Performance-Based Design Examples for Steel Moment-Resisting Frames with Supplemental Damping

Wenshen Pong *Ph.D., P.E.*
School of Engineering, San Francisco State University,
1600 Holloway Avenue, San Francisco, CA 94132, U.S.A.
Email: wspong@sfsu.edu
Received 22 Aug 2001; revised 7 May 2002; accepted 10 May 2002.

ABSTRACT

The goal of this paper is to present a design procedure for steel moment-resisting frames with supplemental damping with performance-based design constraints. The first design example is based on a 4-story steel moment frame building with velocity dependent dampers; the second design example is based on the same building with displacement dependent dampers. The primary seismic-resistant frames, without dampers, were designed to meet the Uniform Building Code of 1997. The amount of supplemental damping for velocity-dependent devices was proportioned based on the first mode of the structural motion. The design of supplemental damping for displacement dependent devices was based on the stiffness of the structure. The seismic resistant frames, with dampers, were designed to remain elastic under a Design Basis Earthquake. The design goal is to limit the lateral drift to 1% of the story height and the Demand-to-Capacity ratio of the moment connections within 1 for a Design Basis Earthquake event. In the event of a larger earthquake, such as Maximum Credible Earthquake, plastic hinge formations and some structural damage would be expected. In that case, the post-Northridge moment connections will provide the ductility to minimize the damage. Lessons learned and suggestions for design guidelines are presented.

KEYWORDS
Performance-based, Steel; Moment-Resisting Frames; Supplemental Damping; Displacement-dependent; Velocity-dependent.