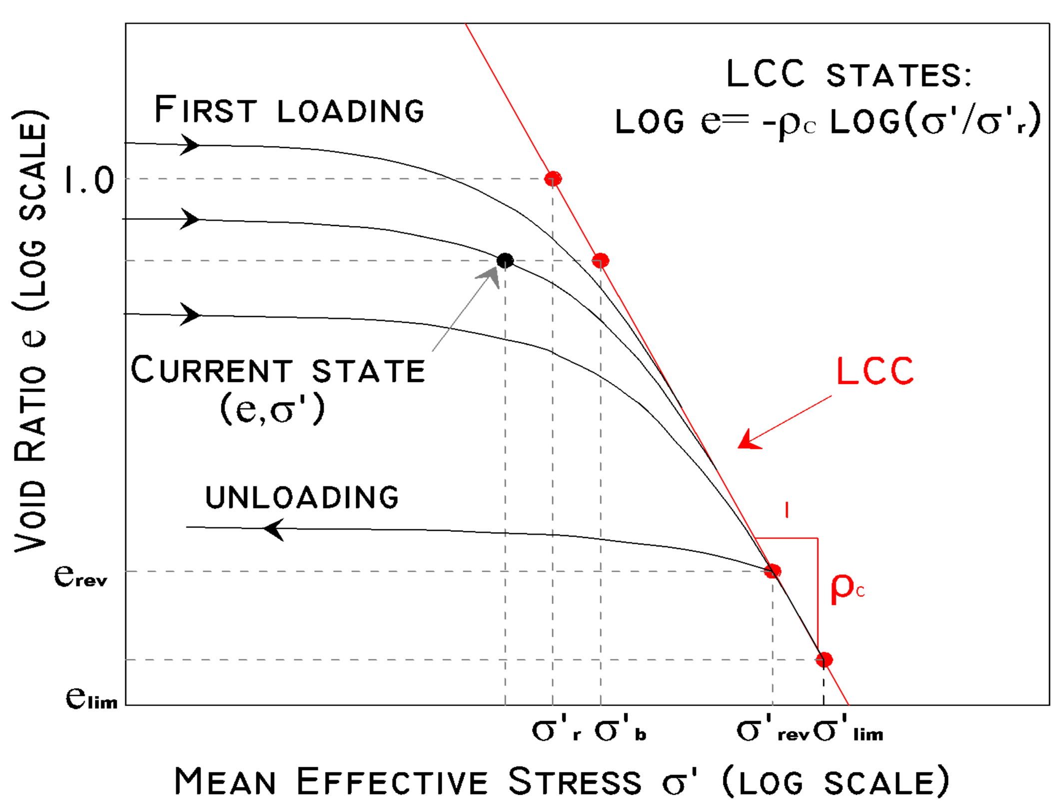
ONE-DIMENSIONAL COMPRESSIBILITY OF INTERMEDIATE NON-PLASTIC SOIL MIXTURES

PEER Internship Program – Summer 2013

Undergraduate Intern: Sean E. Salazar, University of Arkansas
Intern Mentors: Ana Maria Parra & Adam Price, UC Davis
University of California Davis

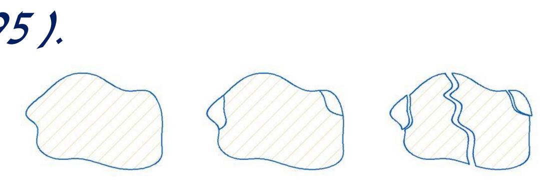
Motivation

❖ Geo-characterization of intermediate soils from in-situ testing is critical for engineering purposes, such as dam stability.
❖ Penetration resistance, as measured in the cone penetration test (CPT), is largely controlled by a soil's crushing characteristics.
❖The Pestana & Whittle (1995) Limiting Compression Curve (LCC) based compression model provides a framework to investigate the crushing behavior of cohesionless soils.



Conceptual model of first loading and unloading of freshly deposited, cohesionless soils (Pestana and Whittle, 1995).

The stages of crushing are as follows:

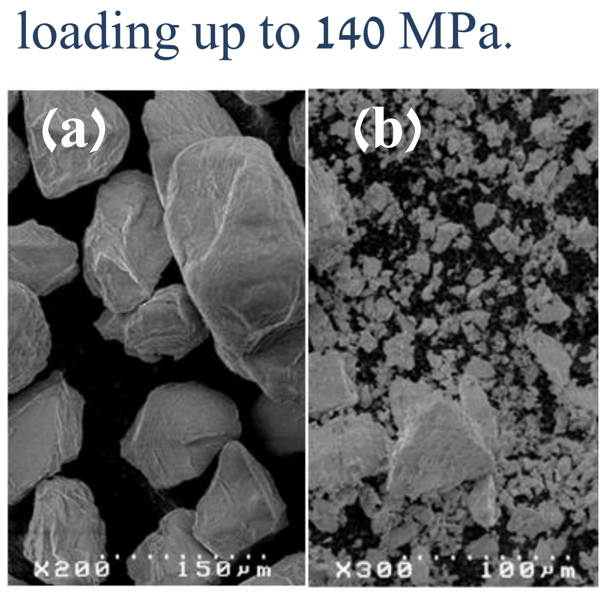


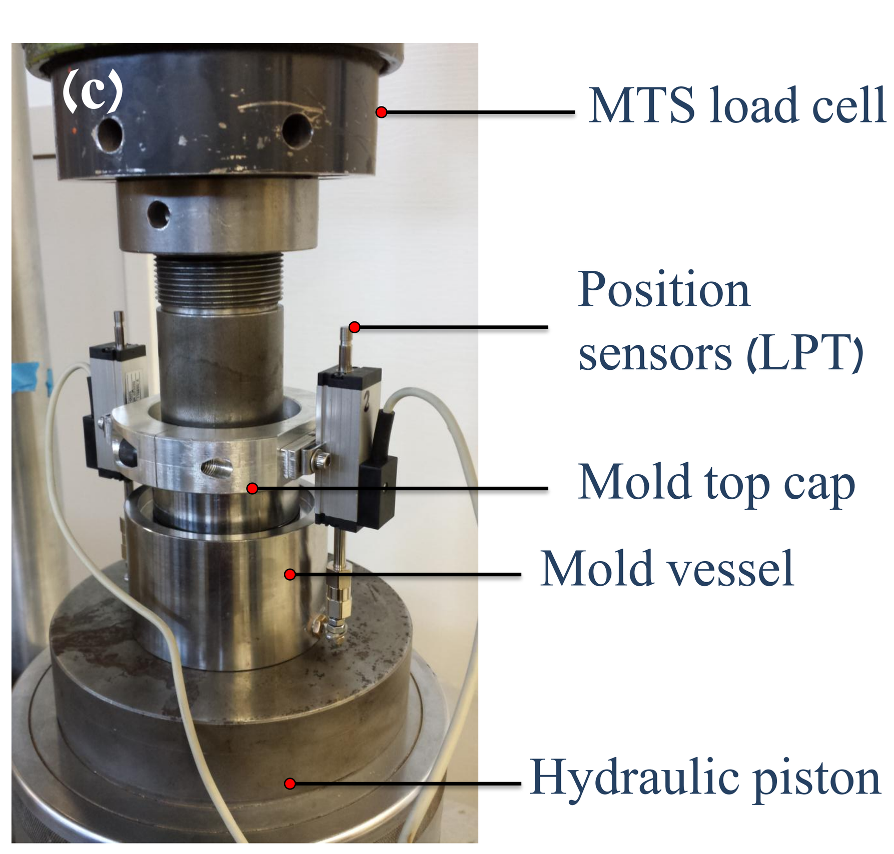
(i) rearrangement of particles (rolling and sliding), (ii) the onset of crushing as asperities are broken, and (iii) major splitting of particles. The LCC is defined as the linear portion of the compression curve in log *e*, log *σ'* space, in which the primary mechanism of volumetric deformation is particle crushing.

The compression behavior of soils is believed to depend on several factors including: (i) initial void ratio, (ii) mineralogy, (iii) particle shape, (iv) particle size, (v) initial grain size distribution, and (vi) nature of fines in the mixture.

Testing Program

Mixtures of Nevada sand and silica silt were subjected to one-dimensional monotonic compression loading up to 140 MPa.

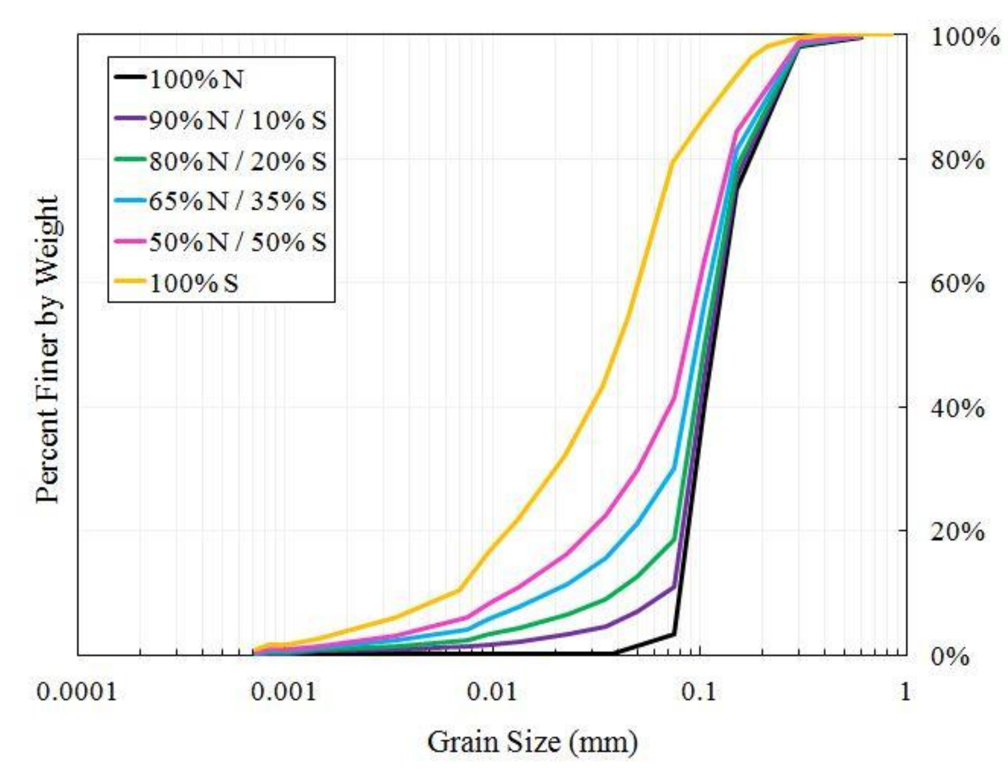




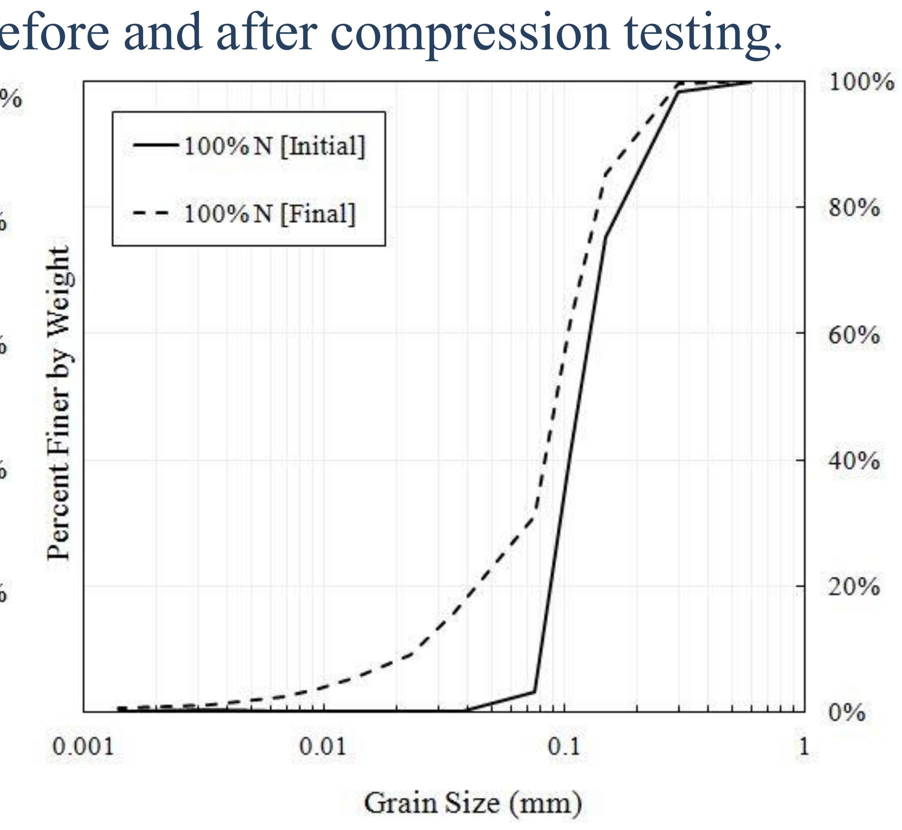
SEM images: (a) Nevada sand, (b) silica silt. Testing apparatus: (c) mold loaded into MTS compression machine.

Results

Particle-size analyses were performed before and after compression testing.

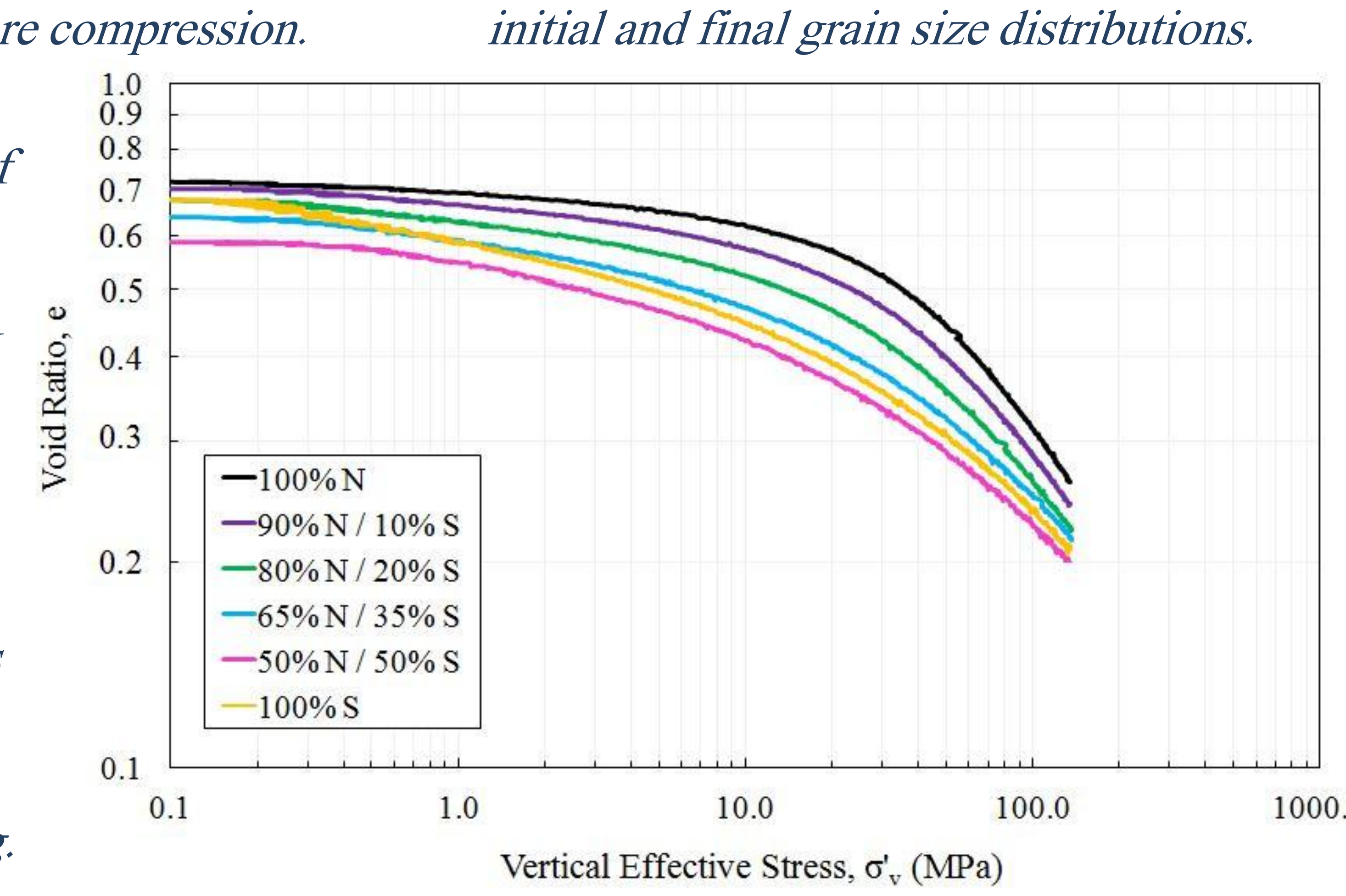


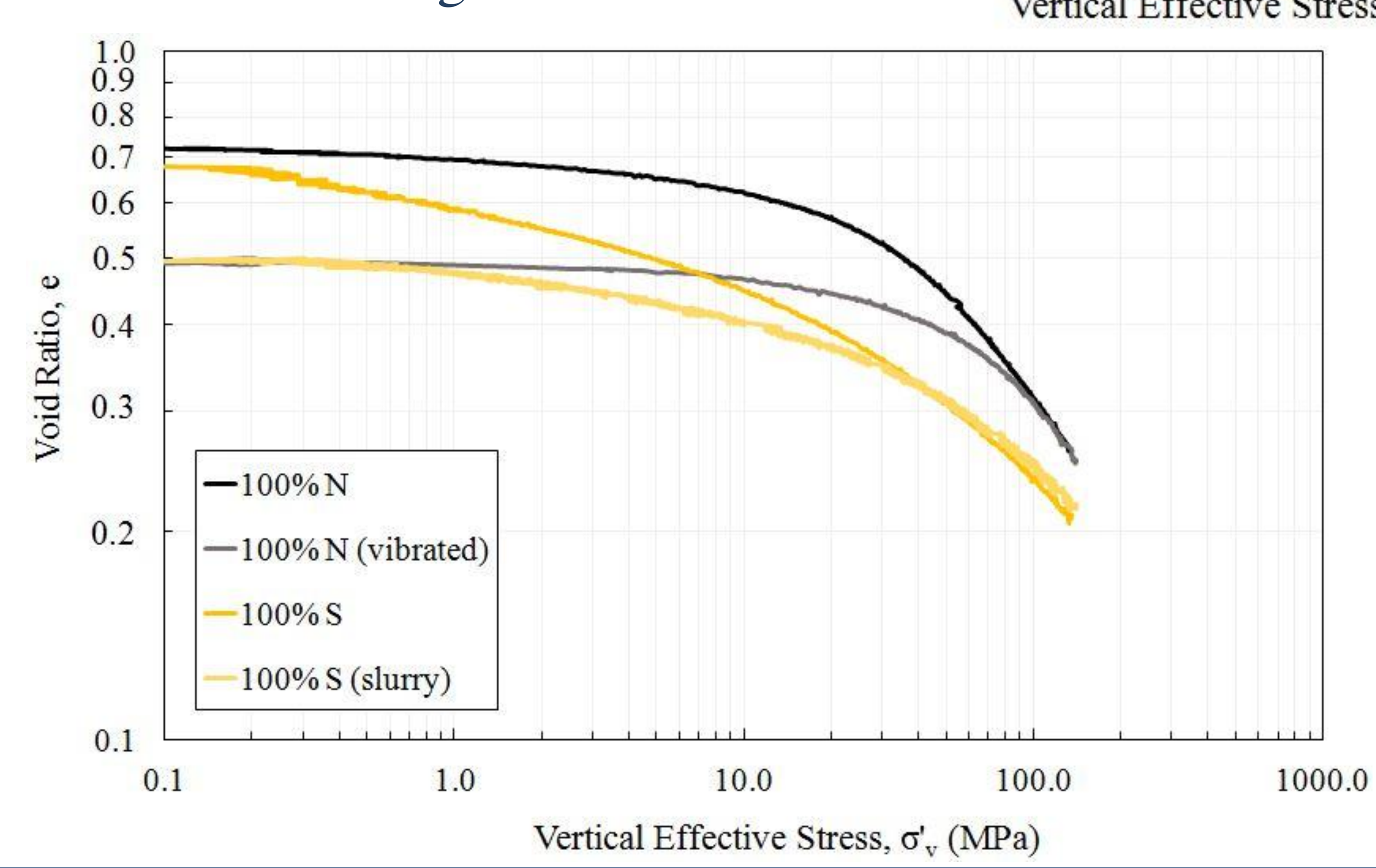
Initial grain size distribution of mixtures before compression.



Crushing is evident in comparison between initial and final grain size distributions.

LCC test results for different mixtures of Nevada sand and silica silt prepared according to ASTM Standard D4254 (2000) Method B. This method likely caused large stable voids in the samples containing angular silica silt particles, due to stress arching.





Test results for 100% Nevada sand and 100% silica silt samples. Dense Nevada sand sample vibrated. Dense silica silt sample prepared in a slurry. The LCC is independent of initial void ratio and soil structure.

Conclusions

(i) All intermediate soil mixtures appear to be approaching a unique LCC, regardless of mix proportions and initial void ratio; however testing to higher stresses would be necessary to confirm this. (ii) The onset of crushing was observed in all tests and verified by grain size analyses. (iii) Sample preparation methods were shown to influence initial sample density.

Acknowledgements

Soil Interactions Laboratory
PEER

PACIFIC EARTHQUAKE ENGINEERING RESEARCH CENTER

PEER Internship Program: UC Berkeley ▪ City of San Francisco ▪ UC Davis ▪ U Washington

The PEER Internship Program is funded from a REU Site Award from the National Science Foundation.
More information can be found at http://peer.berkeley.edu/education/internships.html