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A comment on "Nonlinear thermal buckling of axially functionally graded micro and nanobeams" [Composite Structures 168 (2017) 428–439]

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Abstract

In a recent paper by Shafiei, Mirjavadi, Behzad, Afshari, Rabby, and Hamouda [1], for the first time the nonlinear mathematical formulations of axially functionally graded (AFG) micro/nano-beams under non-uniform temperature distribution in the thickness direction based on the classical theory as well as the non-classical theories (modified couple stress and nonlocal theories) were developed to study the thermal buckling of system. In this comment, it is indicated that the governing equations and associated boundary conditions of system were incompletely established not only for the non-classical models but also for the classical model. The main reason for the inaccuracy of mathematical formulations proposed by Shafiei et al. [1] is to neglect the influence of thermal moment at both the governing equations and boundary conditions. In addition, it is discussed that the size-dependent and –independent buckling temperature rise predicted by Shafiei et al. [1] is meaningless for both the simply supported and fully clamped case studies.

Keywords

Axially functionally graded beam; Thermal loading; Mathematical formulation.

1. Governing equations and related boundary conditions

In this section, the mathematical formulation of an axially functionally graded beam under immovable boundary conditions and in-plane non-uniform thermal loading in the thickness direction is derived based on the classical theory. It should be pointed out that the size-dependent governing equations and associated boundary conditions of system based on modified couple stress and non-local theories reduce to those obtained by using the classical theory when the material length scale parameter is set to zero.

The nonlinear form of axial strain (ε_{xx}) of Euler-Bernoulli beam can be expressed as [2]:

$$\varepsilon_{xx} = \frac{\partial u}{\partial x} + \frac{1}{2}\left(\frac{\partial w}{\partial x}\right)^2 - z\,\frac{\partial^2 w}{\partial x^2} \tag{1}$$

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