



شبكة المعلومات الجامعية

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ





شبكة المعلومات الجامعية



شبكة المعلومات الجامعية

التوثيق الالكتروني والميكرو فيلم

جامعة عين شمس

التوثيق الالكتروني والميكرو فيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأفلام قد اعدت دون أية تغيرات



يجب أن

تحفظ هذه الأفلام بعيداً عن الغبار

في درجة حرارة من 15 – 20 مئوية ورطوبة نسبية من 20-40 %

To be kept away from dust in dry cool place of
15 – 25c and relative humidity 20-40 %



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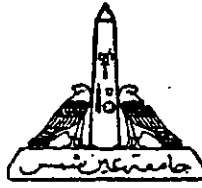
بعض الوثائق الأصلية تالفة



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بالرسالة صفحات
لم ترد بالأصل



**AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING**

**STRENGTHENING OF REINFORCED CONCRETE
COLUMNS USING ADVANCED LAMINATES**

**BY
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**A THESIS
SUBMITTED IN PARTIAL FULFILLMENT FOR THE
REQUIREMENTS OF THE DEGREE OF MASTER OF SCIENCE
IN CIVIL ENGINEERING (STRUCTURAL)**

SUPERVISED BY

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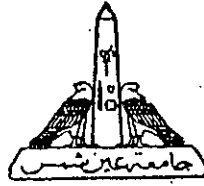
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Cairo – 2002

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**AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING**

APPROVAL SHEET

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Student Name: Tamer Hassan Kamal M. A. El-Afandy
Thesis Title : Strengthening of Reinforced Concrete Columns Using
Advanced Laminates

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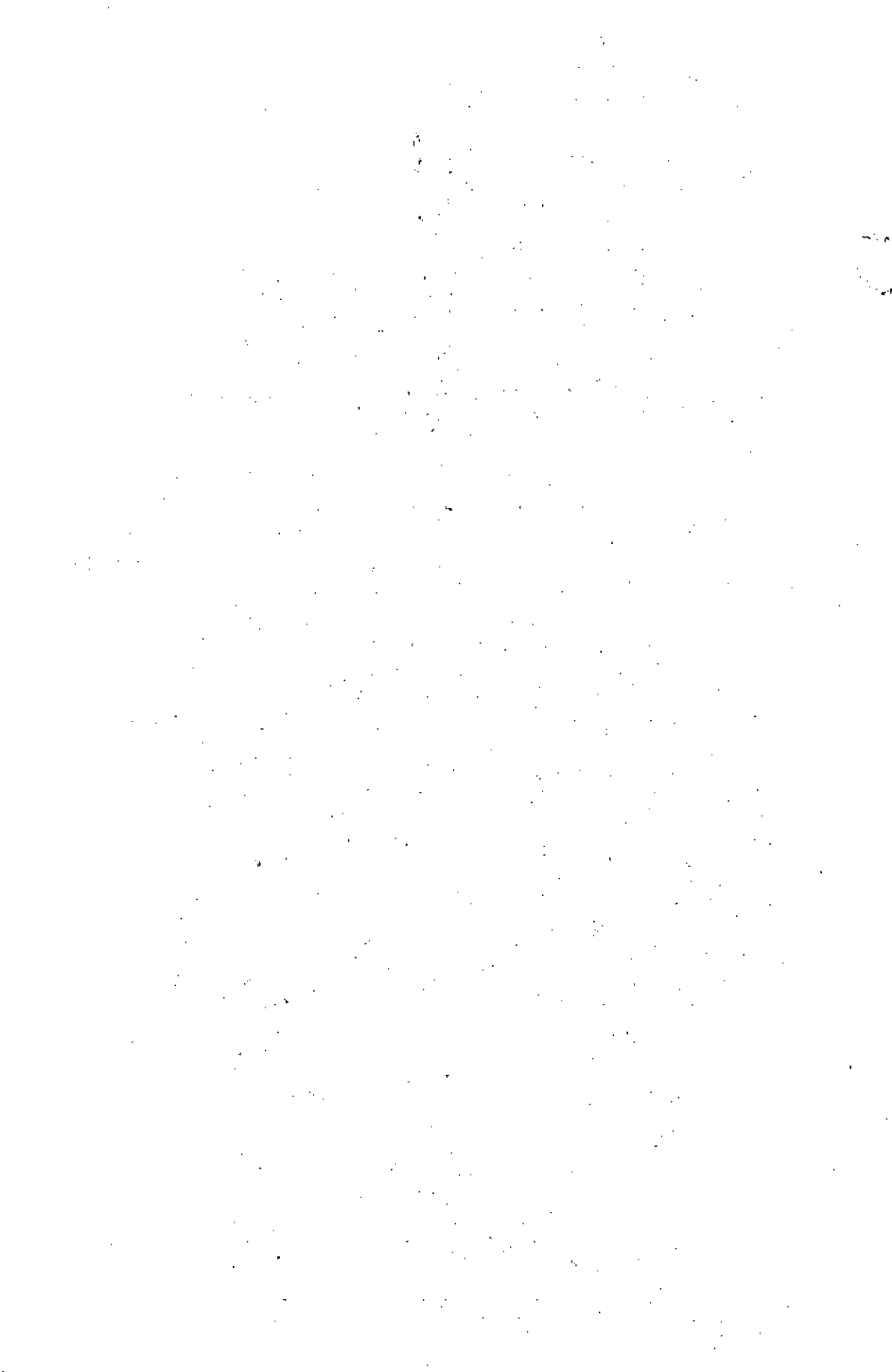
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Date: - - 2002



**AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
STRUCTURAL DEPARTMENT**

Abstract of the M.Sc. Thesis Submitted by

Eng. / Tamer Hassan Kamal M. A. El-Afandy

Title of the Thesis:

**STRENGTHENING OF REINFORCED CONCRETE
COLUMNS USING ADVANCED LAMINATES**

Supervisors:

Prof. Dr. / Abdelhady Hosny

Prof. Dr. / Hamdy H. Shahin

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ABSTRACT

Use of carbon fiber reinforced polymers, (CFRP) laminates in strengthening reinforced concrete element, has increased rapidly for the last ten years. The conventional alternative for CFRP is the use of steel plates bonded to the concrete surface or reinforced concrete, (RC) jackets. The major disadvantages of using the steel plates are referred to corrosion of steel and the need for technical labour and heavy equipment. Furthermore, RC jackets increase the column stiffness and consequently the applied forces due to earthquakes. Advantages of CFRP are the non-corrosive characteristics, high strength-to-weight ratio and good fatigue properties. These characteristics significantly increase the service life of structures compared to conventional strengthening techniques.

Rectangular reinforced concrete, (RC), columns with aspect ratio up to one-to-five are commonly used in residential buildings, because it meets the architectural requirements in cases where partitions are

provided in the building. Upgrading of these structures involves, increasing the ultimate carrying capacity as well as the ductility of the columns.

An experimental program undertaken at the Housing and Building Research Center, (HBRC) to study the behavior of RC rectangular and square columns strengthened with CFRP laminates under axial loading. The program consists of a total of fourteen columns; twelve columns with an aspect ratio of one-to-three and the remaining two columns have a square cross-section. The overall dimensions of the rectangular columns are 150 x 450-mm and 2100-mm high and the overall dimensions of the square columns are 150 x 150-mm and 2100-mm high. The columns were tested under monotonic uniaxial compression loading up to failure. Number of layers, spacing between wraps as well as different types of anchorage systems are used. An analytical model based on the stress-strain characteristics of concrete under triaxial state of stresses is proposed to predict the behaviour of RC columns strengthened by CFRP laminates. Different recommendations and design guidelines of rectangular and square RC columns strengthened by CFRP laminates are introduced.

Keywords: Axial Load, CFRP, Columns, Composite material, Confinement, Reinforced Concrete, Strengthening, Uniaxial Tests, and wrapping.

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The support of my father and my mother can not be praised enough; to them this thesis is dedicated.



STATEMENT

This thesis is submitted to Ain Shams University, Cairo, Egypt, on April 2002 for the degree of Master of Science in Civil Engineering (Structural).

The analytical work included in this thesis was carried out by the author in the Department of Civil Engineering (Structural Division), Ain Shams University, from April 1997 to February 2002.

The experimental work included in this thesis was carried out by the author in the Reinforced Concrete Laboratory of Housing and Building Research Center (HBRC), from April 1997 to February 2002.

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

Date : 12 / 6 / 2002

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