

Nonlinear Impact Responses for a Damped Frame Supported by Nonlinear Springs with Hysteresis Using Fast FEA

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Abstract : This paper deals with nonlinear vibration analysis using finite element method for frame structures consisting of elastic and viscoelastic damping layers supported by multiple nonlinear concentrated springs with hysteresis damping. The frame is supported by four nonlinear concentrated springs near the four corners. The restoring forces of the springs have cubic non-linearity and linear component of the nonlinear springs has complex quantity to represent linear hysteresis damping. The damping layer of the frame structures has complex modulus of elasticity. Further, the discretized equations in physical coordinate are transformed into the nonlinear ordinary coupled differential equations using normal coordinate corresponding to linear natural modes. Comparing shares of strain energy of the elastic frame, the damping layer and the springs, we evaluate the influences of the damping couplings on the linear and nonlinear impact responses. We also investigate influences of damping changed by stiffness of the elastic frame on the nonlinear coupling in the damped impact responses.

Keywords : dynamic response, nonlinear impact response, finite element analysis, numerical analysis

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