EGU2020-21167
https://doi.org/10.5194/egusphere-egu2020-21167
EGU General Assembly 2020

Liquefaction assessment based on CSR-hazard curve through empirical procedure

Giorgio Andrea Alleanza, Filomena de Silva, Anna d'Onofrio, Francesco Gargiulo, and Francesco Silvestri
University of Napoli Federico II, Department of Civil, Architectural and Environmental Engineering, Italy
(giorgioandrea.alleanza@unina.it)

Semi-empirical procedures for evaluating liquefaction potential (e.g. Seed & Idriss, 1971) require the estimation of cyclic resistance ratio (CRR) and cyclic shear stress ratio (CSR). The first can be obtained using empirical relationships based on in situ tests (e.g. CPT, SPT), the latter can be expressed as function of the maximum horizontal acceleration at ground surface (a_{max}), total and effective vertical stresses at the depth of interest (σ_{v0}, σ'_{v0}) and a magnitude-dependent stress reduction coefficient (r_d) that accounts for the deformability of the soil column (Idriss & Boulanger, 2004). All these methods were developed referring to a moment magnitude (M_w) equal to 7.5 and therefore require a magnitude scale factor (MSF) to make them suitable for different magnitude values. Usually, MSF and r_d are computed with reference to the mean or modal value of M_w taken from a disaggregation analysis, while a_{max} is obtained from a seismic hazard curve, including the contribution of various combinations of magnitudes and distances (Kramer & Mayfield, 2005). Thus, there might be inconsistency between the magnitude values used to evaluate either MSF or r_d and a_{max}. To overcome this problem, Idriss (1985) suggests to directly introduce the MSF in the probabilistic hazard analysis of the seismic acceleration. In this contribution, an alternative method is proposed, by properly modifying the acceleration seismic hazard curve conventionally adopted by the code of practice on the basis the disaggregation analysis, so that i) the contribution of the different magnitudes and the associated MSF and r_d-values are considered, ii) the computational effort is reduced since a CSR-hazard curve is straightforward obtained. This alternative method is used to carry out a simplified liquefaction assessment of a sand deposit located in the municipality of Casamicciola Terme (Naples, Italy), where the results of SPT tests are available from recent seismic microzonation studies. The CSR computed using the proposed procedure is lower than that obtained adopting the classical method suggested by Idriss & Boulanger (2004). This can be explained considering that the suggested method takes into account all the magnitudes that contribute to the definition of the seismic hazard, instead of considering the mean or modal value of the disaggregation analysis. Such an accurate prediction of the seismic demand may represent a basis for more reliable seismic microzonation maps for liquefaction and for a less conservative design of liquefaction risk mitigation measures.

References

Idriss, I.M. (1985). Evaluation of seismic risk in engineering practice, Proc. 11th Int. Conf. on Soil Mech. and Found. Engrg, 1, 255-320.

Idriss, I.M., Boulanger, R. W. (2004). Semi-Empirical Procedures for Evaluating Liquefaction Potential During Earthquakes, Proceedings of the 11th ICSDEE & 3rd ICEGE, (Doolin et al. Eds.), Berkeley, CA, USA, 1, 32-56.

Kramer, S.L., Mayfield, R.T. (2005) Performance-based Liquefaction Hazard Evaluation, Proceedings of the Geo-Frontiers Congress, January 24-26, Austin, Texas, USA.

Seed H.B., Idriss M. (1971). Simplified procedure for evaluating soil liquefaction potential, J. Soil Mech. Found. Div., 97, 1249-1273.