



**EVALUATION OF RESPONSE MODIFICATION FACTOR
FOR REINFORCED CONCRETE STRUCTURES WITH
DUAL LATERAL LOADS RESISTING SYSTEM USING
APPLIED ELEMENT METHOD**

By

Ahmed Mohammed El-Hussein Mohammed

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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Title of Thesis:

Evaluation of Response Modification Factor for Reinforced Concrete Structures with Dual Lateral Loads Resisting System using Applied Element Method

Key Words:

Response modification factor, Ductility, Over-strength, Redundancy, AEM.

Summary:

Designing a structure to withstand the seismic loads without any damages (elastic state) is uneconomic, as it produces bulky-sized structural members, therefore it has been a common practice by design codes to design structures for a portion of the seismic load and allow an acceptable degree of damages without failure (inelastic state). A response modification factor (R) is used by design codes to account for inelastic behavior of structures. The value of (R) depends on the ductility, redundancy and over strength of the designed structure. The thesis objective is to estimate the response modification factor for a mid-rise (twelve-storey) reinforced concrete structure with dual lateral loads resisting system consisting of shear walls and ductile moment frames. Three-dimensional dynamic nonlinear analysis based on the Applied Element Method was carried out. A parametric study was conducted to study the effect of different parameters that could affect the response modification factor including (1) peak ground acceleration (PGA), (2) concrete compressive strength (f_c'), (3) reinforcement yield strength (f_y), (4) reinforcement ultimate to yield strength ratio (f_u / f_y), (5) floor height (h) and (6) walls and moment frames configuration. It was concluded that dynamic properties of the building are not the only factors affecting the value of (R) and therefore current values defined by different codes may be unconservative. A proposed equation is introduced to calculate the response modification factor (R) for reinforced concrete structures with dual system.

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guidance, help, motivation, and support.**

Dedication

I dedicate this work to my father, mother, sisters and colleagues for their continuous help, encouragement and support.

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