Accepted Manuscript

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PII: S1359-8368(16)31172-6

DOI: 10.1016/j.compositesb.2016.10.059

Reference: JCOMB 4657

To appear in: *Composites Part B*

Received Date: 29 June 2016

Revised Date: 17 September 2016

Accepted Date: 21 October 2016

Please cite this article as: Akhavan H, Ribeiro P, Geometrically non-linear periodic forced vibrations of imperfect laminates with curved fibres by the shooting method, *Composites Part B* (2016), doi: 10.1016/j.compositesb.2016.10.059.

Geometrically non-linear periodic forced vibrations of imperfect laminates with curved fibres by the shooting method

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Abstract

In this paper, the authors study periodic vibrations of variable stiffness composite laminates excited by a harmonic force. The plates have geometrical imperfection in the form of various sinusoidal out-of-plane initial deflections associated with zero stress. The angle of the curvilinear fibre path is introduced as a function of the horizontal Cartesian coordinate. The theory, used to extract equations of motion for VSCLs, is a third order shear deformation theory that retains rotary inertia. The relations of von Kármán for elastic large deflection are used. A p-version finite element is used to find the solution of the equations of motion using the shooting method; frequency response curves are obtained. Static condensation and a modal summation method are applied to reduce the number of degrees of freedom. A damage analysis based on Tsai-Wu criterion is carried out during the studies on vibration. The effects of curvilinear fibres, and when they happen, the influence of modal interactions on the vibration of imperfect VSCLs are investigated. The stability of the periodic solutions is determined by applying Floquet's theory. Also, the effect of geometric imperfections on the vibrational behaviour is studied.

Keywords: A. Laminates, B. Vibration, C. Computational modelling, E. Tow, Curvilinear Fibres

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