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Free vibration of thin-walled functionally graded open-section beams

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Abstract

The present study is concerned with free vibration of thin-walled functionally graded (FG) open-section beams. The mechanical properties of thin-walled beam are assumed to vary smoothly through the wall thickness according to a power law distribution of volume fraction of constituent phases. Governing differential equations are derived by means of Hamilton's principle. A finite element method is developed to formulate the problem. The theory accounts for warping of cross-section and all the structural coupling coming from anisotropy of material. The natural frequencies and corresponding vibrational modes are obtained for thin-walled FG mono-symmetric I- and channel-sections beams with several types of material distributions. A numerical comparison is carried out to show the validity of the proposed theory with available results in the literature. Furthermore, effects of gradual law and thickness ratio of ceramic on the natural frequencies of beams are also studied.

Keywords: Thin-walled open-section beam; Functionally graded material; Free vibration.

1. Introduction

Functionally graded materials (FGMs) as special composites have been extensively used in a variety of structures because of the optimal strength

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