Accepted Manuscript

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PII: S0997-7538(18)30002-0

DOI: 10.1016/j.euromechsol.2018.06.008

Reference: EJMSOL 3626

To appear in: *European Journal of Mechanics / A Solids*

Received Date: 2 January 2018

Revised Date: 18 May 2018

Accepted Date: 18 June 2018

Please cite this article as: Biswal, D.K., Mohanty, S.C., Free vibration and damping characteristics study of doubly curved sandwich shell panels with viscoelastic core and isotropic/laminated constraining layer, *European Journal of Mechanics / A Solids* (2018), doi: 10.1016/j.euromechsol.2018.06.008.

Free vibration and damping characteristics study of doubly curved sandwich shell panels with viscoelastic core and isotropic/laminated constraining layer

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Abstract

In this work, a shear deformable viscoelastic sandwich shell element is proposed for doubly curved sandwich shell panels with passive constrained layer damping (PCLD) treatment. The transverse displacements of the constraining layer and base layer are considered to be independent besides the in-plane displacements. The transverse and in-plane displacements of the viscoelastic core are considered to be varying linearly through the thickness. Shear as well as normal deformations of the core are included in the analysis. The equation of motion the doubly curved sandwich shell panel under free vibration is derived via Hamilton's principle. The modal frequencies and modal loss factors of the Isotropic elastic-Viscoelastic-Isotropic elastic (IVI) sandwich shell panel and Laminated elastic-Viscoelastic-Laminated elastic (LVL) sandwich panel are obtained from numerical solutions using finite element method in conjunction with Hamilton's principle. Parametric studies are carried out to ascertain the effects of shell geometries, aspect ratio, orthotropicity of the skins, core layer thickness, constraining layer thickness, core loss factor on the natural frequencies and system loss factors under different boundary conditions.

Keywords

Sandwich shell panel, viscoelastic core, natural frequency, system loss factor, PCLD, FEA.

1. Introduction

Vibration control and noise reduction in structures subjected to dynamic loading using damping layers with optimal increase in weight has been a major area of interest for many years to the engineers in the field of aerospace, aeronautics, ship building and structural applications. Owing to the excellent capacity to dissipate energy, structures with viscoelastic shear layer sandwiched in between a constraining layer and the base layer, allured researchers to pursue the subject. The added advantages of being lightweight, enduring and low cost, make these structures competitive. The damping of flexural vibration in structures such as plates and beams using viscoelastic layers was attempted by many researchers in late Fifties and early Sixtie (DiTaranto, 1965; Grootenhuis, 1970; Kerwin Jr., 1959; Mead and Markus, 1969). The behavior of sandwich

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