World Academy of Science, Engineering and Technology
International Journal of Geotechnical and Geological Engineering
Vol:10, No:09, 2016

Implication of Soil and Seismic Ground Motion Variability on Dynamic Pile Group Impedance for Bridges

Authors : Muhammad Tariq Chaudhary

Abstract : Bridges constitute a vital link in a transportation system and their functionality after an earthquake is critical in reducing disruption to social and economic activities of the society. Bridges supported on pile foundations are commonly used in many earthquake-prone regions. In order to properly design or investigate the performance of such structures, it is imperative that the effect of soil-foundation-structure interaction be properly taken into account. This study focused on the influence of soil and seismic ground motion variability on the dynamic impedance of pile-group foundations typically used for medium-span (about 30 m) urban viaduct bridges. Soil profiles corresponding to various AASHTO soil classes were selected from actual data of such bridges and / or from the literature. The selected soil profiles were subjected to 1-D wave propagation analysis to determine effective values of soil shear modulus and damping ratio for a suite of properly selected actual seismic ground motions varying in PGA from 0.01g to 0.64g, and having variable velocity and frequency content. The effective values of the soil parameters were then employed to determine the dynamic impedance of pile groups in horizontal, vertical and rocking modes in various soil profiles. Pile diameter was kept constant for bridges in various soil profiles while pile length and number of piles were changed based on AASHTO design requirements for various soil profiles and earthquake ground motions. Conclusions were drawn regarding variability in effective soil shear modulus, soil damping, shear wave velocity and pile group impedance for various soil profiles and ground motions and its implications for design and evaluation of pile-supported bridges. It was found that even though the effective soil parameters underwent drastic variation with increasing PGA, the pile group impedance was not affected much in properly designed pile foundations due to the corresponding increase in pile length or increase in a number of piles or both when subjected to increasing PGA or founded in weaker soil profiles.

Keywords : bridge, pile foundation, dynamic foundation impedance, soil profile, shear wave velocity, seismic ground motion, seismic wave propagation
Conference Title : ICSMGE 2016 : International Conference on Soil Mechanics and Geotechnical Engineering
Conference Location : Tokyo, Japan
Conference Dates : September 05-06, 2016