PROPOSAL 3-122 (2009)

SCOPE: Part 2, Commentary Chapter 22

PROPOSAL FOR CHANGE:

Add Chapter 22 to Part 2, of the 2009 Commentary:

Proposed Chapter is attached. Text is not underlined to allow easier review.

REASON FOR PROPOSAL:

One of the basic tasks of the 2009 NEHRP *Provisions* update is to develop a viable commentary to Part 1. Since Part 1 adopts ASCE 7-05 and lists any exceptions to it, the Commentary is developed in accordance with the format and sections of ASCE 7-05.

TS 3 VOTE:

TS 3 developed this commentary chapter and approved for submission. The chapter was edited and accepted by TS 3.

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 Puerto Rico/Virgin Islands have been updated from the 2002 edition of the standard. The maps of Alaska, Hawaii, Guam, and Tutuila are unchanged from the 2002 edition.

The USGS also has developed a companion software program that calculates location-specific spectral values based on latitude and longitude or zip code; use of zip codes is discouraged in regions where ground-motion values vary substantially over a 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 should 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~~ websites. The companion software program may be accessed at the USGS ~~Web~~ website (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 the standard. The software program should be used to establish spectral values for design because the maps found in ASCE 7 and at ~~W~~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 Section 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~~ the 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.~~United States (Next Generation Attenuation, Power et al., 2006, 2008) and for the central and eastern ~~U.S.~~United States (e.g., Somerville et al., 2001) that cover the period band, 0 to 10 seconds. Thus, for $T_c \leq 10$ seconds, 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 Equation 15.7-11, which converts a 5 percent damped spectral acceleration to a 0.5 percent damped value, could then be applied to obtain S_{ac}. Alternatively, this factor could be established by statistical analysis of 0.5 percent damped and 5 percent damped response spectra of accelerograms representative of the ground motion expected at the site.

In some regions of the ~~U.S.~~United States, 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 s, 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 (Graves and Pitarka, 2004; Hartzell and Heaton, 1983; Hartzell et al., 1999; Liu et al., 2006; Zeng et al., 1994). 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.~~United States 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~~ 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~~ 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~~ long-period motions to 8 seconds 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 percent 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

Graves, R.W., and Pitarka, A., 2004~~,~~. "Broadband Time History Simulation using a Hybrid Approach," Proc. 13th World Conf. Earthq. Eng., Vancouver, Canada, paper no. 1098.

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