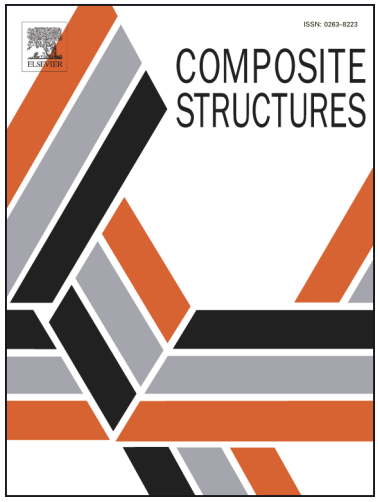

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PII: S0263-8223(17)32103-7
DOI: https://doi.org/10.1016/j.compstruct.2017.09.041
Reference: COST 8904

To appear in: *Composite Structures*

Received Date: 6 July 2017
Revised Date: 31 August 2017
Accepted Date: 16 September 2017

Please cite this article as: Bouazza, M., Kenouza, Y., Benseddiq, N., Zenkour, A.M., A two-variable simplified nth-higher-order theory for free vibration behavior of laminated plates, *Composite Structures* (2017), doi: https://doi.org/10.1016/j.compstruct.2017.09.041

A two-variable simplified nth-higher-order theory for free vibration behavior of laminated plates

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Abstract

In this article, vibration behavior of composite rectangular plates are investigated by using a refined simple nth-higher-order shear deformation theory. Governing equations are derived by using Hamilton's principle. A closed-form solution via Navier's technique limits the applicability of solution technique to simply-supported rectangular laminated plates. The transverse displacement is dividing into two bending and shear components and so the unknown involved functions is reduced to four, as against five or more in other plate theories. There is no need for any shear correction factors to the present theory. Moreover, it is variationally consistent, used nth-order polynomial term to represent displacement field and gave rise to transverse shear stresses satisfying free surface conditions. Numerical results due to present theory are compared with data available in the literature to show the accuracy and simplicity of the proposed theory in analyzing the vibration frequencies of rectangular orthotropic and laminated composite plates.

Keywords: Plates; composite; vibrations; refined nth-order theory; Navier's solution.

1. Introduction

The increased utilization of laminated composite structural components in construction of aerospace and other structures is mainly due to several features of laminates such as light weight, high specific strength and stiffness as well as excellent fatigue and corrosion resistance properties. The wide use of anisotropic composite structures [1, 2] requires investigating vibration frequencies of orthotropic plates to improve accurate and reliable designs. Different problems composite rectangular plates fall into three special classes of boundary conditions [3]. The first class of rectangular plates involved plates with all edges simply-supported while the second class is concerned with rectangular plates with a pair of opposite edges simply-supported. The third class involved plates which do not fall into any of the above classes.

The well-known solutions of Navier and Lévy types are considered as straight forward rigorous analyses and sufficient to treat the problems of first and second classes [4]. However, the third class of problems are difficult to deal with such rigorous analytical solutions [1, 2]. That is because the closed-form solution which satisfy governing equation and boundary conditions exactly of the third class, turn out to be rare. So, the third class of problems may be required developing some approximate methods [5-9].

Senthilnathan et al. [10] have presented vibration behaviors of orthotropic composite plates using a simplified higher-order theory. Gupta and Reddy [11] Gupta and Reddy [11] have proposed one of

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