VIBRATIONS OF UNSYMMETRICAL SANDWICH STRUCTURES

A Thesis submitted in fulfilment of
the requirements for the Degree of
DOCTOR OF PHILOSOPHY

by

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to the

Department of Mechanical Engineering
Indian Institute of Technology, New Delhi.

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CERTIFICATE

This is to certify that the Thesis entitled "Vibrations of unsymmetrical Sandwich Structures" being submitted by Mr. Y.V.K. Sadasiva Rao to the Indian Institute of Technology, Delhi, for the award of the Degree of Doctor of Philosophy in Mechanical Engineering, is record of bonafide research work carried out by him. He has worked under my guidance and has fulfilled the requirements for the submission of this Thesis, which has reached the requisite standard.

The results contained in this Thesis have not been submitted in part or in full, to any other University or Institute for the award of any degree or diploma.

21.3.72

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ABSTRACT

The analysis of flexural vibrations of unsymmetrical sandwich beams has been carried out by deriving frequency equation from equations of motion in which the membrane energy of the faces, energy due to bending of the faces about their own axes, shear and extensional enrgy of the core, transverse, longitudinal translatory and rotary inertia have been included. For the case of free vibrations, a series solution is assumed to satisfy simply supported conditions, and the non-dimensional frequency parameter has been evaluated for all the three resulting families of modes., thus obtained.The influence of rotary and longitudinal translatory inertia is investigated by evaluating the frequency parameters for various values of modal numbers, face thickness ratio, ratio of core thickness to face thickness, ratio of shear modulus of core to Young's modulus of face material and ratio of thickness of face to length of the beam. Influence of these terms is also studied on the strain response in case of sandwich beam with viscoelastic core, subjected to harmonic excitation. Damping action due to strains in visco-elastic layers is investigated by finding the value of system loss factor for varying modal number and other

non-dimensional ratios.

Equilibrium equations and boundary conditions have been derived for the case of unsymmetrical sandwich plate by taking membrane energy of the faces, energy due to bending of the faces about their own axes, shear energy of the core, transverse, longitudinal translatory and rotary inertia and making use of Hamilton's principle. Series solution is assumed for simply supported boundary conditions and the influence of rotatory and longitudinal translatory inertia, for the case of free vibrations is investigated for various non-dimensional parameters. Vibration response is obtained for the case when the core is assumed to be viscoelastic and when the plate is under uniform excitation. Expressions defining damping at various modes of vibration have also been given.

Further work has been restricted to the vibration analysis of unsymmetrical sandwich plate with elastic core for the two types of edge conditions the first type with all edges clamped and second type with two edges simply supported and the remaining two clamped, by using Raleigh-Ritz method. The values of frequency parameter have been given for varying non-dimensional parameters including modal numbers in both cases. Experimental work has been aimed for comparison with the theoretically obtained results on a few samples of laminated plate in both the cases.

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