INVESTIGATIONS OF RC STRUCTURES SUBJECTED TO BLAST LOADS

By

Ahmed Ashraf Hanafy Said Gomaa

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

Prof. Dr. Walid AbdElLatif Attia

Professor of Structural Analysis and Mechanics, Faculty of Engineering, Cairo University

Dr. Mostafa M. Abdelwahab ElSayed

Assistant Professor, Structural Engineering Department, Faculty of Engineering, Cairo University

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Approved by the
Examining Committee

_____
Prof. Dr. Walid AbdElLatif Attia, Thesis Main Advisor

_____
Prof. Dr. Adel Yehia Akl, Internal Examiner

_____
Prof. Dr. Hatem Hamdy Ghith, External Examiner
- Housing & Building National Research Center

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Engineer's Name: Ahmed Ashraf Hanafy Said
Date of Birth: 3/6/1991
Nationality: Egyptian
E-mail: Ahmed.ashraf.hanafy.91@gmail.com
Phone: 01004682361-01272000150
Address: 21aman street- dokki

Registration Date: 01/10/2013
Awarding Date: 01/12/2016
Degree: Master of Science
Department: Structural Department

Supervisors:
Prof. Dr. Walid AbdElLatif Attia
Dr. Mostafa M. Abdelwahab ElSayed

Examiners:
Prof. Dr. Walid AbdElLatif Attia (Main advisor)
Prof. Dr. Adel Yehia Akl (Internal examiner)
Prof. Dr. Hatem Hamdy Ghith (External examiner)
- Housing & Building National Research Center

Title of Thesis:

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Key Words:
blast loads; moment curvature; single-degree-of-freedom; damage level; progressive collapse

Summary:
Recently, progressive collapse of civilian and military facilities became more common as a result of increased number of terrorist attacks and explosions. In order to mitigate this type of collapse, more studies have to be performed on evaluating the nonlinear response of buildings under such extreme loads. Since columns are the key load-bearing elements in structures and exterior columns are probably the most vulnerable structural components to terrorist attacks, column's failure is normally the primary cause of progressive collapse in structures. However, the available techniques, specified in modern blast resistance design standards, for evaluating the response of reinforced concrete (RC) columns under blast loads does not consider the influence of axial on the lateral behavior of columns (buckling effect). This research focuses on studying experimentally the influence of changing exterior column design parameters, such as column aspect ratio, shear reinforcement (stirrups) and also axial load (that already exist from the gravity load), on their lateral behavior. It has been shown that increasing column depth and axial load significantly increases the column's capacity and subsequently, the lateral behavior structures under the action of blast loads. On the other hand, doubling the shear reinforcement slightly increases the column's capacity, but less damage and crack widths are expected. In addition to previous, a case study of a twelve-story RC residential building is considered in this research. In this case, six different thread scenarios (with scaled-distances varies from 1.0 to 4.0 m/kg$^{1/3}$) covering a wide range of design basis threat levels are considered. The thesis outcomes are expected to contribute to the growing reinforced concrete blast performance database of experimental results and the future development of reinforced concrete column design provisions under blast loads in Egypt.

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Dedication

I dedicate this research to parents, for their caring, guidance, supports, patience and help. I do believe that, I couldn't success in all my life steps without their continuous support. God bless them.

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