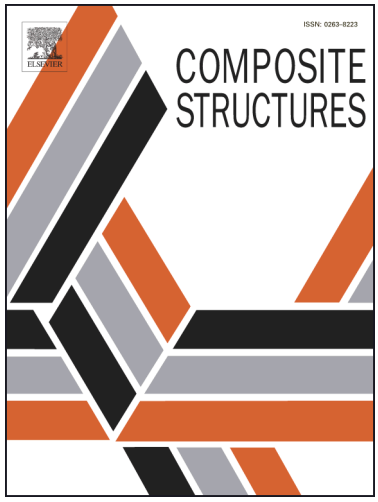

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A shear-deformable beam model for stability analysis of orthotropic composite semi-rigid frames

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Abstract

In this paper, a shear deformable beam model for nonlinear stability analysis of frames made of composite materials is presented. Each wall of the cross-section is assumed to be orthotropic in such a way that normal stress does not cause shear strains to occur. The incremental equilibrium equations for a straight thin-walled beam element are derived within the framework of updated Lagrangian formulation and the nonlinear displacement field of cross-sections, which accounts for the restrained warping and the large rotations effects. Timoshenko's theory for non-uniform bending and modified Vlasov's theory for non-uniform torsion are applied to include the shear deformation effects. The coupled bending-torsion shear deformation effects occurring at the asymmetric cross-section are also included in the model. To account for the semi-rigid connection behaviour, the hybrid finite element is introduced through the special transformation procedure. Several benchmark examples are demonstrated for verification purposes. The obtained results indicate that the proposed model can be classified as shear locking-free one.

Keywords: buckling, orthotropic composite beam, large displacement, semi-rigid frames

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