# بسم الله الرحمن الرحيم

# شبكة المعلومات الجامعية

# التوثيق الالكتروني والميكروفيلم

# جامعة عين شمس

## التوثيق الإلكتروني والميكروفيلم

## قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

## يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار

# ANALYSIS OF RC BEAMS WITH OPENINGS STRENGTHENED WITH CFRP

By

**Yasser Mohamed Magdy Hassan Morsy**

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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Under the Supervision of

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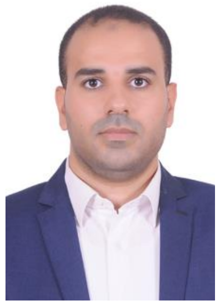

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**Title of Thesis:**

ANALYSIS OF RC BEAMS WITH OPENINGS STRENGTHENED WITH CFRP

**Key Words:**
RC beams; web opening; CFRP sheets; strengthening; finite element

**Summary:**

Creating transvers web opening in existing reinforced concrete beams, to provide a convenient passage for utility ducts, causes local cracking around the opening region leading to a decrease in stiffness and load-carrying capacity of the beam. (ANSYS) software was used to investigate the effect of opening size and shape on simply supported RC beams under four-point loading. Also, the effectiveness of using carbon fiber reinforced polymer (CFRP) sheets, as strengthening around the opening, was studied. A total of 35 (FE) models were created, 10 of them were compared with experimental results to ensure the validity of the (FE) models. The results showed that, circular and rounded corner openings had less crack propagation around openings at early stages of loading and higher ultimate load than rectangular openings. Also, using (CFRP) sheets can prevent early cracking around the opening and retrieve most of the original strength of the solid RC beam depending on the opening size.

# Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

Name: Date:

Signature:

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