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Three-Dimensional Analytical and Semi-Analytical Investigation of Free-Corner Effects

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Stress fields at interfaces of dissimilar layers near free edges and corners of composite laminates are of a localized 3D singular nature (free-edge and free-corner effects). Numerical studies of such stress concentration phenomena require vast computational effort, hence it is of particular interest to develop approximate analysis methods requiring reasonable computational expenses yet performing with high accuracy. In the present contribution, analytical and semi-analytical approaches to 3D laminate corner effects are presented. First, an analytical method in the form of a layerwise assumed-stress approach for rectangular plates with arbitrary layups is used. Second, a hybrid layerwise displacement-based variational formulation proves to be highly efficient for rectangular cross-ply plates. As a closure, a novel semi-analytical approach to the 3D asymptotic corner behaviour is presented using the boundary finite element method which in essence is a fundamental-solution-less boundary element formulation based on finite elements.

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