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Mathematical programming approach for uncertain linear elastic analysis of functionally graded porous structures with interval parameters

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Abstract

This paper investigates the non-deterministic linear elastic problem of bar-type functionally graded porous (FGP) structures with uncertain-but-bounded system parameters. For achieving a robust uncertainty analysis framework, a non-stochastic structural analysis for FGP engineering structures, whose system inputs possess interval uncertainties, through the framework of Finite Element Method (FEM) is proposed. The Timoshenko beam theory is adopted to incorporate the shear effect, so a more generalized uncertain static analysis of FGP structures can be anticipated. Various uncertain system input parameters, for example, the Young's moduli, the dimensions of the cross-sections, the porosities, as well as the applied loads can be simultaneously incorporated within the proposed method. To demonstrate the capability of the proposed approach, two distinctive numerical examples have been thoroughly investigated. Additional numerical experiments have also been conducted to further explore various effects of uncertainties of different system inputs acting on the overall FGP structural responses.

Keywords

Functionally graded materials; Porous materials; Composite structures; Uncertain linear elastic analysis; Timoshenko beam; Non-stochastic FEM.

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