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Two-dimensional analytical solution for multi-segmented Al/ steel-composite panel-An Aerospace Application

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Abstract:

E-vehicles and light weight structural parts in automotive and aerospace industry has led to design and development of new structures where traditional materials aluminium/steel are joined with composite laminated materials. This approach has led the engineers/researchers to reduce weight and ultimately save fuel consumption and reduce carbon footprints.
Moreover, prosthetic limbs are also designed to have varying material along the length for better suitability. The above problems cannot be analysed using functionally graded theories/concepts. In theory, material properties vary linearly, exponentially, or power-law-like along x-values but for the above cases, material property does not follow a particular variation. Further even, it is not always practical to produce or manufacture components having very smooth variations along the length.
Number of research articles are reported on the development of joining techniques for the dissimilar materials [1,2]. Bending, free vibration and buckling analysis is also needed for theses case [3]. At the joining or interface point, local inplane and transverse stresses may rise sharply and may cause debonding and failure of structures. One dimensional analysis based on classical assumption or higher order can not accurately predict the stress behaviour at theses places.
In this paper, an attempt is made to develop the 2D analytical solution for multi-segmented Al/ steel- composite panel under transverse loading. Extended Kantorovich method is used for developing governing equations. Continuity of displacement and stresses are satisfied at interface of each segment. Two segmented panels having aluminium/steel and Gr/Ep equal and unequal segment are considered. The deflection and stresses are compared with the finite element solution and found in good agreement.

REFERENCES

1. Joodaky, A. Joodaky, Bending of edge-bonded dissimilar rectangular plates, Meccanica 54 (3) (2019) 565–572.
2. S. M. Hasheminia, B. C. Park, H.-J. Chun, J.-C. Park, H. S. Chang, Failure mechanism of bonded joints with similar and dissimilar material, Composites Part B: Engineering 161 (2019) 702–709.
3. A. Fereidoon, A. Mohyeddin, M. Sheikhi, H. Rahmani, Bending analysis of functionally graded annular sector plates by extended kantorovich method, Composites Part B: Engineering 43 (5) (2012) 2172–2179.