On the Use of Timoshenko Beams Theory for Ultrasonic Fatigue Testing

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ABSTRACT

An exact approach for free longitudinal and transverse vibrations of specimens used in Ultrasonic Fatigue Testing (UFT) based on Timoshenko beam theory 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, several mathematical models used to simulate the presence of cracks.

The proposed mathematical model allows to obtain different values of the natural frequencies parameters with the corresponding modal shapes of the specimens. These results are essential to define an optimum design of the UFT parameters including different materials, testing frequencies and geometries of the specimens. Results are compared with some cases available in the literature. New results are presented for different cracked and uncracked samples.

REFERENCES

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