Shaking Table Tests on Dynamic Behavior of Liquefiable Ground and Pile Foundation Reinforced by In-situ Cement-mixing Lattice Wall

(格子状改良体で補強された液状化地盤及び杭基礎の動的挙動に関する振動台実験)

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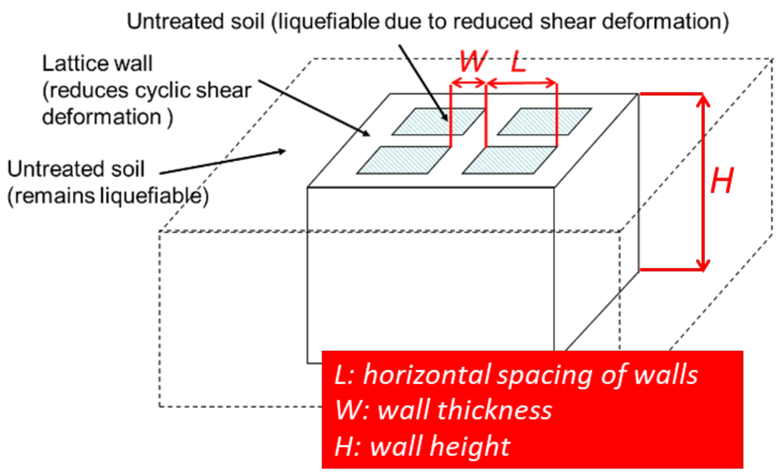
Research Introduction

Structures on liquefiable ground can suffer from severe damage during earthquake. Lattice wall can be used as an effective countermeasure against liquefaction. The mechanism of lattice wall is to reduce the shear deformation inside. The research objective is to evaluate the effects of the lattice wall quantitatively and to assess its influence on pile foundation.

Tilted damage caused by liquefaction in Tohoku earthquake (Tokimatsu et al., 2012)



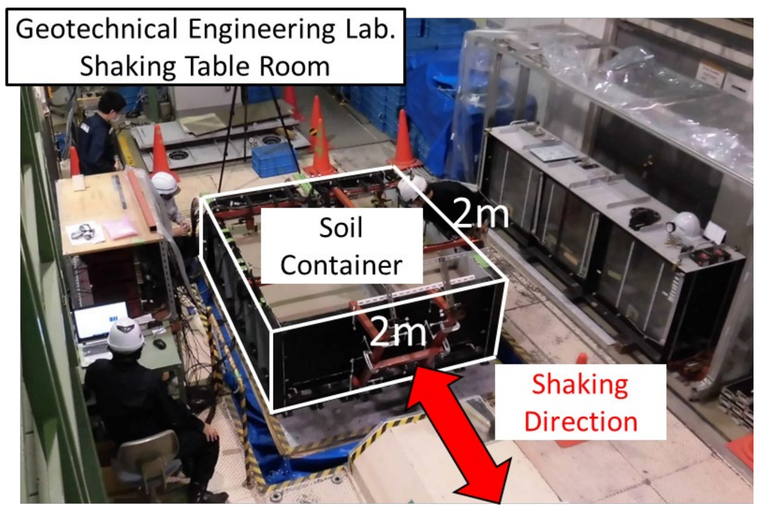
Lattice walls as countermeasure against liquefaction (Koseki., 2018)

In the previous design against L1 earthquake, the L/H was usually 0.8 or less.

For the performance-based design against L2 earthquake, how about the performance of the lattice wall with L/H over 1.0?

Vacuum Saturation Method

To conduct the research on liquefaction, it is important to make the ground saturated. The vacuum saturation method is first used to saturate the 2m × 2m large-scale soil container in the Lab.



Large soil container

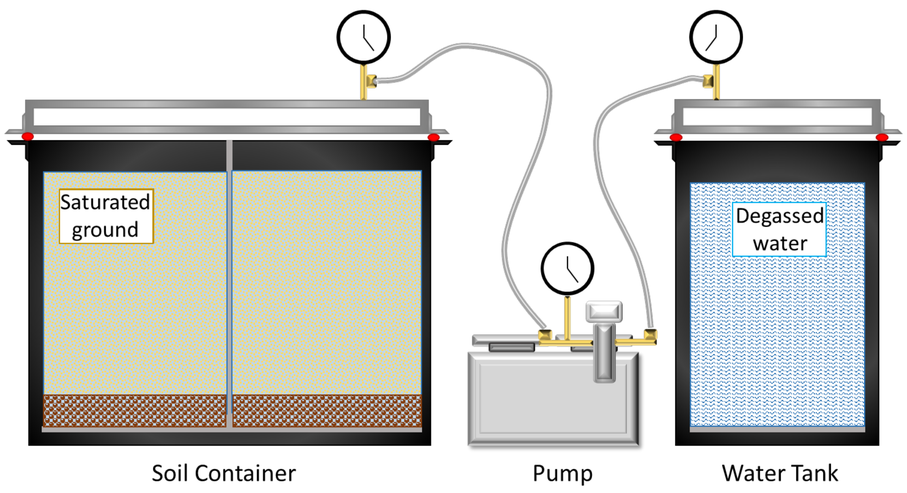
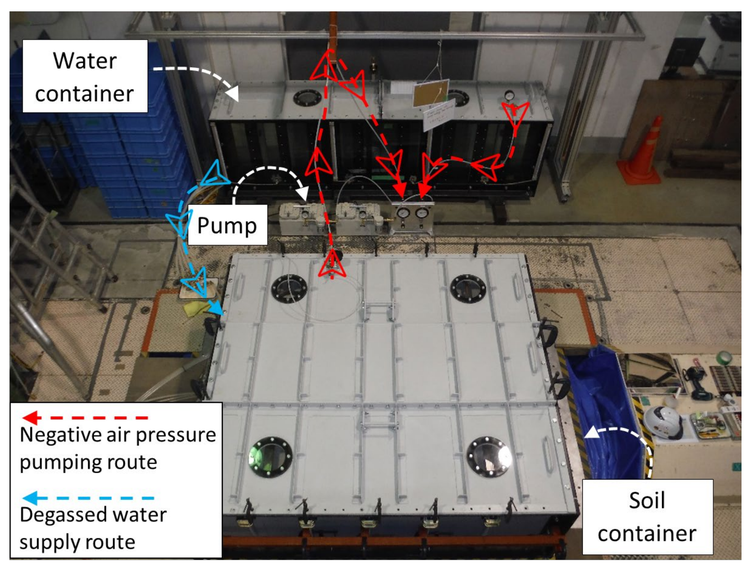


Illustration of vacuum saturation method



Negative air pressure pumping route & degassed water supply route

Quantitative Evaluation of Lattice Wall

Lattice wall with different L/H:

This is the first case where the effect of lattice wall was evaluated by the shear strain of the ground during shaking.
Maximum shear strain in free ground is from -12%~12%;
Maximum shear strain inside 口 shape lattice wall is from -8%~8%;
Maximum shear strain inside 田 shape lattice wall is from -2%~2%.

Quantitative evaluation of shear strain of the ground, inside & outside of lattice wall with different L/H

Influence on pile foundation:

Excess pore water pressure time history inside 口 shape lattice wall shows 2 seconds time delay;
Maximum bending moment inside 口 shape lattice wall is reduced 10% than without lattice wall (obvious cost reduction).

Quantitative evaluation of the influence of lattice wall on pile foundation

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