USING SYNTHETIC LINER SYSTEM FOR ATTENUATION OF SEISMIC RESPONSE OF LANDFILLS

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Nowadays, due to the development of civilization and lack of space for city developments, the municipal waste is buried in places called Landfill. It is obvious that the demolition of landfills can cause environmental and social problems. Therefore, reinforcing landfills is an important issue. In this regard, Redwood landfill is located in California State which was exposed to an earthquake with a Magnitude of 5.7 in 1969 and the clay isolation layer was damaged. In 1975, San Fernando earthquake caused significant damages to several landfills such as Russel Moe, Lopez Canyon. Recently, smooth geosynthetic system as an isolator has been used to attenuate seismic waves in various geotechnical projects. Kavanzanjian et al. (1991), Matasovic and Kavazanjian (1998) and Yegian and Lahlaf (1992) studied the concept of using geosynthetics in foundation isolation by slipping mechanism in the geosynthetic interface and reduction in transferred acceleration from under foundation to topper structure. The first scheme is to place isolator just under the foundation. The second scheme is to place synthetics in depth of soil profile (Yegian and Catan, 2004). Experimental assessments by Yegian and Catan (2004) are a proof for appropriate selection of synthetic. Hence, the recent studies represent the feasibility of using synthetics as an earthquake energy damper and thus reduction in structure response and minimizing damage potential of the structure during earthquakes.

In this regard, using synthetics practically are efficient for attenuation of ground motions in landfill structures. However, the studies conducted in this regard are very limited. Hence, in this paper, using geosynthetic elements for reducing seismic effects on stability of landfills has been investigated. For this purpose, a parametric analysis is conducted on location of layers and length of synthetic by using ABAQUS program. In order to verify the numerical modeling, Feng et al. (2015) studies have been considered (Figure 1).

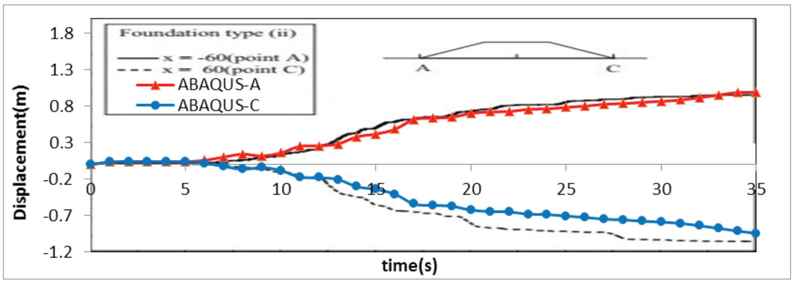

Figure 1. Verification of numerical simulation based on Feng et al. (2015) study.

To study the effects of different placement location and different synthetic liner lengths on seismic performance of landfills, a numerical model has been assessed according to Figure 2.

Figure 2 indicates the dimensions of the landfill, infinite elements as absorbing boundaries and landfill. It is worth mentioning that all dimensions of the landfill are constant for parametric analysis, except placement depth and length of the synthetic liners.

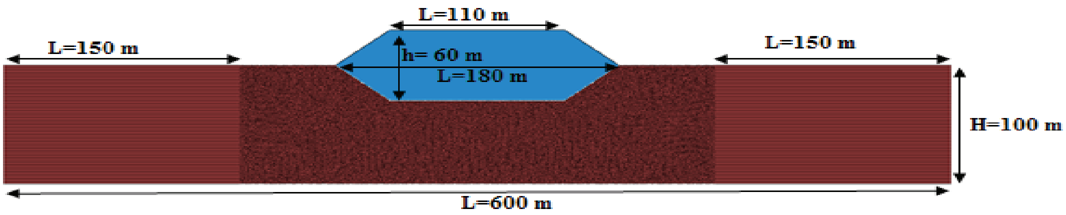

Figure 2. Numerical modeling and geometries of landfill.

In order to perform the parametric studies, depth of geosynthetic liners equal to 35, 40 and 60 m and its length of 200, 240 and 290 m have been taken into account. Moreover, for dynamic analysis, time history acceleration of El Centro earthquake is considered.

The obtained results illustrated that by examination of maximum horizontal acceleration (MHA), response spectra and stress content, it was observed that placing geotextile in soil profile cause to the reduction in MHA compared to the geotextile-free model. However, changing the depth of the synthetic liner is not much effect in reducing MHA. Besides, increasing the length of synthetic system can attenuate MHA. The horizontal acceleration variation results in the bottom edge of landfill showed that placing the geosynthetic system in soil profile can lead to 95% reduction in horizontal acceleration compared to the geotextile-free model, although moving geosynthetic in depth is not efficient. Furthermore, extending synthetic liner length from 240 m to 290 m in depth of 60 m from free-field, reduce the horizontal acceleration about 50.7%. Response spectra results indicated that synthetic system placement generally attenuate the response spectra compared to the geotextile-free model. On the other hand, synthetic liner movement in depth is not efficient on response spectra reduction. extending geotextile length from 240 m to 290 m for depth on 60 m and from 200 m to 290 m for depth of 40 m, improve the seismic performance of landfill and decrease the energy level imposed to the structure. Moreover, placing geosynthetic in depth of 35 m reduce the stress content to 53.4%, and with increasing depth of geotextile more, no more variation was observed. In depth of 40 m, by extending length of the synthetic liner from 240 m to 290 m, the stress content has a 46% reduction.

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