

Free Vibration Analysis of Sandwich Beams Resting on an Orthotropic Pasternak Foundation: An Analytical Approach

Büşra Uzun^{*1}, Merve Ermis² and Alim Berk Çağlayan¹

¹Bursa Uludag University, Faculty of Engineering, Civil Engineering Department, 16059,
Bursa/TURKEY

²Kırklareli University, Faculty of Engineering, Civil Engineering Department, Kırklareli/TURKEY

ABSTRACT

This study investigates the vibration of sandwich beams resting on an orthotropic Pasternak foundation. The considered beam configuration consists of a homogeneous core layer and functionally graded upper and lower face sheets, whose mechanical properties vary continuously through the thickness according to a power-law distribution. Although the free vibration behaviour of beams on elastic foundations has been extensively studied in the literature [1], the majority of existing studies are limited to isotropic foundation models. Accordingly, in sandwich beam vibration analyses, the foundation is commonly represented by a direction-independent Pasternak formulation, while direction-dependent effects become important when the supporting medium exhibits orthotropic characteristics. The novelty of this study lies in incorporating an orthotropic Pasternak foundation [2] into the vibration analysis of sandwich beams. The equations of motion are derived within the framework of Euler–Bernoulli beam theory, and the resulting governing differential equations are solved analytically using the Navier method. A systematic parametric study examines the effects of the material grading index, the degree of foundation orthotropy, and foundation stiffness parameters on the vibration characteristics. The results show that the presence of foundation orthotropy has a significant impact on the frequencies of sandwich beams, emphasizing the role of direction-dependent medium properties in the dynamic response.

ACKNOWLEDGMENT: The authors gratefully acknowledge the financial support provided by The Scientific and Technological Research Council of Türkiye (TÜBİTAK) under the 2224-A International Scientific Events Participation Support Program.

REFERENCES

- [1] A.S. Sayyad and Y.M. Ghugal. Bending, buckling and free vibration of laminated composite and sandwich beams: A critical review of literature. *Composite Structures*, Vol. 171, pp. 486-504, 2017.
- [2] M. Ermis, A. Kutlu, N. Eratlı and M.H. Omurtag. Free vibration of axially FG curved beam on orthotropic Pasternak foundation via mixed FEM. *Journal of the Brazilian Society of Mechanical Sciences and Engineering*, Vol. 44(12), 597, 2022.