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STUDY OF THE PERFORMANCE OF R.C. WALLS WITH OPENINGS USING AN ANALYTICAL FINITE ELEMENT MODEL

Alaa Morsy, Youssef Ibrahim^(*)

Department of Building and construction, Faculty of Engineering, The Arab Academy for Science, Technology and Maritime Transport, Alexandria, Egypt

^(*)*Email: youssef.ibrahim654@gmail.com*

ABSTRACT

Earthquake is one of the most catastrophic events which make enormous harm to properties and human lives. As a piece of a safe building configuration R.C. walls are given in structures to decrease horizontal displacements under seismic load. Shear walls are additionally used to oppose the horizontal loads that might be incited by the impact of wind. R.C walls in residential buildings might have openings that are required for windows in outside walls or for doors in inside walls or different states of openings due to architectural purposes. The size, position, and area of openings may fluctuate from an engineering perspective. Shear walls can encounter harm around corners of entryways and windows because of advancement of stress concentration under the impact of vertical or horizontal loads. The openings cause a diminishing in shear wall capacity. It might have an unfavorable impact on the stiffness of R.C wall and on the seismic reaction of structures. Finite element modelling approach has been conducted to study the effect of opening shape, size and position in RC wall with different thicknesses under axial & lateral static loads. Finite Element Method using software package " ANSYS" becomes an essential approach in analyzing civil engineering problems numerically. Now we can make various models with different parameters in short time by using ANSYS instead of doing it experimentally, which consumes a lot of time and money. Proposed F.E approach has been verified with other experimental programs conducted by other researchers and gives a very good correlation between the model and experimental outputs including load capacity, failure mode and lateral displacement. A parametric study is applied to investigate the effect of opening size, shape, position on different R.C. wall thicknesses. The research may be useful for improving existing design models and to be applied in practice, as it satisfies both the architectural and the structural requirements.

Keywords: R.C. walls, earthquake, seismic loads, finite elements method.

INTRODUCTION

Shear walls are frequently pierced for doors, windows and building services or other functional reasons. Openings are usually avoided in reinforced concrete (RC) structural elements because the size and location of openings in the shear wall may have adverse effect on seismic responses. These openings are also source of weakness and can reduce the structures' stiffness and load-bearing capacity. As a designer, it is necessary to know the effects of large openings sizes and configurations in shear wall on stiffness as well as on seismic responses and behavior of structural system as a considerable amount of concrete and reinforcing steels has to be removed. So that a suitable configuration of openings in shear walls should be made. On the other hand, it is generally believed that effects of small

openings can often be neglected due to the ability of the structure to redistribute stresses (Ashok Kankuntla, *et al.* 2016).

By using ANSYS, the behavior of RC walls with openings will be explored. It simulates the elastic and plastic deformations that would happen in concrete until ultimately concrete crushing as the load is stepwise increased which is considered next to exact solution if the material properties are correctly implemented.

RESEARCH SCOPE AND OBJECTIVE

The objective of this study is to investigate the behavior of shear walls with openings. The study includes a parametric study to gain an optimum opening shape, size and position in RC wall with different thicknesses under the effect of various types of loads in order to increase capacity and control cracks. This paper is part of a larger research program on the importance of configuration of shear wall openings and fiber-reinforced polymers (FRPs) for strengthening these opened shear walls to improve their behavior in resisting lateral loads in high-rise buildings. The ongoing program is expected to significantly extend the findings of the previous studies.

RESEARCH METHODOLOGY

The research plan includes two phases, the first phase; includes verification of the experimental results conducted by other researchers using an ANSYS model to make validation for the model and ensure the correlation between both analytical and experimental results for load capacity, failure mode and lateral displacement. The second phase; After the model has been verified with the experimental results, a parametric study has been conducted by changing opening shape, opening position, size of opening, aspect ratio of opening, rectangular opening orientation, R.C. wall thickness, applied load type and applied load eccentricity. Table 1 shows the details of the examined parameters and its variation.

Table 1 - Examined Parameters by F.E.M

Examined Parameters							
	Load Type	Wall Thickness (mm)	Eccentricity (mm)	Shape	Opening Dim. (m)	Aspect Ratio	Position
Variables	Lateral	60	10	Square	0.4 x 0.4	1	Middle
	Vertical	90	15	Rectangular	0.6 x 0.4	1.5, 2, 2.5	Upper middle
		Lower middle					
		120	20	Circular	R = 0.4	-	Lower corner

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