Analysis of laminate boxes made of vat composites by higher-order CUF models

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ANALYSIS OF LAMINATE BOXES MADE OF VAT COMPOSITES BY HIGHER-ORDER CUF MODELS

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The composite laminates still have a lot of hidden potentials and the research is engaged in their optimization. Typically these laminate are manufactured with the fibers placed in straight patterns intersected between them providing a constant stiffness over the whole structure (*CSCL - Constant Stiffness Composite Laminate*). The laminates with a variable stiffness (*VSCL - Variable Stiffness Composite Laminate*) are in the spotlights because of they allow the *stiffness/mass ratio* to be increased improving the rigidity only in the critical areas, saving weight where is possible. Different approaches can be possible, but thanks to the new automatic manufacturing processes, the Variable Angle Tow (VAT) composites are of great interest. This method removes the imposition to have straight fibers and allows composite material with curvilinear fibers to be produced. This approach increases the design possibilities and provides a more efficient tailoring process for the definition of the material proprieties. The use of the VAT allows the redirection of the stress fluxes, local stiffness increases, to control the vibrational behavior or the introduction of coupling effects to be possible guaranteeing excellent control on the weight of the laminate. Considering complicated pattern where the trajectory is a function of two or more variables, the material coefficients have to be integrated into the definition of the global stiffness matrix. Because of the limited capacities of the classical models, efficient tools are required to provide an accurate prediction of displacements, stresses or of the modal behavior. A refined beam model based on the Carrera Unified Formulation (CUF) able to deal with the VAT problem is proposed in this work. The CUF introduces expansions to approximate the displacement field over the cross-section in the definition of the model kinematics providing a a layer-wise approach [1]. In this way, each layer can be characterized by different proprieties and also by a different pattern of the fiber. The work proposes an extensive assessment on free-vibration analyses of VAT laminates and results compared with literature. Simple boxes are taken into account and the modal behavior using different fiber pattern are evaluated.

REFERENCES

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