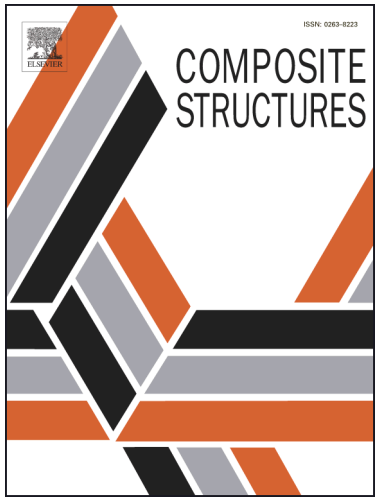

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An Efficient Approach for In-Plane Free and Forced Vibrations of Axially Functionally Graded Parabolic Arches with Nonuniform Cross Section

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Abstract

This article presents an effective approach for analyzing the in-plane free and forced vibration responses of axially functionally graded (AFG) parabolic arches with a nonuniform cross section. Material and geometric properties of the arch are considered to vary continuously along the axial direction of the arch. The effect of shear deformation is considered in the formulations. The governing differential equations of motion are solved by the Complementary Functions Method (CFM) in the Laplace domain. Furthermore, in the damped forced vibration case, the Kelvin model is employed. A detailed study is carried out to demonstrate the effects of material variations on the natural frequencies and on the transient response of the AFG arches. Current results are compared with the numerical results of ANSYS to confirm the validity and effectiveness of the present approach. Effects of the material index on dynamic behavior of the AFG structures are examined. It is believed that derived results can be used as benchmark solutions for validation of future works on the dynamic behavior of AFG arches.

Keywords: Free Vibration; Forced Vibration; Complementary Functions Method (CFM); Inverse Laplace Transforms; Functionally Graded Materials (FGM); Arch.