

DISSERTATION WORK

on

**“EFFECT OF VARIOUS STRUCTURAL & SITE SPECIFIC PARAMETERS ON
BEHAVIOUR OF R.C.C FRAMED BUILDINGS IN SIESMIC CONDITIONS”**

Submitted By

**NIHARIKA SINGH
ROLL NO. 18/STR/2010**

*for partial fulfilment of the requirements
for the award of the degree of*

MASTER OF TECHNOLOGY

in

STRUCTURAL ENGINEERING

Under the guidance of

**SHRI .ALOK VERMA
(Associate Professor)
DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING**



**DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING
DELHI TECHNOLOGICAL UNIVERSITY
SHAHBAD DAULATPUR, BAWANA ROAD
DELHI-110042**

CERTIFICATE

This is to certify that the Dissertation work entitled “**Effect Of Various Structural and Site Specific Parameters on the Behavior Of R.C.C Framed Buildings in Seismic Conditions.**” being submitted by me towards partial fulfillment of the requirement towards the award of the degree of Masters of Technology (Structural Engineering) is a work carried out by me under the supervision and guidance of Associate Professor **Shri.Alok Verma** and has not been submitted anywhere else and free from plagiarism.

NIHARIKA SINGH
Roll No:18/STR/2010
M. Tech(Str.)

This is to certify that the above statement made by candidate is correct to the best of our knowledge.

Mr. ALOK VERMA
(Associate Professor)



**DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING
DELHI TECHNOLOGICAL UNIVERSITY
SHAHBAD DAULATPUR, BAWANA ROAD
DELHI-110042**

DECLARATION

I Certify that

- a. The work contained in this thesis is original and has been done by me under the guidance of my supervisor.
- b. The work has not been submitted to any other Institute for any degree or diploma.
- c. I have followed the guidelines provided by the University in preparing the thesis.
- d. I have conformed to the norms and guidelines given in the Ethical Code of Conduct of the Institute.
- e. Whenever I have used materials (data, theoretical analysis, figures, and text) from other sources, I have given due credit to them by citing them in the text of the thesis and giving their details in the references.

NIHARIKA SINGH
(18/STR/2010)
M.Tech (STRUCTURES)

ACKNOWLEDGEMENT

It is a moment of great pleasure and immense satisfaction for me to express my sense of gratitude and indebtedness towards my guide Mr. Alok Verma , Associate Professor of Department of Civil Engineering , Delhi Technological University , for their eminent guidance , keen interest and constant encouragement during the course of project. I am indebted to them for their supervision and guidance at all stages of work.

Most importantly, I would like thank my all family members, for their unconditional support, love, and affection. Their encouragement and endless love made everything easier to achieve.

Dated:

NIHARIKA SINGH

Place: Delhi.

TABLE OF CONTENTS

| | |
|--|-------------|
| TITLE | i |
| CERTIFICATE | ii |
| DECLARATION | iii |
| ACKNOWLEDGEMENT | iv |
| TABLE OF CONTENTS | v |
| LIST OF FIGURES | vii |
| LIST OF TABLES | viii |
| LIST OF MODELS | ix |
| LIST OF PLOTS | x-xi |
| ABSTRACT | xii |
| | |
| Chapter 1 INTRODUCTION | 1-3 |
| 1.1 INTRODUCTION | 1 |
| 1.2 CODAL PROVISIONS OF DIFFERENT COUNTRIES..... | 2 |
| 1.3 OBJECTIVE OF STUDY..... | 3 |
| | |
| Chapter 2 THE EARTHQUAKE | 5-16 |
| 2.1 INTRODUCTION..... | 5 |
| 2.2 EARTHQUAKE, EARTHQUAKE WAVES AND GROUND MOTION..... | 5-9 |
| 2.3 SEISMIC ANALYSIS OF STRUCTURES..... | 9 |
| 2.3.1 EQUIVALENT STATIC ANALYSIS..... | 9-11 |
| 2.3.2 DYNAMIC ANALYSIS..... | 11 |
| 2.3.2.1 RESPONSE SPECTRUM ANALYSIS..... | 12-15 |
| 2.3.2.1. 2 RESPNSE SPECTRUM METHOD BY USING STAAD Pro..... | 15 |
| 2.3.2.2 TIME HISTORY ANALYSIS..... | 15 |

| | |
|---|--------------|
| 2.4 MODES TO BE CONSIDERED..... | 16 |
| Chapter 3. PROGRAMME OF STUDY..... | 17-26 |
| 3.1 INTRODUCTION..... | 17 |
| 3.2 METHOD OF ANALYSIS..... | 17 |
| 3.3 MODELING AND ANALYSIS IN STAAD Pro..... | 17-18 |
| 3.4 INPUT DATA FOR STRUCTURE ANALYSIS IN STAAD PRO..... | 18 |
| 3.5 BUILDING CONFIGURATIONS..... | 19-21. |
| 3.6 INPUT PARAMETERS..... | 22-23 |
| 3.7 LOAD CALCULATIONS..... | 23 |
| 3.8 LOAD COMBINATIONS..... | 24 |
| 3.9 ASSUMPTIONS IN ANALYSIS..... | 24 |
| 3.10 DETAILS OF STEPS PERFORMED..... | 24-26 |
| 3.11 OUTPUT PARAMETERS..... | 26 |
| | |
| Chapter 4. ANALYSIS OF RESULTS & DISCUSSION..... | 34-55 |
| | |
| CONCLUSIONS..... | 56 |
| | |
| SCOPE OF FURTHER STUDY..... | 57. |
| | |
| REFERENCES..... | 58 |
| | |
| APPENDIX..... | 59-71 |

LIST OF FIGURES

| No. | FIGURE | PAGE NO |
|------|--|---------|
| (01) | BLOCK DIAGRAM SHOWS THE SCOPE OF STUDY | 4 |
| (02) | TYPES OF EARTHQUAKE WAVES..... | 7 |
| (03) | SIEMIC ZONES IN INDIA AS PER IS 1893-2002..... | 8 |
| (04) | RESPONSE SPECTRA FOR DIFFERENT SOIL CONDITIONS..... | 13 |
| (05) | FLOOR PLAN (TYP.)..... | 21 |
| (06) | LOADING ON TWO STOREY BUILDING..... | 27 |
| (07) | MODE SHAPE OF TWO STOREY BUILDING IN MODE 1..... | 27 |
| (08) | MODE SHAPE OF TWO STOREY BUILDING IN MODE 2..... | 28 |
| (09) | MODE SHAPE OF TWO STOREY BUILDING IN MODE 3..... | 28 |
| (10) | BENDING MOMENT IN TWO STOREY BUILDING (ENVELOPE CASE.)..... | 29 |
| (11) | LOADING ON SIX STOREY BUILDING..... | 29 |
| (12) | MODE SHAPE OF SIX STOREY BUILDING FOR MODE 1 | 30 |
| (13) | MODE SHAPE OF SIX STOREY BUILDING FOR MODE 2..... | 30 |
| (14) | MODE SHAPE OF SIX STOREY BUILDING FOR MODE 3..... | 31 |
| (15) | BENDING MOMENT IN SIX STOREY BUILDING (ENVELOPE CASE.)..... | 31 |
| (16) | LOADING ON TEN STOREY BUILDING | 32 |
| (17) | MODE SHAPE OF TEN STOREY BUILDING FOR MODE 3..... | 32 |
| (18) | MODE SHAPE OF TEN STOREY BUILDING FOR MODE 15..... | 33 |
| (19) | BENDING MOMENT IN TEN STOREY BUILDING (ENVELOPE CASE.) | 33 |

LIST OF TABLES

| NO. TABLE | PAGE NO |
|---|---------|
| (01) STRUCTURAL DATA | 18 |
| (02) EARTHQUAKE DATA | 18 |
| (03) DATA OF FREQUENCY FOR SOIL TYPES AS HARD/MEDIUM/SOFT AND SIESMIC ZONE IV&V..... | 34 |
| (04) DATA OF TIME PERIOD FOR SOIL TYPES AS HARD/MEDIUM/SOFT AND SIESMIC ZONE IV&V | 35 |
| (05) MASS PARTICIPATION FACTOR FOR SOIL TYPES AS HARD/MEDIUM/SOFT AND SIESMIC ZONE IV&V (SIESMIC IN X DIRECTION)..... | 39 |
| (06) TABLE 6: MASS PARTICIPATION FACTOR FOR SOIL TYPES AS HARD/MEDIUM/SOFT AND SIESMIC ZONE IV&V (SIESMIC IN Z DIRECTION)..... | 40 |
| (07) DESIGN BASE SHEAR FOR SOIL TYPES AS HARD/MEDIUM/ SOFT (SIESMIC IN X & Z DIRECTION) (ZONE-IV) | 44 |
| (08) DESIGN BASE SHEAR FOR SOIL TYPES AS HARD/MEDIUM/ SOFT (SIESMIC IN X & Z DIRECTION) (ZONE- V)..... | 45 |
| (09) STOREY SHEAR DATA FOR TWO STOREY BUILDING | 49 |
| (10) STOREY SHEAR DATA FOR THREE STOREY BUILDING | 49 |
| (11) STOREY SHEAR DATA FOR FOUR STOREY BUILDING | 50 |
| (12) TABLE12: STOREY SHEAR DATA FOR FIVE STOREY BUILDING | 50 |
| (13) TABLE13: STOREY SHEAR DATA FOR SIX STOREY BUILDING..... | 51 |
| (14) TABLE14: STOREY SHEAR DATA FOR SEVEN STOREY BUILDING..... | 51 |
| (15) TABLE15: STOREY SHEAR DATA FOR EIGHT STOREY BUILDING | 51 |
| (16) TABLE16: STOREY SHEAR DATA FOR NINE STOREY BUILDING..... | 52 |
| (17) TABLE17: STOREY SHEAR DATA FOR TEN STOREY BUILDING..... | 53 |

LIST OF MODELS

| No. | MODELS | PAGE NO |
|------|---|---------|
| (01) | ISOMETRIC VIEW: TWO STOREY BUILDING | 19 |
| (02) | ISOMETRIC VIEW: THREE STOREY BUILDING..... | 19 |
| (03) | ISOMETRIC VIEW: FOUR STOREY BUILDING | 19 |
| (04) | ISOMETRIC VIEW: FIVE STOREY BUILDING | 19 |
| (05) | ISOMETRIC VIEW: SIX STOREY BUILDING | 20 |
| (06) | ISOMETRIC VIEW: SEVEN STOREY BUILDING | 20 |
| (07) | ISOMETRIC VIEW: EIGHT STOREY BUILDING | 20 |
| (08) | ISOMETRIC VIEW: NINE STOREY BUILDING..... | 20 |
| (09) | ISOMETRIC VIEW: TEN STOREY BUILDING | 20 |

LIST OF PLOTS

| NO. | PLOTS | PAGE NO. |
|------|---|----------|
| (01) | VARIATIONS IN FREQUENCY OF DIFFERENT STOREY BUILDINGS FOR MODE 1 TO | 36 |
| (02) | VARIATIONS IN FREQUENCY OF TWO STOREY TO TEN STOREY BUILDING FOR MODE 1 TO 30..... | 36 |
| (03) | VARIATIONS IN TIME PERIOD OF DIFFERENT STOREY BUILDINGS FOR MODE 1 TO 5..... | 37 |
| (04) | VARIATIONS IN TIME PERIOD OF TWO STOREY TO 10 STOREY BUILDING FOR MODE 1 TO 30 | 37 |
| (05) | MASS PARTICIPATION FOR EQ IN EARTHQUAKE IN X DIRECTION FOR SOIL TYPES AS HARD / MEDIUM / SOFT AND SIESMIC ZONE IV & V | 41 |
| (06) | MASS PARTICIPATION FOR EQ IN EARTHQUAKE IN Z DIRECTION FOR SOIL TYPES AS HARD / MEDIUM / SOFT AND SIESMIC ZONE IV & V..... | 41 |
| (07) | VARIATIONS IN MODAL MASS PARTICPATION OF TWO STOREY BUILDING FOR MODE 1 TO 30 (SIESMIC IN X/Z DIRECTION) | 42 |
| (08) | VARIATIONS IN MODAL MASS PARTICPATION OF SIX STOREY BUILDING FOR MODE 1 TO MODE 30 (SIESMIC IN X /Z DIRECTION)..... | 42 |
| (09) | VARIATIONS IN MODAL MASS PARTICPATION OF TEN STOREY BUILDING FOR MODE 1 TO 30 (SIESMIC IN X DIRECTION) | 43 |
| (10) | VARIATIONS IN DESIGN BASE SHEAR FOR HARD SOIL IN EQ ZONE IV & V (SIESMIC IN X DIRECTION)..... | 46 |
| (11) | VARIATIONS IN DESIGN BASE SHEAR FOR MEDIUM SOIL IN EQ ZONE IV & V (SIESMIC IN X DIRECTION)..... | 46 |
| (12) | VARIATIONS IN DESIGN BASE SHEAR FOR SOFT SOIL IN EQ ZONE IV & V (SIESMIC IN X DIRECTION)..... | 47 |
| (13) | VARIATIONS IN DESIGN BASE SHEAR FOR ALL STOREY BUILDING IN EQ ZONE IV (SIESMIC IN X DIRECTION) | 47 |
| (14) | VARIATIONS IN DESIGN BASE SHEAR FOR ALL STOREY BUILDING IN EQ ZONE V (SIESMIC IN X DIRECTION) | 48 |
| (15) | STOREY SHEAR FOR TWO STOREY BUILDING..... | 53 |

| | |
|--|----|
| (16) STOREY SHEAR FOR SIX STOREY BUILDING..... | 54 |
| (17) STOREY SHEAR FOR TEN STOREY BUILDING..... | 54 |

ABSTRACT

Buildings are the utmost important part of human survival, and study has revealed that large number of buildings in India is severely deficient against earthquake forces and the number of such buildings is growing very rapidly. Safety of the life in the seismic event is the prime consideration of earthquake resistance design Philosophies. Experience from the past earthquake has shown that much loss of the life and property results due to inadequacies and faulty practices in seismic design of the structures. To capture the real behavior of buildings, advanced analysis (seismic analysis) of the buildings is required.

This dissertation work describes the dynamic Analysis of the buildings using program in STAAD Pro with various structural and site specific parameters. Nine different RCC building models have been generated from 2 storey to 10 storey all having the same configurations in terms of floor plan at each level with same loading as well as same geometric and material properties (keeping the same stiffness in all the building models)considering in seismic Zones IV and V with all the three soil site parameters (Hard ,Medium and Soft soil) as recommended by IS codes are analyzed in STAAD Pro using Response spectrum Method and variations in responses in all the buildings in terms of base shear, storey shear, mass participation , frequency, time period has been observed.