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Vibration Analysis of FGM Sandwich Panel with Cut-Outs Using Refined Higher-Order Shear Deformation Theory (HSDT) Based on Isogeometric Analysis

Authors : Lokanath Barik, Abinash Kumar Swain

Abstract : This paper presents vibration analysis of FGM sandwich structure with a complex profile governed by refined higher-order shear deformation theory (RHSDT) using isogeometric analysis (IGA). Functionally graded sandwich plates provide a wide range of applications in aerospace, defence, and aircraft industries due to their ability to distribute material functions to influence the thermo-mechanical properties as desired. In practical applications, these structures generally have intrinsic profiles, and their response to loads is significantly affected due to cut-outs. IGA is primarily a NURBS-based technique that is effective in solving higher-order differential equations due to its inherent C1 continuity imposition in solution space for a single patch. Complex structures generally require multiple patches to accurately represent the geometry, and hence, there is a loss of continuity at adjoining patch junctions. Therefore, patch coupling is desired to maintain continuity requirements throughout the domain. In this work, a novel strong coupling approach is provided that generates a well-defined NURBS-based model while achieving continuity. The methodology is validated by free vibration analysis of sandwich plates with present literature. The results are in good agreement with the analytical solution for different plate configurations and power law indexes. Numerical examples of rectangular and annular plates are discussed with variable boundary conditions. Additionally, parametric studies are provided by varying the aspect ratio, porosity ratio and their influence on the natural frequency of the plate.

Keywords : vibration analysis, FGM sandwich structure, multipatch geometry, patch coupling, IGA
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