

SIMULATION OF STRONG ASYMMETRICAL VERTICAL ACCELERATION AT HEATHCOTE VALLEY IN THE 2010-2011 CANTERBURY EARTHQUAKES

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The strong motion station at Heathcote Valley School (HVSC) recorded conspicuously high peak ground accelerations (2.21g vertical and 1.41g horizontal) during the February 2011 Christchurch earthquake, where the vertical component shows strong asymmetry. The vertical acceleration is much larger in upward direction than the downward acceleration, where the downward acceleration often doesn't exceed the gravitational acceleration. Ground motions recorded at HVSC in a few other strong events also exhibited asymmetry in the vertical acceleration, although they were not as severe as the February 2011 event.

This study investigates the underlying cause of such intense upward vertical accelerations and the associated asymmetry observed at HVSC, by means of non-linear dynamic finite element analyses, where recorded motions at LPCC (Lyttelton Port Company station) are used as input motions. The dynamic response of soils at HVSC is simulated by the pressure dependent multi yield plasticity model, in which dynamic properties and the thickness of the soil have been characterized by seismic cone penetration tests (sCPT) and surface wave inversion analyses (MASW).

Simulated time series and response spectra show good agreement with the observation and suggest that the strong asymmetric acceleration time series observed during the 2010-2011 Canterbury earthquakes is likely caused by the strong non-linear response of shallow soils, which was accentuated by some extreme near-field ground shaking events during the earthquake sequence.