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FINITE ELEMENT MODELING OF RC SHEAR WALLS STRENGTHENED WITH CFRP SUBJECTED TO CYCLIC LOADING

By

Ayman Kamal Adly

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
STRUCTURAL ENGINEERING

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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Finite Element Modeling of RC Shear Walls Strengthened With CFRP
Subjected To Cyclic Loading.

Key Words:

RC shear Walls – Seismic Behavior- CFRP sheets - Cyclic Loading - Finite element
method using ANSYS software program.

Summary:

Reinforced concrete (RC) shear walls are considered as the main lateral force resisting system which are used in many RC structures. Many factors influence on the seismic performance and ductility of a RC shear wall. Several retrofitting schemes are founded to improve seismic behavior for shear walls in terms of the overall strength, stiffness and ductility. Among these, fiber reinforced polymer (FRP) composite materials is considered as an essential material for strengthening of existing RC structures. This thesis presents a study for the behavior of RC shear walls strengthened with CFRP subjected to cyclic loading using ANSYS program software. The finite element (FE) results are validated using experimental results available in the literature. The parameters considered in this study involves the effect of changing concrete compressive strength, thickness of FRP sheets, number of FRP layers and position of FRP sheets. An extensive parametric study was conducted to investigate the effect of different parameters on the capacity, deflection, crack pattern and mode of failure. The results showed that using FRP sheets enhances the behavior of the shear wall when exposed to cyclic loading. It was concluded also that, the number of FRP layers and its thickness have a great effect on the behavior of the RC shear wall.

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DEDICATION

To my parents, my brother, my sisters, my fiancée and all my friends

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ABSTRACT

Establishing effective strength methods for enhancing the seismic behavior of existing reinforced concrete (RC) shear walls needs new schemes for estimating the response of RC shear walls. In general, experimental testing of strengthened RC shear walls is considered as the most significant scheme to assess the seismic behavior but this requires great efforts in terms of the equipment of test and time as well as the high cost. On the other hand, a numerical model is taking into consideration the main parameters that effect the complex behavior of strengthened shear walls showed to be an effective tool for representing such behavior. A number of experimental tests available in the literature could be used for the initial verification of numerical analyses.

In this thesis, a numerical modeling of RC shear walls using ANSYS finite element program is performed. A total of seven wall specimens from two experimental programs were modeled and analyzed under monotonic and inverted cyclic loading. The numerical results were in good agreement with the experimental data. One of the experimentally tested models was chosen for more detailed investigation.