



Updates to USGS National Seismic Hazard Model (NSHM) and Design Ground Motion Maps for 2020 NEHRP Recommended Provisions

Sanaz Rezaeian, Research Structural Engineer
Nicolas Luco, Research Structural Engineer
U.S. Geological Survey (USGS)
Golden, CO

This presentation summarizes the proposed updates to earthquake design ground motions for the 2020 edition of the *NEHRP Recommended Seismic Provisions*, expected to be incorporated into the *ASCE 7-22 Standard*. The implications of these updates on the values of design ground motions for example locations in both conterminous and non-conterminous U.S. cities are shown and discussed.

Background

The U.S. Geological Survey (USGS) computes the design ground motions of the *NEHRP Provisions* by combining hazard results from the *USGS National Seismic Hazard Models (NSHMs)* with the site-specific design code procedures developed by the *Building Seismic Safety Council (BSSC) Provisions Update Committee (PUC)*. In previous versions of *NEHRP Provisions*, these design code procedures have consisted of risk-targeted ground motion calculations, multiplication by maximum-direction factors, deterministic capping, and multiplication by site amplification coefficients.

For the 2020 *NEHRP Provisions*, the design code procedures are updated based on the recommendations of the *BSSC Project '17* committee, one of which is to use Multi-Period Response Spectra (MPRS). As a result, the site amplification coefficients are eliminated from the provisions and the USGS provides hazard results not only for many more periods (i.e., 22 periods ranging from PGA to 10sec), but also for various site classes ranging from hard rock to soft soil (i.e., eight site classes ranging from A to E). Values of design parameters (and corresponding MPRS) will be obtained from the USGS website for user-specific values of site location (latitude and longitude) and site class.

Updates to CONUS Design Ground Motions

Updates to the 2020 NEHRP design ground motions in the lower 48 states of the conterminous U.S. (CONUS) come from two main sources: a) updates for the 2018 *USGS NSHM*, which improves the modeling of earthquake sources

and ground motions, and b) recommendations from the *BSSC Project '17* committee on updating the design code procedures.

Major updates for the 2018 *USGS NSHM* include: 1) incorporation of new ground motion models (GMMs) and soil amplification factors in the central and eastern U.S. (CEUS), which include the new NGA-East models; 2) incorporation of basin depths from local seismic velocity models in the western U.S. (WUS), which improves estimates of long-period ground motion amplification in deep sedimentary basins in the Los Angeles, San Francisco Bay, Salt Lake City, and Seattle regions; 3) minor modifications to WUS and subduction zone GMMs to maintain consistency across all periods and site classes now requested by Project '17, and to consider the aforementioned basin depths; and 4) updating the background seismicity model to include recent earthquakes.

Major changes to the design code procedures recommended by the *BSSC Project '17* committee include: 1) using MPRS, 2) modifying the deterministic capping procedure through deaggregation of probabilistic hazard, and 3) updating the maximum-direction factors.

Updates to OCONUS Design Ground Motions

Updates to the 2020 NEHRP design ground motions in the U.S. states and territories outside of the conterminous U.S. (OCONUS) are due to: a) the recommendations of *BSSC Project '17* to use MPRS and new maximum-direction factors, and b) relatively minor updates to the risk-targeted ground motion calculations, which include truncation of hazard curves and updating the “beta” parameter from 0.8 to 0.6 for all regions to be consistent with the most recent CONUS calculations. The OCONUS regions include Alaska, Hawaii, Guam and the Northern Mariana Islands, Puerto Rico and the U.S. Virgin Islands, and American Samoa, for which new USGS hazard models are not yet developed. The procedure to approximate MPRS is discussed.