In Situ Testing

CPT
&
SPT

CPT Testing

CPT Testing

Three Measurements

q_C = Cone-tip resistance

u_P = Penetration pore pressure (piezocone)

f_S = sleeve friction

Ratios

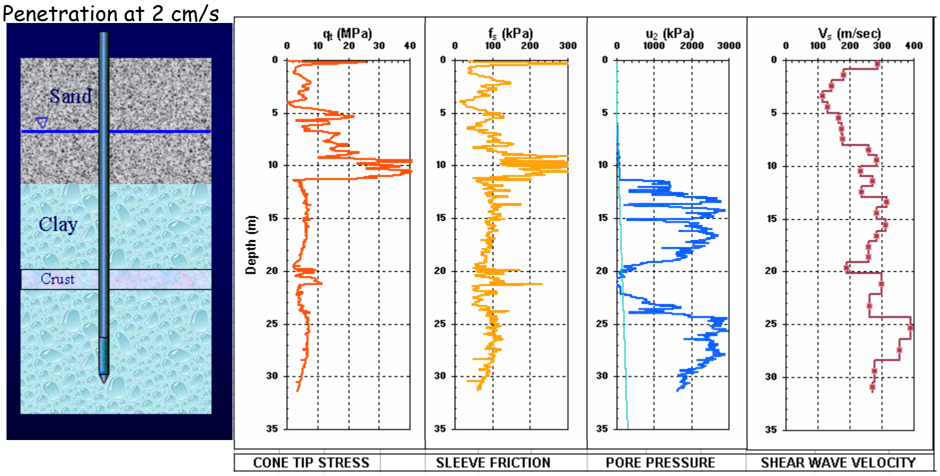
FR = friction ratio = f_S / q_C

B_q = pore pressure ratio = $\dfrac{u_p - u_h}{q_T - \sigma'_v}$

SCPTu Sounding, Memphis, Tennessee

Real-Time readings in computer screen

Penetration at 2 cm/s



q_T

Corrected cone-tip resistance

$q_T = q_c + (1-a_n)u_P$

only for type 2 (type B) cones

$a_n = 0.8 = fn(cone)$ net area ratio

CPT-parameters

φ´ (Sands)

See page 129 fig. 4.16

$$\phi' = 17.6 + 11 \log \left(\frac{q_c}{(\sigma'_{vo} \cdot p_a)^{0.5}} \right)$$ Kulhawy & Mayne (1990)

$$\phi' = \arctan[(0.1 + 0.38 \log \left(\frac{q_c}{\sigma'_{vo}} \right))]$$

$$q_{C1} = \left(\frac{q_c}{(\sigma'_{vo} \cdot p_a)^{0.5}} \right)$$

CPT-parameters

D_r = **relative density (sands)**

$$D_r = 100\left(\frac{q_{C1}}{305 \cdot OCR^{0.2}}\right)^{0.5}$$

↓

if unknown, use OCR = 1

e = **void ratio**

$$e = 1.152 - 0.233 \cdot \log(q_{C1}) + 0.043 \log(OCR)$$

CPT - parameters

OCR **(iterative)**

$K_o = 0.192\ (q_C / p_a)^{0.22}\ (\sigma'_{vo} / p_a)^{-0.31}\ OCR^{0.27}$ *(1)*

$K_o = [1 - \sin(\phi')]\ OCR^{\sin \phi'}$ *(2)*

p_a = 100 kPa

(1) Mayne, CPT'95

(2) Mayne & Kulhawy, 1982

a) Find ϕ'

b) Vary OCR until both K_o values (for eq 1 & 2) are similar

SPT Testing

SPT Testing

Procedure

1) Drill boring (hole)

2) Insert SPT sampler (hollow)

3) Drive sampler into the ground 18” & count N of blows

to drive each 6” interval

if N for 6” > 50 } Refusal

if N for all 18” >100 }

SPT Testing

4) N_{SPT} = ΣN for last two 6 " intervals

5) Retrieve sampler & save soil

6) Drill to next depth & go to step 2

N_{SPT} = fn (Method of drilling, how clean boring is, hammer location, hammer type, "hangover level" of technician……..)

see p.117-118

SPT Testing

Efficiency corrections:

From " N_{SPT}" to "N_{60}"

$$N60 = \frac{E_m C_b C_s C_R N_{SPT}}{.60}$$

E_m = hammer efficiency = fn (hammer type) $\rightarrow$ Table 4.3

P.119

C_B = borehole dia. correction - table 4.4

C_s = sampler correction - table 4.4

C_R = rod length correction - table 4.4

SPT Testing

More corrections:

$N_{SPT}\uparrow$ as $\sigma'\uparrow$, so

$$(N_1)_{60} = N_{60}\sqrt{\frac{p_a}{\sigma_z'}}$$

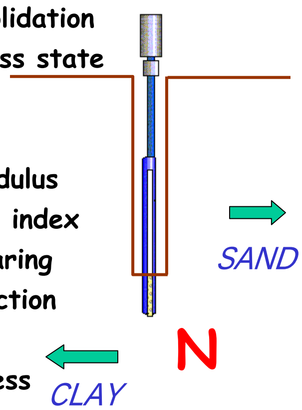
$p_a = 100$ kp$_a$

$(N_1)_{60} \leq 2N_{60}$

N's have been correlated with everything !!

Is One Number Enough???

c_u = undrained strength
γ_T = unit weight
I_R = rigidity index
☠' = friction angle
OCR = overconsolidation
K_0 = lateral stress state
e_o = void ratio
V_s = shear wave
E' = Young's modulus
C_c = compression index
q_b = pile end bearing
f_s = pile skin friction
k = permeability
q_a = bearing stress



D_R = relative density
γ_T = unit weight
LI = liquefaction index
☠' = friction angle
c' = cohesion intercept
e_o = void ratio
q_a = bearing capacity
σ_p' = preconsolidation
V_s = shear wave
E' = Young's modulus
Ψ = dilatancy angle
q_b = pile end bearing
f_s = pile skin friction