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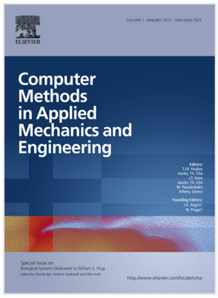

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A Fourier−related double scale analysis on the instability phenomena of sandwich plates

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Abstract

This paper presents a Fourier-related double scale analysis to study the instability phenomena of sandwich plates. By expanding the displacement field into Fourier series, the sandwich plate model proposed by Yu et al. [1], using the classical plate theory in the skins and high-order kinematics in the core, is transformed into a new Fourier-based reduced two-dimensional sandwich plate model with the slowly varying Fourier coefficients as macroscopic unknowns. The resulting nonlinear equations are solved by the Asymptotic Numerical Method (ANM), which is very efficient and reliable to capture the bifurcation point and the post-buckling path in wrinkling analyses. Both antisymmetrical and symmetrical wrinkling for sandwich plates under uni-axial and equi-biaxial compressive loads are studied and the numerical results demonstrate that the Fourier-based finite element model can accurately yet efficiently predict wrinkling patterns and critical loads, especially when dealing with wrinkling phenomena with extremely large wavenumbers.

Keywords: Sandwich plate, Fourier series, Instability, Wrinkling, Asymptotic Numerical Method.

1 Introduction

During recent decades, sandwich structures are widely used in aerospace, automotive and civil engineering fields. For the typical sandwich structures, the skins are usually made of high-strength materials such as lightweight metal alloys so that the skins can carry almost all the axial loads, whereas the core can be made of low-density materials such as carbon, balsa or plastic materials to transmit the transverse normal and shear loads. Thus very attractive properties in terms of light weight and high flexural stiffness can be obtained within this principle of construction. When designing this kind of structures, one of the major concerns belongs to the buckling phenomena (global and local instabilities). Hence, this paper aims to accurately and efficiently predict the critical load and describe the structural responses in these phenomena.

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