Accepted Manuscript

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PII: S1359-8368(18)32307-2

DOI: 10.1016/j.compositesb.2018.09.086

Reference: JCOMB 6056

To appear in: *Composites Part B*

Received Date: 25 July 2018

Revised Date: 4 September 2018

Accepted Date: 24 September 2018

Please cite this article as: Vinyas M, A higher-order free vibration analysis of carbon nanotube-reinforced magneto-electro-elastic plates using finite element methods, *Composites Part B* (2018), doi: https://doi.org/10.1016/j.compositesb.2018.09.086.

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A Higher-order free vibration analysis of Carbon Nanotube-reinforced Magneto-electro-elastic plates using finite element methods

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Abstract:

This article deals with the free vibration analysis of Carbon Nanotube-reinforced magneto-electro-elastic (CNTMEE) rectangular and skew plates using finite element (FE) methods. The plate kinematics is assumed to follow a higher-order shear deformation (HSDT) theory. The coupled equations of motion are derived with the aid of Hamilton's principle. The material properties of CNTMEE material are estimated using the rule of mixture. The various carbon nanotube (CNT) distribution fashions such as UD, FG-X, FG-O, and FG-V are employed in the present analysis. Further, the FE formulation is extended for skew CNTMEE plates to assess the effect of geometrical skewness on the natural frequencies of the plate. A special emphasize is provided on analyzing the influence of various multi-physical fields such as magnetic, electric and elastic fields on the coupling characteristics of CNTMEE plates. In this article, a detailed parametric study on the effect of boundary conditions, CNT distributions and volume fraction, aspect ratio, length-to-width ratio are considered. The research outcome of this article suggests that these parameters have a significant influence on the coupled free vibration characteristics of CNTMEE plate. It is believed that the results presented in this article may serve as a benchmark in the design and analysis of smart CNTMEE structures for sensors and actuators, energy harvesting application.

Keywords: coupling fields; CNT's; finite element analysis; higher-order shear deformation; magneto-electro-elastic; skew angle.

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