Three-Dimensional Elasticity Analysis of Sandwich Laminated Finite Shell with FG Core by Numerical Integration Approach

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KEYWORDS : *Sandwich laminates, functionally graded core, three-dimensional elasticity analysis, numerical integration technique.*

Sándwich panel are widely employed in engineering applications such as aerospace, construction**,** and transportation, where high strength-to-weight and stiffness-to-weight ratios are essential. A critical issue in such structures is delamination between the core and face-sheets, primarily caused due to the mis-match in their material properties. Previous studies indicate that the resistance to delamination can be enhanced by tailoring the material properties of the core. Consequently, the concept of functionally graded (FG) materials has gained significant attention in sandwich panel design.

Accurate evaluation of stresses, particularly transverse stresses responsible for delamination, is crucial for reliable structural assessment. Classical theories often fail to capture these stresses with sufficient accuracy, whereas three-dimensional (3-D) elasticity theories account for the complete stress state. In this study, a 3-D elasticity-based solution is developed using a numerical integration approach for the bending analysis of a finite sandwich laminated circular cylindrical shell with a FG orthotropic core.

The core material properties are assumed to vary exponentially in a symmetric manner with respect to the shell mid-surface, while the face sheets are considered homogeneous. Continuity of material properties is maintained at the interfaces. The proposed formulation employs a mixed approach, enabling the simultaneous evaluation of displacements and stresses with equal accuracy. The method utilizes the full set of 3-D elasticity equations without introducing simplifying assumptions, and the solution is obtained through an efficient numerical integration technique. The proposed method offers a valuable tool in advancing the understanding and analysis of laminated sándwich composite shell structures.

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