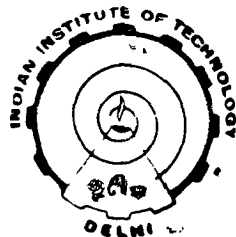


THREE DIMENSIONAL DYNAMIC ANALYSIS OF TALL BUILDINGS DUE TO WIND FORCES

by

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Thesis submitted in fulfilment of
the requirements for the degree of
DOCTOR OF PHILOSOPHY



**Department of Civil Engineering
INDIAN INSTITUTE OF TECHNOLOGY, DELHI**

September, 1988

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Dedicated to
my Father
and to
the memory of my Mother.

CERTIFICATE

This is to certify that the thesis entitled, "THREE DIMENSIONAL DYNAMIC ANALYSIS OF TALL BUILDINGS DUE TO WIND FORCES", being submitted by MRS. PRATIMA RANI BOSE, to the Indian Institute of Technology, Delhi, for the award of the degree of DOCTOR OF PHILOSOPHY in Civil Engineering, is a record of the bonafide research work carried out by her under my supervision and guidance. She has fulfilled the requirements for the submission of this thesis, which to the best of my knowledge has reached the requisite standard.

The material contained in this thesis has not been submitted, in part or full to any other University or Institute for the award of any degree or diploma.

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ACKNOWLEDGEMENTS

I take this opportunity to express profound gratitude to my supervisor, Dr. T. K. Datta, Department of Civil Engineering, Indian Institute of Technology, (IIT), Delhi, for his guidance, stimulus and constructive criticism during the course of present investigations.

Mr. Amit Bose, Lecturer, Department of Architecture, University of Roorkee, (UOR), has not only given me increasing inspiration in pressing times, but has also always generously overlooked the neglect of my wifely duties.

I am indebted to Professor and Head, Department of Civil Engineering, IIT, Delhi, for extending Departmental facilities required during the course of this work, and to Professor and Head, Department of Earthquake Engineering, (DEQ), UOR, and the authorities of UOR for providing leave when necessary and for the use of Departmental facilities.

Dr. A. Sinvhal, Lecturer, DEQ, UOR, has always given moral support and her many valuable suggestions considerably improved this manuscript. The work embodied in this thesis was carried out at the Computer Centres of IIT Delhi, Roorkee University Regional Computer Centre, (RURCC), and at the computer laboratory of DEQ, UOR. Dr. Prem Krishna, Professor, Department of Civil Engineering, UOR, furnished the requisite introduction for the

authorities at ISI for allowing the use of their Library facilities. For this I am thankful to him.

A work of this dimension could not have been possible without the encouragement and help of a myriad of friends, relatives, and colleagues. Mr. Abhinav Gupta of ME Ist Year, DEQ, UOR, has given continuous and voluntary help. I would specially like to thank Professors S.K. Thakkar, S. Basu and D.K. Paul, and Messers. A.D. Pandey, V.V. Appa Rao, Vipul Prakash and Dr. Alok Goyal, all of DEQ, UOR, for their computer related help.

For non technical phases of this work I have exploited the readily available help of Miss Neelima Vadnere and Mr. Vinod Kumar for typing, and that of the staff at the drawing office, DEQ. To them I express my gratitude.

I am under an obligation to my 5 year old daughter, Ilina, for cooperating in critical times and to all those who lovingly looked after her during my frequent absences.

Dated 26.9.88

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ABSTRACT

The present study is concerned with the three dimensional response of tall buildings (rectangular in plan) to along wind dynamic forces. For the response analysis, a method based on spectral approach and discrete matrix formulation is presented. The power spectral density function (PSDF) matrix of response is related to the PSDF matrix of random dynamic forces through complex frequency response function matrix (corresponding to dynamic d.o.f of the building). The PSDF matrix of random forces is obtained by dividing the face of the building into a number of elemental areas forming a mesh and lumping the wind forces acting over the area at its centroid. The method is developed for a fixed base condition and wind incident normal to one of the faces of the building. It is then extended for a flexible base condition and wind incident at an angle with the faces of the building.

With the proposed methods of analyses, a parametric study is conducted to investigate the influence of different factors on response. The factors include number of mode shapes to be considered in the analysis, exponential decay coefficients, spatial correlation of wind forces, torsional coupling, shear wave velocity characterizing the flexibility of the base, terrain coefficients, slenderness of the building, angle of incidence of wind and cross terms in the PSDF matrix of dynamic forces. Some of the important outcomes of the parametric study reveal that

i) the first mode response may grossly underestimate the torsional and across wind responses; ii) the spatial correlation of wind forces on the faces of the building have significant influence on their responses; iii) the torsional coupling, angle of incidence of wind and width wise spatial correlation have maximum influence on the torsional response; iv) the base flexibility increases the along wind response but decreases the torsional and across wind response; v) terrain coefficients significantly influence the responses especially for tall, slender buildings.

A critical appraisal of the provisions recommended by American, British, Australian and Canadian codes to take into account the dynamic effects of wind on tall buildings is made utilizing the numerical results of the present study.

CONTENTS

(vi)

	Page No.
CERTIFICATE	(i)
ACKNOWLEDGEMENT	(ii)
ABSTRACT	(iv)
LIST OF CONTENTS	(vi)
LIST OF TABLES	(xi)
LIST OF FIGURES	(xiii)
1.0 INTRODUCTION	1
1.1 NATURE OF WIND	1
1.2 EFFECT OF WIND ON STRUCTURES	4
1.3 TYPES OF VIBRATION INDUCED BY WIND	6
1.3.1 AEOLINE TYPE VIBRATION	6
1.3.2 GALLOPING	6
1.3.3 FLUTTER	7
1.3.4 BUFFETING	7
1.4 WIND INDUCED VIBRATION OF TALL BUILDINGS	7
1.5 NEED FOR THE PRESENT WORK	9
1.6 OBJECT AND SCOPE OF THE PRESENT WORK	10
1.7 ORGANISATION OF THE CHAPTERS	11
2.0 REVIEW OF LITERATURE	14
2.1 GENERAL	14
2.2 GENERAL DYNAMICS OF 3D TALL BUILDING	15
2.3 SOIL STRUCTURE INTERACTION	16
2.3.1 HALF SPACE MODE (Elastic or Viscoelastic)	18
2.3.2 FINITE ELEMENT AND OTHERS MODELS	22

2.4	WIND LOADING	23
2.5	RESPONSE OF TALL BUILDING TO WIND INDUCED FORCES	27
2.5.1	ALONG WIND RESPONSE OF 2D TALL BUILDING	28
2.5.2	ALONG WIND RESPONSE OF 3D TALL BUILDING	31
2.5.3	ACROSS WIND RESPONSE OF TALL BUILDING	35
3.0	RESPONSE OF FIXED BASE BUILDINGS DUE TO ALONG WIND FORCES	38
3.1	INTRODUCTORY REMARKS	38
3.2	STRUCTURAL IDEALIZATION	39
3.2.1	ASSUMPTIONS	40
3.3	EQUATION OF MOTION	41
3.4	FREQUENCIES AND MODE SHAPES	41
3.5	COMPLEX FREQUENCY RESPONSE FUNCTION MATRIX	43
3.6	SPECTRAL ANALYSIS OF RESPONSE	46
3.7	POWER SPECTRAL DENSITY FUNCTION MATRIX [S] OF LOADING P(t) P	47
3.8	RMS RESPONSE	55
3.9	RESPONSE DUE TO WIND BLOWING AT AN ANGLE TO THE PRINCIPAL AXES OF THE BUILDING	56
3.9.1	ELEMENTS OF [S] MATRIX P	56
3.10	NUMERICAL EXAMPLES AND DISCUSSION OF RESULTS	61
3.10.1	EFFECT OF MESH SIZE ON THE RESPONSE	63
3.10.2	EFFECT OF NUMBER OF MODE SHAPES	65
3.10.3	EFFECT OF EXPONENTIAL DECAY COEFFICIENTS C _y and C _z	67
3.10.4	EFFECT OF NATURE OF WIND VELOCITY SPECTRUM	67

3.10.5	EFFECT OF ANGLE OF INCIDENCE OF WIND VELOCITY ON THE RESPONSE OF BUILDING	69
3.11	CONCLUSIONS	71
	TABLES	73
	FIGURES	80
	APPENDIX - A	101
	A.1 - COMPUTER PROGRAM TDAFS	101
	A.2 - COMPUTER PROGRAM RESPON	102
	FIGURES	104
	APPENDIX - B	106
	B.1 - WIND VELOCITY PROFILE	106
	B.1.1 POWER LAW PROFILE	106
	B.1.3 LOGARITHMIC PROFILE	107
	B.2 SPECTRUM OF WIND TURBULENCE	108
	B.2.1 DAVENPORT'S SPECTRUM	108
	B.2.2 HIGH FREQUENCY RANGE SPECTRUM	108
	B.2.3 SIMIU'S SPECTRUM	109
	B.2.4 CANADIAN CODE SPECTRUM	110
	NOTATIONS	111
4.0	RESPONSE OF FLEXIBLE BASE BUILDINGS DUE TO ALONG WIND FORCES	119
	4.1 INTRODUCTION	119
	4.2 IDEALIZED MODEL	120
	4.3 EQUATION OF MOTION	121
	4.4 INTERACTION FORCES	129

4.5	DETERMINATION OF FREQUENCY RESPONSE FUNCTION MATRIX	137
4.6	DETERMINATION OF RESPONSE SPECTRUM (POWER SPECTRAL DENSITY FUNCTION)	147
4.7	RMS RESPONSE	147
4.8	NUMERICAL STUDY	148
4.8.1	EFFECT OF BASE FLEXIBILITY	150
4.8.2	EFFECT OF FREQUENCY DEPENDENCY OF THE IMPEDANCE FUNCTIONS	151
4.8.3	EFFECT OF NUMBER OF FIXED BASE MODES	151
4.8.4	EFFECT OF EXPONENTIAL DECAY COEFFICIENTS	152
4.9	CONCLUSIONS	153
	TABLES	155
	FIGURES	159
	APPENDIX C	170
	NOTATIONS	172
5.0	PARAMETRIC STUDY	178
5.1	INTRODUCTION	178
5.2	METHOD OF ANALYSIS	178
5.3	NUMERICAL STUDY	179
5.3.1	EFFECT OF TORSIONAL COUPLING	180
5.3.2	EFFECT OF SLENDERNESS RATIO	182
5.3.3	EFFECT OF SHEAR WAVE VELOCITY	183
5.3.4	EFFECT OF ANGLE OF INCIDENCE OF WIND ON FLEXIBLE BASE BUILDING	185
5.3.5	EFFECT OF TERRAIN CONDITION	186
5.3.6	EFFECT OF CROSS TERMS OF PSDF MATRIX OF WIND FORCES	186

5.3.7	EFFECT OF WIDTH WISE CROSS CORRELATION	187
5.4	CONCLUSIONS	188
	TABLES	189
	FIGURES	196
6.0	CRITICAL APPARAISAL OF CODAL PROVISIONS FOR DYNAMIC EFFECTS ON TALL BUILDINGS DUE TO WIND	205
6.1	INTRODUCTION	205
6.2	CODAL PROVISIONS FOR DYNAMIC EFFECTS OF WIND	207
6.2.1	NATIONAL BUILDING CODE OF CANADA 1985, PART 4 STRUCTURAL DESIGN	208
6.2.2	AMERICAN NATIONAL STANDARD ANSI 58.1- 1982	215
6.2.3	BRITISH STANDARD CP3 CHAPTER V WIND LOADS 1972 (BSI-1972)	219
6.2.4	AUSTRALIAN STANDARD 1170, PART 2- 1981, SAA LOADING CODE	219
6.2.5	NOTE ON INDIAN CODE	223
6.3	COMPARATIVE EVALUATION OF SIGNIFICANT CODAL PROVISIONS	224
6.4	COMPARISON OF CODAL PROVISIONS WITH THE HELP OF NUMERICAL STUDY	226
6.4.1	DISCUSSION OF RESULTS	228
6.5	CONCLUSIONS	229
	TABLES	231
	APPENDIX D	232
7.0	CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE WORK	237
7.1	CONCLUSIONS	237
7.2	RECOMMENDATIONS FOR FUTURE WORK	240
	REFERENCES	242