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‘One-half order shear deformation theory’ as a new naming for the transverse, but not in-plane rotational, shear deformable structural models

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Abstract

Based on Hamilton’s principle and using method of hypotheses, governing equations for the existing typical thin-walled structure analysis models are first derived systematically in addition to those for the author’s alternative beam and plate theories with the deformation concept that the total deflection w can be assumed as the sum of the bending and shearing deflections w_b and w_s, and in addition formal expressions of shear forces for some static beam and plate models are described. Two specific static beam boundary value analyses are then carried out based on the alternative, Euler-Bernoulli and Timoshenko beam theories for which the respective calculated results turn out to differ. Through the discussions, it is shown that in the alternative beam and plate theories only the half categories of shear deformations, which involve also in-plane rotational shearing in addition to transverse shearing, can be expressed explicitly in terms of fundamental variables, in contrast to the traditional first-order shear deformation theories. Thus, it is proposed to call the alternative theory ‘one-half order shear deformation theory’ as a new naming for the moderately thick structural models with the superimposed total deflection concept as $w = w_b + w_s$.

Keywords:
one-half order shear deformation theory; beams; plates; shear deformation; bending deformation; superimposed total deflection.