



A New Approach for Dynamic Analysis of Composite Beam with an Interply Crack

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Abstract: In this work, a new approach is developed for dynamic analysis of a composite beam with an interply crack, in which a physically impossible interpenetration of the crack faces is prevented by imposing a special constraint, leading to taking account of a force of contact interaction of the crack faces and to nonlinearity of the formulated boundary value problem. The shear deformation and rotary inertia terms are included into the formulation, to achieve better accuracy. The model is based on the first order shear deformation theory, i.e. the longitudinal displacement is assumed to vary linearly through the beam's thickness. A variational formulation of the problem, nonlinear partial differential equations of motion with boundary conditions and the finite element solution of the partial differential equations with the use of the FEMLAB package are developed. The use of FEMLAB facilitates automatic mesh generation, which is needed if the problem has to be solved many times with different crack lengths. An example problem of a clamped-free beam with a piezoelectric actuator is considered, and its finite element solution is obtained. A noticeable difference of forced vibrations of the delaminated and undelaminated beams due to the contact interaction of the crack faces is predicted by the developed model.

Keywords: *composite delaminated beam; piezoelectric actuator; contact of crack faces; Lagrange multipliers; penalty function method; shear deformation theory; nonlinear partial differential equations; nonlinear finite element analysis.*

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