Nonlinear structural analysis of a masonry wall

Guangli Du

Department of the Built Environment, Aalborg University Copenhagen, Denmark

Thomas Cornelius

Department of the Built Environment, Aalborg University Copenhagen, Denmark

Joergen Nielsen

Department of the Built Environment, Aalborg University Copenhagen, Denmark

Lars Zenke Hansen

Niras A/S, Copenhagen, Denmark

Contact: gdu@build.aau.dk

Abstract

Structural modelling of a masonry wall is challenging due to material properties, eccentricity of the vertical load, slenderness ratio etc. In recent theoretical developments for design of masonry walls, a new "Phi" method to determine the eccentricity is adopted in Eurocode 6. However, the comparisons between this method and the conventional "Ritter" method shows that for certain prerequisites it would result in substantial different load-bearing capacity. Hence, in order to investigate how support conditions influence the load bearing capacity of the wall, this study performs a nonlinear numerical analysis of a wall for several load cases in ABAQUS and the result is verified with an independently developed calculation tool using MATLAB. The results show that the top rotation plays a significant role for the load bearing capacity of the masonry wall supported by slabs at both ends. It is difficult to estimate the eccentricities without a rigorous calculation.

Keywords: Masonry, load eccentricity, load bearing capacity, nonlinear structural analysis, macro modelling, FEM

1 Introduction

Masonry is a widely used building material in Denmark. Today there are more than 50 million m^2 areas of masonry buildings in Denmark. In an earlier Danish design code, a method called "Ritter" [1] was used to calculate the load bearing capacity of masonry walls, see details in Danish standard [2]. The method was proven to be on the safe side in all cases. However, in Eurocode 6, a new method called 'Phi' was introduced, see details in section 6.1.2 in Eurocode 6 [3]. In order to ensure that the new 'Phi' method is also on the safe side and therefore could replace the old 'Ritter' method in the Danish standard, the permanent committee in Danish standard conducted several analyses and tests to investigate this new method. The analyses showed that the new 'Phi' method in principle gives results at the same level as the old 'Ritter' method, except a slightly higher load-bearing capacity for walls with small slenderness figures (low walls) and for walls

https://doi.org/10.2749/ghent.2021.0809
Distributed by structurae