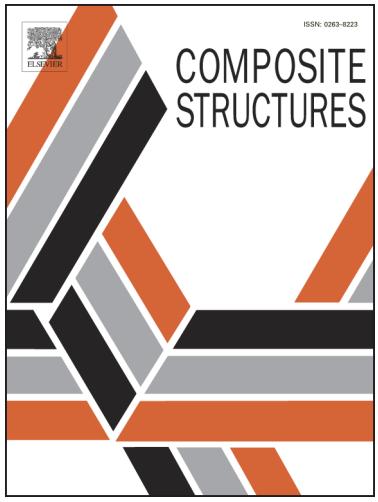

Nonlinear analyses of functionally graded microplates based on a general four-variable refined plate model and the modified couple stress theory

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Nonlinear analyses of functionally graded microplates based on a general four-variable refined plate model and the modified couple stress theory

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Abstract:

In this paper, a general nonlinear four-variable refined plate model is developed to investigate the bending and free vibration behavior of a functionally graded (FG) microplate resting on an elastic foundation. In this model, a shape function is defined to describe the effect of the transverse shear deformation, and the size effects of the microplate are captured by using the modified couple stress theory. Firstly, the equations of motion and boundary conditions are derived from the Hamilton's principle. Then the equations of motion are reduced to ordinary differential equations by applying the Galerkin method, and via solving the ordinary differential equations, closed-form solutions for the nonlinear bending deflection and vibration frequency are obtained. It is found that the solutions for the general refined plate model are identical to those for a size-dependent Kirchhoff plate model and a refined first-order plate model respectively when the shape function of the transverse shear deformation is chosen to be certain forms. In addition, numerical studies are carried out to compare a special nonlinear size-dependent refined higher-order plate model with its linear counterpart as well as the nonlinear refined first-order plate model.

Keywords:

Functionally graded microplate; Nonlinear bending; Nonlinear free vibration; Refined plate theory; Modified couple stress theory; Galerkin method

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