FAYOUM UNIVERSITY

FACULTY OF ENGINEERING

CIVIL ENGINEERING DEPARTMENT

STRENGTHENING OF RC SHEAR WALLS WITH OPENINGS BY FRP

By

Mostafa Mamdouh Mohamed Rashad

A thesis submitted in partial fulfillment

Of

The requirements for the degree of

Master of Science

In

Civil Engineering

Structural Engineering

Civil Engineering Department

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2020

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Under the supervision of

Dr. Alaa Aly El-Sayed

Associate professor of Reinforced Concrete Structures

Department of Civil Engineering

Faculty of Engineering - Fayoum University

Signature ……

Dr. Mohamed Sayed Gomaa

Associate Professor of Structural Engineering

Department of Civil Engineering

Faculty of Engineering - Fayoum University

Signature ……

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Master Degree

This thesis for M.Sc. degree has been approved by

Examination Committee : Name and Affiliation	Signature
Dr. Hany Ahmed EL-Ghazaly Professor of Structural Analysis and Mechanics, Civil Engineering Department, Fayoum University	Chairman of the committee
Dr. Adel Yehia Akl Professor of Structural Engineering, Civil Engineering Department, Cairo University	Member
Dr. Alaa Aly El-Sayed Associate professor of Reinforced Concrete Structures Civil Engineering Department, Fayoum University	Main Supervisor

Date of Examination: 2/9/2020

Faculty of Engineering
Fayoum University
2020

The summary not more than 500 words

ABSTRACT

High-rise reinforced concrete buildings contribute a considerable share of the real estates all over the world. In order to resist lateral loads, most of these buildings are provided with reinforced concrete shear walls that may contain openings for architectural or mechanical requirements. These openings have a harmful effect on the capability of RC shear walls to resist seismic or wind loads. Because of the inability to prevent the construction of these openings, the retrofitting of shear walls with openings by fiber reinforced polymer (FRP) is considered to be one of the most effective methods to increase their shear capacity. In this study, the influence of openings with different positions and dimensions on the nonlinear behavior of shear walls have been conducted using the finite element software ANSYS 14.5. The study also aims to investigate the amount of improvement in the shear capacity of these shear walls after retrofitting them by CFRP sheets with a specific configuration. First, four different openings with nine different locations have been constructed in RC squat shear walls with dimensions of (900x900x100 mm) under the application of lateral monotonic loads. Then, the previous thirty six numerical models have been reanalyzed after retrofitting the walls by CFRP sheets with a certain scheme around openings. After that, cyclic loads have been applied laterally on RC shear walls with large dimensions (2900x2900x300 mm) and four different dimensions of openings with six different positions have been used. Finally, the same configuration of CFRP sheets that used in monotonic loading tests has been used to figure out the percentage of increase in shear strength of the retrofitted shear walls that subjected to lateral cyclic loads. Although the proposed scheme of CFRP sheets has proved its ability to strength most of the tested shear walls with openings, its effect becomes not very significant in case of the existence of openings in some not recommended and inappropriate locations.