Research Project Highlight

Analysis of Fine-Grained Soil Failure in Chiba During 2011 Tohoku Earthquake, and Development of Community Lab Test Database

TSRP Topic G1 - Triggering Criteria

Principal Investigators
Scott J. Brandenberg, Professor and Associate Dean, Department of Civil and Environmental Engineering, UCLA
Jonathan P. Stewart, Professor, Department of Civil and Environmental Engineering, UCLA

Research Team
- Claudia Rangel, Graduate Student Researcher, UCLA
- Paolo Zimmaro, Project Scientist, UCLA

Start-End Dates:
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Abstract

Liquefaction susceptibility of fine-grained soils remains an important unresolved issue in geotechnical earthquake engineering. Ground failure and associated structural damage has been observed at many sites consisting of fine-grained soils during recent earthquakes. Traditional liquefaction triggering procedures developed for sands are inappropriate for analyzing fine-grained soils with moderate plasticity, and recently developed suitable alternative have not yet been validated with adequate field performance data. This project will document and analyze the Mihama Ward case history in Chiba, Japan, which exhibited various levels of ground failure during the 2011 Tohoku earthquake. Mihama Ward was composed by sluicing fill material through pipes such that coarse grained sediments tended to deposit close to the pipes while fine grained sediments were deposited further away. The result is a gradual gradient in plasticity characteristics. Ground performance observations indicated a gradient in ground failure characteristics that are correlated with plasticity. We will study available boring logs and cone penetration test results, and we will perform cyclic and monotonic direct simple shear tests on samples of soil from Mihama Ward. These test data will be performed on soils with a range of plasticity characteristics, and the laboratory findings will form an integral part of the case history interpretation. This project will also develop a relational database consisting of laboratory test data on fine grained soils. This database will be implemented as part of the Next-Generation Liquefaction (NGL) project, and it is envisioned as a community resource that will continue to grow with time. All of the laboratory tests performed as part of this project will be curated in the database and available as a public resource.

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Deliverables

A PEER report, conference, and journal papers detailing our findings from the Mihama Ward case history, and a community database of geotechnical laboratory tests.

Research Impact

There will be two primary benefits to practice that result from the proposed work. First, the Mihama Ward case history is very valuable and will shed light on liquefaction susceptibility and triggering evaluation procedures for fine-grained soils. This is currently an area of confusion among practice due to disagreements regarding the plasticity characteristics that render a soil susceptible to liquefaction triggering. The Mihama Ward case history is unique due to the range of plasticity characteristics present at the site, and the manner in which damage observations map spatially in relation to those plasticity characteristics.

Second, the proposed database will be a very useful resource for practitioners. Many projects lack the budget for cyclic laboratory testing, even though researchers agree that laboratory testing is currently the best way to assess cyclic strength loss potential for fine-grained soil. We anticipate the database will grow over time, and ultimately become a community resource. Practitioners will undoubtedly benefit from this resource, enabling them to make better decisions regarding strength loss potential for the soils they encounter in their projects.

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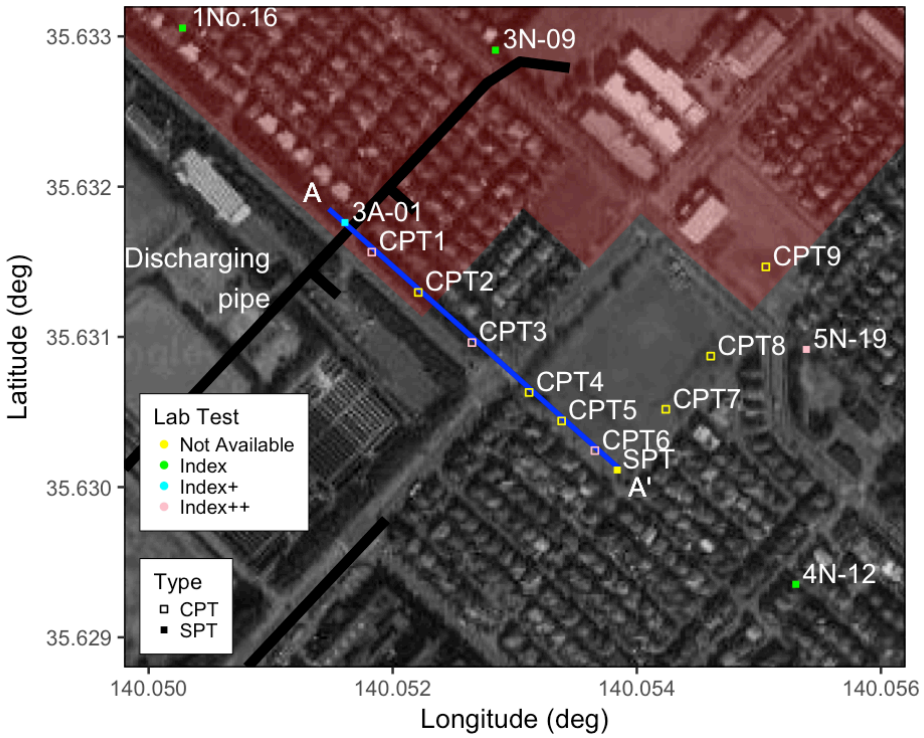
Project Image



Plan view of 8 Chome Meeting Place site in Mihama Ward, Chiba, Japan. Soil discharging pipe and area with sand boils and ground failure (red shading) are shown. Adapted from: Sekiguchi T, Nakai S. Effects of local site conditions on liquefaction damage in Mihama Ward of Chiba City. *Proceedings of the international symposium on engineering lessons learned from the 2011 greatest Japan earthquake*; March 1–4, 2012; Tokyo, Japan.

PEER Center – 325 Davis Hall, UC Berkeley, CA 94720 | peer_center@berkeley.edu