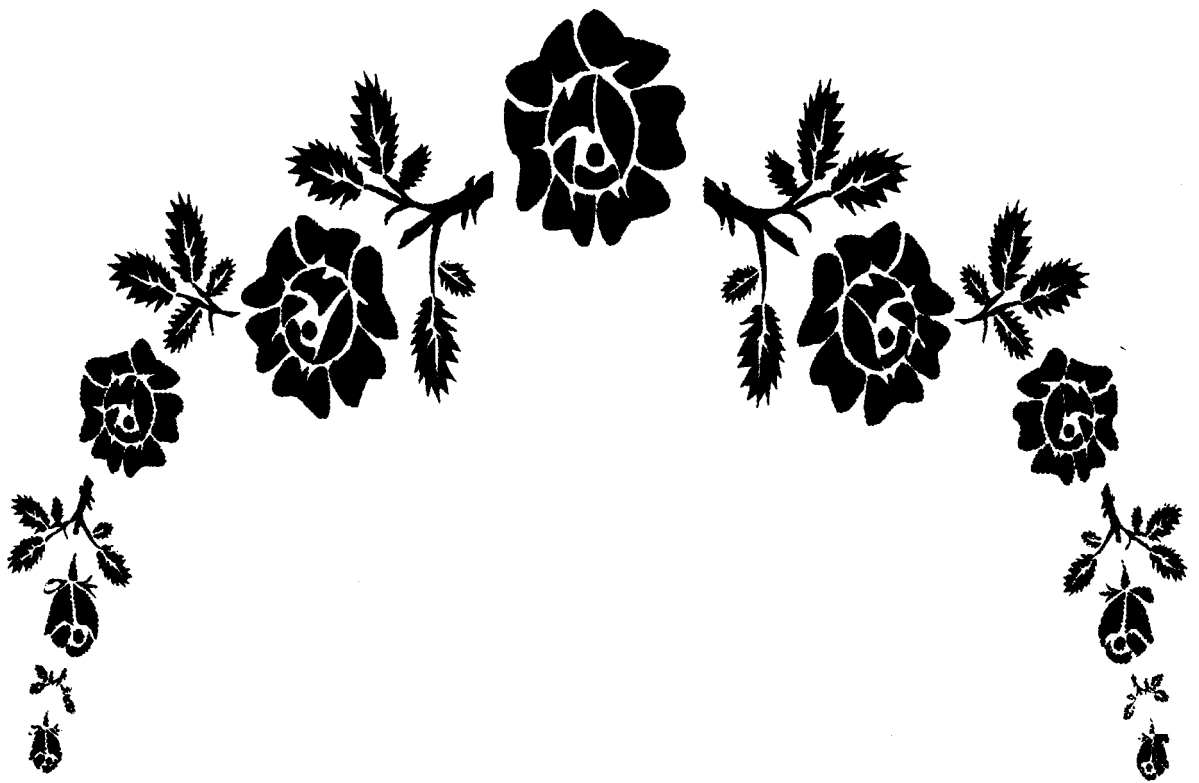


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*Arabic Summary*



## بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

### الملخص العربي

الحمد لله رب العالمين، اللهم صلى على سيدنا محمد صلى الله عليه وسلم خاتم أنبيائك ورسلك صلاة ابتغى بها مرضاتك يا رب العالمين.

في السنوات القليلة الماضية اهتزت مصر بفعل العديد من الزلازل، الشيء الذي لم يكن يرد بقوة في خواطر ومن ثم في اعتبارات المهندسين، لذا فقد بات ضرورياً أن يتجه مهندسي مصر نحو هذا العامل المهم من عوامل التصميم والذي كانت تفتقده الكودات السابقة، وتمثل هذا الاتجاه في تسجيل هذه الزلازل وتحليل نتائج هذا التسجيل ثم إيجاد الطريقة العلمية الدقيقة لعمل تصميم مناسب لمقاومة مثل هذه الزلازل. ومن أحد العوامل الهامة التي تؤخذ في الاعتبار عند إيجاد الطريقة العلمية الدقيقة لعمل تصميم مناسب لمقاومة هذه الزلازل - هو زمن الذبذبة الأساسية الطبيعية للمنشأ. وقد اقترح العديد من المهندسين من قبل العديد من الطرق لتقدير هذا الزمن ظهر معظمها في صورة معادلات تقريبية افتقد معظمها لتأثير بعض العوامل التي تؤثر على هذا الزمن.

وتدرس هذه الرسالة تقدير زمن الذبذبة الأساسية الطبيعية للمنشأ بطريقة تأخذ في اعتبارها العوامل المختلفة المؤثرة على هذا الزمن.

وقد تم أولاً تحديد العوامل المختلفة المؤثرة على زمن الذبذبة الأساسية الطبيعية للمنشأ والمتمثلة في وزن المنشأ وجسائه والتي يمكن تفصيلها في الآتي:

- ☞ وزن المنشأ.
- ☞ ارتفاع المنشأ.
- ☞ عرض المنشأ.
- ☞ جساءة أعمدة المنشأ.
- ☞ جساءة كمرات المنشأ.

تم دراسة تأثير كل عامل من العوامل السابقة على حده على زمن الذبذبة الأساسية الطبيعية للمنشأ، بعد ذلك تم محاولة الربط بين زمن الذبذبة الطبيعية للمنشأ وبين زمن الذبذبة الأساسية الطبيعية لإطار بسيط (وحدة إطارية) يتكون من باكية واحدة وطابق واحد يمكن تحديد زمن الذبذبة الأساسية الطبيعية له تحت تأثير وزن قدرة واحد طن.ث/م<sup>٢</sup>، ثم تم استنتاج أربعة معادلات أحدها يعتمد على طريقة الوحدة الإطارية لتحديد زمن الذبذبة الأساسية الطبيعية للمنشأ والثلاثة الأخرى هي ثلاثة معادلات تقريبية لتقرير زمن الذبذبة للثلاثة اهتزازات الأولى للمنشأ.

وأخيراً تم عمل اختبار للطريقة المستنتجة وكذلك للمعاملات التقريبية على مجموعة من النماذج ذات العوامل المتغيرة.

والرسالة مكونة من خمسة أبواب وملحق محتواها كما يلي :

**الباب الأول:** يتناول نظره عامة على المشكلة محل الدراسة ومراجعة تاريخية لطرق تحديد زمن الذبذبة الأساسية الطبيعية للمنشآت مع عرض لبعض المعادلات التقريبية المستخدمة في تقدير هذا الزمن والهدف من هذا الفصل هو عرض الطرق الدقيقة لتقدير هذا الزمن ومحاولات تقريبها لطرق أسهل مع توافر الدقة.

**الباب الثاني:** وفيه تم عمل دراسة مقارنة بين بعض المعادلات التقريبية المقترحة وأحد طرق تقدير زمن الذبذبة الأساسية الطبيعية بدقة عالية، والهدف من هذا الفصل هو تحديد مدى دقة هذه المعادلات التقريبية وتحديد الأسباب التي تؤدي الى عدم دقتها.

**الباب الثالث:** وفيه تم دراسة تأثير العوامل المختلفة على زمن الذبذبة الأساسية الطبيعية للمنشأ. ودراسة علاقة تربط المنشأ ككل بالإطار الأحادي.

**الباب الرابع:** يتناول تحليل نتائج الدراسة التي تمت بالفصل الثالث ودراسة علاقة تربط المنشأ ككل بالوحدة الإطارية واستنتاج العلاقة الرياضية التي تربط زمن الذبذبة الأساسية الطبيعية للمنشأ بزمن الذبذبة الأساسية الطبيعية للوحدة الإطارية بالإضافة الي استنتاج ثلاثة معادلات تقريبية لتحديد زمن الاهتزازات الثلاثة الأولى للمنشأ. تم بعد ذلك عمل اختبار على عدة نماذج ذات عوامل مختلفة وتحديد زمن الذبذبة الأساسية الطبيعية لها باستخدام إحدى الطرق الدقيقة وباستخدام المعادلات المستنتجة والمعادلات التقريبية التي تم استخدامها في الباب الثاني وذلك للوقوف على مدى دقة المعادلات المستنتجة.

**الباب الخامس:** وفيه تم عرض ملخص الرسالة وعرض النتائج التي تم التوصل إليها.

**ملحق (أ):** وفيه تم عرض البرامج المستخدمة في الرسالة.

## **ABSTRACT**

This thesis deals with the dynamic analysis of multistory reinforced concrete buildings and aims at finding a simple approach for evaluating the fundamental period of vibration of such buildings.

A comparative study for previous formulae in different codes and researches has been presented.

A parametric study is made on multistory- multibay frames with different properties to investigate the influence of the different parameters affecting the fundamental period of vibration of such frames.

Two formulae for the calculation of the fundamental period have been developed for the cases of frames of uniform properties and of frames of different member properties, and of different bay lengths. One of the two formulae are based on calculating the fundamental period of a unit frame which can be chosen arbitrarily from the different units of the frame under consideration. The formulae account for the effect of the frame height, width, members properties and frame mass on the magnitude of the fundamental period.

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Structural Engineering Department

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*By*

*Aiman Ezzat Mohammed Morsy*

*B.Sc. (Civil Eng.) May, 1992*

*A Thesis*

*Submitted in Partial Fulfillment of the Requirements for the Degree of  
Master of Science in Structural Engineering*

*Under Supervision of*

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

﴿قَالُوا سُبْحَانَكَ لَا عِلْمَ لَنَا إِلَّا مَا عَلَّمْتَنَا﴾

﴿إِنَّكَ أَنْتَ الْعَلِيمُ الْحَكِيمُ﴾

صَلَّى  
الْعَظِيمِ

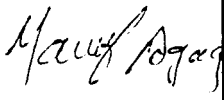
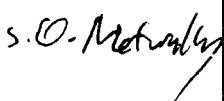
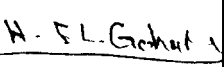
سورة البقرة آية (٣٢)

# SUPERVISORS

**THESIS TITLE** : FUNDAMENTAL PERIOD OF VIBRATION OF  
MULTISTORY REINFORCED CONCRETE BUILDINGS

**CANDIDATE NAME** : AIMAN EZZAT MOHAMMED MORSY

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*Ayman Ezzat Mohammed*

## **ABSTRACT**

This thesis deals with the dynamic analysis of multistory reinforced concrete buildings and aims at finding a simple approach for evaluating the fundamental period of vibration of such buildings.

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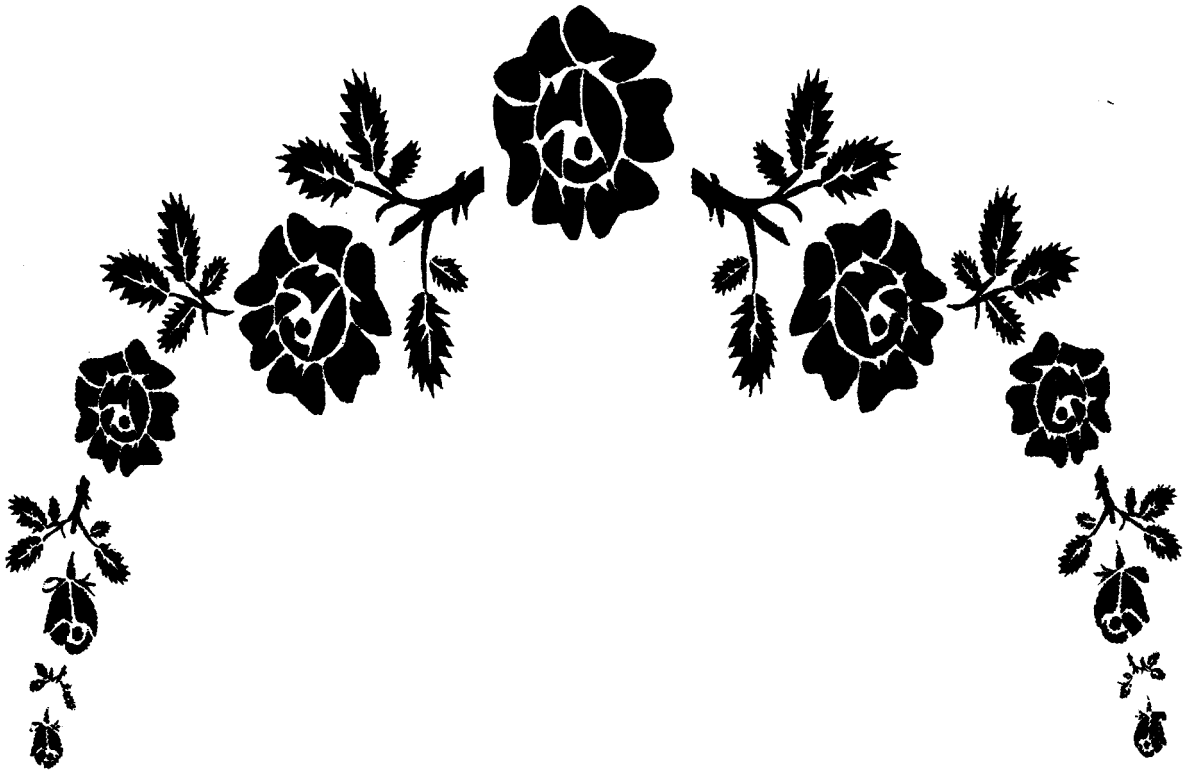
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*Chapter 1*

*Literature Review*



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## CHAPTER (1)

# LITERATURE REVIEW

### 1.1 INTRODUCTION

An important fact is that over 300 thousand earthquakes occur annually all over the world in inhabited or uninhabited regions. Many of these earthquakes cause a great structural damage and perhaps a life loss. So it becomes an important role for the structural engineers to pay more attention to the effect of earthquake on structures and to know how to carry out a design of earthquake resistant structures. An important factor in the design process that governs the effect of earthquakes on structures is the fundamental period of vibration,  $T$ . For its importance this factor must be estimated accurately in order to avoid a lack of accuracy which may lead to unsafe or uneconomic design.

### 1.2 BASIC DEFINITIONS

#### 1.2.1 Dynamic

The term dynamic refers to loads which suddenly change in time, with variations in magnitude, direction, and point of application taking place either jointly or separately. Dynamic loads impart accelerations to bodies (structural elements or entire structure) on which they are imposed, thereby giving rise to inertia forces and causing the system to vibrate [34].



---

### **1.2.2 Inertia Forces**

Inertia forces are the products of the constituent masses (or their moments of inertia) and the acceleration given by the second-order derivatives of the linear (or angular) displacements with respect to time [34].

### **1.2.3 Number of Degrees of Freedom**

The number of degrees of freedom is the number of independent coordinates necessary to specify the configuration or position of a system at any time [33].

### **1.2.4 Free Vibration**

The free vibration is the vibration experienced by a system, on which an external force was applied to upset the stable equilibrium of that system, upon the removal of the disturbing (or exciting) force. It depends on the system's properties and the initial conditions (that is, displacements and velocities) at the instant when the force is removed [34].

### **1.2.5 Natural Mode of Vibrations**

The name "natural" implies that the modes of these vibrations and the respective frequencies depend solely on the properties of the system itself, namely on the magnitude and distribution of its masses and stiffness and the type of supports [34].

### **1.2.6 Cyclic Frequency $\omega$**

The cyclic frequency is the number of cycles of oscillations during  $2\pi$  seconds [4].

---

### **1.2.7 Period of Vibration T**

The period of vibration is the time over which the system undergoes a complete vibration cycle and regains its original state [4]. The reciprocal of the period, defined as the number of vibrations cycles per second, is called the frequency of vibration.

### **1.2.8 Elastic Restoring Force**

The elastic restoring force is the force of elastic reaction in the system, and it appears when the system is deflected from the static equilibrium position. This force tends to return the system to the static equilibrium position. It is directed oppositely to the displacement and is proportional to the deflection [15].

### **1.2.9 Damping Force**

The damping force is the force that may cause energy dissipation to the vibrated system such as the friction between the system and the surrounding media. According to the viscous-friction hypothesis (Voigt hypothesis) the damping (dissipative) forces accompanying vibrations are assumed to be proportional to the velocity of vibration [34].

### **1.2.10 Partial Mode of Vibration**

The partial mode of vibration is one in which a part of the structure remains stationary whilst the rest vibrates [4]. It occurs when two of the members meeting at a joint are vibrating so as to apply equal and opposite dynamic moments at that joint. This naturally results in zero rotation of the joint and any other member framing into that joint will not vibrate by the vibrating members.

Fundamental Perion of Vibratation of Multistory Reinforced Concrete Buildings	العنوان:
Morsy, Aiman Ezzat Mohammed	المؤلف الرئيسي:
Agag, Youssef Q., El Gohary, Hamdy A. A., El Metwaly, Salah E.(Super.)	مؤلفين آخرين:
1999	التاريخ الميلادي:
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1 - 166	الصفحات:
537551	رقم MD:
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جامعة المنصورة	الجامعة:
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مصر	الدولة:
Dissertations	قواعد المعلومات:
هندسة الإنشاءات، الخرسانة المسلحة، الهندسة الميكانيكية	مواضيع:
<a href="https://search.mandumah.com/Record/537551">https://search.mandumah.com/Record/537551</a>	رابط:



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كجزء من متطلبات الحصول على درجة الماجستير في الهندسة الإنشائية

تحت إشراف

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El-Mansoura University  
Faculty of Engineering  
Structural Engineering Department

# **FUNDAMENTAL PERIOD OF VIBRATION OF MULTISTORY REINFORCED CONCRETE BUILDINGS**

*By*

*Aiman Ezzat Mohammed Morsy*

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