Accepted Manuscript

Nonlinear low-velocity impact response of FG-GRC laminated plates resting on visco-elastic foundations

Yin Fan, Y. Xiang, Hui-Shen Shen, D. Hui

PII: S1359-8368(18)30068-4

DOI: 10.1016/j.compositesb.2018.02.016

Reference: JCOMB 5541

To appear in: *Composites Part B*

Received Date: 8 January 2018

Revised Date: 9 February 2018

Accepted Date: 17 February 2018

Please cite this article as: Fan Y, Xiang Y, Shen H-S, Hui D, Nonlinear low-velocity impact response of FG-GRC laminated plates resting on visco-elastic foundations, *Composites Part B* (2018), doi: 10.1016/j.compositesb.2018.02.016.

Nonlinear low-velocity impact response of FG-GRC laminated plates resting on visco-elastic foundations

Yin Fan [1,3], Y. Xiang [3,4], Hui-Shen Shen [1,2,*] , D. Hui [5]

[1] School of Aeronautics and Astronautics, [2] School of Ocean and Civil Engineering, Shanghai Jiao Tong University, Shanghai 200240, People's Republic of China
[3] School of Computing, Engineering and Mathematics, [4]Centre for Infrastructure Engineering, Western Sydney University, Locked Bag 1797, Penrith, NSW 2751, Australia
[5]Department of Mechanical Engineering, University of New Orleans, New Orleans, LA 70148, USA

Abstract The nonlinear transient response of functionally graded graphene reinforced composite (FG-GRC) laminated plates resting on visco-Pasternak foundations in thermal environments under impact load is investigated in this paper. Each layer of a laminated plate is assumed to have the same thickness, but the volume fraction of graphene is assumed to be functionally graded in a piece-wise pattern along the plate thickness direction. The stiffness of FG-GRC is then obtained by an extended Halpin-Tsai model, where the graphene efficiency parameters are introduced and determined by molecular dynamics (MD) simulations. The impactor is assumed to be a metal sphere and the contact process between the impactor and the laminated plate is described by a modified Hertz model. The effects of the visco-Pasternak foundation and the temperature variation as well as the initial load are taken into consideration. In the framework of von Kármán type of kinematic nonlinearity, the motion equations of an FG-GRC laminated plate are established based on a higher-order shear deformation theory and solved by a two-step perturbation technique. Finally, the motion equations of the impactor and the FG-GRC laminated plate can be simultaneously solved by the Runge-Kutta approach. The numerical results illustrate the effects of functionally graded graphene distribution, foundation stiffness, temperature variation, initial in-plane load and different impactor velocities on the contact force and the deflection of the FG-GRC laminated plate.

Key words: A. Nano-structures; A. Plates; B. Laminates; C. Analytical modeling; Functionally graded materials