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Effects of carbon nanotube inclusion into the carbon fiber reinforced laminated composites on flexural stiffness: A numerical and theoretical study

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ABSTRACT

Because of increased usage areas, and advances in characterization of the nanostructured materials, determination of the engineering properties of composites that includes carbon nanotubes has gained importance. It is possible to designate material properties of carbon nanotube based composites theoretically and experimentally. In this study, engineering constants of carbon nanotube based unidirectional carbon fiber reinforced composite lamina determined theoretically with two different approaches. Then, a composite plate whose laminas were stacked up as a $[0°/+45°/-45°/90°]_s$ layup was built up in ANSYS, ACP Module. Finally, three point bending analyzes were performed separately under concentrated and distributed load. The results showed that there were negligible differences between the engineering constants obtained from two different theoretical approaches. Engineering constants, E_1, E_2, G_{12} and G_{23}, increased as the added carbon nanotube fraction is increased. Besides that, flexural rigidity of composite plate also showed ever-decreasingly increase, as carbon nanotube content is increased. The results of theoretical and numerical bending analyzes exhibited a good agreement with the maximum percentage relative error of 9.1.

Keywords: A. Nano-structures, B. Mechanical properties, C. Analytical modelling, C. Finite element analysis (FEA)

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