A Major Project Report on

DYNAMIC INSTABILITY OF COLUMN SUBJECTED TO PERIODIC AXIAL LOAD

Submitted in Partial Fulfillment for the Award of the Degree of

MASTER OF TECHNOLOGY

IN

STRUCTURAL ENGINEERING

By

M. Pradeep

(Roll No. 04/STR/2K10)

Under The Supervision of

Dr. Sarat Kumar Panda

Department of Civil and Environmental Engineering

Delhi Technological University, Delhi

Department of Civil & Environmental Engineering

Delhi Technological University, Delhi

JULY-2012

Department of Civil and Environmental Engineering
Delhi Technological University
Delhi

CERTIFICATE

This is to certify that **Mr. M. Pradeep**, a student of final semester M.Tech (Structural Engineering), Department of Civil and Environmental Engineering, during the session 2010-2012 has successfully completed the project work on ***"Dynamic Instability of Column Subjected to Periodic Axial Load"*** under my guidance and supervision and has submitted a satisfactory report in partial fulfillment for the award of the degree of Master of Technology.

The assistance and help received during the course of investigation have been fully acknowledged. He is a good student and we wish him good luck in future.

Dr. Sarat Kumar Panda

Department of Civil and Environmental Engineering

Delhi Technological University

Delhi

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.

M. Pradeep
(04/STR/2K10)
Department of Civil and Environmental Engineering
Delhi Technological University, Delhi

Acknowledgements

I would like to express my deepest sense of gratitude and indebtedness to my supervisor **Dr. Sarat Kumar Panda**, Assistant Professor, Department of Civil and Environmental Engineering, Delhi Technological University for his guidance and support in all the phases from conceptualization to final completion of the project.

I wish to convey my sincere gratitude to Prof. A.K. Gupta, H.O.D, and all the faculties of Civil Engineering Department, Delhi Technological University who have enlightened me during my project.

My parents and other family members have been my unfailing source of love and inspiration. If not for their love, encouragement and support, all this would not have been possible.

Last but not the least I would like to thank all the people directly and indirectly involved in successful completion of this project.

M. Pradeep

Roll No. 04/STR/2k10

List of Symbols

The Various notations and symbols used in the text or in the figures have been enlisted below for ease of reference. Symbols not contained in the list have been explained in the sections when they appear first.

E	Young's Modulus
I	Moment of Inertia
m	mass per unit length of column or rod
ω	Frequency of vibrations
ω_0	Natural frequency of column
ν	Excitation frequency
T	Time period
μ	Loading parameter
$\mathcal{A}(\,)$	Averaging operator
a	Amplitude
Δ	Detuning parameter
k	Frequency ratio
q	Displacement function
ζ	Damping coefficient
γ	Nonlinearity coefficient

Abstract

Geometric effects cause structural instability failure in elastic structures. Nonlinearities are introduced by the geometry of deformation which amplify the stresses calculated based on the initial undeformed configuration of the structure. Different definitions of stability are used for different problems. However, dynamic stability definition is applicable to all structural stability problems. The structures appear stable from static buckling analysis when subjected to dynamic axial loads but actually they fail due to ever increasing amplitude of vibration. This is correctly detected by dynamic analysis. The new phenomena are existence of solution for all values of the frequency rather than only for a set of characteristic values and dependence of amplitude on frequency. In this project the simply supported column, uniform in cross-section along the length subjected to periodic longitudinal force. The stability boundaries are derived which are periodic solution of second order differential equation with period T and 2T to the Mathieu equation. Usual assumptions are made i.e. Hooke's law is valid and plane sections remain plane. Different zones of instability of column under periodic axial loading are plotted and instability of different points on amplitude frequency curve are studied through phase portraits.