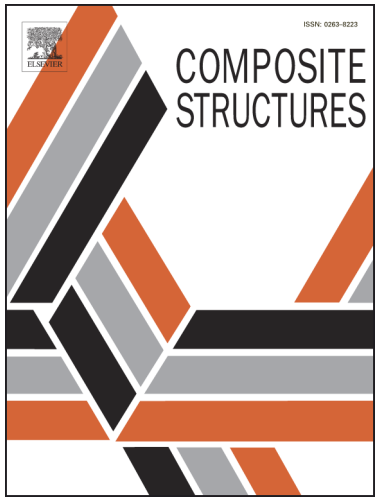

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Thermo-mechanical analysis of composite beams

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Abstract

The study is formulated within the framework of the linear weak coupled thermo-elasticity and for problems where the temperature solution may be assumed as invariant along the beam axis. This working hypothesis, which is not so restrictive in terms of engineering applications, leads to reduce the heat conduction problem to a thermal cross-section analysis solved by 2D-FEM. Then, using the temperature solution as an external loading, the mechanical beam problem is carried out through a 1D refined beam theory. The latter is based on a displacement model that includes the main own displacement modes (in and out-of plane warpings) of the cross-section and an additional one related to the thermal conditions. Such a model leads to a beam theory that really fits the cross-section nature (shape and materials), the thermal conditions, and hence the beam problem. The proposed method has been applied to solve a significant set of thermo-mechanical composite beam problems and, to show its efficiency, the 3D-results (especially the stresses) have been systematically compared with those provided by full 3D-FEM computations.

Keywords: Refined beam theory, Saint-Venant's solution, composite section, heat conduction, finite element method

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