units and the joints discretely was used to study the detailed damage and failure mechanisms. For an adequate representation of the load bearing behaviour in the simulation of the walls the material properties of the brick units and the bonding properties of the joints were determined in a large number of small-scale specimen tests. Further information on the material behaviour for instance the shape of the tensile softening diagram could be found inversely with the aid of finite element simulations.

The aim of the first project, the analysis of masonry shear walls, was to check whether the standardized test method (see Fig. 1), which is carried out in Germany on storey-high square masonry panels within the scope of tests on the general building inspection approval, is suitable in order to determine the shear strength of masonry.

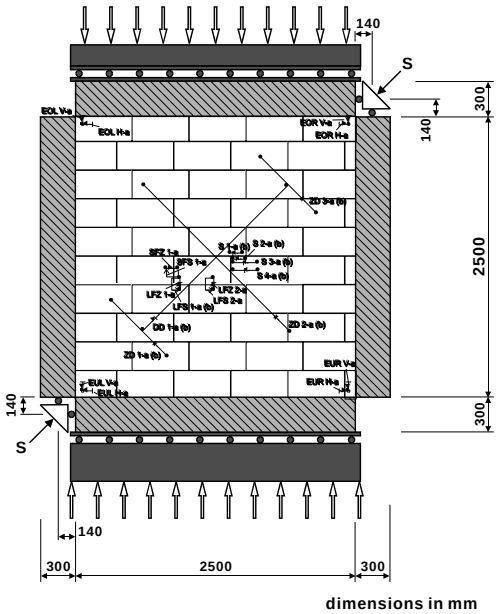

Figure 1 – Standardized test method for masonry shear walls

The results of the simulations point out that the test boundary conditions lead to stress concentrations in the corners of the wall instead of an uniform stress distribution. The FE model could be verified by means of experimental tests which had been carried out. A comparison between the results of the simulations and the experimental results shows a good accordance.

In order to estimate the real shear strength of the walls an idealised boundary condition has been proposed, which produces an almost uniform stress distribution.

The motivation of the second project, the analysis of non-load-bearing inner walls, was the fact that cracks often occur in the walls due to the deflection of the lower floor. The aim of this project was to calculate the material strengths, e.g. the sufficient adhesive shear strength of the joints, required for different wall lengths to avoid harmful cracks.
In order to verify the FE model experiments with an idealised test set-up (see Fig. 2) have been carried out, which ensure well-defined boundary and loading conditions.

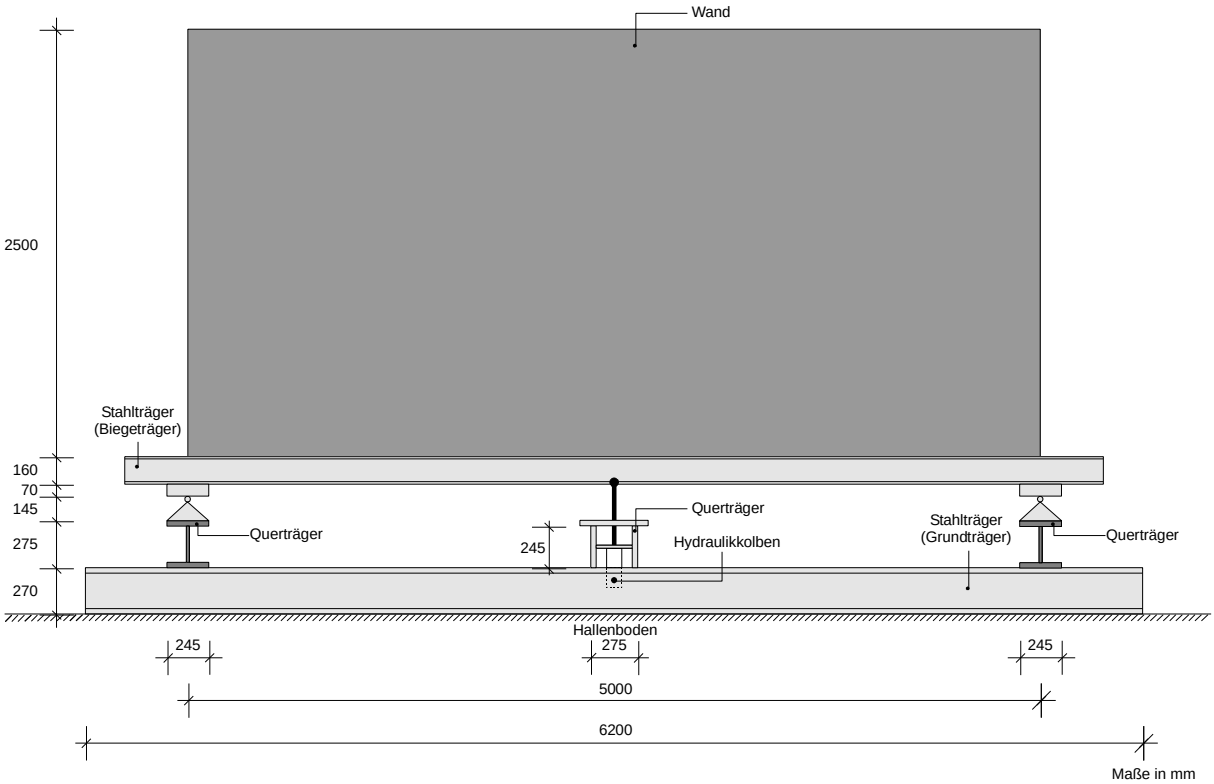

Figure 2 – Test set-up for masonry non-load-bearing inner walls