18.2.4 Procedure Selection

A structure with a damping system shall be designed using linear procedures, nonlinear procedures, or a combination of linear and nonlinear procedures, as permitted in this section.

Regardless of the analysis method used, the peak dynamic response of the structure and elements of the damping system shall be confirmed by using the nonlinear response-history procedure if the structure is located at a site with S_1 greater than or equal to 0.6.

18.2.4.1 Nonlinear Procedures

The nonlinear procedures of Section 18.3 are permitted to be used for design of all structures with damping systems.

18.2.4.2 Response-Spectrum Procedure

The response-spectrum procedure of Section 18.4 is permitted to be used for design of a structure with a damping system provided that

1. In the direction of interest, the damping system has at least two damping devices in each story, configured to resist torsion.
2. The total effective damping of the fundamental mode, β_{mD} (m = 1), of the structure in the direction of interest is not greater than 35 percent of critical.

18.2.4.3 Equivalent Lateral Force Procedure

The equivalent lateral force procedure of Section 18.5 is permitted to be used for design of a structure with a damping system provided that

1. In the direction of interest, the damping system has at least two damping devices in each story, configured to resist torsion.
2. The total effective damping of the fundamental mode, β_{mD} (m = 1), of the structure in the direction of interest is not greater than 35 percent of critical.
3. The seismic force-resisting system does not have horizontal irregularity Type 1a or 1b (Table 12.3-1) or vertical irregularity Type 1a, 1b, 2, or 3 (Table 12.3-2).
4. Floor diaphragms are rigid as defined in Section 12.3.1.
5. The height of the structure above the base does not exceed 100 ft (30 m).

18.2.5 Damping System

18.2.5.1 Device Design

The design, construction, and installation of damping devices shall be based on response to maximum considered earthquake ground motions and consideration of the following:

1. Low-cycle, large-displacement degradation due to seismic loads.
2. High-cycle, small-displacement degradation due to wind, thermal, or other cyclic loads.
3. Forces or displacements due to gravity loads.
4. Adhesion of device parts due to corrosion or abrasion, biodegradation, moisture, or chemical exposure.
5. Exposure to environmental conditions, including, but not limited to, temperature, humidity, moisture, radiation (e.g., ultraviolet light), and reactive or corrosive substances (e.g., salt water).

Damping devices subject to failure by low-cycle fatigue shall resist wind forces without slip, movement, or inelastic cycling.

The design of damping devices shall incorporate the range of thermal conditions, device wear, manufacturing tolerances, and other effects that cause device properties to vary during the design life of the device.

18.2.5.2 Multiaxis Movement

Connection points of damping devices shall provide sufficient articulation to accommodate simultaneous longitudinal, lateral, and vertical displacements of the damping system.

18.2.5.3 Inspection and Periodic Testing

Means of access for inspection and removal of all damping devices shall be provided.

The registered design professional responsible for design of the structure shall establish an appropriate inspection and testing schedule for each type of damping device to ensure that the devices respond in a dependable manner throughout their design life. The degree of inspection and testing shall reflect the established in-service history of the damping devices and the likelihood of change in properties over the design life of the devices.

18.2.5.4 Quality Control

As part of the quality assurance plan developed in accordance with Section 11A.1.2, the registered design professional responsible for the structural design shall establish a quality control plan for the manufacture of damping devices. As a minimum, this plan shall include the testing requirements of Section 18.9.2.