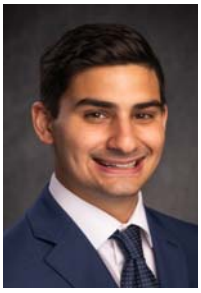
Best-practices for seismic site response analysis for the Central and Eastern US



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Project Background

The most seismically active areas in the United States are in California and the Western United States (WUS); however, historical records indicate there have been major seismic events in the Central and Eastern United States (CEUS) that have not only been of equal or greater magnitude but have shaken broader areas of the CEUS. For this reason, it is important to account for seismic considerations for design in the CEUS. The assessment of seismic hazard must include the influence of local site conditions on predicted ground surface motions. This can be accomplished either using code-specified factors or by performing site-specific ground response analyses. Site-specific ground response is required for sites with Site Class F soils and is commonly performed to lower the seismic design category or for sites with critical structures or subsurface conditions. Current building code procedures for site-specific ground response are based on developments and experiences from the WUS and other seismically active areas. Therefore, certain requirements may not be applicable to the CEUS due its different geological and seismotectonic characteristics. In particular, CEUS sites generally have very hard bedrock, high impedance contrasts, and the bedrock ground motions tend to be rich in high frequencies. Moreover, available strong motions data in the CEUS are sparse, which makes the task of ground motion selection difficult. In this research, we address uncertainties and best-practices in site-specific ground response for the CEUS. This includes: selection of east coast compatible input ground motions, scaling and matching methods to develop hazard compatible ground motion time histories for rock, and defining subsurface stratigraphy and properties in the model.

Project Objectives

- Investigate various databases and procedures to develop CEUS compatible ground motions and investigate the difference in site amplification factors between WUS and CEUS
- Provide recommendations for selecting input motions and conducting site-specific site response analyses in CEUS

This project strives to provide a manual of best-practices for site-specific site response analyses in the CEUS that cannot generally be captured with code-based site factors which are based on WUS methodology. Site-specific site response procedures without conducting a comprehensive Probabilistic Seismic Hazard Analysis (PSHA) will be addressed. Project objectives will be achieved by performing site response analyses using various ground motion databases, ground motions scaling or matching methods, and comparing the site amplification factors for the WUS and CEUS.

Research Plan and Progress

A list of research tasks and key findings is provided below:

1. A literature review was conducted, resulting in a summary of guidelines for site response analysis procedures. Literature about differences and characteristics about site-specific site response procedures and amplification factors particular to the CEUS was reviewed. (Completed)

2. A literature review of the NUREG/CR-6769 McGuire (2001) report outlining guidance on design ground motions was conducted, resulting in a summary of the development of the WUS and CEUS ground motion database. (Completed)

3. A literature review of the ASCE/SEI 7-16, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures,* was conducted regarding site-specific ground motion procedures for seismic design. A flow chart for each method of creating a site-specific design spectrum was developed. (Completed)

4. Equivalent-linear (EQL) and linear site response analyses were conducted for an east coast subsurface profile, using a various WUS and CEUS ground motions. Motions were selected form the McGuire WUS and CEUS ground motion database, as well as, the Pacific Earthquake Engineering Research Center (PEER) Strong Motion Database. Simple scaling and spectral matching methods were utilized to match the motions to a target response spectrum. The objective was to determine if amplification functions are influenced by choice of input motion and if so which parameters of the input motion are important. Initial results indicate regardless if EQL or linear site response analyses are conducted, ground motion selection becomes important to compute amplification functions for short periods (high frequencies). Choosing WUS motions will result in different amplification factors than choosing appropriate CEUS motions for east coast conditions. (In progress)

5. Develop recommendations for selecting input ground motions, scaling input motions to target spectrum, and choosing an appropriate target spectrum. (Not yet started)

6. Develop recommendations to on how to ultimately compute amplification factors for CEUS sites. (Not yet started)

7. Determine best-practice to define elastic half space in profile (Not yet started)