Chapter 16
SEISMIC RESPONSE HISTORY PROCEDURES

16.1 LINEAR RESPONSE HISTORY PROCEDURE

Where linear response history procedure is performed the requirements of this chapter shall be satisfied.

16.1.1 Analysis Requirements

A linear response history analysis shall consist of an analysis of a linear mathematical model of the structure to determine its response, through methods of numerical integration, to suites of ground motion acceleration histories compatible with the design response spectrum for the site. The analysis shall be performed in accordance with the requirements of this section.

16.1.2 Modeling

Mathematical models shall conform to the requirements of Section 12.7.

16.1.3 Ground Motion

A suite of not less than three appropriate ground motions shall be used in the analysis. Ground motion shall conform to the requirements of this section.

16.1.3.1 Two-Dimensional Analysis

Where two-dimensional analyses are performed, each ground motion shall consist of a horizontal acceleration history, selected from an actual recorded event. Appropriate acceleration histories shall be obtained from records of events having magnitudes, fault distance, and source mechanisms that are consistent with those that control the maximum considered earthquake. Where the required number of appropriate recorded ground motion records are not available, appropriate simulated ground motion records shall be used to make up the total number required. The ground motions shall be scaled such that the average value of the 5 percent damped response spectra for the suite of motions is not less than the design response spectrum for the site for periods ranging from $0.2T$ to $1.5T$ where T is the natural period of the structure in the fundamental mode for the direction of response being analyzed.

16.1.3.2 Three-Dimensional Analysis

Where three-dimensional analyses are performed, ground motions shall consist of pairs of appropriate horizontal ground motion acceleration components that shall be selected and scaled from individual recorded events. Appropriate ground motions shall be selected from events having magnitudes, fault distance, and source mechanisms that are consistent with those that control the maximum considered earthquake. Where the required number of recorded ground motion pairs is not available, appropriate simulated ground motion pairs are permitted to be used to make up the total number required. For each pair of horizontal ground motion components, a square root of the sum of the squares (SRSS) spectrum shall be constructed by taking the SRSS of the 5 percent-damped response spectra for the scaled components (where an identical scale factor is applied to both components of a pair). Each pair of motions shall be scaled such that in the period range from $0.2T$ to $1.5T$, the average of the SRSS spectra from all horizontal component pairs does not fall below the corresponding ordinate of the response spectrum used in the design, determined in accordance with Section 11.4.5 or 11.4.7.

At sites within 3 miles (5 km) of the active fault that controls the hazard, each pair of components shall be rotated to the fault-normal and fault-parallel directions of the causative fault and shall be scaled so that the average of the fault-normal components is not less than the MCE_R response spectrum for the period range from $0.2T$ to $1.5T$.

16.1.4 Response Parameters

For each ground motion analyzed, the individual response parameters shall be multiplied by the following scalar quantities:

a. Force response parameters shall be multiplied by I_e/R, where I_e is the importance factor determined in accordance with Section 11.5.1 and R is the Response Modification Coefficient selected in accordance with Section 12.2.1.
b. Drift quantities shall be multiplied by C_d/R, where C_d is the deflection amplification factor specified in Table 12.2-1.

For each ground motion i, where i is the designation assigned to each ground motion, the maximum value of the base shear, V_i, member forces, Q_{Ei}, scaled as indicated in the preceding text and story drifts, Δ_i, at each story as defined in Section 12.8.6 shall be