ASSESSMENT OF NON-LINEAR STATIC PROCEDURE FOR ALTERNATE PATH METHOD FOR DESIGNING REINFORCED CONCRETE STRUCTURES AGAINST PROGRESSIVE COLLAPSE

By

Mohamed Ayman Mohamed Aly Maidan

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. Hamed M. Salem
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Professor of Reinforced Concrete Structures
Structural Engineering Department
Faculty of Engineering, Cairo University

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_____
Prof. Dr. Hamed M. Salem **Thesis Main Advisor**

_____
Prof. Dr. Hany A. Abdalla **Internal Examiner**

_____
Prof. Dr. Hatem H. Ghith **External Examiner**
Professor of Concrete Structures, Housing and Building National Research Center

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2020

Engineer's Name : Mohamed Ayman Mohamed Aly Maidan
Date of Birth : 1/11/1990
Nationality : Egyptian
E-mail : maidan65@gmail.com
Phone : 002 0106 8808009
Address : 115khamayeal–Shekh Zayed-Egypt

Registration Date : 01/10/2012
Awarding Date : / / 2020
Degree : Master of Science
Department : Structural Engineering Department

Supervisors : Prof. Dr. Hamed M. Salem

Examiners :
Prof. Dr. Hamed M. Salem (Thesis Main Advisor)
Prof. Dr. Hany A. Abdalla (Internal Examiner)
Prof. Dr. Hatem H. Ghith (External Examiner)
Professor, Housing and Building National Research Center

Title of Thesis:

Assessment of nonlinear static procedure for alternate path method for designing reinforced concrete structures against progressive collapse.

Key Words:

Progressive Collapse, catenary action, UFC, AEM, APM.

Summary:

Progressive collapse is a tragic partial or total failure of the existing structure, when a primary structural vertical element fails, the structure undergoes progressive collapse. Progressive collapse became a hot spot in many research areas after many terrorist events occurred in the twentieth century. In a chance to prevent or minimize such as those events, many codes added a part of design for progressive collapse resistance. 'Unified Facilities Criteria' (UFC) one of these codes including guidelines to assess the progressive collapse resistance. Alternate Path Method (APM) is the direct design approach of progressive collapse resistance defined in the UFC. In this thesis, a ten-story reinforced concrete structure subjected to gravity load and designed according to ACI-318-14 against progressive collapse following the non-linear static analysis for the APM approach was performed. According to the UFC guidelines, to assess the progressive collapse of any structure based on non-linear static analysis, the gravity load combination should be increased by Dynamic Increase Factor (DIF). DIF was found to be 1.07. All studied cases satisfied the UFC guidelines with safety factors equal to (3.31) and (3.03) for beams and slabs, respectively. A comparison between the nonlinear static and nonlinear dynamic analysis was carried out and it showed that, the non-linear static analysis gave a conservative solution with higher values of rotation compared to nonlinear dynamic analysis. Also it figured out that the maximum increase in beams and slab rotation is 53.0% due to column removal, and 74.0% due to internal wall removal.

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: Mohamed Ayman Maidan Date:

Signature:

Dedication

To my Father Prof. Dr. Ayman Maidan and my gorgeous Mother Mrs. Sarah Ahmed, whose are giving me everything I need, before I need and before I ask. Whose created everything good inside me and I can't imagine my life without them.

To my Sisters Dr. Suhad and Eng. Arch. Sara. To my Brothers Eng. Islam and Dr. Hadi.

The most important thing in the humanity history is the family. Family comes first and you can't turn your back on them. 'Salute mi familia'.

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