A design procedure for buildings equipped with energy dissipation devices using nonclassical damping and iso-performance curves

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Abstract

This article describes a design procedure for elastic buildings equipped with linear and nonlinear energy dissipating devices. The objective is to achieve a design that responds to a target building performance following a simple and robust step-by-step algorithm. The proposed procedure identifies first the modal significance of key design performance indicators and controls the modal properties by solving a singular two-parameter eigenvalue problem. For that purpose, a new modal significance metric is proposed, and a target frequency shift and damping ratio for the complete structure are obtained from the so-called iso-performance design curves. The design algorithm employs linear-equivalent stiffness and damping properties, which are then transformed into parameters characterizing inelastic force-deformation constitutive models corresponding to physical devices. The design algorithm leads to an optimal damper distribution corresponding to the minimum global amount of supplemental equivalent damping needed to achieve a maximum modal perturbation. The design procedure is first demonstrated using a five-story building example and then a real and complex 22-story free-plan building with two towers of rhomboid-shape plan with a very singular dynamic behavior.

Keywords design method, energy dissipation devices, iso-performance curves, nonclassical damping, optimaldamper distribution