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**ZAGAZIG UNIVERSITY BANHA BRANCH
FACULTY OF ENGINEERING - SHOUBRA**

Strengthening Of Concrete Members

BY

KHALED MAHMOUD AHMED MAHMOUD

*M. Sc. – Structural Engineering 1997- Ain Shams University
High diploma - Geotechnical Engineering 1990- Ain Shams University
B. Sc. Civil Engineering 1987 - Ain Shams University*

A Thesis

*Submitted To Faculty Of Engineering - Shoubra,
Zagazig University - Banha Branch
In Fulfillment For The Requirements
Of The Degree Of*

Doctor of Philosophy

*In Civil Engineering
Department of Civil Engineering*

Cairo - Egypt

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ABSTRACT

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Abstract of the Ph.D. Thesis Submitted by

Eng./ Khaled Mahmoud Ahmed Mahmoud

Title of the Thesis:

STRENGTHENING OF CONCRETE MEMBERS

Supervisors :

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ABSTRACT

Confinement of concrete is an effective way for strengthening of concrete members, especially columns. The behaviour of strengthened concrete columns wrapped by Fibre Reinforced Polymer composite (FRP) sheets opens the way to new powerful strengthening technique. Square and rectangular-section columns were found to experience less increase in strength and ductility than their circular counterparts when wrapped with FRP because the distribution of lateral confining pressure varies from a maximum at the corners to a minimum in between. Most of the recent researches on non-circular concrete columns concluded that increasing the stiffness of the FRP wrapping is a promising way to increase the wrapping efficiency. To improve the effectiveness of wrapping, a sandwich-wrapping method is used in this research. Sandwich wrapping consisted of wrapping the column with two layers of FRP, inner and outer, separated by an incompressible material as filling material. Acrylic plates were used as filling material between FRP sheets. Twelve square RC columns with dimensions 200X200X1500 mm were tested. Two columns were considered as control specimens while the remaining ten columns were strengthened with different wrapping schemes. The effectiveness of the sandwich wrapping system was investigated either in straps or full wrapping. The variables of the study were: the method of wrapping; percentage of wrapping; thickness of acrylic plates and type of wraps (Glass FRP or Carbon FRP). The number of layers was kept constant as two layers, except for one column where another layer was added to examine its effect on the column performance. The use of sandwich wrapping greatly enhanced the maximum axial load capacity of the columns. The ductility of the sandwich wrapped specimens also was higher than regular wrapped specimens; thus proves that using sandwich technique improves the behaviour of rectangular RC columns under axial loads. A model was proposed to describe the stress-strain behaviour of confined square or rectangular RC columns. The proposed model is suitable for different wrapping configurations including regular and sandwich wrapping. The results of the model showed good agreement with experimental tests results. The model also showed good agreement with several other available test results considering different columns aspect ratios, straps or full wrapping, different types of FRP types (Carbon, Aramid and Glass)

Keywords: Concrete, Confinement, Column, FRP, Strengthening, Jacket

ACKNOWLEDGMENT

It is a pleasure to acknowledge the efforts of all those who have helped in completing this thesis.

The author gratefully acknowledges *Fyfe* Company in U.S.A. particularly *Mr. Edward Donnelly* for donating the *TYFO S* Fiber wrap materials needed in this research and *Mrs. Sarah Cruickshank* for her positive support and continuous feeding with needed technical information for wrapping.

It is a pleasure to express my deepest gratitude and appreciation to *Prof. Dr. Assem Mostafa Kamal Abd-Elaleem* Professor of Material Properties Department of Civil Engineering Faculty of Engineering – Shoubra - Zagazig University - Banha Branch for his valuable advice and encouragement throughout this thesis.

I would also acknowledge gratefully *Dr. Mohamed Osama Ramadan El-Hariri*, Associate Professor of Material Properties Department of Civil Engineering Faculty of Engineering – Shoubra - Zagazig University - Banha Branch, for his continuing professional guidance throughout this research.

I would like to express my deep gratitude and thanks to *Dr. Ehab Foad Ibrahim* Assist. Prof. of R.C. Structures, Reinforced Concrete Department, Housing & Building Research Center (H.B.R.C.) for his simulating supervision, guidance and sincere efforts, which are reflected in much of the material of this thesis, and his helpful advice which contributed significantly in the creating research line for the author.

The support from the technical staff at the Housing and Building Research Center (H.B.R.C.) including *Prof. Dr. Omaima Salah Eldin* and *Dr. Yehia Abd Elmegeed* is gratefully appreciated.

I shall be always grateful to *My wife* for her support and patience throughout this study. My education would never have been possible without the continued encouragement and support of my *Parents*, I shall be always thankful to them.

STATEMENT


This thesis submitted to Zagazig university - Banha branch for the degree of Doctor of Philosophy in Civil Engineering.

The analytical work included in this work was carried out by the author in the Department of Civil Engineering Faculty of Engineering – Shoubra - Zagazig University Banha branch, from January 2001 to August 2004.

The experimental work included in this work was carried out by the author in the Reinforced Concrete Laboratory of Housing & Building Research Center (H.B.R.C.), from January 2001 to August 2004.

No part of this thesis has been submitted for a degree or qualification at any other university or institute.

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