



**NUMERICAL EVALUATION OF RESPONSE  
MODIFICATION FACTOR FOR RC STRUCTURES  
UNDER THE EFFECT OF VERTICAL AND  
HORIZONTAL GROUND MOTIONS**

**By**

**Abdelrahman Mohammed Hussein Ahmed**

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  
GIZA, EGYPT  
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Under the Supervision of

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**Title of Thesis:**

NUMERICAL EVALUATION OF RESPONSE MODIFICATION FACTOR FOR RC STRUCTURES UNDER THE EFFECT OF VERTICAL AND HORIZONTAL GROUND MOTIONS.

**Key Words:**

Vertical Ground motion, Response modification factor, Ductility, Over-strength, Redundancy, AEM.

**Summary:**

This research aims to evaluate the response modification factor for reinforced concrete structure with ductile moment resisting frames system, which was designed according to the Egyptian Code of Practice (ECP) under the effect of vertical and horizontal ground motions. A non-linear dynamic analysis is performed using the Extreme Loading for Structures (ELS<sup>®</sup>) software which based on the Applied Element Method (AEM). The values of (R) factor were evaluated under the effect of the vertical ground acceleration, combined vertical and horizontal ground accelerations, concrete compressive strength and reinforcement grades defined by (ECP). The obtained values of (R) factor from the numerical analysis were compared to the values defined by (ECP), the Euro Code (EC8), the American Codes (ASCE) and (UBC97).





## **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: Abdelrahman Mohammed

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Thanks to ALLAH for helping me finish this work.

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