Impedance Issues in the Soil Structure Interaction of Embedded and Deeply Embedded Structures
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The soil structure interaction analysis of embedded and deeply embedded structures has two key components, the development of the dynamic soil impedance supporting the structure and the application of seismic loads to the soil-structure system. This presentation will discuss impedance issues in both frequency and time domain analyses. A second presentation by Tom Houston will discuss the development of loading for various seismic waveforms.

The presentation will begin with a review of the current range of frequency domain SSI validation developed for the U.S. Department of Energy SASSI Verification and Validation Project. These validation problems focus on power reactor and DOE facility analyses which typically consider relatively shallow foundation embedment.

Deeply embedded structures are currently being considered by several advanced reactor design teams and the geometry of these structures is outside the range of parameters considered in the U.S. Department of Energy SASSI Verification and Validation Project. Examples of the potential pitfalls of extending frequency domain solutions to deeply embedded structures using the current SSI analysis guidance are presented. The cause of anomalous results is postulated. Alternatives to the current SSI analysis guidance are discussed.

Nonlinear soil structure interaction (NLSSI) analyses capabilities are currently being developed by the Idaho National Laboratory. NLSSI analyses use a soil-box with nonlinear properties in time history analyses to evaluate nonlinear seismic response. NLSSI analyses have the ability to consider gapping and sliding at the soil-structure interface in addition to local soil nonlinearlity. Consideration of these nonlinear responses in an equivalent linear frequency-domain analysis is problematic.

The application of several SASSI Verification and Validation Project surface and shallow embedment validation problems to various soil-box model geometries will be presented. The soil-box models considered in the current validation are limited to lightly damped elastic soil behavior with fully connected contact surfaces to focus on the foundation impedance effects in an environment which evaluates the potential reflection of dynamic waves. The effect of soil-box on foundation impedance will be discussed.