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Evaluation of the Liquefaction Hazard at the western side of the city of Thessaloniki Based on Data Provided by in – Situ Tests

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Extended abstract

Soil liquefaction is the phenomenon in which a loose saturated soil layer suddenly loses its strength as a result of seismic vibration and instantly behaves as a liquid. Historically, earthquake-induced liquefaction events have occurred in Japan (1964 Niigata), Alaska (1964 Prince William Sound), Taiwan (1999 Chi - Chi), Washington (2001 Tumwater) and Greece (2014 Cephalonia) to name a few.

In the wider area of Thessaloniki three geological formations are present (Chortiatis magmatic suite, sedimentary rocks of Neogene and Quaternary deposits). The area is of great interest due to the recent geological deposits and the existence of seismogenic areas in near vicinity. The last century two moderate events occurred triggering failures to the manmade environment at the city of Thessaloniki.

For the purposes of this study, data from 64 geotechnical boreholes (figure 1) have been collected and analyzed. In particular, the liquefaction susceptibility per soil layer has been examined according to the criteria of Bray and Sancio (2006); based on the values of Plasticity index (PI), liquid limit (LL) and water content (wc). Afterwards, the factor of safety of susceptible to liquefaction soil layers was computed following the procedure recommended by Youd et al. (2001).

The aim of this study is to develop a map showing the value of the critical peak ground acceleration that should be generated, adopting a seismic scenario of M_w = 6.6, in order to classified a site as liquefiable at the central and western part of Thessaloniki. In order to achieve this, two published models of liquefaction hazard are adopted that were developed by taking into account the Liquefaction Potential Index (LPI); the first model was presented by Toprak and Holzer (2003) and the second one by Papathanassiou (2008).

According to Toprak and Holzer (2003) sand boils are likely to occur where LPI =5 and lateral spreading phenomena will occur where LPI =12, while according to Papathanassiou (2008) the possibility of liquefaction surface evidences is more than 50% for LPI>14.

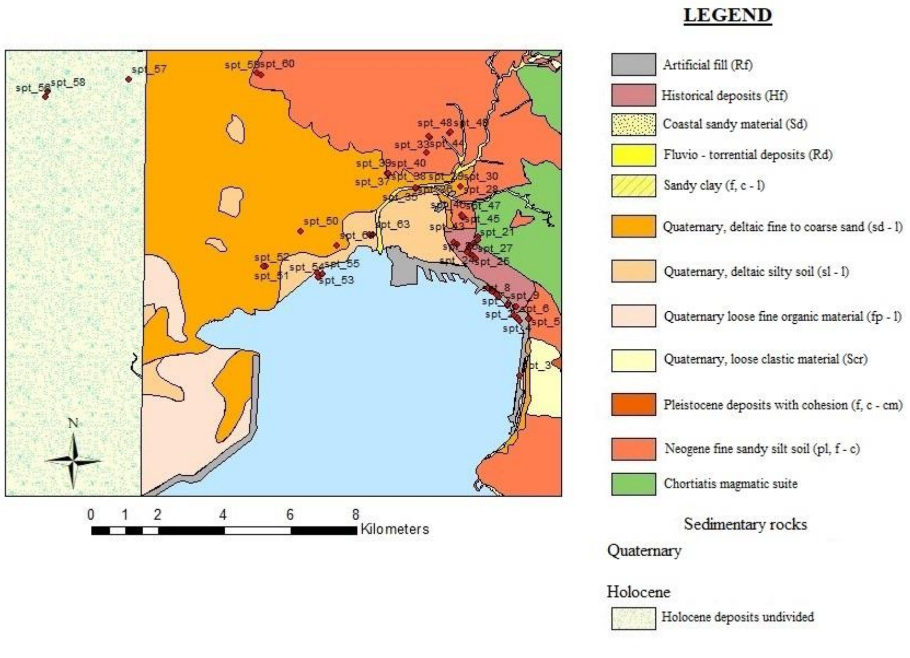

Figure 1 Map with the 64 boreholes that have been analyzed.

As an outcome, it is concluded that the liquefaction hazard is relatively high at the area of Kalohori and at the coastal area and at the western region of Thessaloniki, and that the consequences may be quite important for the manmade environment. At these areas, sand boils are likely to occur according to Toprak and Holzer (2003) when the PGA values ranges between 0.1 and .0.3g for a scenario of M_w = 6.6.

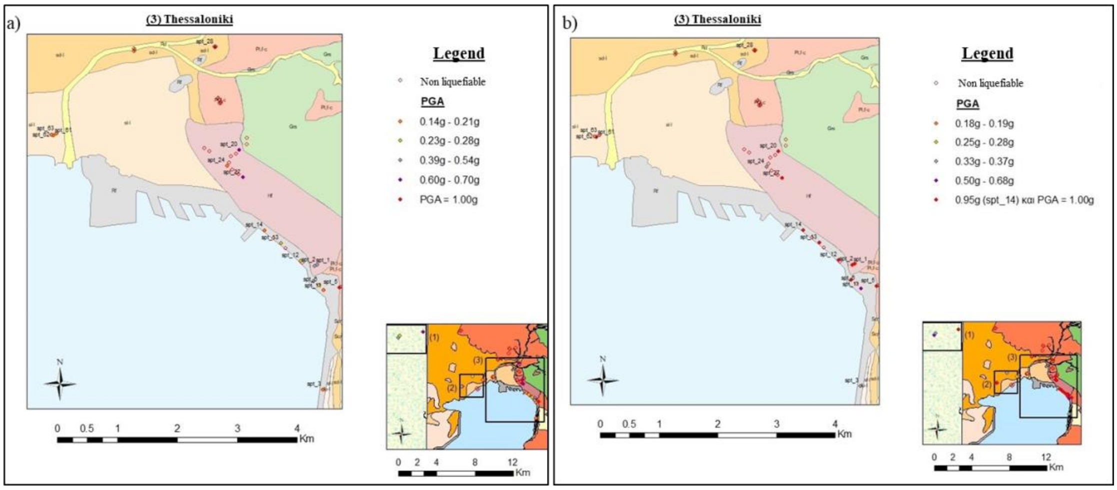

Figure 2 PGA map of Thessaloniki for the classification model of a) Toprak and Holzer (2003) and b) Papathanassiou (2008)

According to the model of Toprak and Holzer (2003), the thickness of the liquefiable soils varies between 0.50m and 4.00m at the coastal area and the western region of Thessaloniki while at the Kalohori area ranges between 3.50m and 6.85m, reaching at some sites 8.40m. Regarding the model of Papathanassiou (2008), the thickness of the liquefiable soils varies between 0.50m and 4.00m at the coastal area, while at the western region of Thessaloniki ranges between 5.00m and 9.00m and at the Kalohori area ranges between 3.50m and 5.15m.

In addition, this study shows that the classification model of Toprak and Holzer (2003) is more conservative than the one suggested by Papathanassiou (2008).

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