



## **SEISMIC RESPONSE AS AFFECTED BY SITE SOIL CONDITIONS**

### **Upul Atukorala**

Principal, Golder Associates Ltd., Vancouver, Canada  
[Upul\\_Atukorala@golder.com](mailto:Upul_Atukorala@golder.com)

**ABSTRACT:** Site soil conditions play a key role in the assessment of seismic response of soil-structure systems. Soils are inherently non-linear and inelastic, and undergo volume changes when subjected to oscillatory loads such as those induced by seismic shaking. As a result, a wide range of seismic behavior is observed in soils ranging from “cyclic mobility” to “liquefaction”. “Cyclic mobility” results in the gradual development of ground displacements with the application of each loading cycle, whereas “liquefaction” results in large and catastrophic ground displacements due to loss of shear stiffness and strength of soils. Such behaviour is likely for sites underlain by saturated and loose cohesionless soils.

The response of a given site to seismic shaking is primarily influenced by the thickness of the soil deposit, type and consistency of soil, and site topography. The ground conditions cause the seismic motions to amplify or attenuate as they propagate towards the surface. The current Codes and Standards address the seismic demand due to soil effects via Site Classification and Amplification Factors reasonably well. However, other aspects of soil behavior such as permanent ground displacements, resulting from either cyclic mobility or liquefaction, are difficult to quantify, and hence they are not explicitly addressed in the existing Codes and Standards. The permanent ground displacements play a key role in the design of foundations and buried structures. There is a recent trend of being more prescriptive in the manner how site soil effects are incorporated in seismic response analysis; e.g. 2014 CHBDC (CSA-S6-14).

The presentation provides an overview of the state-of-practice on seismic response as affected by site soil conditions. The presentation draws from the author’s consulting experience and his recent involvement with the Canadian Highway Bridge Design Code, and highlights areas where the engineers/designers need to exercise caution.