



FLAT GROUND, DEEP SOIL, TALL EMBANKMENT, GEOTECHNICAL CHALLENGES

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CHALLENGING FOUNDATION SOILS

Where do you find flat ground with thick foundation soils?

- Fluvial water laid deposits.
- Eolian wind laid deposits.
- Glacial landforms and deposits.

FLUVIAL WATERLAID LANDFORMS

River flood plains and deltas.

Alluvial valley fills and fans.

Freshwater lake beds and organic deposits.

WINDLAID EOLIAN LANDFORMS

Sand dunes.
Loess deposits.

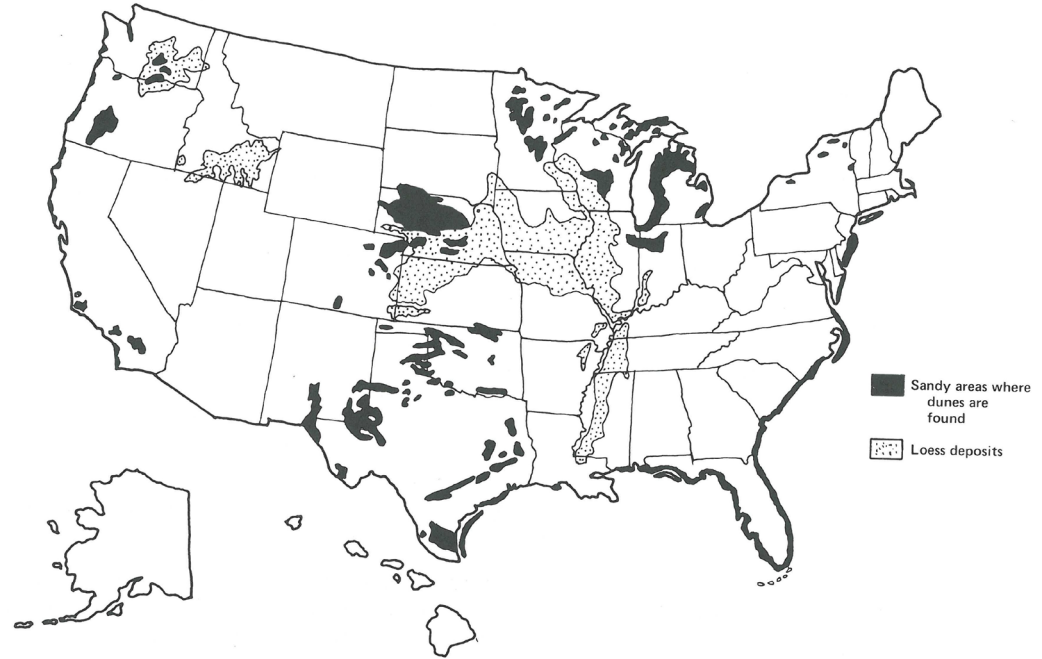


Figure 10.3. Distribution of eolian landforms within the United States.
(After U.S. Geological Survey, Washington, D.C., "National Atlas," 1971)

GLACIAL LANDFORMS

Till plains.
Moraines.
Outwash.
Lake Beds.

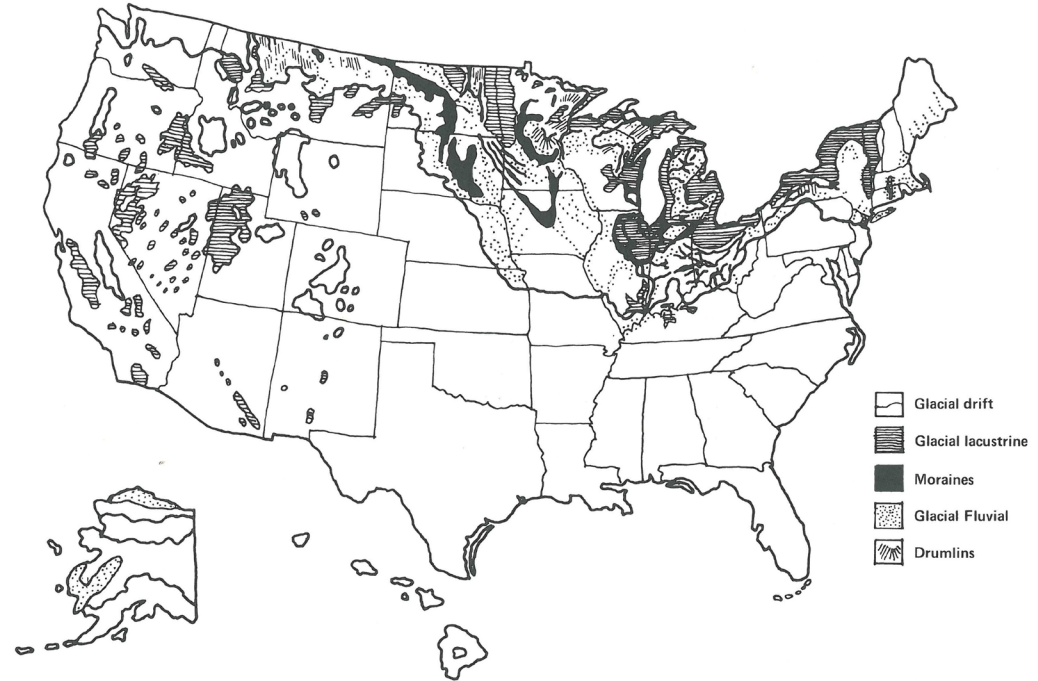
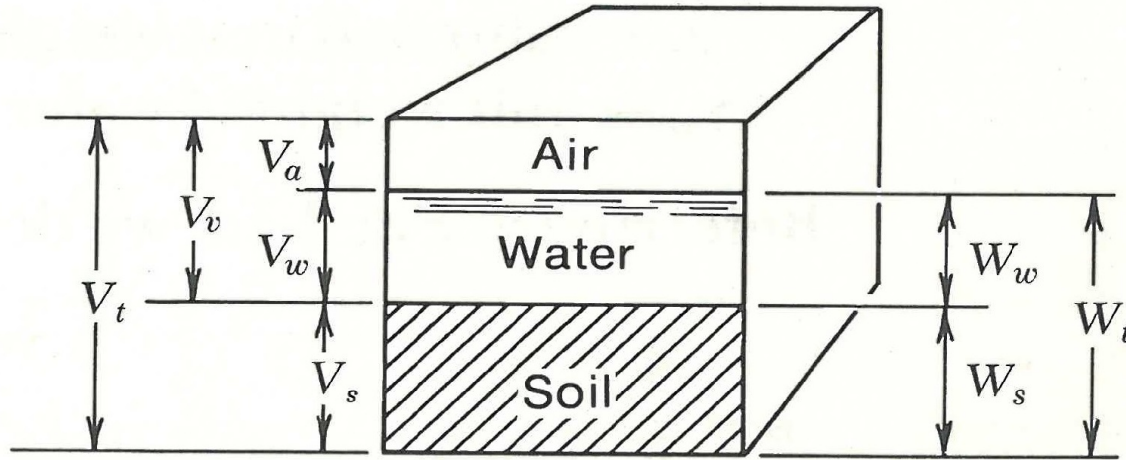


Figure 9.5. Distribution of major groups of glacial landforms across the United States.
(After U.S. Geological Survey, Washington, D.C., "National Atlas," 1971)

SOIL MECHANICS



(d) Volumetric and weight relationships for the original soil mass.

VOID RATIO

$$e = \frac{\textit{Void Volume}}{\textit{Solids Volume}}$$

Void Ratio will be within a range of 0.3 to 1.2 depending on particle shape, minerology and degree of sample consolidation.

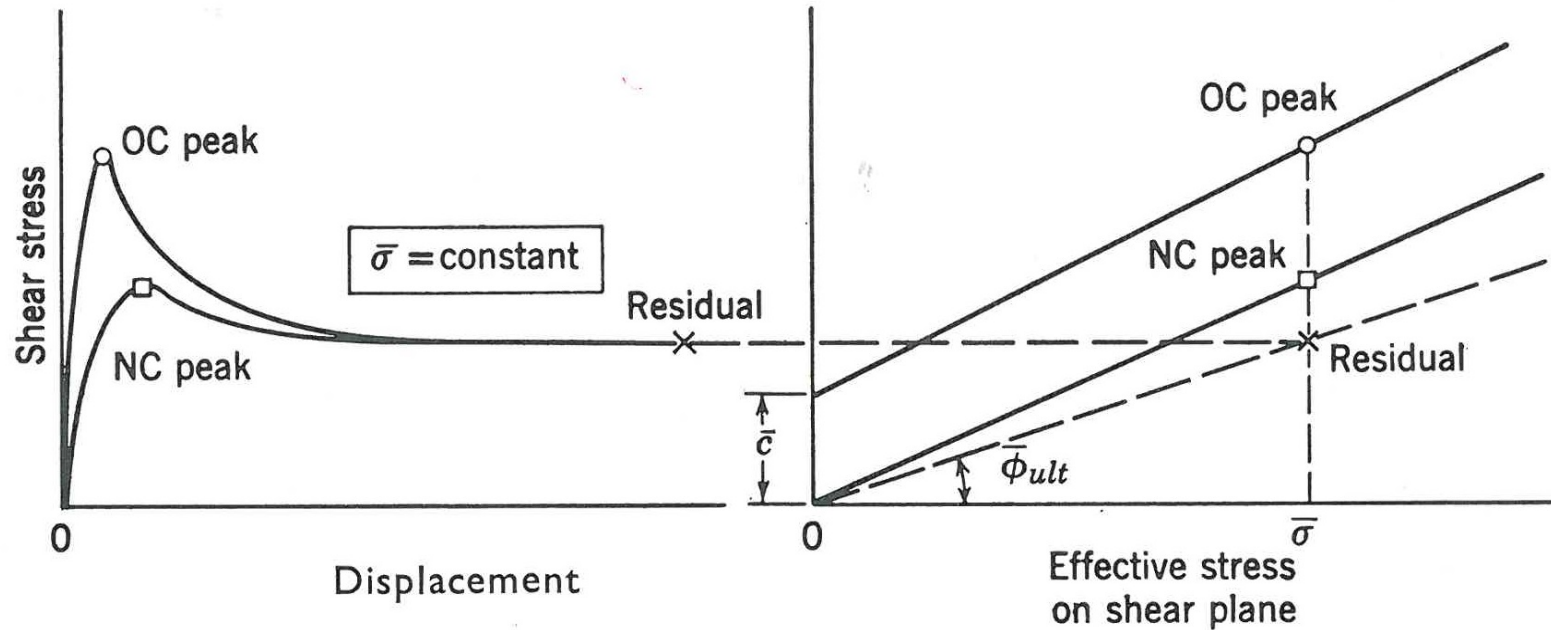
SHEAR STRENGTH

- Short Term – Total Stress
 - Undrained Peak
 - Undrained Residual
- Long Term – Effective Stress
 - Drained Peak
 - Drained Residual

SAMPLE CONSOLIDATION

- Normally Consolidated – a soil that is at equilibrium under the maximum stress it has ever experienced.
- Pre-Consolidation Pressure – The stress level that a soil has experienced in the past when consolidated.
- Over Consolidated – a soil that is at equilibrium under a stress that is less than that which it once experienced.

SHEAR STRENGTH



FIELD SAMPLING AND TESTING

- Test Pits
- Auger Borings
- Standard Penetration Tests
- Cone Penetration Tests
- Vane Shear Tests
- Undisturbed Tube Samples
- Geophysical



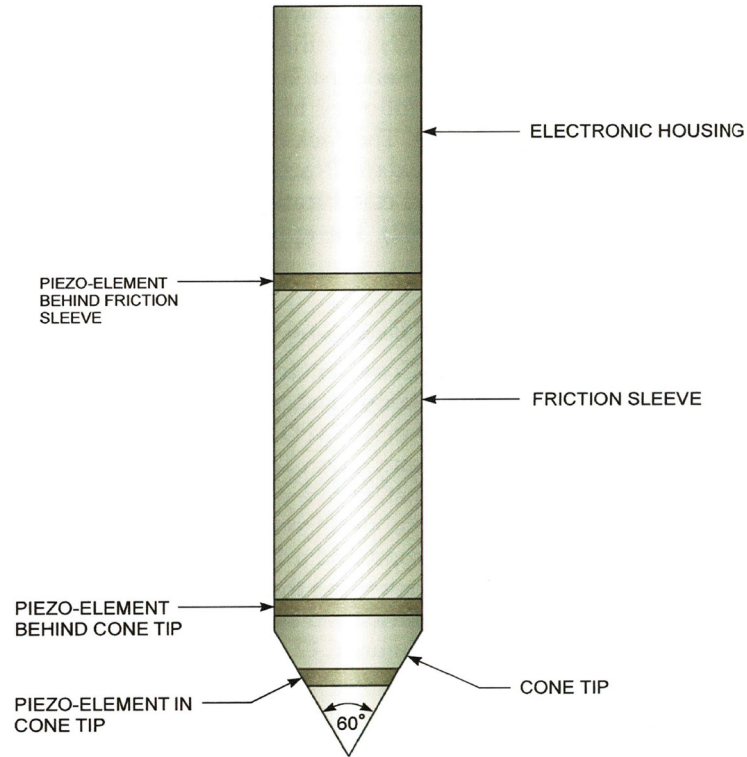
VANE SHEAR TEST





DYNAMIC CONE PENETRATION TEST

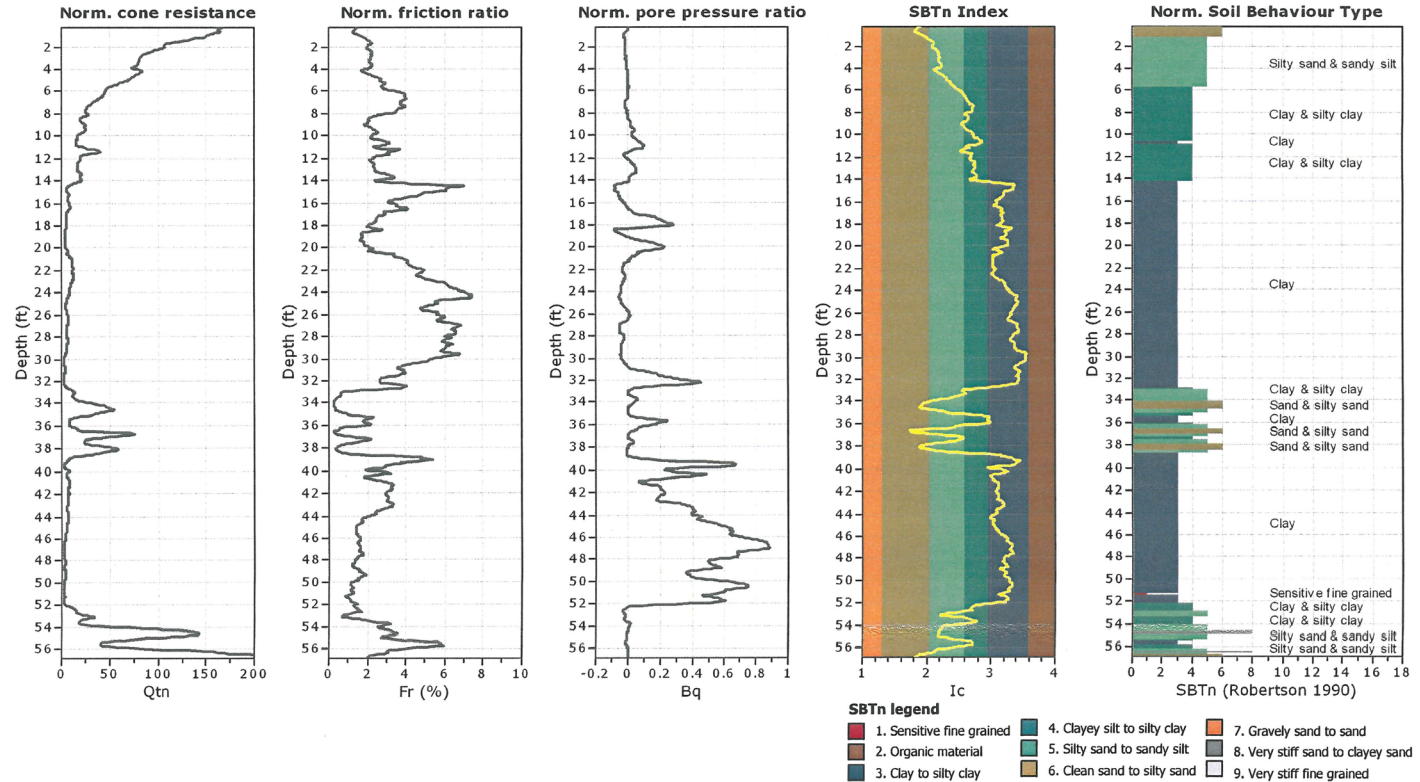
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(ADAPTED FROM FHWA, 1992)

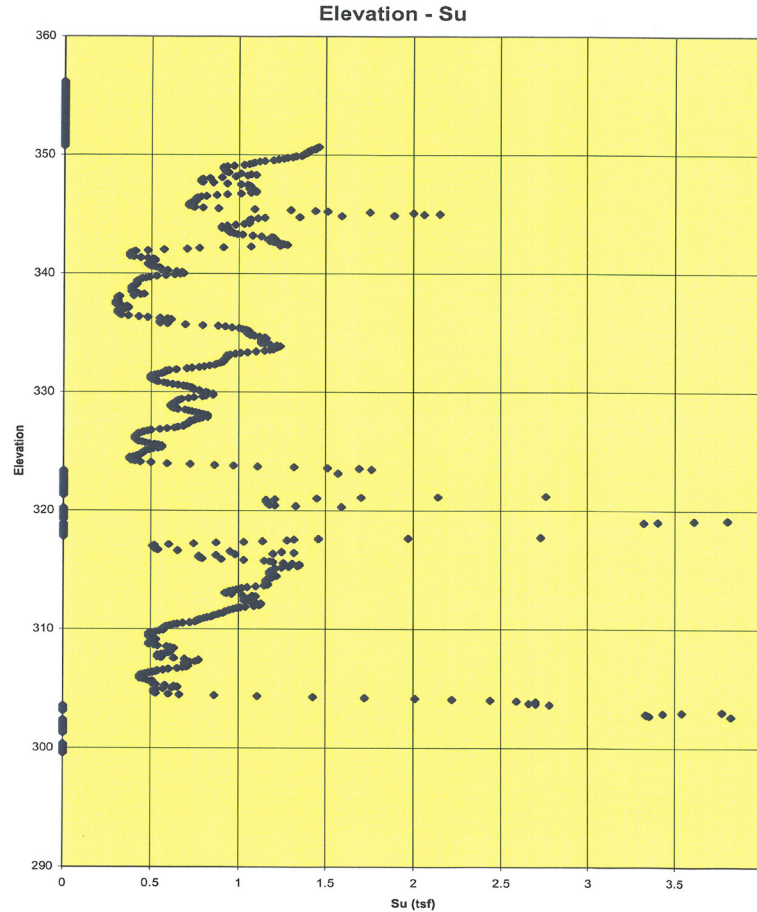
FIGURE 6.12 PIEZOCONE PENETROMETER

Cone Penetration Test Data

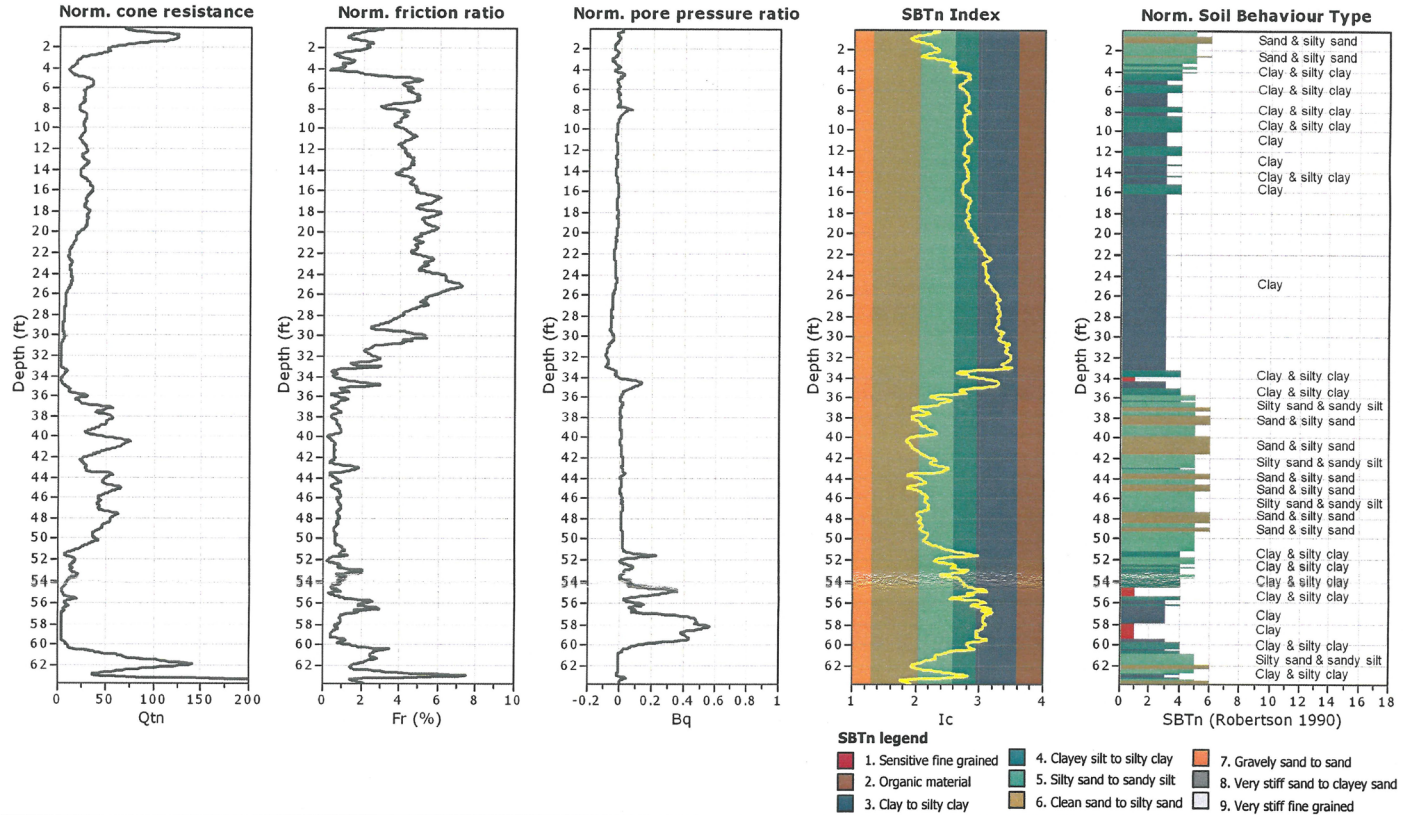




Undrained Shear Strength From CPT Test



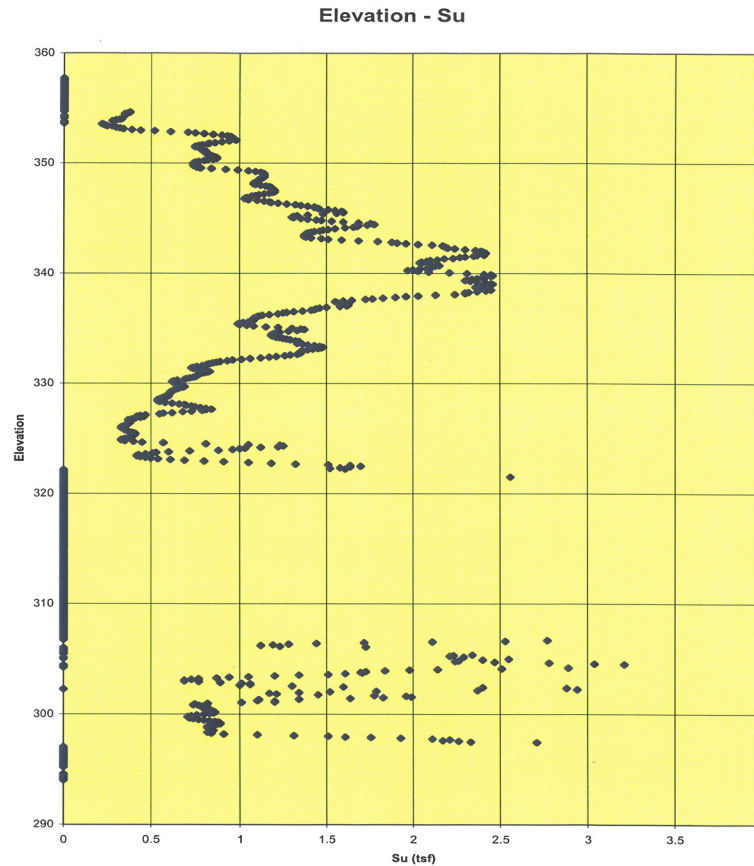
Cone Penetration Test Data





Undrained Shear Strength From CPT Test

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LABORATORY TESTING

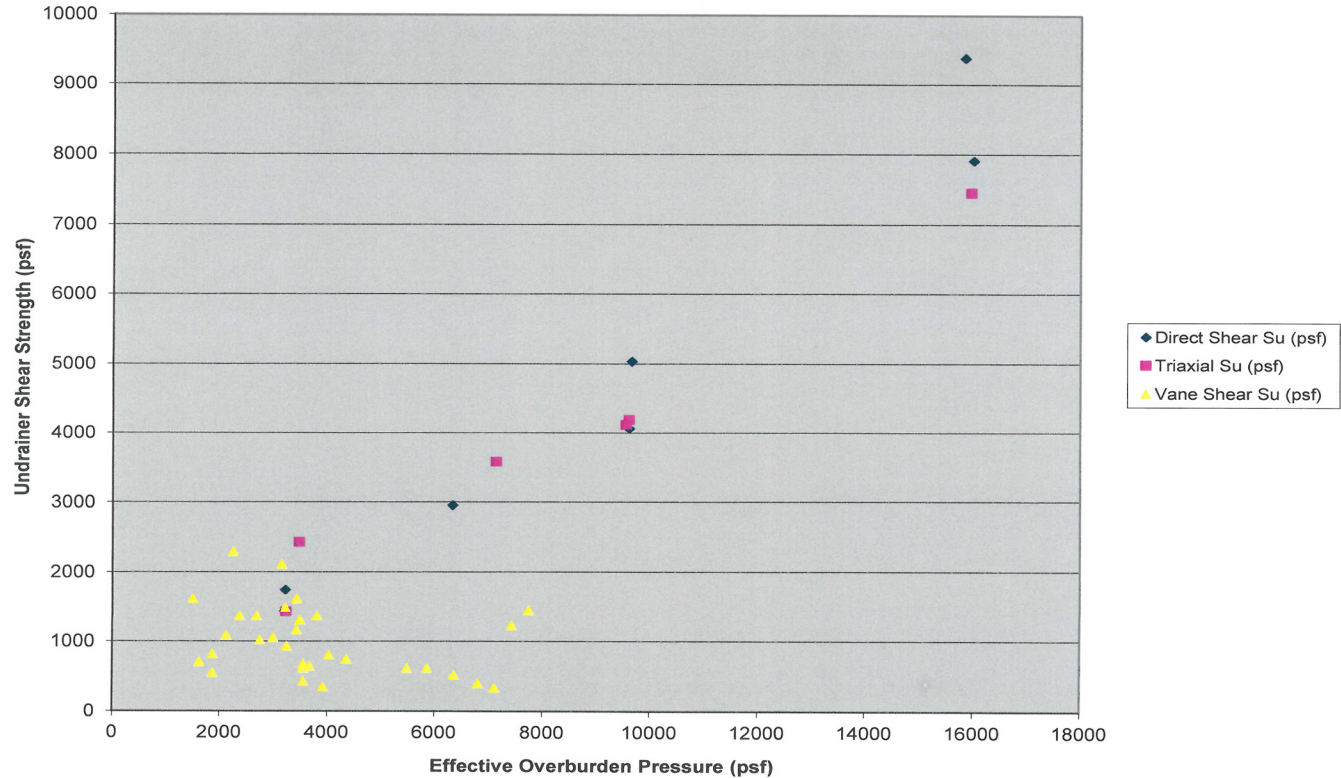
- Soil Classification
- Specific Gravity
- Triaxial Compression (UU, CD and CUPP)
- Direct Shear
- Consolidation (Traditional and Controlled Rate of Strain)
- Permeability

Triaxial Shear Strength Testing



Combined Shear Strength Data

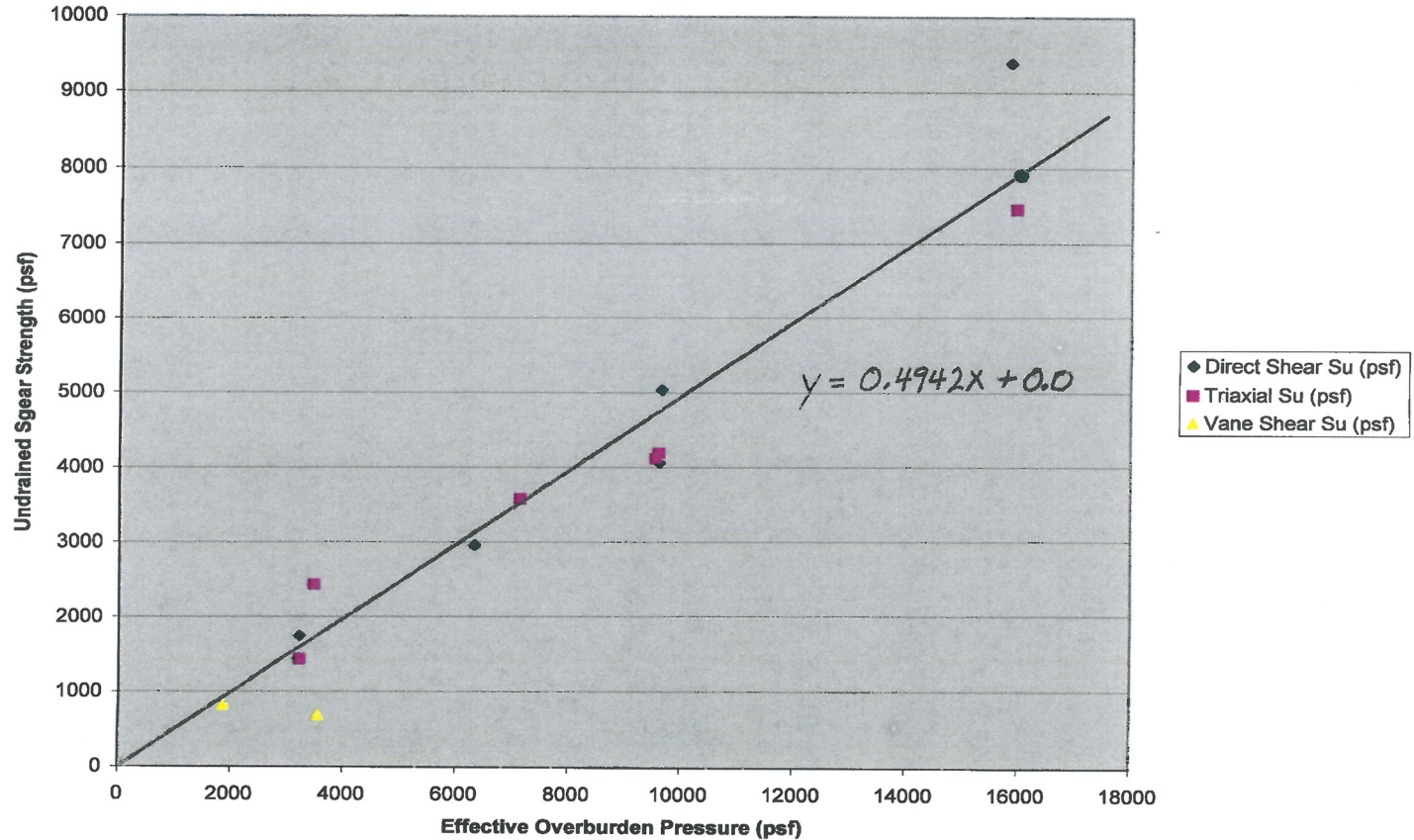
Undrained Shear Strength Testing

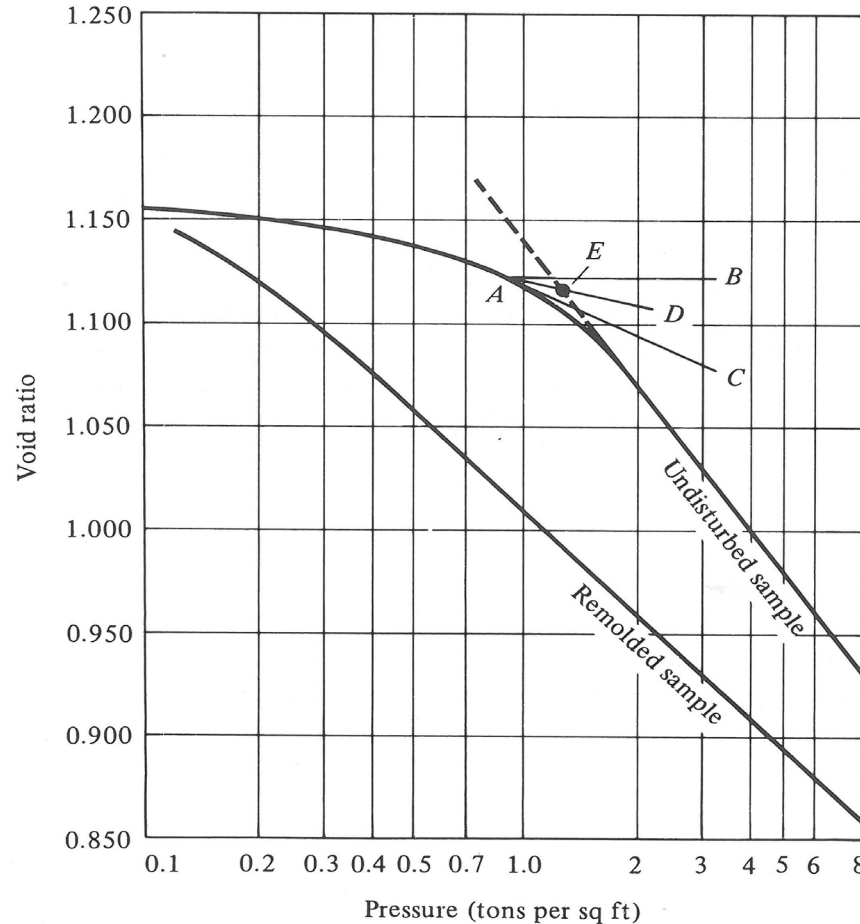




Combined Shear Strength Data

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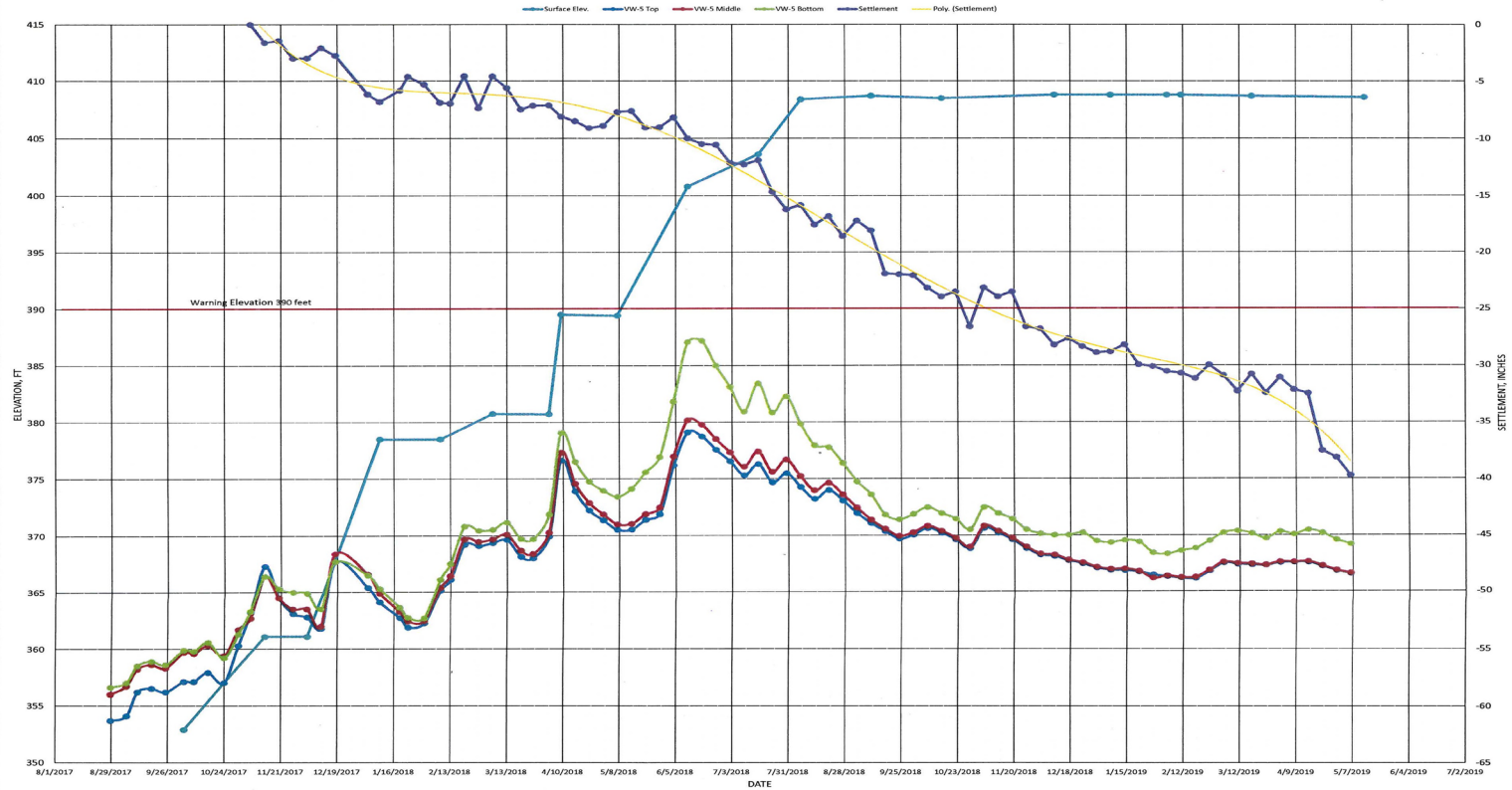
Example Laboratory Consolidation Test e / log p Curve

GEOTECHNICAL CHALLENGES

- Foundation soil profile, thickness and complexity
- Soil profile stress history, degree of consolidation
- Short term undrained soil strength
- Consolidated long term soil strength
- Rate of embankment construction
- Potential settlement and pore pressure response

MONITORING DURING CONSTRUCTION

- Vibrating Wire Piezometers – used to monitor pore water pressure within a soil layer.
- Settlement Cell and Platforms – used to determine foundation soil consolidation



Thank You For Your Time



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