

2016

# Analysis of Free Vibration of Sandwich Beams Consider Normal Deformation Effect

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**Abstract :** A new refined hyperbolic shear and normal deformation beam theory is developed to study the free vibration of functionally graded (FG) sandwich beams under various boundary conditions. The effects of transverse shear strains as well as the transverse normal strain are taken into account. Material properties of the sandwich beam faces are assumed to be graded in the thickness direction according to a simple power-law distribution in terms of the volume fractions of the constituents. The core layer is still homogeneous and made of an isotropic material. Equations of motion are derived from Hamilton's principle. Analytical solutions for the bending, free vibration and buckling analyses are obtained for simply supported sandwich beams. Illustrative examples are given to show the effects of varying gradients, thickness stretching, boundary conditions, and thickness to length ratios on the bending, free vibration of functionally graded sandwich beams.

**Keywords :** refined shear deformation theory, Stretching effect, free vibration, boundary conditions., functionally graded sandwich beam