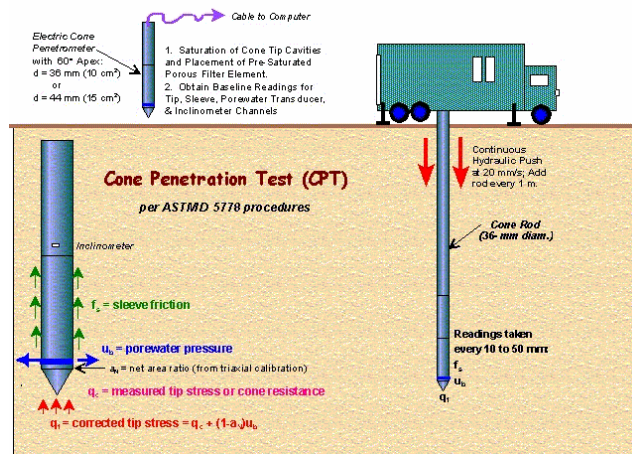


C&EE 121 - Foundations

Cone Penetration Testing (CPT)



Cone Penetration Testing (CPT) ASTM D3441

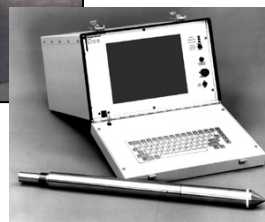


Cones

- 60 degree apex cone
- Standard cone
 - $\phi = 35.7 \text{ mm}$
 - Area = 10 cm^2
- Measures:
 - Tip resistance (q_c)
 - Sleeve friction (f_s)
 - Pore pressure (p_w)
 - Shear wave velocity (v_s)



nees@UCLA CPT Truck

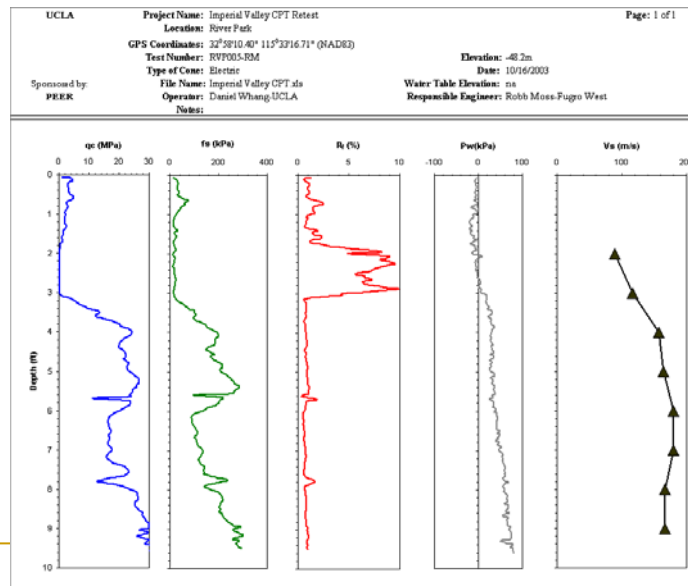


CPT Applications

- Soil profile (stratigraphy)
- Estimation of geotechnical parameters (strength, liquefaction resistance, v_s)
- Evaluation of groundwater conditions
- Geo-environmental: distribution and composition of contaminants



Sample data



CPT Soil Classification

- Based on ratio of tip and sleeve resistance
- Tip resistance:
 - High in sands
 - Low in clays
- Sleeve friction:
 - Low in sands
 - High in clays



Classification Charts

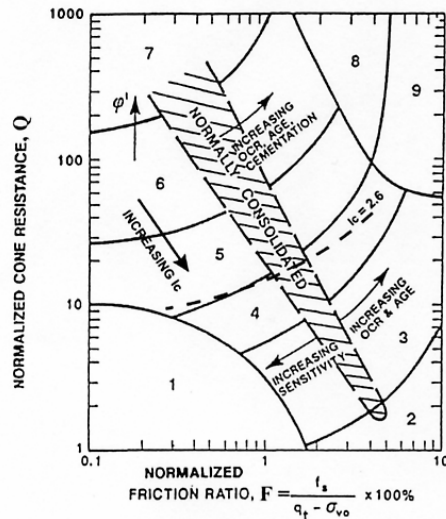
- Tip and sleeve resistance increase with increasing overburden stress
- Normalize q_t & f_s by overburden stress

$$Q = \left(\frac{q_c - \sigma_v}{P_a} \right) \left(\frac{P_a}{\sigma'_v} \right)^n$$

$$F = \frac{f_s}{q_c - \sigma_v} \cdot 100\%$$



Robertson (1990)



Zone	Soil Behaviour Type	I_c
1	Sensitive, fine grained	N/A
2	Organic soils – peats	> 3.6
3	Clays – silty clay to clay	2.95 – 3.6
4	Silt mixtures – clayey silt to silty clay	2.60 – 2.95
5	Sand mixtures – silty sand to sandy silt	2.05 – 2.6
6	Sands – clean sand to silty sand	1.31 – 2.05
7	Gravelly sand to dense sand	< 1.31
8	Very stiff sand to clayey sand*	N/A
9	Very stiff, fine grained*	N/A

* Heavily overconsolidated or cemented

Note: Soil behaviour type index (I_c) is given by
 $I_c = [(3.47 - \log Q)^2 + (\log F + 1.22)^2]^{0.5}$



Advantages/Disadvantages of CPT

ADVANTAGES:

- Continuous data
- Elimination of operator error
- Reliable, repeatable test results

DISADVANTAGES:

- Inability to penetrate through gravels and cobbles
- Newer technology = less populated database than SPT
- Lack of sampling

