Nonlinear Mechanics Laboratory
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Anish Kumar

Research Interests

Dynamics of continuous systems, Shell theory, Linear and Nonlinear Vibrations of the Structures, Parametric Instability of Thin Structures and Fluid Structure Interaction.

Education

2012(Jan) - Present **Ph.D, Mechanical Engineering**, *Indian Institute of Technology Kanpur, India.* *CPI: 8.67/10* (Thesis Submitted in June 2017)

2009 - 2011 **M.Tech, Mechanical Engineering**, *Indian Institute of Technology Kanpur, India.* *CPI: 7.75/10*

2005 - 2009 **B.Sc. Engineering, Mechanical Engineering**, *Muzaffarpur Institute of Technology, Muzaffarpur (B.R.A. Bihar University, Muzaffarpur), India*, *Percentage: 80.75%*.

Research and Teaching Experience

September 2011 - December 2011 **Senior Project Associate**, *Department of Mechanical Engineering*, Indian Institute of Technology Kanpur.
Understanding the parametric instability of a fluid-filled thin-walled vessel. (Technical report submitted to the Indra Gandhi Center for Atomic Research, IGCAR, Kalpkkam, India, Principal Investigator: Dr. Pankaj Wahi).

Journal Publications

Anish Kumar, Sovan Lal Das and Pankaj Wahi (2017), *Effect of radial loads on the natural frequencies of thin-walled circular cylindrical shells.* International Journal of Mechanical Sciences, 122, 37-52.

Anish Kumar, Sovan Lal Das and Pankaj Wahi (2015), *Instabilities of thin circular cylindrical shells under radial loading*, International Journal of Mechanical Sciences, 104, 174-189.

Anish Kumar, Sovan Lal Das and Pankaj Wahi , *Effect of fluid loading on the dynamic behavior and stability of circular cylindrical shells* (Manuscript under preparation).

Anish Kumar, Sovan Lal Das and Pankaj Wahi , *Static and dynamic buckling of the short cylindrical shell* (Manuscript under preparation).

Conferences

Anish Kumar, Sovan Lal Das and Pankaj Wahi (2015), *Effect of Radial Loading on the Beam Mode Vibration of Circular Cylindrical Shells*, Indian National Conference on Applied Mechanics (INCAM), 13-15 July 2015, IIT Delhi, India.

Anish Kumar, Sovan Lal Das and Pankaj Wahi (2013), *Effect of radial hydrostatic loads and boundary conditions on the natural frequencies of thin walled circular cylindrical shells*, 11th International Conference on Vibration Problems (ICOVP), Lisbon, Portugal, 9-12 September 2013.

Anish Kumar, Sovan Lal Das and Pankaj Wahi (2011), *Dynamic buckling of thin walled cylindrical shells subjected to fluctuating radial loads*, 21st International Conference on Structural Mechanics in Reactor Technology 2011 (SMiRT 21), 6-11 November 2011, New Delhi, India.

Doctoral thesis

Title **Dynamics and Instabilities of Thin-Walled Circular Cylindrical Shells under Radial loading.**

Supervisors Dr. Pankaj Wahi and Dr. Sovan Lal Das

Abstract Present study explores the dynamic behavior of the thin-walled circular cylindrical shells. Toward this end, first the equations of motion of the thin shell with predominant radial deflection has been developed, which are consistent with assumptions taken. Additional terms have been identified in shell equations, which have mostly been neglected in the existing studies and also ascertained their importance in predicting the correct buckling pressure. Donnell shell theory is very popular among researchers to study the static and dynamic behavior of the shells. But the present study has shown that Donnell shell theory does not predict correct buckling pressure for lower circumferential wave number. For being consistent with assumptions, strain-displacement relation according to Flügge-Luré-Byrne shell theory has been used. Stability charts have been obtained for cylindrical shell subjected to uniform dynamic radial pressure. These stability charts are obtained in the plane of forcing parameters, like the static component of the pressure, the amplitude and frequency of the fluctuating component of the pressure have been presented which can serve as design guideline for shells subject to fluctuating radial loads. The variations of the natural frequencies of the circular cylindrical shells subjected to uniform radial and hydrostatic pressure. For hydrostatic pressure, we have studied with and without incorporation of the fluid inertia. Along with these studies, we have also studied the post-buckling behavior of the cylindrical shells. For predicting post buckling behavior, the nonlinear terms, which play important role in the analysis, are identified.

Master thesis

Title **Dynamic buckling of thin walled circular cylindrical shells under radially fluctuating pressure.**

Supervisors Dr. Pankaj Wahi and Dr. Sovan Lal Das

Abstract We investigated the dynamic buckling of a thin walled circular cylindrical shell for infinite length under radially fluctuating pressure. First we did a thorough study of all the existing shell theories. We calculated the static buckling of a circular cylindrical shell of infinite length using these shell theories and compared the results with FEA results using ABAQUS. It was noticed that only a few shell theories are more consistent and give results which have good agreement with FEA results. Flugge-Lure-Byrne shell theory is found out to be the most consistent. Parametric instability of infinitely long cylindrical shell subjected to time varying radially applied pressure has been studied.

Academic Projects

Stress analysis of the crane structures

Crane's elements are subjected to different kind of stresses at different level during working. Finite element method has been employed to study the behavior of crane structure when subjected to loads. A MATLAB code was developed for this purpose, stress and strain responses were studied.

Linear and Non-linear FEM code for the general bar and beam

Linear and nonlinear FEM code has been developed to study the behavior of bar and beam under axial and transverse load, respectively. Various type of elements have been used to observe the convergence of the solutions and obtained results are verified with the results obtained using FEA software like ABAQUS.

Parametric stability analysis of the circular cylindrical shell under radially fluctuating pressure.

Using Donnell nonlinear shell theory, stability charts has been developed numerically using MATLAB.

Elastic wave propagation in a thin circular ring

A theoretical model of the thin circular ring was developed, using MAPLE and MATLAB numerical solutions were found to study the shear wave and bending wave in the ring.

Derivation of drag force on a cylindrical particle moving in a thin sheet of viscous fluid.

A mathematical model has been developed for a cylindrical particle moving in thin sheet of the viscous fluid and then the expression for the drag force acted on the cylindrical particle during movement has been calculated analytically.

Study of the dynamics of the cytoskeleton inside the biological cell membrane.

Stability of spherical vesicle membrane under external pressure.

Relevant Courses

Post Graduate	Continuum Mechanics, Advance Dynamics and Vibrations, Vibrations of Continuous System, Vibration Control, Nonlinear Vibration, Stability of Structures, Theory of Elasticity, Finite Element Method, Calculus of Variation, Wave Propagation in Solid, Approximate Methods in Engineering Mathematics, Nonlinear Finite Element Method, Mechanics of Biological Membrane.

Teaching Assistantship

Spring 2009, Spring 2010 and Fall 2012	ME251, ***Machine Design and Graphics***, IIT Kanpur, India.
Fall 2010	ME621, ***Introduction to Solid Mechanics***, IIT Kanpur, India.
Spring 2012	ME222A, ***Nature and Properties of Materials Lab***, IIT Kanpur, India.
Fall 2013 and Fall 2015	ESO209, ***Dynamics***, IIT Kanpur, India.
Spring 2013	ESO204, ***Mechanics of Solids***, IIT Kanpur, India.
Fall 2014	ME321A, ***Advance Mechanics of Solids***, IIT Kanpur, India.
Spring 2014	ME354A, ***Vibration and Control Lab***, IIT Kanpur, India.
Spring 2015	ME627A, ***Nonlinear Vibration***, IIT Kanpur, India.

Tutorship

Summer 2014	ESO204, ***Mechanics of Solids***, IIT Kanpur, India.

Computer Skills

Languages	Fortran, C
Packages	Matlab, ABAQUS, ANSYS, Maple
Operating System	UNIX(Linux), Windows

References

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