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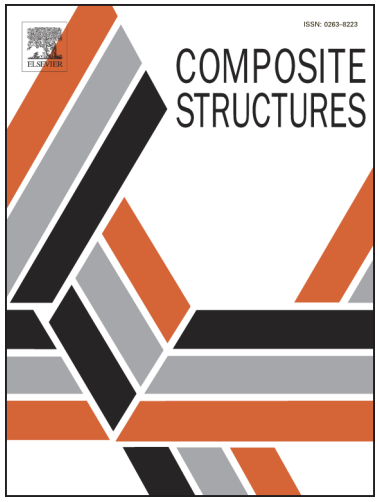

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Exact Solutions of Bending Deflections for Nano-beams and Nano-plates Based on Nonlocal Elasticity Theory

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Abstract

In this paper, we applied the nonlocal continuum mechanics to deriving a complete and asymptotic representation of the infinite higher-order governing differential equations for nano-beam and nano-plate models. Results show that the vanishing issue of small scale effects under some boundary conditions such as a clamped nano-beam subjected to distributed uniformly load is solved by using the present nonlocal continuum model. Several typical examples for nano-beam and nano-plate are studied and the scale effect on bending deflection is discussed at length. The analytical prediction for nonlocal bending deflection gives a good prediction of molecular dynamics simulation results which confirms the accuracy of the present model. It is found that when the external characteristic length tends to internal characteristic length, a property of a rigid body for the nano-beam and nano-plate is presented.

Keywords: Nonlocal elasticity theory; scale effect; bending deflection; nano-beam; nano-plate

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