The two most far-reaching differences among the 1993, 1995, 1998, 2002, and 2005 editions of ASCE 7 and these prior editions are that the newer editions are based upon a strength-level limit state rather than an equivalent loading for use with allowable stress design and that it contains a much larger set of provisions that are not directly statements of loading. The intent is to provide a more reliable and consistent level of seismic safety in new building construction.

Earthquakes “load” structures indirectly. As the ground displaces, a building will follow and vibrate. The vibration produces deformations with associated strains and stresses in the structure. Computation of dynamic response to earthquake ground shaking is complex. As a simplification, this standard is based upon the concept of a response spectrum. A response spectrum for a specific earthquake ground motion does not reflect the total time history of response, but only approximates the maximum value of response for simple structures to that ground motion. The design response spectrum is a smoothed and normalized approximation for many different ground motions, adjusted at the extremes for characteristics of larger structures. The BSSC *NEHRP Commentary*, Chapters 4 and 5, contains a much fuller description of the development of the design response spectrum and the maps that provide the background information for various levels of seismic hazard and various ground conditions.

The seismic requirements of ASCE 7 are stated in terms of forces and loads. However, the user should always bear in mind that there are no external forces applied to the above-ground portion of a structure during an earthquake. The design forces are intended only as approximations to produce the same deformations, when multiplied by the Deflection Amplification factor C_d, as would occur in the same structure should an earthquake ground motion at the design level occur.

The design limit state for resistance to an earthquake is unlike that for any other load within the scope of ASCE 7. The earthquake limit state is based upon system performance, not member performance, and considerable energy dissipation through repeated cycles of inelastic straining is assumed. The reason is the large demand exerted by the earthquake and the associated high cost of providing enough strength to maintain linear elastic response in ordinary buildings. This unusual limit state means that several conveniences of elastic behavior, such as the principle of superposition, are not applicable, and makes it difficult to separate design provisions for loads from those for resistance. This is the reason the *NEHRP Provisions* contain so many provisions that modify customary requirements for proportioning and detailing structural members and systems. It is also the reason for the construction quality assurance requirements. All these “nonload” provisions are presented in Chapter 14.

Use of Allowable Stress Design Standards. The conventional design of nearly all masonry structures and many wood and steel structures has been accomplished using Allowable Stress Design (ASD) standards. Although the fundamental basis for the earthquake loads in Chapters 11 through 23 is a strength limit state beyond first yield of the structure, the provisions are written such that the conventional ASD standards can be used by the design engineer. Conventional ASD standards may be used in one of two fashions:

1. The earthquake load as defined in Chapters 11 through 23 may be used directly in allowable stress load combinations of Section 2.4 and the resulting stresses compared directly with conventional allowable stresses.
2. The earthquake load may be used in strength design load combinations and resulting stresses compared with amplified allowable stresses (for those materials for which the design standard gives the amplified allowable stresses, e.g., masonry).

Method 1 is changed somewhat since the 1995 edition of the standard. The factor on E in the ASD combinations has been reduced to 0.7 from 1.0. This change was accomplished simultaneously with reducing the factor on D in the combination where dead load resists the effects of earthquake loads from 1.0 to 0.6.

The factor 0.7 was selected as somewhat of a compromise among the various materials for which ASD may still be used. The basic premise suggested herein is that for earthquake loadings ASD is an alternative to strength-based design, and that ASD should generally result in a member or cross-section with at least as much true capacity as would result in strength-based design. As this commentary will explain, this is not always precisely the case.

There are two general load combinations, one where the effects of earthquake load and gravity load add, and a second where they counteract. In the second, the gravity load is part of the resistance, and therefore only dead load is considered. These combinations can be expressed as follows, where α is the factor on E in the ASD combination, calibrated to meet the premise of the previous paragraph. Using the combinations from Sections 2.3 and 2.4: