

# **ACKNOWLEDGEMENT**

I wish to express my sincere gratitude to *Mr. Alok Verma*, Associate Professor, Department of Civil Engineering, Delhi Technological University, New Delhi, who has graciously provided me his valuable time whenever I required his assistance. His counselling, supervision and suggestions were always encouraging and it motivated me to complete the project at hand. He will always be regarded as a great mentor for me.

I am deeply grateful to Prof. A. K. Trivedi, Head of Department (Department of Civil Engineering), Delhi Technological University, for his support and encouragement in carrying out this project.

I would like to express my heartiest thank to my friends and seniors for constant support and motivation. I would like to thank the Department of Civil Engineering, for providing us with the facilities of laboratory, faculty members and all staff members. Last but not least I thank my parents, for everything I am and will be in future. It's your unspoken prayers and affection that keep me moving forward.

**Dushyant Kumar Sahu**

Roll No.: 2K12/STE/04

Department of Civil Engineering

Delhi Technological University

## **ABSTRACT**

OROS NVGate is a software tool to measure the vibrations. It is helpful on response analysis of vibrating structural models. Any structural system can be modelled to a certain scale and then its behaviour may be analysed by giving it some acceleration. Here a model of three storey building has been analysed at different guiding frequencies by changing their floor mass and their lateral displacements are measured with the help of instrument. In this fashion their natural frequencies at different modes are found experimentally. In this work, these values have been cross checked by the values getting from some other tools also, Such as, manual calculation, Excel Programming and SAP2000. And then other seismic parameters have also been determined by using those values. Meanwhile, damping ratio ( $\xi$ ) of the experimental aluminium frame has also been found by experiment and some calculations.

As the second part of work, some models were created by changing some parameters, to understand the change in seismic behaviour, thus establishing relations for dimensional analysis of the structure for seismic conditions. Then a realistic structure is designed to best fit for earthquake conditions.

# Table of Contents

<i>CERTIFICATE</i> .....	<i>I</i>
<i>ACKNOWLEDGEMENT</i> .....	<i>II</i>
<i>ABSTRACT</i> .....	<i>III</i>
<b>CHAPTER-1: INTRODUCTION</b> .....	<b>1-5</b>
1.1.GENERAL .....	1
1.2.ABOUT EARTHQUAKE, DAMAGES AND PAST OCCURRENCES.....	2
1.3.AIMS AND OBJECTIVES IN BRIEF .....	5
<b>CHAPTER-2: LITERATURE REVIEW</b> .....	<b>6-21</b>
2.1. MODAL ANALYSIS.....	6
2.2. NATURAL FREQUENCY .....	10
2.3. DAMPING RATIO .....	12
2.4. REGRESSION ANALYSIS.....	13
2.5. GENERAL CONSIDERATIONS FOR EARTHQUAKE RESISTANT DESIGN .....	16
2.6. SOME SPECIFICATIONS FROM IS 1893 (PART-1): 2002 .....	19
2.7. CONCLUSIONS BASED ON LITERATURE SURVEY.....	21
<b>CHAPTER-3: AIMS AND OBJECTIVES</b> .....	<b>22</b>
<b>CHAPTER-4: MODEL STUDY</b> .....	<b>23-33</b>
4.1. EXPERIMENTAL SETUP .....	24
4.2. FLOOR DISPLACEMENTS BY EXPERIMENT .....	25
4.3. FREE DAMPED VIBRATION .....	30
<b>CHAPTER-5: THEORETICAL STUDY</b> .....	<b>34-50</b>
5.1. MATHEMATICAL CALCULATIONS .....	34
5.2. MODAL CALCULATION BY EXCEL PROGRAMMING .....	37
5.3. DIMENSIONAL ANALYSIS.....	40
5.3.1. CHANGING SIZE OF ELEMENT IN THREE DIMENSIONS .....	40
5.3.2. CHANGING ONLY UNIT WEIGHT OF MATERIAL .....	46

5.3.3. CHANGING ONLY ELASTICITY OF MATERIAL .....	48
<b>CHAPTER-6: DESIGN OF MULTI-STOREY BUILDING .....</b>	<b>51-56</b>
6.1. BASIC PARAMETERS .....	51
6.2. LOAD CASES .....	53
6.3. DESIGN LOAD COMBINATIONS .....	54
6.4. SAP2000 OUTPUT FILE .....	55
<b>CHAPTER-7: ANALYSIS AND DISCUSSION OF RESULTS .....</b>	<b>57-63</b>
7.1. MODAL RESULTS .....	57
7.2. DAMPING RATIO .....	58
7.3. DIMENSIONAL ANALYSIS RESULTS .....	58
7.4. DESIGN RESULTS .....	60
<b>CHAPTER-8: CONCLUSION .....</b>	<b>64</b>
<b>CHAPTER-9: SCOPE OF FUTURE WORK .....</b>	<b>65</b>
<i>References</i> .....	66