LIQUEFACTION TRIGGERING AND EFFECTS AT SILTY SOIL SITES

PEER Transportation Systems Research Program (Duration: Jan 2018 – Dec 2019)

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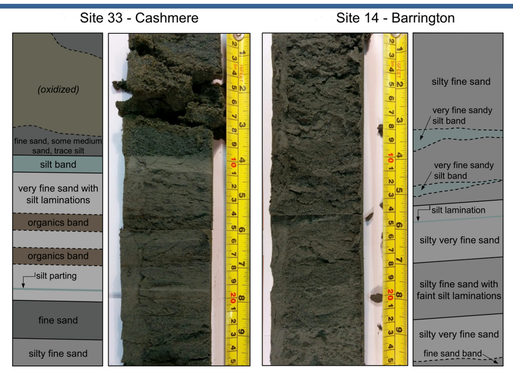
Overview

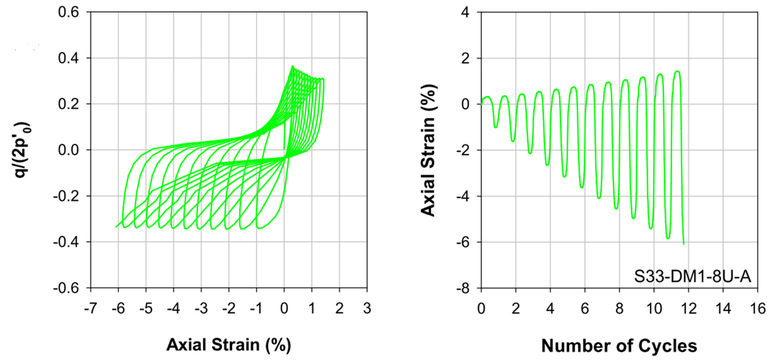
- Several sites that CPT methods indicate should have liquefied did not exhibit manifestations of liquefaction during the Christchurch, NZ earthquakes.
- Those sites are mostly underlain by stratified deposit of silty soils.

Goals

- Identify characteristics of 55 sites in Christchurch that **did** or **did not** manifest liquefaction.
- Recommend adjustments to state-of-art liquefaction triggering procedures for silty soil sites.



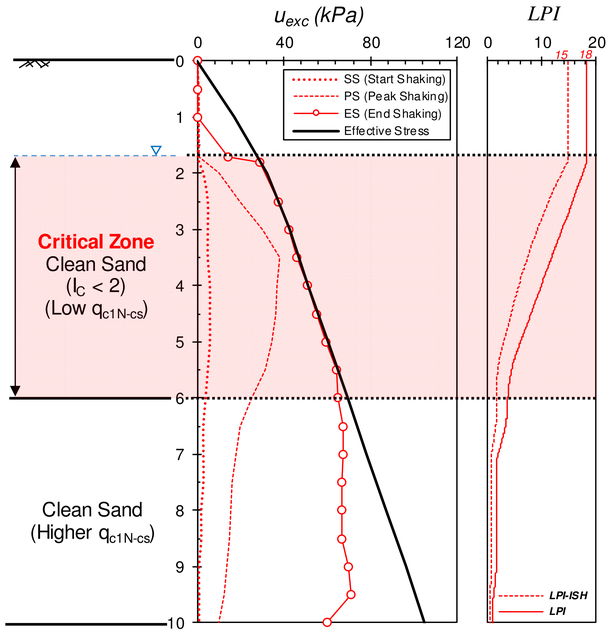
Stratigraphy at silty sites (Beyzaei et al. 2018 – SDEE)



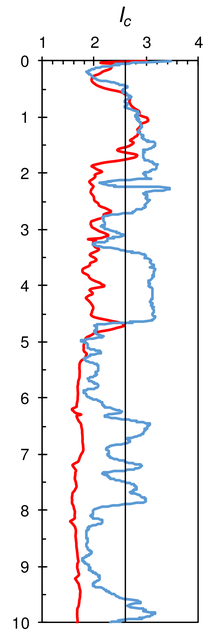
Cyclic triaxial (CTX) test result of silty soil sample at Site 33-Cashmere (Beyzaei et al. 2018 - SDEE)

Avondale Site

- Thick, hydraulically connected critical zone of clean sand.
- High LPI → Severe manifestation of liquefaction.



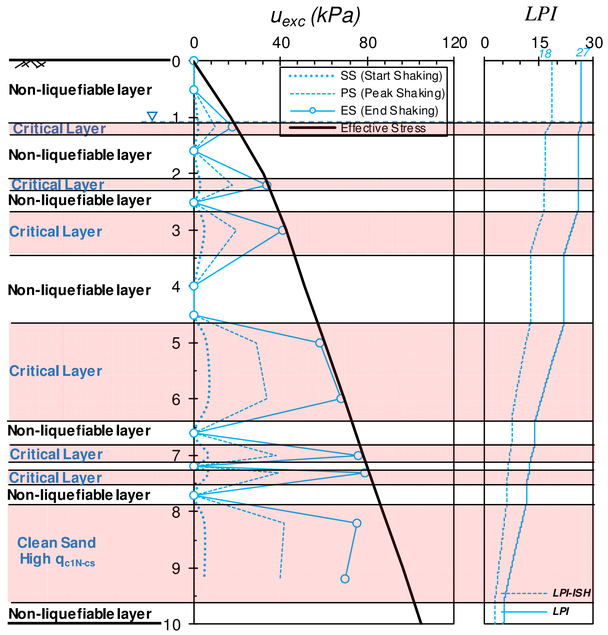
Typical Red Site (Cubrinovski et al. 2017 PBDIII)



Typical SBT Index

Gainsborough Site

- Highly stratified deposits of silty soil; discontinuous critical layers; thick critical zone absent.
- High LPI → Yet no manifestation of liquefaction.



Typical Blue Site

Scope and Future Plan

- Investigate the geologic characteristics of silty soil sites that did not manifest liquefaction.
- Evaluate the soil-water response of stratified silty soil deposits through a nonlinear effective stress analysis using PM4Sand within OPENSEES.
- Propose new design guidelines.

Preliminary Findings

- Simplified triggering procedures can overestimate the hazard due to their incapability to assess the interaction between different critical layers.
- Continuity of critical layer plays an important role to initiate upward flow of water from a higher to lower state of excess pore water pressure.

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