AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING

ANALYTICAL MODELING OF REINFORCED MASONRY STRUCTURAL WALLS SYSTEMS

A Thesis Submitted in Partial Fulfillment of the

Requirements for the Degree of

MASTER OF SCIENCE IN CIVIL ENGINEERING

DEPARTMENT OF STRUCTURAL ENGINEERING

By

AHMAD TAREK ALI ELSAYED ABDELWAHAB

Supervised by

Prof. Dr. AMR ALI ABDELRAHMAN
Professor of Concrete Structures, Department of Structural Engineering, Ain Shams University

Dr. MARWAN TAREK SHEDID
Associate Professor, Department of Structural Engineering, Ain Shams University

Dr. HUSSEIN OSAMA OKAIL
Associate Professor, Department of Structural Engineering, Ain Shams University

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AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING

Name	:	Ahmad Tarek Ali Elsayed Abdelwahab
Thesis	:	Analytical Modeling of Reinforced Masonry Structural Walls Systems
Degree	:	Master of Science in Civil Engineering (Structural)

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Prof. Dr. Amr Ali Abdelrahman Professor of Concrete Structures, Department of Structural Engineering, Ain Shams University	
Dr. Marwan Tarek Shedid Associate Professor, Department of Structural Engineering, Ain Shams University	

Date: 2 / 2 / 2020

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SUPERVISORS COMMITTEE

Name and Affiliation	**Signature**
Prof. Dr. Amr Ali Abdelrahman Professor of Concrete Structures, Department of Structural Engineering, Ain Shams University	
Dr. Marwan Tarek Shedid Associate Professor, Department of Structural Engineering, Ain Shams University	
Dr. Hussein Osama Okail Associate Professor, Department of Structural Engineering, Ain Shams University	

Date: 2 / 2 / 2020

Postgraduate Studies

Authorization stamp: The thesis is authorized at / / 2020

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STATEMENT

This thesis is submitted in partial fulfillment of the requirements for the degree of Master of Science in Civil Engineering, Faculty of Engineering, Ain Shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

Student Name

Ahmad Tarek Ali Elsayed Abdelwahab

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ABSTRACT

Fully-grouted RMSW have been widely used in numerous countries, mostly in North America as the main LLRS in midrise buildings. Several research programs were carried out to study the behavior of RMSW as individual walls, but limited research programs were carried out to study the behavior a system of RMSW. This study presents a simplified analytical approach for modeling the behavior of both individual reinforced masonry structural walls (RMSW) (component level) and systems of RMSW as the main lateral load resistance system (LLRS) (system level) under lateral loading. Analytical modeling of individual RMSW, with different end configurations (rectangular, flanged & end-confined), was achieved by generating the P-Δ relationships for these walls based on simple mechanics and accounting for plastic hinging. Knowing that plastic hinging is concentrated at the base of cantilever structural wall, its value was estimated based on experimental results and plasticity theory, taking into consideration the effect of strain penetration inside concrete foundation, inclined flexural-shear cracking and variation of curvature profile following yielding. Also, analytical modeling of a system of RMSW may be conducted and the displacement of each wall can be calculated by simple geometrical relations, if the displacement at the center of mass (CM) and the rotation angle of the building are known. Results of previous experimental studies were used to verify the results of the developed analytical models for individual RMSW. The maximum error obtained in all models at maximum load, deformation at maximum load and deformation at

20% strength degradation, compared to experimental results, were 8.05%, 8.55% and 9.87%, respectively. A third-scale building composed of a number of RMSW as its main LLRS was used to verify the developed analytical approach for a system of RMSW and the showed that error in predicting of the building resistance was less by around 7% from experimental results determined as average between push and pull cycles. As a result, better understanding of the behavior of a system of RMSW when subjected to seismic loads can be achieved. This resulted in reducing the computational time for each analytical model, ranging from 3 to 5 minutes compared to about 90 to 120 minutes using other software packages. The factors affecting the accuracy of the developed modeling technique are presented and discussed throughout this study. Recommendations for the problems faced through the development of the modeling approach are presented throughout this study. Based on the analytical verification presented, a parametric study was carried out to investigate the effect of different parameters as lateral load eccentricity, torsional effects, and presence of orthogonal walls to the loading direction.

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