IIS UNIVERSITY OF TOKYO
GDM

Earthquake-induced failure mechanisms of sandy sloped ground evaluated by torsional shear tests

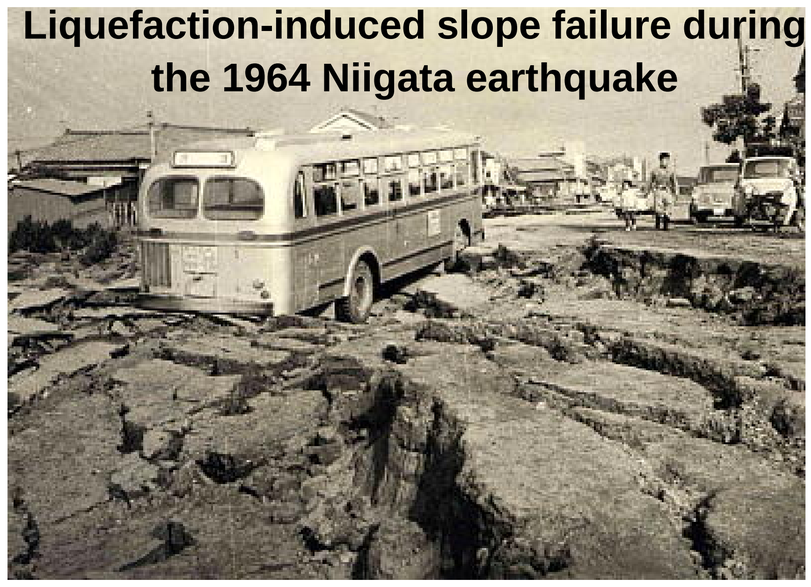
Geo-disaster Mitigation Engineering

Gabriele CHIARO

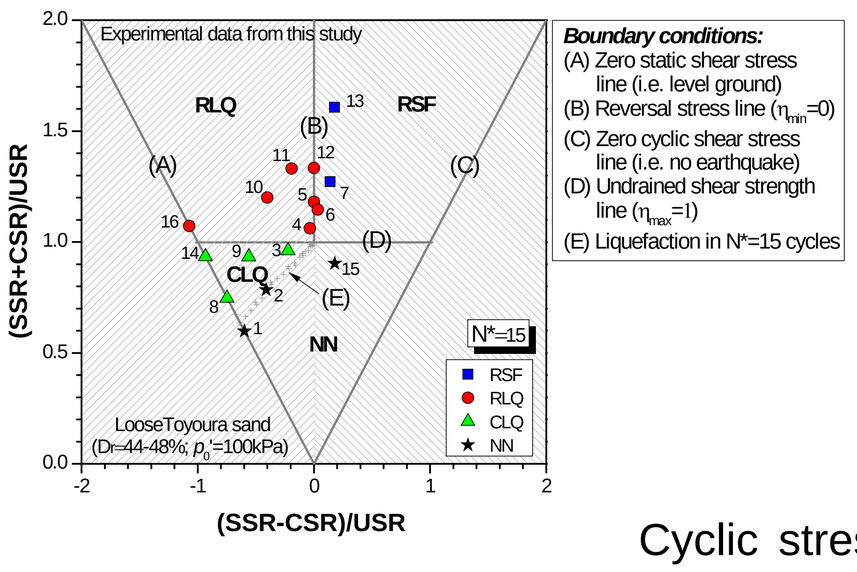
Research Objective

Earthquake-induced failure of sandy sloped ground is one of the most serious geotechnical disaster that may cause severe damage to buildings, infrastructure and lifeline facilities. Its mechanisms is only poorly understood.

In this study, the **failure mechanisms** of sandy sloped ground, namely failure induced by liquefaction and/or brought about by a large extent of deformation (shear failure) were investigated by means of **torsional shear tests** on hollow cylinder specimens.



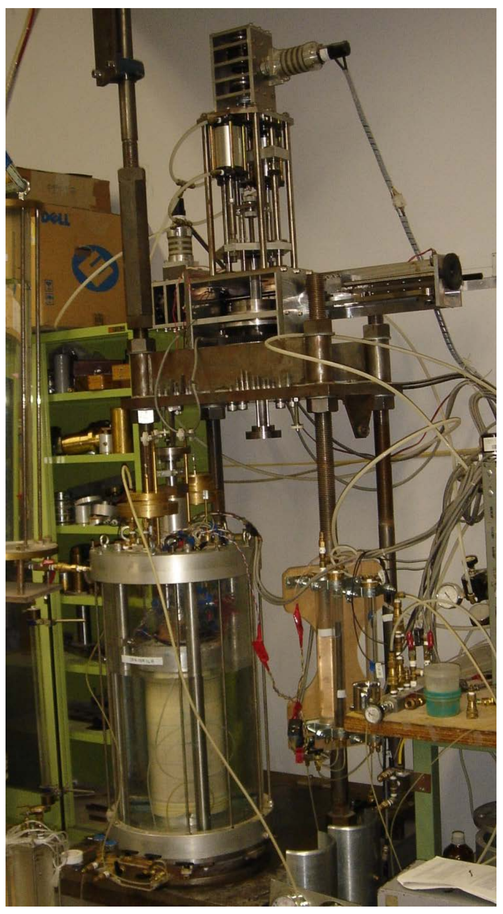
Failure mechanisms



Based on the differences in the effective stress path and the modes of residual shear strain development observed in both monotonic and cyclic torsional shear tests, three different types of failure mechanisms were defined:

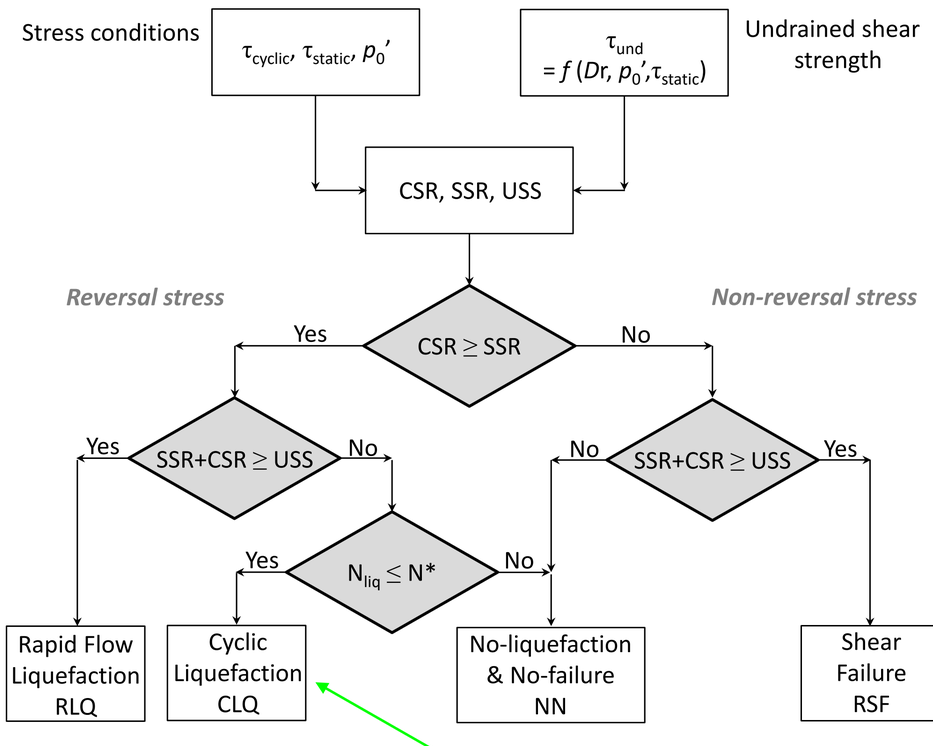
- **Cyclic liquefaction** (CLQ)
- **Rapid flow liquefaction** (RLQ)
- **Shear failure** (RSF; i.e. residual deformation failure)

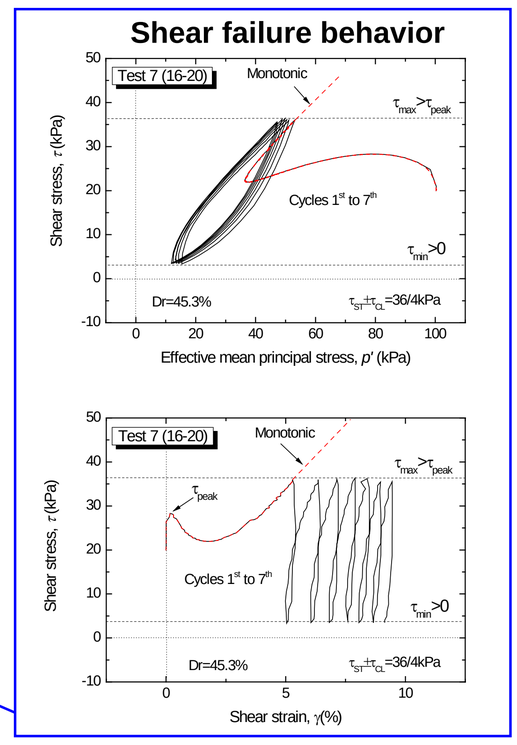
As well, the case of **no-liquef. and no-failure** (NN) was identified.

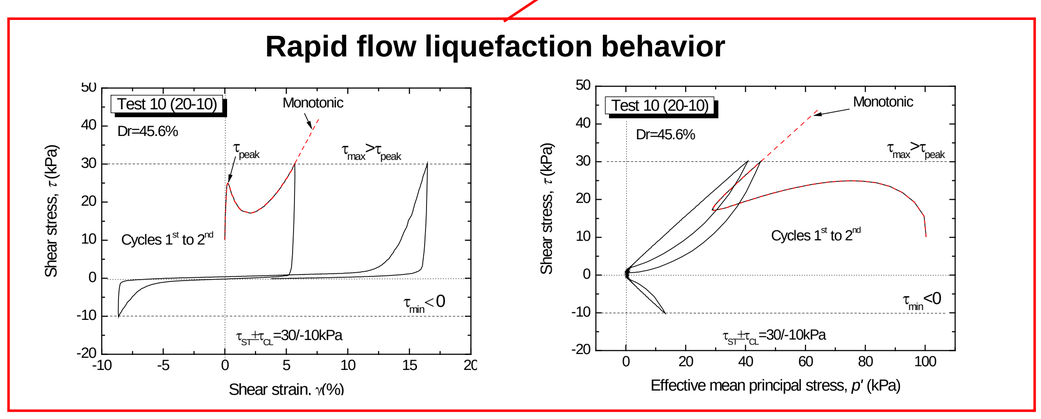


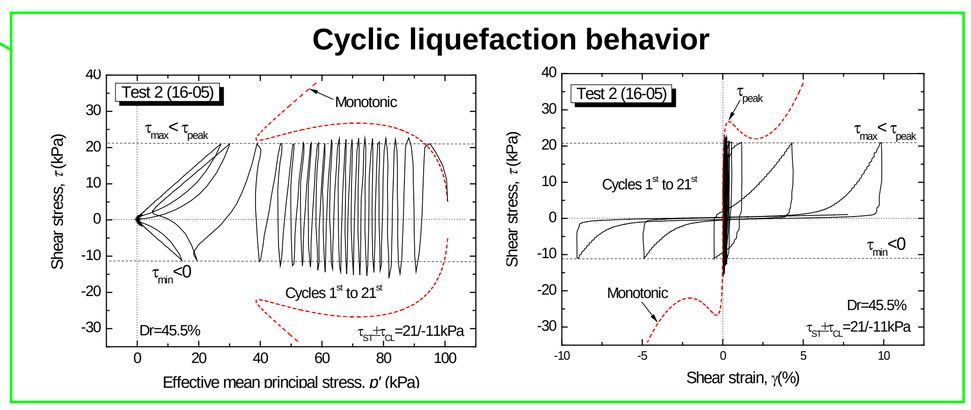
Torsional shear apparatus used in thus study

Cyclic stress ratio (CSR = τ_{cyclic}/p_0'), static stress ratio (SSR = τ_{static}/p_0') and undrained shear strength ratio (USS = τ_{und}/p_0') were identified as the key factors governing the occurrence or not of liquefaction and shear failure of sandy sloped ground, where τ_{und} varies mainly depending on initial relative density (D_r) and effective mean principal stress (p_0'), among other factors.









References: (1) Chiaro G., Koseki J. & Sato T. 2012. Effects of initial static shear on liquefaction and large deformation properties of loose saturated Toyoura sand in undrained cyclic torsional shear tests. Soils and Foundations 52(3): 498-510. **(2)** Chiaro G., Kiyota T. & Koseki J. 2013. Strain localization characteristics of loose Toyoura sand in undrained cyclic torsional shear tests with initial static shear. Soils and Foundations 53(1): 23-34.