Accepted Manuscript

Free vibration and buckling analyses of geometrically non-linear and shear-deformable FGM beam fixed to the inside of a rotating rim

Debabrata Das

PII: S0263-8223(16)32926-9
DOI: http://dx.doi.org/10.1016/j.compstruct.2017.07.051
Reference: COST 8706

To appear in: *Composite Structures*

Received Date: 22 December 2016
Revised Date: 29 June 2017
Accepted Date: 17 July 2017

Please cite this article as: Das, D., Free vibration and buckling analyses of geometrically non-linear and shear-deformable FGM beam fixed to the inside of a rotating rim, *Composite Structures* (2017), doi: http://dx.doi.org/10.1016/j.compstruct.2017.07.051

Free vibration and buckling analyses of geometrically non-linear and shear-deformable FGM beam fixed to the inside of a rotating rim

Debabrata Das

Department of Mechanical Engineering, Jadavpur University, Kolkata-700032, India.

Email: debudas.ju@gmail.com, debudas@mech.jdvu.ac.in, Tel./ Fax: +91 33 2414 6890

Abstract

The present work investigates the out-of-plane (or flap-wise) and in-plane (or chord-wise) free bending vibration of FGM beam, which is fixed to the inside of a rotating rim. A general formulation considering non-linearity for both normal and shear strains is presented employing Timoshenko beam theory. A symmetric through-thickness material gradation following power law distribution of volume fraction is considered. The first step of the problem determines the beam configuration under time-invariant centrifugal loading through a geometrically non-linear analysis, employing minimum total potential energy principle. The second step of the problem determines the free vibration frequency of the beam about the deformed configuration, and in that case, the tangent stiffness of the beam configuration is used to formulate the governing equations employing Hamilton's principle. The effects of spin-softening and Coriolis acceleration components are considered. The solution of the governing equations is obtained following Ritz method, and the free vibration problem is transformed to a standard eigenvalue problem by transforming the equations to the state-space. The critical speed leading to buckling of the rotating beam is reported. The results are presented in non-dimensional speed-frequency plane for different root offset parameters, volume fraction indices and FGM compositions.

Keywords: Rotating beam; functionally graded; free vibration; buckling; Timoshenko beam; Tangent stiffness.