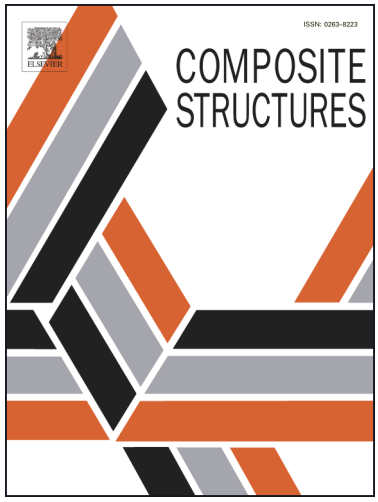

Bending, free vibration and buckling analyses of anisotropic layered micro-plates based on a new size-dependent model

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Bending, free vibration and buckling analyses of anisotropic layered micro-plates based on a new size-dependent model

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Abstract: A new size-dependent composite laminated plate model is proposed in this study based on a re-modified couple stress theory (RMCST) and a zigzag theory. In contrast to the published size-dependent models for composite laminated plates, present model a priori satisfies the continuity conditions of transverse shear stresses (TSSs) at the interfaces. In the present formulation, the discontinuous TSSs obtained from the constitutive relations are replaced by the new continuous TSSs by using the Reissner's Mixed Variational Theorem (RMVT). In addition, the RMVT is utilized to obtain the governing equations and corresponding boundary conditions. Subsequently, the deflections, stresses, frequencies and critical loads of cross-ply simply supported plates are considered to verify the present formulation. The results prove that the scale effects of present size-dependent models are effectively investigated. Moreover, the results predicted by present size-independent models are in accordance with the exact solutions. Eventually, the differences of the mechanical performance among the following three models, i.e. present, Mindlin and Reddy for composite laminated plates are discussed in different modulus and span-to-thickness ratios.

Key words: transverse shear stresses; modified couple stress theory; scale effects; zigzag functions; composite laminated plate

1. Introduction

Owing to the excellent mechanical properties, composite laminates have been extensively used in the aerospace and automotive industries. In these applications, the structures have relatively low transverse shear modulus which highlights the importance of the transverse shear deformation (TSD). However, the TSSs caused by TSD may make the composite structures delaminate which is the main damage form in the engineering. Therefore, it needs to accurately