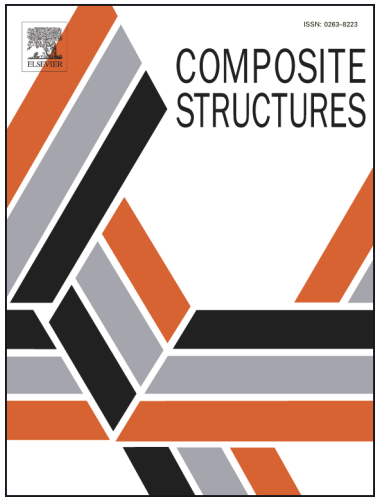

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DYNAMIC INSTABILITY OF VARIABLE STIFFNESS COMPOSITE PLATES

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Abstract

Due to its tailorability intrinsic characteristics, composite materials are an effective option in structural design or on its reengineering, especially when the ratios stiffness and/or strength to weight are relevant. Dual-phase or multiphase fibre reinforced composites can thus be found in many engineering and science applications. However, in the majority of the cases these composites are made from unidirectional plies stacking. The possibility of building fibre reinforced composite structures, wherein these fibres follow curvilinear paths, may be an important enhancement to structural mechanical response and in particular to its dynamic stability, as variable fibre orientation is responsible for variable elastic stiffness within a generic layer. This work aims characterizing the dynamic instability response of variable stiffness composite plates, according to different material and geometrical parameters. To this purpose one considers Rayleigh-Ritz method to perform buckling, free vibrations and dynamic instability analyses, using orthogonal polynomials. The dynamic instability problem is solved considering Bolotin's method. A set of verification and illustrative case studies is considered and discussed.

Keywords

Dynamic instability of plates, Variable stiffness composites, Rayleigh-Ritz method, Bolotin's method, Orthogonal polynomials.

1. INTRODUCTION

The technological developments concerning the automated production of fibre reinforced composites allowed not only for an increased accuracy on fibre tows placement but also for alternative non-unidirectional fibres paths. These composites, in which the placement of fibre tows follows a curvilinear path, are therefore topologically different from traditional straight-fibre composite laminates, presenting varying material properties thus variable elastic stiffness coefficients throughout each laminate ply. The widely known customization feature that characterizes long fibre reinforced composites is thus extended considering the possibility of defining curvilinear paths.

From the literature review, one may find published works on this topic of variable stiffness fibre reinforced composites. Among them we may refer the one developed by Tatting and