Input Ground Motions for Performance-Based Seismic Design of Soil-Structure Systems

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Input ground motions play a key role in the design and analysis of soil-structure systems under seismic loading. Seismic loading-induced soil displacements constitute a key input for assessing the performance of structures supported on soils that exhibit non-linear behavior and/or a significant reduction in stiffness and strength such as due to liquefaction. For structures supported on competent soils, their response may be controlled by the inertial demand rather than the soil displacement demand. The selection of input ground motions needs to account for the mechanisms expected to govern the design, i. e. inertial loads or displacements.

Due to the unique plate tectonic set up that exists offshore of Vancouver Island, seismic design in Southwestern British Columbia considers ground motions originating from three sources of earthquakes; i.e. shallow crustal, deep Inslab and interface. The distribution of input ground motions that represent each earthquake source generally follow the percent contributions from the different earthquake sources via de-aggregation of the inertial hazard at a site. While this approach may be appropriate for soil-structure systems controlled by the inertial demand, different time-history distributions may be more appropriate for soil-structure systems designed using performance-based or displacement-based methods. The development of ground motion records is an interactive process amongst consultants carrying out the seismic hazard assessment and the end-user designer.

The presentation discusses an end-user's perspective of the state-of-practice of development of input seismic ground motion records for design of soil-structure systems. Key aspects such as the depth of application of ground motions, response quantities of interest and associated design philosophies, key inputs and assumptions made in the development of various Ground Motion Models (GMMs) that the end-users are generally unaware of are discussed.