Dynamic Site Characterisation and Site Response in Auckland, New Zealand

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Introduction:
The Auckland region has been targeted by local government to accommodate a large portion of the city’s future urban and commercial expansion. The area has highly variable geology; in terms of dynamic site characterisation, the areas with thick organic soils, alluvium, and where basalt has been deposited over soft soils provide particularly challenging characteristics.

Auckland is assumed to have a low seismic hazard because of its tectonic setting away from plate margins and major known fault systems. Seismic sources with the potential to cause significant shaking in Auckland are associated with the Hikurangi Subduction zone and the Taupo Volcanic Zone. Nearby seismic sources (e.g. Wairua North Fault, 60 km away) have low activity rates and have been less of a hazard. There is also potential for a significant earthquake along an unidentified or off-shore fault, as there may also be large faults in close vicinity to the city whose seismic potential are unknown.

The initial stages of this research involved geotechnical and geophysical field investigations to characterise the shear wave velocity (Vs) of the dominant surficial deposits in the Manukau Lowlands region of Auckland (Figure 1). This poster provides an overview of the typical deposits in this region and the surface wave testing methodology.

Field testing methodology:
Both active and passive source surface wave testing techniques were used to develop realistic shear wave velocity (Vs) profiles at a number of sites across the city, with borehole and cone penetration testing data used to constrain layering during surface wave inversion. Vs profiles representative of the region were used to carry out site response analyses to investigate potential earthquake ground motion amplification effects across the region. The results of the investigation are compared to the framework of the current New Zealand seismic design standards.

Results:

1. Tauranga Group

<table>
<thead>
<tr>
<th>Unit</th>
<th>Vs</th>
<th>Site Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undifferentiated Alluvium</td>
<td>150 m - 200 m</td>
<td>0.6 s</td>
</tr>
<tr>
<td>Puketoka Formation</td>
<td>150 m - 200 m</td>
<td>0.6 s</td>
</tr>
<tr>
<td>East Coast Bays</td>
<td>150 m - 200 m</td>
<td>0.6 s</td>
</tr>
</tbody>
</table>

2. Volcanic Deposits

- Deposits with a high organic content.
- Deposits have a thickness greater than the site class E limit of 10 m, and Vs may be appropriate for different structures.

Future Work:
This research is part of an ongoing PhD project and will increase the coverage of surface wave testing and other site investigations across the region. This information will be used to inform site response analyses of representative site profiles. Future work will focus on the soft highly organic silt and peats in the Manukau region to better understand the amplification effects of these deposits, and the effect of the stiff over soft layering due to the presence of surface volcanic deposits that have been deposited in valleys. This work will provide a better indication as to how these profiles fit into the current New Zealand Standards framework.