

Variational Approach of Timoshenko Beams with Internal Elastic Restraints

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Abstract:

An exact approach for free transverse vibrations of a Timoshenko beam with ends elastically restrained against rotation and translation and arbitrarily located internal restraints is presented. The calculus of variations is used to obtain the equations of motion, the boundary conditions and the transitions conditions which correspond to the described mechanical system. The derived differential equations are solved individually for each segment of the beam with the corresponding boundary and transitions conditions. The derived mathematical formulation generates as particular cases, and several mathematical models are used to simulate the presence of cracks. Some cases available in the literature and the presence of some errors are discussed. New results are presented for different end conditions and restraint conditions in the intermediate elastic constraints with their corresponding modal shapes.

Keywords: Calculus of variations, Timoshenko beams, elastically restrained ends, exact result