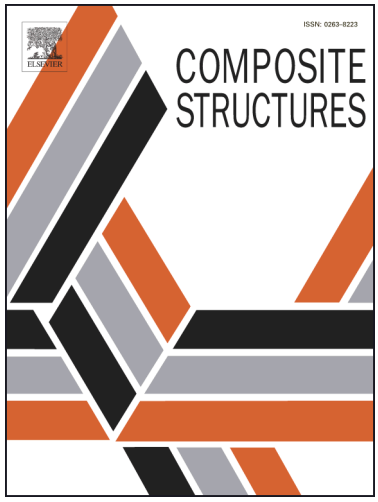

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A unified higher order plate theory for functionally graded microplates based on the modified couple stress theory

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Abstract

In the present paper, a unified higher order plate theory for functionally graded microplates is proposed by adopting the modified couple stress theory to capture size effects and using a generalized shape function to characterize the transverse shear deformation. The developed plate theory can be degenerated to size-dependent Kirchhoff, Mindlin, Reddy and four-variable refined plate theories respectively by choosing the corresponding shape functions. By using Hamilton's principle, the nonlinear equations of motion and boundary conditions are derived with von Karman's geometric nonlinearity taken into account. For the case of small deformation, the linear version of the equations of motion is obtained, on this basis, closed-form solutions for the bending deflection, critical buckling load, and natural frequency of simply supported functionally graded microplates are presented. Furthermore, results calculated from different size-dependent plate theories are compared by using the proposed unified plate theory and choosing the corresponding shape functions. It is also demonstrated that for any existing higher order shear deformable plate theory, the development of a corresponding size-dependent higher order shear deformable plate theory becomes a trivial task with the assistance of the developed unified plate theory.

Keywords

Functionally graded microplate; Modified couple stress theory; Bending; Buckling; Free vibration

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