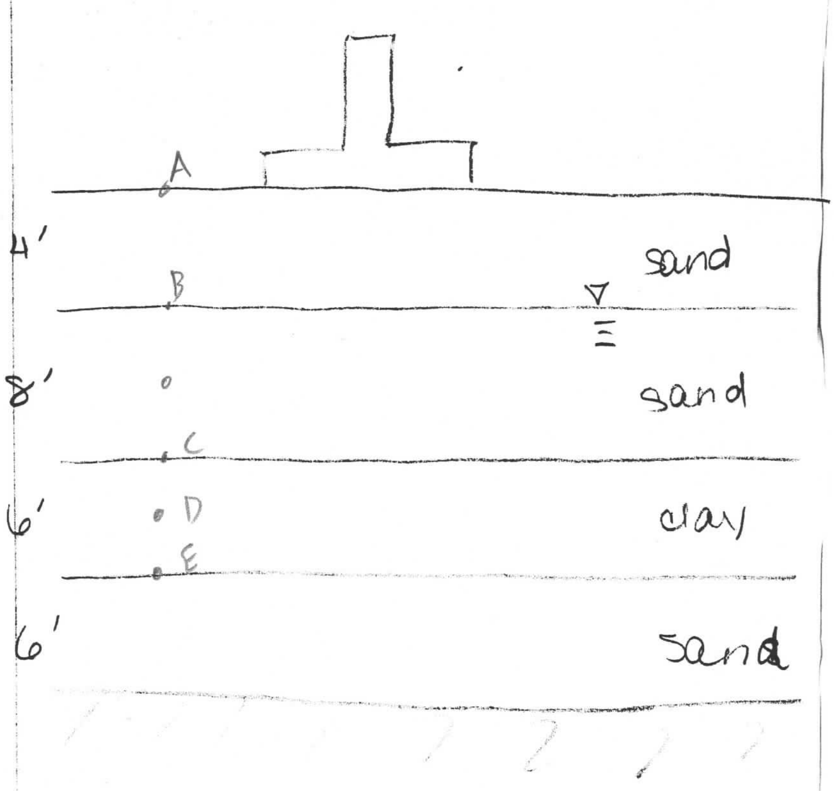
1. water Table 4ft below surface

A) plot TOTAL vertical stress DISTRIBUTION TO MIDDLE OF CLAY

B) plot THE PORE WATER Pressure DISTRIBUTION TO THE middle OF the " "

C. effective vertical stress " "



$\gamma = 85$ pcf
$\phi' = 28°$

$\gamma_s = 103$
$\phi' = 28$

$e_o = 0.8$
$G_s = 2.69$
$\gamma_d = 96$ pcf

$\gamma_s = 120$ pcf

(1)

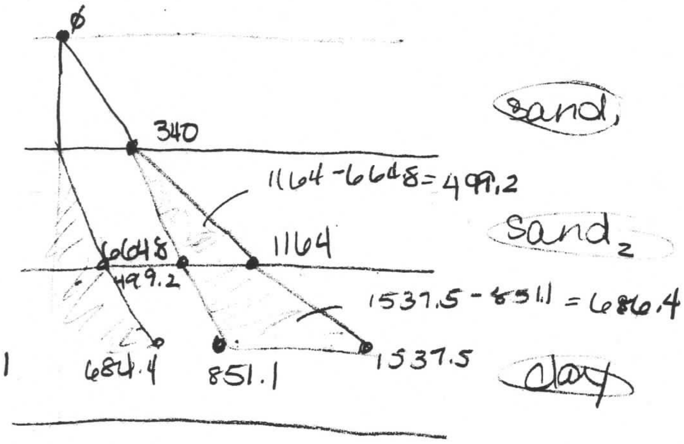
Clay. $\gamma = \gamma_d(1 + w_c)$
$= (96\,pcf)(1 + .2973)$
$\gamma = 124.5\ pcf$

$G_s w_c = \cancel{S}^{1} e$
$w_c = 0.8/2.69$
$w_c = .2973$

Sand$_1$: $\sigma = (85)(4) = 340$

$\sigma = 340 + (103)(8) = 1,1164$
$\sigma' = 340 + (103 - 62.4)(8) = 6648$

$\sigma = 1164 + (124.5)(6/2) = 1537.5$
$\sigma' = 664.8 + (124.5 - 62.4)(6/2) = 851.1$



2) A 7.2' × 7.2' FOOTING SUPPORTS A 75K lb Load (including the self-weight of the footing), & it is to be CONSTRUCTED on THE GROUND SURFACE OF THE SOIL profile shown.
calc. the avg stress increase in the layer

$$q = \frac{75000}{(7.2)^2} = 1{,}446.8 \text{ psf}$$

$$\Delta\sigma = q(I_5) \qquad \Delta\sigma_{AVG} = \frac{\Delta\sigma_{TOP} + 4\Delta\sigma_{MID} + \Delta\sigma_{BOT}}{6}$$

→ $\Delta\sigma_{TOP}\big|_{12'}$ $\quad m_1 = \frac{L}{B} = \frac{7.2}{7.2} = 1 \qquad n_1 = \frac{z}{b} \rightarrow \frac{B}{2} = \frac{12}{7.2/2} = 3.333$

n_1	m_1
3	.179
3.33	m_1
4	.108

$$\frac{4-3}{.108-.179} = \frac{3.33-3}{m_1 - .179} = m_1 = .1556$$

$$\Delta\sigma = (1446.8)(.1556) = 225.12\text{ psf} = \Delta\sigma_{TOP}$$

→ $\Delta\sigma_{MID}\big|_{15'}$ $\quad m = 1 \quad n = 15/3.6 = 4.167 \qquad I_5(1, 4.167) =$

$$\Delta\sigma_{MID} = (1446.8)(.102) = 147.6\text{ psf} = \sigma_{MD}.$$

→ $\Delta\sigma_{BOT}\big|_{18'}$ $\quad m = 1 \quad n = 18/3.6 \quad n = 5 \qquad I_5(1,5) = .072$

$$\Delta\sigma = (1446.8)(.072) = 104.17$$

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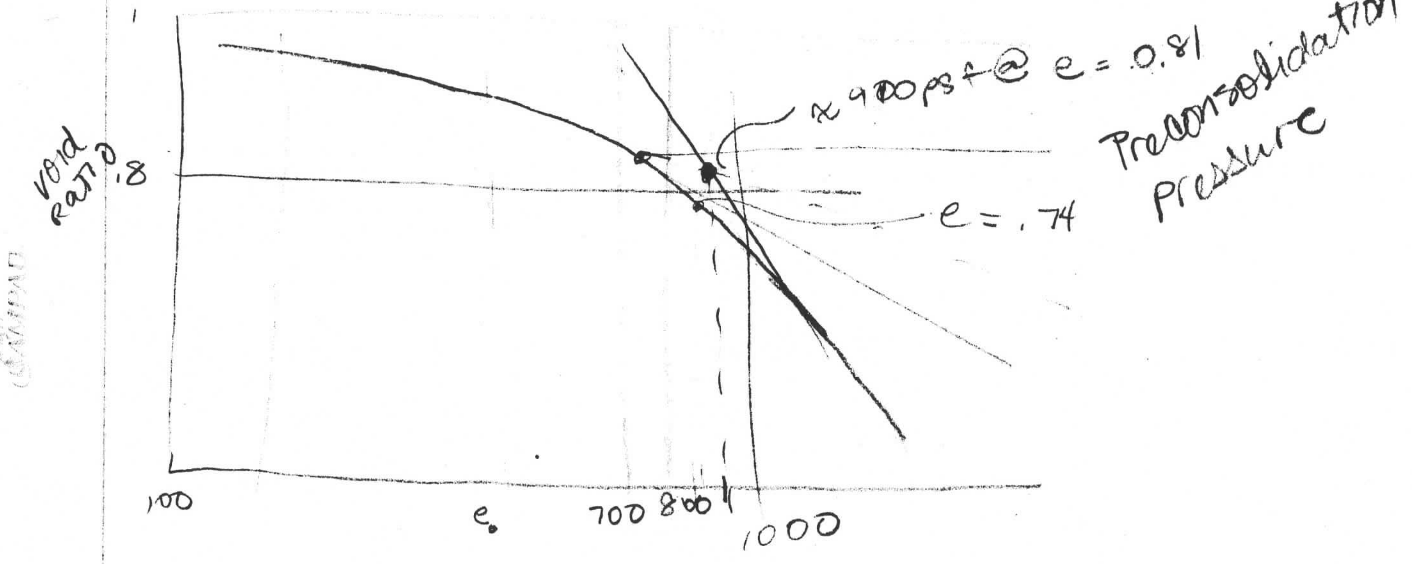
n	m
4	.108
4.167	m
5	.072

$$m = \frac{5-4}{.072-.108} = \frac{4.167-4}{m-.108} = .102$$

$$\Delta\sigma_{AVG} = \frac{225.12 + (4)(147.6) + 104.12}{6} = \Delta\sigma_{AVG} = 153.27$$

3) For the footing, calc. the primary consolidation settlement in the clay layer using



FROM #1: $\Delta\sigma_o' = 851.1$ psf

#2: $\Delta\sigma = 153.27$

$\Delta\sigma' = 204.37$

$e_o = .8$ (problem # 1)

$e_1 = .74$

$H_o = 6$ ft

$$\boxed{OCR = \frac{\sigma_c'}{\sigma_o} = \frac{900}{851.1} > 1}$$

$$\frac{\Delta H}{H_o} = \frac{(e_o - e_1)}{1 + e_o}$$

$$\Delta H = 6 \frac{(.8 - .74)}{1 + .8}$$

$\Delta H = 0.2$ ft $\Rightarrow$ 2.4 in

$\Delta\sigma_o' = 851.1$ psf

$+ \Delta\sigma' = 153.27$

$\sigma_1' = 1004.4$ psf

$e_o = 0.8$

$e_1 = .76$

$$S_c = \frac{C_s H_o}{1+e_o} \log\left(\frac{\sigma_c'}{\sigma_o'}\right) + \frac{C_c H_o}{1+e_o} \log\left(\frac{\sigma_o' + \Delta\sigma'}{\sigma_c'}\right)$$

4. How Long will it take to reach a consolidation settlement of 1 in.?

$C_v = .0005137 \; in^2/min$

$$t = \frac{T_v \; H_{dr}}{C_v}$$

$U = \frac{S}{S_c} \quad \frac{1}{2.4} = 0.4167$ $\qquad U < 0.6$

$\qquad\qquad\qquad\qquad .4167 < 0.6$ ✓

$T_v = (1/4)\pi U^2$

$T_v = (1/4)\pi(.4167)^2 = .1368$

H_{dr}

sand

clay $\updownarrow H_{dr}$ $\Rightarrow H_{dr} = \frac{6}{2} = 3\,ft \Rightarrow 36\,in$

sand

$t = \frac{(0.1368)(36^2)}{.0005137} = 34,5129 \; in/min$

$\Rightarrow 239.67 \Rightarrow 240 \; in./day$

5) A) Calc. the ultimate Bearing capacity assuming general shear failure

B) Calc. NET allowable bearing capacity, F.S. = 25

$q_u = 1.3 \underbrace{\not{c}}_{\phi\text{-noclay}} N_c + \underbrace{q}_{\gamma D_f \to \phi \text{ on surface}} N_q + 0.8 \left(\tfrac{1}{2} \underbrace{\gamma}_{\gamma_{AVG.}} B N_\gamma\right)$

$\gamma_{AVG} = \frac{1}{B}\left(\gamma D + \gamma'(B-D)\right)$

$= \frac{1}{7.2}\left[(85)(4) + (103-62.4)(7.2-4)\right]$

$\gamma_{AVG} = 65.27$

Tbl

$q_u = \phi + \phi + (.8)(1/2)(65.27)(7.2)(13.7)$

$q_u = 2{,}575.29$ l.

$q_{NET} = q_u - q = 2575.29 = q_{NET}$

$q_{allow} = \frac{q_{NET}}{F.S} = \frac{2575.29}{2.5} = 1{,}030.12$

$(F.S.)\, q_{allow} = q_{NET} \Rightarrow (2.5)(1446.8) = \boxed{3{,}617 = q_{NET}}$

6) (A) Use prev. calc, is the applied load w/in the allowable limit? You must Validate your Response w/ calculations (B) If Bearing capacity does not govern the design (the applied load is calculated to be w/in the allowable limit), then how might the primary consolidation settlement be reduced? (C) If the bearing capacity governs the design (the applied load is calculated to be outside the allowable limit), then how might the bearing capacity be increased?

A) $q_{allow} = \frac{q_{net}}{S.F.}$

$1{,}446.8 > 1{,}030$

$\frac{1446.8}{1030} = 1.4 \approx 1$

barely w/in allowable Limit
but compared to F.S. 2.5, not allowable

if F.S. is < 1, it's not good

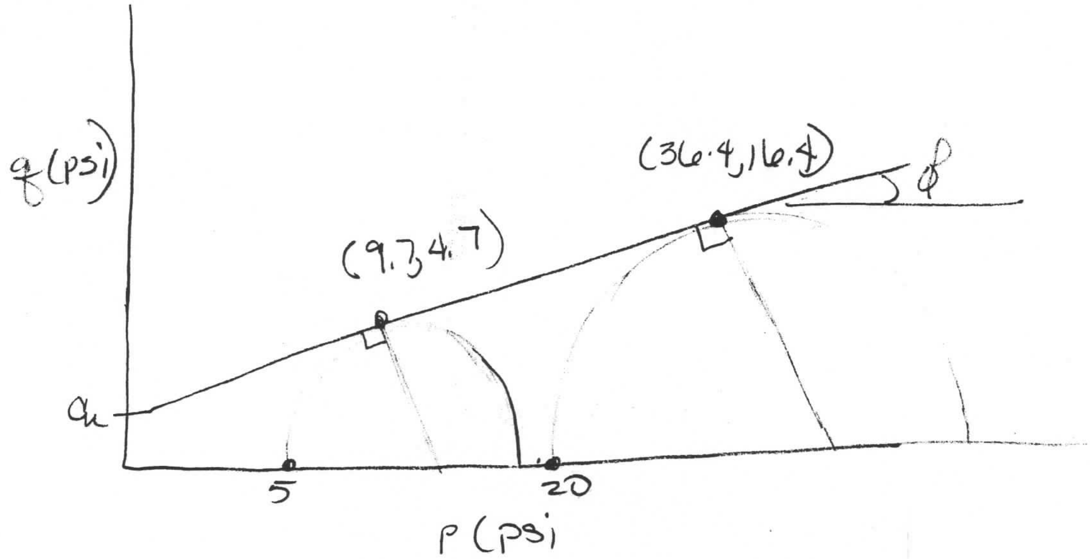
B.) By compacting, we reduce void ratio

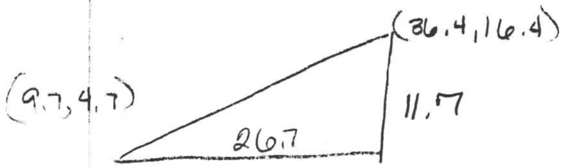
C.) - increase surface area
- put the footing under ground
& incr. depth & compact soil

7.) The stress path from a CD triaxial test on a soil sample is plotted

A) Plot Mohr's circle @ failure for the 2 tests run @ confining pressures of $\bar{5}$ & 20 psi

B) Determine the cohesion & friction angle for the soil sample.





$\phi = \tan^{-1}\left(\frac{11.7}{26.7}\right) = 23.66$

$90 - 23.66 = 66.33$

$\sin 66.3° = \frac{4.7}{R}$

$R = 5.13$

$\sigma_1 = 5 + 2(5.13)$

$\underline{\sigma_1 = 15.26}$

$\sin 66.3° = \frac{16.4}{R'}$

$R' = 18.24$

$\underline{\sigma_1 = 56.48}$

$\tau = c' + \sigma' \tan\phi'$

$4.7 = c' + (9.7)(0.4382)$

$\underline{C = 0.4495}$

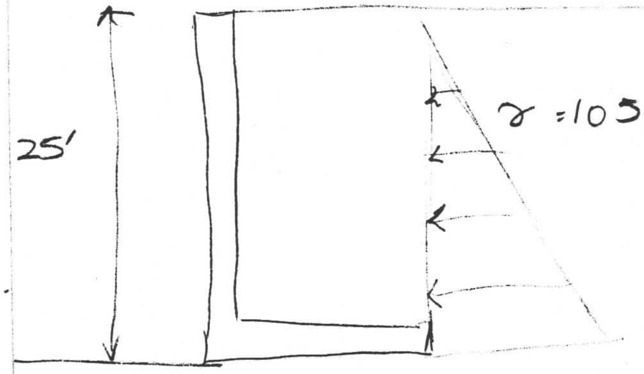
$2\theta = 90 + \phi$

$\theta = 56.83$

8) Using the results from 7,

A) plot the lateral stress distribution along the 25' frictionless, flexible wall shown below

B.) Determine the magnitude of the overturning moment about the TOE



$\sigma = \gamma H = (105)(25)$
$\sigma = 2,625$

no clay

$\sigma_H' = K_A \sigma_v' - \cancel{2c}\sqrt{K_A}$

$\sigma_H' = K_A \sigma_v'$

$K_A = \tan^2(45 - \frac{\phi}{2}) = \tan^2(45 - \frac{23.66}{2})$

$K_A = .427$

$\sigma_v = \gamma H = (105)(25) = 2,625$

$\sigma_H' = (2625)(.427) = 1120.88$

$R = (1/2)(25)(1120.88) = 14,011$

$M = (14.011)(\frac{25}{8.3}) = 116.7$ kip