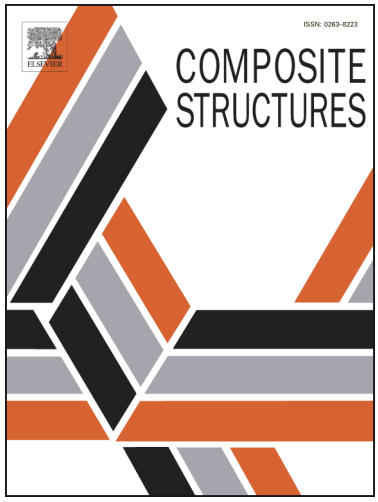

Enhancement of Non-linear Thermal Stability of Temperature Dependent Laminated Beams with Graphene Reinforcements

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PII: S0263-8223(17)33000-3
DOI: https://doi.org/10.1016/j.compstruct.2017.11.086
Reference: COST 9152

To appear in: *Composite Structures*

Received Date: 14 September 2017
Revised Date: 4 November 2017
Accepted Date: 30 November 2017

Please cite this article as: Y. Kiani, Mirzaei, M., Enhancement of Non-linear Thermal Stability of Temperature Dependent Laminated Beams with Graphene Reinforcements, *Composite Structures* (2017), doi: https://doi.org/10.1016/j.compstruct.2017.11.086

Enhancement of Non-linear Thermal Stability of Temperature Dependent Laminated Beams with Graphene Reinforcements

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Abstract

Present investigation deals with the thermal postbuckling behaviour of a composite laminated beam where graphene is used as reinforcement of each lamina. The composite laminated beam may be piecewise functionally graded by changing the volume fraction of graphene in each lamina. Mechanical properties in each layer are obtained according to the modified Halpin-Tsai approach which contains efficiency parameters to capture the size dependency of the nanocomposite properties. Thermomechanical properties of the matrix and reinforcements are assumed to be temperature dependent. Beam is resting on an elastic foundation which acts in compression as well as in tension. The first order shear deformation beam theory and von Kármán type of geometrical nonlinearity are used as the basic assumptions to establish the total strain energy of the system. Beam is subjected to uniform temperature elevation. With the aid of conventional Ritz method and the simple polynomials as the basic functions, the matrix representation of the governing equations is derived. The adopted solution method may be used for arbitrary combinations of boundary conditions. The obtained system of equations is nonlinear in terms of both temperature and displacements. An iterative displacement control strategy is proposed to extract the thermal postbuckling curves of the beam resting on a conventional elastic foundation. Numerical results are given to discuss the effects of graphene distribution, stacking sequence, boundary conditions, side to thickness ratio and foundation stiffness on critical buckling temperature and thermal postbuckling equilibrium path of the beam. It is shown that, through a piecewise functionally graded distribution of graphene in matrix, critical buckling temperature may be enhanced significantly and thermal postbuckling deflection may be alleviated.

Keywords: Thermal Postbuckling; Composite Beam; Graphene Reinforced Composite; Ritz Method; Temperature Dependency; Halpin-Tsai Rule.

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