



AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
STRUCTURAL DEPARTMENT

NONLINEAR RESPONSE OF COLUMNS
STRENGTHENED BY NON-SYMMETRIC CONCRETE
JACKETS UNDER ECCENTRIC VERTICAL LOADING

Thesis

Submitted for the Partial Fulfillment of
The Requirements for the Degree of Doctor
Of Philosophy in Structural Engineering

By

Mohamed Ahmed Abdallah AL-Azzouny

M.sc. Structural Engineering (2008)

B.Sc. Structural Engineering (2002)

Ain Shams University Faculty Of Engineering

Under the Supervision

Prof. Dr. Ahmed. A. Korashy

Professor of Structural Eng.

Ain Shams University

Dr. Hany. M. A. El Shafie

Assoc. Prof. of Structural Eng.

Ain Shams University

Dr. Hisham. A. El Arabaty

Assoc. Prof. of Structural Eng.

Ain Shams University

Cairo, Egypt

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APPROVAL SHEET

Thesis : Doctor of Philosophy in Structural Engineering
Student Name : Mohamed Ahmed Abdallah AL-Azzouny
Thesis Title : Nonlinear Response of Columns Strengthened By Non-Symmetric Concrete Jackets under Eccentric Vertical Loading

Examiners Committee :

Signature

Prof. Dr. Nabil Ahmed Fouad
Professor of Structural Engineering,
Hanover University, Germany

.....

Prof. Dr. Amr Aly Abdel Rahman
Professor of Structural Engineering,
Faculty of Engineering, Ain Shams University

.....

Prof. Dr. Ahmed Abdelmonem Korashy
Professor of Structural Engineering,
Faculty of Engineering, Ain Shams University

.....

Dr. Hisham Ahmed El-Arabaty
Assoc. Professor of Structural Engineering,
Faculty of Engineering, Ain Shams University
(Supervisor)

.....

Date: 01/ 06 / 2017



AIN SHAMS UNIVERSITY
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Student Name : Mohamed Ahmed Abdallah AL-Azzouny
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Supervisors Committee :

Signature

Prof. Dr. Ahmed Abdelmonem Korashy
Professor of Structural Engineering,
Faculty of Engineering, Ain Shams University

.....

Dr. Hany Mohamed Abdelfattah El-Shafie
Assoc. Professor of Structural Engineering,
Faculty of Engineering, Ain Shams University

.....

Dr. Hisham Ahmed El-Arabaty
Assoc. Professor of Structural Engineering,
Faculty of Engineering, Ain Shams University

.....

Registration Date: 11 / 3 / 2009
Examination Date: 01 / 06 / 2017

INFORMATION ABOUT THE RESEARCHER

Name : Mohamed Ahmed Abdallah AL Azzouny

Date of Birth : May 4, 1980.

Place of Birth : Giza, Egypt

Qualifications : M. Sc. Degree in Civil Engineering (Structural),
Ain Shams University (2008).
B. Sc. Degree in Civil Engineering (Structural),
Ain Shams University (2002).

Present Job : Senior Structure Design Engineer at ACE Consultant
(Moharam Bakhoum)

Personal Mail : m_a_azz@yahoo.com

Contact Phones : 01005498744 , 01116655243

STATEMENT

This thesis is submitted to Ain Shams University for the degree of Doctor of Philosophy in Civil Engineering (Structural).

No part of this thesis has been previously submitted for obtaining a degree or a qualification before.

Name: Mohamed Ahmed Abdallah AL Azzouny

Date : 01 / 06 /2017

Signature:

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ABSTRACT
AIN SHAMS UNIVERSITY
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Abstract of Thesis Submitted for Partial Fulfillment for the Degree of Doctor of Philosophy in Structural Engineering by:

Eng. Mohamed Ahmed Abdallah AL Azzouny

Title: Nonlinear Response of Columns Strengthened By Non-Symmetric Concrete Jackets under Eccentric Vertical Loading

Supervisors:

- 1. Prof. Dr. Ahmed Abdelmonem Korashy.**
- 2. Assoc. Prof. Dr. Hany Mohamed Abdelfatah El Shafie.**
- 3. Assoc. Prof. Dr. Hisham Ahmed El Arabaty.**

The main objective of this research study is an in-depth investigation of the nonlinear structural behavior of concrete column jackets, with an emphasis on the case of non-symmetric jackets used to strengthen edge and corner under strength columns. A highly sophisticated analytical algorithm is developed, incorporating the nonlinear behavior of the concrete material, together with accurate modeling of the shear transfer mechanism at the contact surface. The relation between normal pressure and the developed shear stresses at the contact surface is studied in detail, and included in the developed analytical model. Finite element models are developed for actual lab specimens, and the analysis results are used to verify the developed model by comparison to available experimental results. A parametric study is performed on a number of actual building rectangular columns strengthened using non-symmetric concrete jackets. The developed analytical model is used to obtain results including the load fraction transferred from the existing column to the jacket for cases of corner, edge and interior columns. The results obtained are utilized to develop an in-depth understanding of the behavior of non-symmetrical column jackets, and provide insight into the behavior of these 3-sided, and 2-sided jackets, and their efficiency in strengthening existing columns. Useful conclusions, and recommendations are provided to assist designers in the field of this research.

Key words: Strengthening, Reinforced Concrete Columns, Non-Symmetric Concrete Jackets, Non-linear Analysis, Finite Element Method.

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