International Workshop on Protection of Build Environment against Earthquakes
Ljubljana, 27th and 28th of August 2010

Seismic fragility of bridges supported on liquefiable soil

Anastasios Sextos

Aristotle University Thessaloniki, Greece
email: asextos@civil.auth.gr

ABSTRACT

The foreseen presentation is related to the development of fragility curves for a bridge supported on liquefiable soil. A refined computational scheme is implemented for this purpose involving (a) a three-dimensional inelastic multi-platform finite element model and (b) a simpler nonlinear model calibrated to the results derived from multi-platform analysis. Artificial and recorded earthquake ground motions corresponding to various source-to-site distances are used at the base of a nonlinear, liquefaction susceptible, multi-layered soil profile to account for input motion uncertainty, while uniform and non-uniform soil conditions along the bridge length lead to asynchronous support excitation patterns. As a result of the complex seismic response of the overall bridge-soil system, non-conventional damage indices are proposed to account for different soil, foundation and superstructure failure modes. The results of the study indicate that the inelastic dynamic response and the subsequent damage of a soil-structure interacting system may be significantly affected by the presence of liquefiable soils as well as of their extent along the axis of the bridge. It is also shown that in such cases, the fragility of bridges has to be assessed not only by accounting for soil liquefaction but also using appropriate local and global damage indices that are able to consider the unfavorable impact of liquefaction on the displacements and stresses developed at the soil-foundation interface.

Keywords: bridges, vulnerability, fragility curves, soil-structure interaction, inelastic response, damage indices, liquefaction, multi-platform simulation