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Back-calculation of surface acceleration from penetration resistances at liquefied sites of 1956 Dunaharaszti earthquake, in Hungary

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Liquefaction and paleoliquefaction studies are being used increasingly to interpret ground motion parameters (acceleration, magnitude, epicenter location) in regions that experience infrequent but damaging earthquakes. These are especially applicable where the most recent damaging earthquakes occurred prior to the development of ground motion instrumentation.
In Hungary, a damaging earthquake of magnitude 5.6 occurred in Dunaharaszti in 1956. 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. A Wiechert type seismometer was operated in Budapest 15-20 km from the epicenter but it saturated by the earthquake so instrumental information does not exist about the shaking strength. Ground accelerations caused by the event can be deduced only from the macroseismic intensity values and from the analogies of recent similar earthquakes where strong motion data exist.
The epicentral area of Dunaharaszti earthquake was 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, geotechnical measurements could be performed. Therefore an alternative possibility to estimate shaking strength can be the back-analysis of liquefaction field data. Unlike the paleoliquefaction studies, in our case the source of the earthquake and the magnitude is known, our purpose was only to estimate the peak ground acceleration and acceleration-related parameters, such as Arias intensity.
Back-calculation of surface acceleration was performed at two locations, where evidences of liquefaction had been observed after the earthquake. On both locations SPT and CPT measurements were carried out, and back-analysis from them was performed with different empirical methods. This allowed the assessment of the selected method's and the used in-situ test's significance in the back-calculated acceleration. As both deterministic and probabilistic methods were used, drawbacks of deterministic back-calculations can be evaluated. Physical properties of the liquefied soils retrieved from the SPT sampler were determined in laboratory.