PROPOSAL 8-10R (2009)

SCOPE: Sec. 15.7.6.1 and Commentary to Chapter 22

PROPOSAL FOR CHANGE:

Revise the following Sec. 15.7.6.1 to Part 1 of the 2008 *Provisions*:

For $T_c > T_L$:

$$S_{ac} = \frac{1.5 S_{D1} T_L}{T_c^2} \qquad (15.7\text{-}11)$$

EXCEPTION: For T_c > 4 sec, S_{ac} may be determined by a site-specific study using one or more of the following methods: (i) the procedures found in Chapter 21, provided such procedures, which rely on ground-motion attenuation equations for computing response spectra, cover the natural period band containing T_c , (ii) ground-motion simulation methods employing seismological models of fault rupture and wave propagation, and (iii) analysis of representative strong-motion accelerogram data with reliable long-period content extending to periods greater than T_c . However, in no case shall the value of S_{ac} be taken as less than the minimum of:

a. the value determined in accordance with Eq. 15.7-11 using 50% of the mapped value of T_L from Chapter 22, or

b. 0.8 times the value determined in accordance with Equation 15.7-11 using the mapped value of T_L from Chapter 22.

In determining the value of S_{ac}, the value of T_L shall not be less than 4 seconds.

Add the following to the Commentary for Chapter 22 (prepared by C.B. Crouse)

Chapter 22
SEISMIC GROUND MOTION AND LONG-PERIOD TRANSITION MAPS

SEISMIC GROUND MOTION MAPS

The 2005 edition of ASCE 7 continues to use contour maps of spectral response acceleration (Figures 22-1 through 22-14). The spectral acceleration design maps were prepared by the United States Geological Survey (USGS) based on USGS probabilistic maps of the 48 conterminous states (2002), Alaska (1998), Hawaii (1998), and Puerto Rico/Virgin Islands (2003) with modifications based on the 1997 recommendations of the Building Seismic Safety Council. The maps of the 48 states and PRVI have been updated from the 2002 edition of this standard. The maps of Alaska, Hawaii, Guam, and Tutilla are unchanged from the 2002 edition.

The USGS has also developed a companion software program that calculates location-specific spectral values based on latitude and longitude or zip code; use of the latter method is discouraged in regions where ground-motion values vary substantially over short distance. The calculated values are based on the data used to prepare the maps shown as Figures 22-1 through 22-14. The spectral values may be adjusted for Site Class effects using the Site Classification Procedure in Section 20 and the site coefficients in Section 11.4. Latitude and longitude for a given address can be found at a variety of Web sites. The software program may be accessed at the USGS Web site (http://earthquake.usgs.gov/research/hazmaps/) by clicking on "Seismic Design Values for Buildings." This site can also be used to obtain values from the 2002 edition of this standard. The software program should be used to establish spectral values for design because the maps found in ASCE 7 and at Web sites are at too large a scale to provide accurate spectral values for many sites.

LONG-PERIOD TRANSITION MAPS

The maps of the Long-Period Transition Period, T_L, are new in this edition (Figures 22-15 through 22-20). They were prepared by the USGS based on the 2003 recommendations of the BSSC. See Section C11.4.5 for a discussion of the technical basis of these maps. The value of T_L obtained from these maps is used in equation 11.4-7 to determine values of S_a for periods greater than T_L.

The Exception in Sect. 15.7.6.1, regarding the calculation of S_{ac}, the convective response spectral acceleration for tank response, is intended to provide the user the option of computing this acceleration with three different types of site-specific procedures: (1) those procedures in Chapter 21, provided they cover the natural period band containing T_c, the fundamental convective period of the tank-fluid system, (2) ground-motion simulation methods using seismological models , and (3) analysis of representative accelerogram data. Elaboration of these procedures is provided below.

With regard to the first procedure, attenuation equations have been developed for the western U.S. (Next Generation Attenuation [ref. here]) and for the central and eastern U.S. (e.g., Somerville et al., 2001) that cover the period band, 0 to 10 sec. Thus, for $T_c \leq 10$ sec, the fundamental convective period range for nearly all storage tanks, these attenuation equations can be used in the same PSHA/DSHA procedures described in Chapter 21 to compute S_a (T_c). The 1.5 factor in Eqn. (15.7-11), which converts a 5% damped spectral acceleration to a 0.5% damped value, could then be applied to obtain S_{ac}. Alternatively, this factor could be established by statistical analysis of 0.5% damped and 5% damped response spectra of accelerograms representative of the ground motion expected at the site.

In some regions of the U.S., such as Pacific Northwest and southern Alaska, where subduction-zone earthquakes dominate the ground-motion hazard, attenuation equations for these events only extend to periods between 3 and 5 sec, depending on the equation. Thus, for tanks with T_c greater than these periods, other site-specific methods are required.

The second site-specific method to obtain S_a at long periods is simulation through the use of seismological models of fault rupture and wave propagation. These models could range from simple seismic source-theory and wave-propagation models, which currently form the basis for many of the attenuation equations used in the central and eastern U.S. for example, to more complex numerical models that incorporate finite fault rupture for scenario earthquakes and seismic wave propagation through 2-D or 3-D models of the regional geology, which may include basins. These models are particularly attractive for computing long-period ground motions from great earthquakes ($M_w \geq \sim 8$) because ground-motion data are limited for these events. Furthermore, the models are more accurate for predicting longer-period ground motions because (1) seismographic recordings may be used to calibrate these models, and (2) the general nature of the 2-D or 3-D regional geology is typically fairly well resolved at these periods, and can be much simpler than would be required for accurate prediction of shorter period motions.

A third site-specific method is the analysis of the response spectra of representative accelerograms that have accurately recorded long period motions to periods greater than T_c. As T_c increases, the number of qualified records decreases. However, as digital accelerographs continue to replace analog accelerographs, more recordings with accurate long period motions will become available. Nevertheless, a number of analog and digital recordings of large and great earthquakes are available that have accurate long period motions to 8 sec and beyond. Subsets of these records, representative of the earthquake(s) controlling the ground-motion hazard at a site, can be selected. The 0.5% damped response spectra of the records can be scaled using seismic source theory to adjust them to the magnitude and distance of the controlling earthquake. The levels of the scaled response spectra at periods around T_c can be used to determine S_{ac}. If the subset of representative records is limited, then this method should be used in conjunction with the aforementioned simulation methods.

REFERENCES

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Hartzell, S., Harmsen, S., Frankel, A., and Larsen, S., 1999, "Calculation of broadband time histories of ground motion: comparison of methods and validation using strong ground motion from the 1994 Northridge earthquake." Bull. Seism. Soc. Am., v. 89, p. 1484-1504.

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Power, M., Chiou, B., Abrahamson, N., and Roblee, C., 2006, The Next Generation of Ground Motion Attenuation Models, Proceedings of the 100th Anniversary Earthquake Conference Commemorating the 1906 San Francisco Earthquake, San Francisco, CA, April.

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REASON FOR PROPOSAL:

Actual site specific studies carried out since the introduction of the T_L requirements of ASCE 7-05 indicate that the mapped values of T_L are extremely conservative. Because a revision of the T_L maps is a time consuming task that will not be possible in this revision cycle, it is proposed that site specific values may be used that are less than the mapped values with a floor of 4 seconds or one-half the mapped value of T_L. The exception is added under 15.7.6 because T_L is a tank issue.

TS 8 VOTE:

YES-10 *Yes with Reservations-0* *No-0* *Not Voting-3*