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Jung Woo Lee, Jung Youn Lee

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Jung Woo Lee, Jung Youn Lee*

Department of Mechanical System Engineering, Kyonggi University, 154-42, Gwanggyosan-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16227, Republic of Korea

*Corresponding Author. Tel.: +82-31-249-9811, Fax: +82-31-244-6300, e-mail address: jylee@kgu.ac.kr .

Abstract

In this paper, we developed an exact transfer matrix method to analyze the free vibration characteristics of a functionally graded beam. The transfer matrix for the functionally graded beam is deduced from the relationship of the displacements and forces at both ends of the beam. Because the results obtained from the present method are independent of the number of subdivisions, this method can be used as a useful tool to produce the natural frequencies and mode shapes for such problems in which material properties such as the elastic modulus and density are assumed to vary continuously along the height direction of the beam cross-section depending on a power-law form. The use of functionally graded materials leads to a sixth-order differential equation because of the coupling of the axial and bending displacements, and its effect is analyzed by varying the length to height ratio. The calculated natural frequencies to demonstrate the accuracy of the proposed method are compared with those discussed in previous papers. The various analyses for the natural frequencies and mode shapes of functionally graded beams are performed via a parametric study. In addition, the effect of the power-law index on the eigenpairs of functionally graded beams connected by two elements with different top and bottom properties is examined.

Keywords

transfer matrix method, functionally graded beam, FGM, FGB, TMM