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Abstract

DESIGN CRITERIA AND ANALYTICAL RESULTS FOR YIELDING ENERGY DISSIPATORS

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The introduction of energy dissipating devices as passive vibration controllers in structural systems under earthquake excitation is intended to reduce structural deformation and in certain cases to reduce the risk of damage to equipment attached to the structural system. Viscoelastic, frictional and elastoplastic elements are among the most commonly employed components of energy dissipating devices. All these devices provide the desired damping capability to the structural system and in certain cases increase the stiffness of the structural system.

In this paper the generic criteria and numerical simulation are presented for designing yielding devices, including a description of the engineering characteristics of the devices, and a description of important device-to-structure connectivities and flexibilities.

The engineering characteristics of yielding devices, i.e. the yield force, F_y, yield displacement, Δ_y, strain-hardening ration, SHR, initial stiffness, K_d, and ductility ratio, $u=\Delta_{max}/\Delta_y$, are defined in Section 2. Furthermore, there are described the various elements that are typically involved for supplemental damping application and the manner how they are related. In Section 3 is presented a comparison of the models behavior with and without metallic yielding devices for 1 DOF and 3 DOF. Analyses were carried out using the single-story model (three-story model) and the commercially available computer program SAP-2000 (Computers and Structures Inc.2000). The Nllink element is used in SAP-2000 to model local structural non-linearities which only exhibit during nonlinear time-history analyses. The computer model is subjected to 12 seconds of ground motions (El Centro). Many numerical simulations were performed for different values of the yielding force, F_y. In order to compare the results, the initial elastic stiffness of the device is described as a product of the elastic frame stiffness, SR*K_s, and the yield force of the device, F_y, is described as a fraction of the story-shear, FR*F. In order to compare single-story model and three-story model, the ratio of the interstory drifts of the unprotected model to the interstory drifts of protected model, FRD, and the ratio of the story shear of unprotected model to the story shear of protected model, FRF, are defined.

Finally, Section 4 presents the conclusions emerging from the cases studies taken up in this paper.

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