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Geometrically nonlinear analysis of laminated composite quadrilateral plates reinforced with graphene nanoplatelets using the element-free IMLS-Ritz method

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Abstract

This paper investigates the nonlinear bending of graphene nanoplatelet (GPL) reinforced laminated composite quadrilateral plates using the element-free IMLS-Ritz method. The effective material properties including Young's modulus, mass density and Poisson's ratio are determined by the modified Halpin-Tsai model and rule of mixture. The first-order shear deformation theory (FSDT) and the IMLS-Ritz approximation are employed to obtain the discrete nonlinear governing equation of quadrilateral plates with large deformation. The Newton-Raphson method is used to solve the nonlinear equation. The accuracy of the IMLS-Ritz results is examined by comparing with the published values. A comprehensive parametric study is carried out, with a particular focus on the effects of geometric parameters of quadrilateral plates and GPLs distribution pattern, weight fraction, total number of layers, and geometry and size of GPLs on the nondimensional deflection of GPLs reinforced laminated composite quadrilateral plate.

Keywords: Nonlinear bending; Large deflection; Quadrilateral laminated composite plates; Graphene nanoplatelets; Functionally grade materials; Element-free IMLS-Ritz method

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