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Multilayered structures, such as sandwich panels, composite laminated structures are extensively used to build large part of next generation aircraft, spacecraft and advanced components of ship and automotive vehicles.

Analysis of failure mechanisms in layered structures demands an accurate evaluation of strain and stress fields in each lamina. Advanced shell models with variable kinematic as well as zig-zag theories have been proposed in last three decades literature. However, the solutions of real structures with complex geometries and boundary conditions requires the use of computational methods. Among these numerical methods, a relevant role is played by finite element method, FEM [1]. On the other hand, such models could demand specific efforts to overcome the limitations due to numerical mechanisms, such as shear and membrane locking.

The formulation of an efficient and robust shell finite element for the analysis of multilayered composite structures is the topic of this paper. The variable kinematic modeling in the framework of Carrera's Unified Formulation (CUF) [2] is referred to. Linear, parabolic, cubic and forth order displacement fields in the shell thickness direction are used. Both cases of equivalent single layer (the multilayered plate is seen as an equivalent one layered plate) and layer-wise (each layer is considered as an independent plate) variable descriptions are accounted for. Nine-nodes elements are considered and a number of applications are developed to isotropic and multilayered anisotropic shells. In order to avoid the locking phenomenon the MITC type technique proposed in [3] is employed. The performance of the element is tested by solving benchmark problems involving very thin shells.

References

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