INVESTIGATING THE TOPOGRAPHICAL EFFECT ON SEISMIC RESPONSE OF MUNICIPAL SOLID WASTE LANDFILLS - A NUMERICAL STUDY

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According to the environmental impacts of municipal solid waste (MSW) landfills failures the stability of these landfills has drawn a great consideration. In recent decades, the stability of MSW landfills are mostly evaluated in static conditions; however, less attention has been paid to the seismic response of these landfills in high seismic regions. Topographical effect of slopes as one of the major site effects influencing the seismic response of slopes plays a significant role in landfill stability. The conventional seismic analyses methods such as pseudo-static, Newmark and pseudo-dynamic have limitations to examine the effect of topography (Choudhury & Savoikar, 2011a; Choudhury & Savoikar, 2011b). While, numerical approach overcomes these limitations considering actual seismic and landfill structural conditions. In this study, six commonly used MSW landfills including Hill type, Canyon type, Side type 1 and 2, Stepped base and Stepped base and fill type, with different geometrical conditions are numerically investigated using Universal Distinct Element Code (UDEC) (Itasca Consulting Group, 2014). Figure 1 shows Hill type and Canyon type as samples.

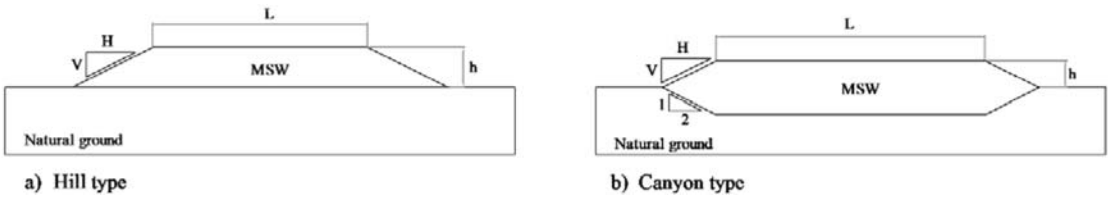

Figure 1. Typical MSW landfill geometries used in the numerical analysis: a) Canyon type, b) Hill type.

To study the topographical effect, according to Figure 1, both slope angle (V/H) and the crest width over height (L/h) ratio, as geometrical variables, are presented in Table 1 extracted from literature (Savoikar & Choudhury, 2010).

Table 1. Geometrical values considered in numerical analyses.

<table>
<tr><td>V/H</td><td colspan="4">1:2</td><td colspan="4">1:2.5</td><td colspan="4">1:3</td></tr>
<tr><td>L/h</td><td colspan="3">2:1</td><td colspan="3">3:1</td><td colspan="3">4:1</td><td colspan="3">5:1</td></tr>
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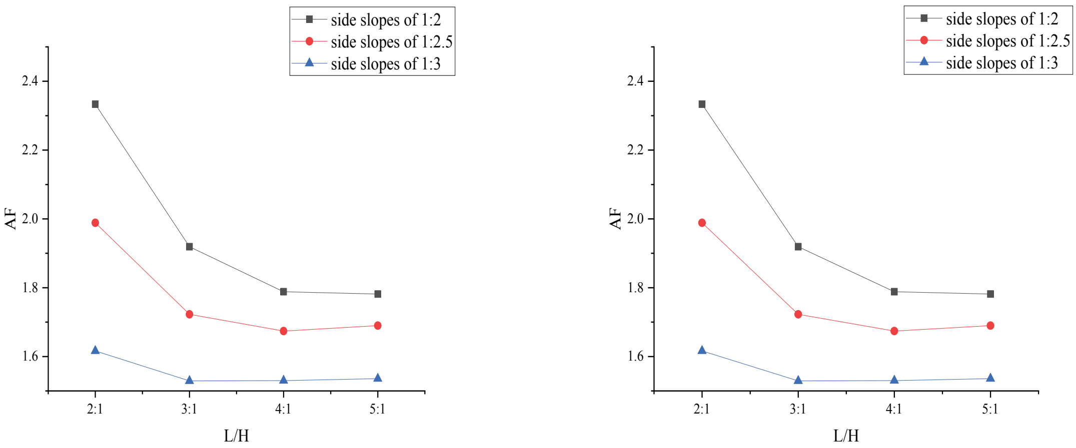
In this research, the amplification factor (AF), defined as the ratio of slope surface acceleration over input acceleration, is derived to evaluate the influence of topographical effect on the considered landfills. The results show that, there is a significant fluctuation on AF in different geometrical conditions. This trend can be seen in Figure 2 for Canyon and Hill type.



(a) Canyon type (b) Hill type

Figure 2. Amplification factor results for Canyon and Hill types in various V/H and L/h ratios.

According to obtained results, for two-sided landfills, hill and canyon types, the AF decreases drastically by increase in L/h ration and grows significantly while the slope angle rises. However, for sidehill types 1 and 2 L/h ratio has no meaningful effect on AF, while the slope angle rises the AF from 1.8 to more than 2.0. For stepped base types as well as other types the AF generally increases by slope angle growth for L/h of more than 2.5:1. However, despite other four landfill types, for the stepped base landfill, AF does not follow a specific trend in different L/h ratios. In addition, the results show that for stepped base and fill, the AF rises by increase in L/h ratio which is in contrast with observed trend for canyon and hill type. However, the variation of AF against the slope angle ratio is similar to canyon and hill type. The obtained results can be proved due to wave propagation traveling according to different geometry conditions (Anggraeni, 2010). As a result, the most suitable geometry can be recommended according to the seismic response of municipal solid waste landfills, based on the seismic amplification factor numerical analysis.

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