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Simplified Method For Shear Strength Prediction Of Confined Masonry Walls Subjected To In Plane Loads

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Abstract

The paper deals with the shear strength prediction of confined masonry wall subject to in-plane horizontal loading and to investigate the possibility of using strut and tie model for predicting the ultimate strength of confined masonry walls subjected to in plane loads. Shear strength of confined masonry wall subject to in plane horizontal loading are calculated using strut and tie analysis, MSJC-2013 recommendations, EC6 recommendations, and finite element analysis. The result obtained is compared to check the accuracy of the different methods used.

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Keywords: EC6; Finite element models; In-plane loading; MSJC-2013; strut and tie model.

1. Introduction

Masonry is one of the most commonly used and important construction materials around the world. Despite this, nowadays there is a lack of information and research to characterize its mechanical properties and structural performance. Several researchers have studied the use of various methodologies for predicting the behavior of masonry walls. The methodologies commonly used by the researchers are Finite element models, equivalents frame models and

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strut and tie model etc. Roca [2005] studied about the possibility of using simple equilibrium models (STM) for estimating the ultimate capacity of masonry walls, and suggested the tentative rules for the construction of the models for solid walls under different loading conditions. Voon [2008] suggested two strut and tie models and compared the accuracy of the models suggested. Nolph [2010] investigated the effectiveness of the MSJC (2008) shear strength equations and idealized truss model for predicting the shear strength of partially grouted masonry walls. From the previous research works it was clear that the strut and tie model can be used as an effective tool for assessment of masonry. The possibility of using strut and tie for the assessment of masonry walls has not received much attention. There is no sufficient code provisions for the assessment of the confined masonry walls, some of the researchers used the recommendations for the partially grouted masonry walls for the assessment of the confined masonry walls. The existing analytical models couldn't simulate the behavior of masonry structures accurately. This is due to the complex material properties and composition of masonry.

The prime objectives of this work are as follows:

- To predict the shear strength of the confined masonry walls subjected to in plane loads.
- Investigate the possibility of using strut and tie models for predicting the ultimate strength of confined masonry walls subjected to in plane loads.
- To validate the formulas available in the code for shear strength prediction.

2. Shear Strength / Resistance

The in- plane shear strength / resistance of masonry is calculated using following methods

2.1. Shear strength using strut and tie model

Strut-and-tie modelling (STM) is a versatile, lower-bound (i.e., conservative) design method for reinforced concrete structural components. In STM, the complex flow of forces through a structural component is first simplified into a truss model, known as a strut-and-tie model. The advantageous of using strut and tie model are it is simple, less time consuming and better accuracy. Fig. 1. shows a two dimensional strut and tie model for confined masonry walls.

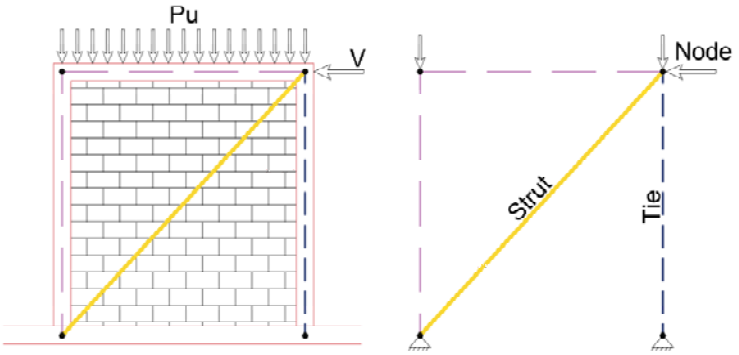

Fig. 1. Strut and tie model for confined masonry.

The strength of wall is the horizontal load at which the force in compression strut was approximately at the strength of the compression strut or a tension tie yielded prior to the failure of a compression strut.

Compression strut strength was determined as presented in ACI 318-11 Appendix A. The nominal compressive strength of a strut, is the minimum of F_{ns} or F_{nn}, is given by Equations (1), (3)

Nominal compressive strength of a strut

$$F_{ns} = f_{ce} \times A_{cs} \quad (1)$$