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Analytical and Numerical Buckling and Vibration Investigation of Isotropic and Orthotropic Hyper Composite Materials Structures

Muhannad Al-Waily

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The analytical solution of the general equation of bucking behaviors and general equation of motion (to evaluated the natural frequency of plate) of isotropic and orthotropic composite plate is investigation. The composite materials studied are isotropic and orthotropic hyper composite materials plate combined from three materials as reinforcement powder, mat or short reinforcement fiber (for isotropic plate) and unidirectional or woven reinforcement fiber (for orthotropic plate) and resin materials. The method using to evaluating the buckling load and natural frequency of orthotropic and isotropic hyper composite plate are theoretical analysis method with derivation the general equation of buckling and general equation of motion of orthotropic hyper composite, and general equation of buckling and general equation of motion of isotropic hyper composite plate. In addition to, drive the equation of properties of hyper composite materials of plate with effect of powder reinforcement and unidirectional, woven, mat or short fiber and resin materials. The results evaluated are the buckling load and the natural frequency of isotropic and orthotropic hyper composite simply supported plate with different aspect ratio of plate ( ), various volume fraction of reinforcement powder and fiber, and different reinforcement and resin materials types. The theoretical results evaluated of buckling and natural frequency of plate comparison with numerical results evaluated with finite element method by using Ansys program ver. 14, where, the compare between the theoretical and numerical results shown a good agreement with maximum error about (2.7%) with buckling results of isotropic materials plate and maximum error about (1.9%) with buckling results of orthotropic materials plate and maximum error about (3.2%) with natural frequency of orthotropic materials plate and maximum error about (1.8%) with natural frequency of isotropic materials plate. The results evaluated are the buckling load and the natural frequency of simply supported orthotropic and isotropic hyper composite plate combined from powder reinforcement and unidirectional, woven, mat or short fiber and resin materials with different volume fraction and materials types of resin and reinforcement, and different dimensions of plate. The results shown that the adding of reinforcement powder causes increasing of modulus of elasticity of hyper composite plate, and then, the increasing the volume fraction of reinforcement powder causes increase the natural frequency of isotropic and orthotropic hyper composite plate structure. And, the results shown that the buckling load of plate increasing with increase of the reinforcement powder and the buckling load non effect with the powder reinforcements types. Also, the results shown that the buckling load increases with increase the mat, short, unidirectional or woven reinforcement fiber more than the increases of the buckling load of composite plate with increase of powder reinforcement. And, the buckling load increasing with increase the modulus of elasticity of resin materials types used. Also, the effect of powder reinforcement on the natural frequency of unidirectional and woven hyper composite material beam was studied. The study of natural frequency was evaluated with three methods, the first is theoretical method with driving of the general equation of beam motion with shear deformation and rotary inertia effects, the second is driving of the general equation of motion for single degree of freedom beam, and the third is the numerical method with finite element method by using Ansys program Ver. 14. The study included the powder reinforcement volume fraction effect for hyper composite material beams of the following types: unidirectional, woven hyper composite beams with different volume fractions of fiber.

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