boundary conditions on the nonlinear response of laminated composite plate structures is presented. A number of interesting conclusions regarding the efficiency of the presented model are highlighted. The post-buckling equilibrium curves and the stress distributions of laminated composite plates obtained accurately by the proposed efficient method are compared by many strain displacement assumptions made in the literature on the kinematics of highly flexible plates. The findings of this research demonstrate that the full Green-Lagrange nonlinear model based on the 2-D CUF model can predict the nonlinear behavior of laminated composite plates efficiently and accurately that can be a basis to evaluate the effectiveness of different structural theory approximation orders and nonlinear strain assumptions.

VIBRATIONS AND BUCKLING OF COMPOSITE PLATES BASED ON STRAIN GRADIENT THEORY AND MESHLESS METHODS

abst. 2263
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In the current literature MEMS (Micro-Electro-Mechanical- System) and NEMS (Nano-Electro-Mechanical-System) are topics of relevant interest because of their various uses. Indeed, these types of materials can be employed in many areas of application, i.e. engineering, medicine and electronics, in the form of generators, transistors, sensors, actuators, resonators, detectors etc. Vibrations and buckling of nano plates are investigated using second-order strain gradient theory. The differential problem has been solved by means of weak forms meshless methods for different boundary condition configurations for the plates as well as stacking sequencies. Different geometries and material properties for isotropic and laminated materials are considered, and numerical simulations are discussed in terms of plate aspect ratio and non local ratio. A comparison with the classical analytical solution is provided whenever possible for buckling loads and fundamental frequencies.

Numerical Model for Global/Local Buckling Analysis of I-Beam via Hierarchical One-Dimensional Finite Elements

abst. 2278
Room 3
Thursday
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12h50

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Thin-walled structures, including I-beam, have wide application in engineering. However, these structures tend to have severe instability phenomena such as buckling, wrinkling and global-local coupling buckling before reaching the ultimate strength state of the material because of the large slenderness ratio and the narrow cross-section features. This paper proposes a numerical model based on a hierarchical one-dimensional unified formulation for the analysis of buckling and wrinkling phenomena in the I-beam. The model is constructed within the framework of Carrera's Unified Formulation (CUF), which uses Lagrange polynomials to express the three-dimensional displacement field as an arbitrary order approximation by displacement variables on each layer. Due to its high efficiency and step size adaptability by expanding nonlinear equilibrium path with power series, Asymptotic Numerical Method (ANM) is adopted to solve the nonlinear governing equations. Numerical investigations show that the proposed model are able to capture the instability phenomena in thin-walled I-beam. In order to validate the reliability and efficiency, the critical buckling point and wrinkling displacement field can be precisely obtained by the proposed model, and a very good agreement is found in the comparison with those obtained via three-dimensional finite element solution.
