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Probabilistic liquefaction hazard analysis at liquefied sites of 1956 Dunaharaszti earthquake, in Hungary

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Liquefaction potential evaluations are generally made to assess the hazard from specific scenario earthquakes. These evaluations may estimate the potential in a binary fashion (yes/no), define a factor of safety or predict the probability of liquefaction given a scenario event. Usually the level of ground shaking is obtained from the results of PSHA. Although it is determined probabilistically, a single level of ground shaking is selected and used within the liquefaction potential evaluation. In contrary, the fully probabilistic liquefaction potential assessment methods provide a complete picture of liquefaction hazard, namely taking into account the joint probability distribution of PGA and magnitude of earthquake scenarios; both of which are key inputs in the stress-based simplified methods. Kramer and Mayfield (2007) has developed a fully probabilistic liquefaction potential evaluation method using a performance-based earthquake engineering (PBEE) framework. The results of the procedure are the direct estimate of the return period of liquefaction and the liquefaction hazard curves in function of depth. The method combines the disaggregation matrices computed for different exceedance frequencies during probabilistic seismic hazard analysis with one of the recent models for the conditional probability of liquefaction.
We have developed a software for the assessment of performance-based liquefaction triggering on the basis of Kramer and Mayfield method. Originally the SPT based probabilistic method of Cetin et al. (2004) was built-in into the procedure of Kramer and Mayfield to compute the conditional probability however there is no professional consensus about its applicability. Therefore we have included not only Cetin's method but Idriss and Boulanger (2012) SPT based moreover Boulanger and Idriss (2014) CPT based procedures into our computer program.
In 1956, a damaging earthquake of magnitude 5.6 occurred in Dunaharaszti, in Hungary. Its epicenter was located about 5 km from the southern boundary of Budapest. The quake caused serious damages in the epicentral area and in the southern districts of the capital. The epicentral area of the earthquake is located along the Danube River. Sand boils were observed in some locations that indicated the occurrence of liquefaction. Because their exact locations were recorded at the time of the earthquake, in situ geotechnical measurements (CPT and SPT) could be performed at two (Dunaharaszti and Taksony) sites. The different types of measurements enabled the probabilistic liquefaction hazard computations at the two studied sites. We have compared the return periods of liquefaction that were computed using different built-in simplified stress based methods.