

Assignment 2 - Solutions

Question 1

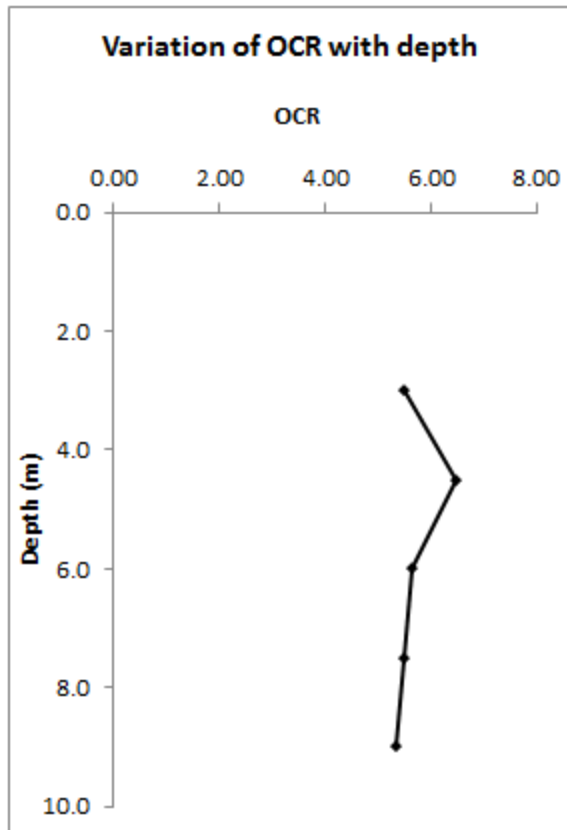
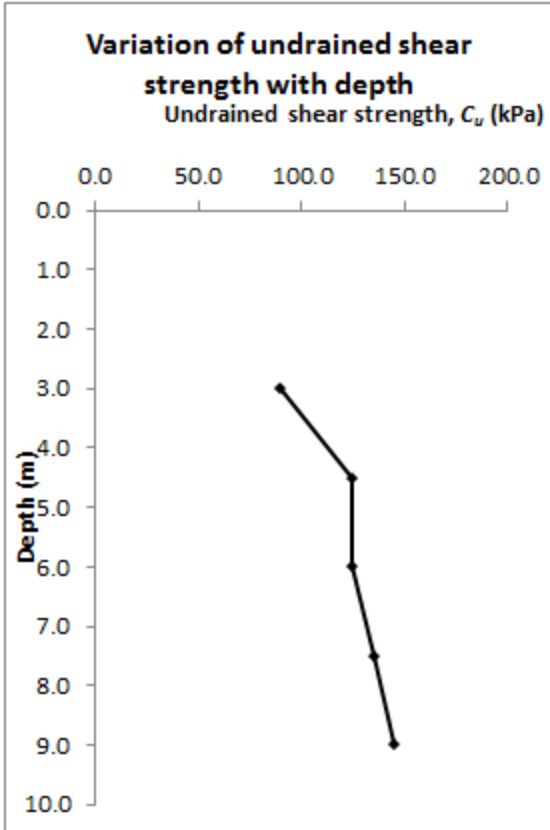
$$(N_1)_{60} = C_N N_{60} \text{ where: } C_N = \left[\frac{1}{\left(\frac{\sigma'_0}{P_a} \right)} \right]^{0.5} < 1.7$$

Depth (m)	N_{60}	σ'_{vo} (kPa)	C_N	$C_{N(\text{design})}$	$(N_1)_{60}$	ϕ'	tangent term	
1.50	6	27.0	1.92	1.70	10.2	34.7	0.692	
3.00	8	54.0	1.36	1.36	10.9	34.9	0.697	
4.50	9	81.0	1.11	1.11	10.0	34.0	0.675	
6.00	8	108.0	0.96	0.96	7.7	31.4	0.611	
7.50	13	123.6	0.90	0.90	11.7	34.9	0.699	
9.00	14	139.2	0.85	0.85	11.9	34.9	0.697	
Design ϕ' (average)							34	

$\gamma_d = 18 \text{ kPa}$
 $\gamma_{\text{sat}} = 20 \text{ kPa}$

Question 2

Depth from ground surface (m)	N_{60}	c_u (kN/m ²)	σ'_o (MN/m ²)	OCR
3.0	5	89.47	$\frac{1}{1000} [(1.5)(16.5) + (1.5)(19 - 9.81)]$ = 0.03854	5.51
4.5	8	124.33	$0.03854 + \frac{1}{1000} (1.5)(16.8 - 9.81)$ = 0.0490	6.46
6.0	8	124.33	$0.0490 + \frac{1}{1000} (1.5)(16.8 - 9.81)$ = 0.0595	5.65
7.5	9	135.01	$0.0595 + \frac{1}{1000} (1.5)(16.8 - 9.81)$ = 0.07	5.48
9.0	10	145.34	$0.07 + \frac{1}{1000} (1.5)(16.8 - 9.81)$ = 0.0805	5.35



Question 3

Parameters:

Vane dimensions : D=60 mm, H=120 mm

Liquid limit: LL=100%

Plastic limit: PL=30%

Calculation:

$$K = \left(\frac{\pi}{10^6}\right) \left(\frac{D^2 H}{2}\right) \left(1 + \frac{D}{3H}\right) = \left(\frac{3.141593}{10^6}\right) \left(\frac{60^2 \times 120}{2}\right) \left(1 + \frac{60}{3 \times 120}\right) = 0.7917 \text{ m}^3$$

Tested shear strength:

$$C_u = \frac{T}{K}$$

$$PI = LL - PL = 100 - 30 = 70\%$$

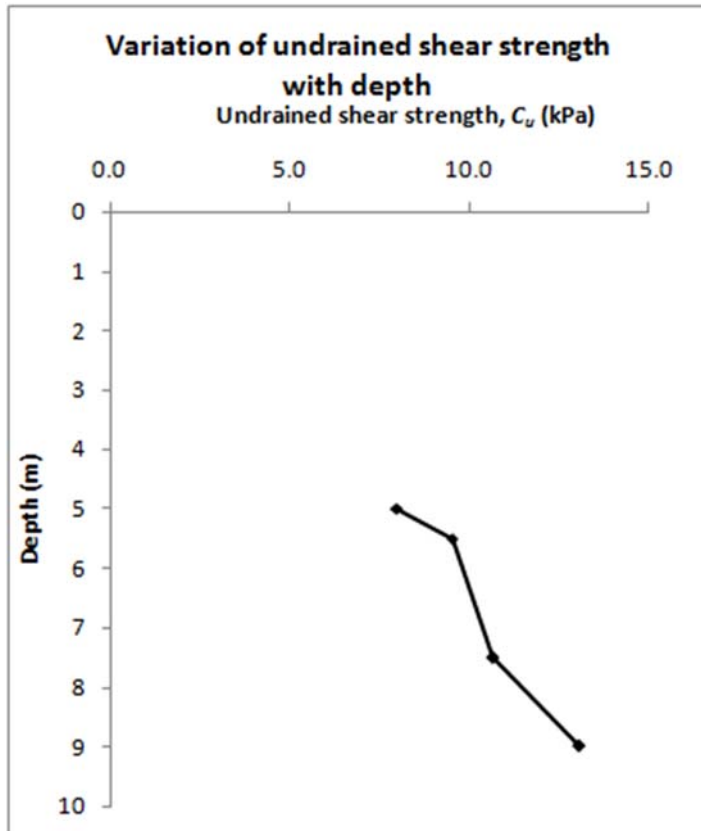
$$\text{Bjerrum's correlation factor: } \lambda = 1.7 - 0.54 \log[PI(\%)] = 1.7 - 0.54 \log 70 = 0.704$$

$$\text{Shear strength: } C_{u(\text{corrected})} = \lambda C_u$$



Depth (m)	T (N.m)	K (-)	C_u (kPa)	λ	$C_{u\ corr.}$ (kPa)
5	9	0.7917	11.37	0.704	8.0
5.5	10.7	0.7917	13.52	0.704	9.5
7.5	12	0.7917	15.16	0.704	10.7
9	14.7	0.7917	18.57	0.704	13.1

LL = 100
 PL = 30
 d = 60 mm
 h = 120 mm





Question 4

Solution

a) $B = 2.0 \text{ m}$

$L = \infty$

$D_f = 1.0 \text{ m}$

$\phi' = 30^\circ$

$c' = 0$

$\gamma = 17 \text{ kN/m}^3$

Terzaghi's BC eq. for strip footings:

$$q_u = c' N_c + q N_q + \frac{1}{2} \gamma B N_\gamma$$

For $\phi' = 30^\circ$ from Table $\rightarrow N_q = 22.46 \quad N_\gamma = 19.13$

$q = D_f \times \gamma = 1.0 \times 17 = 17 \text{ kN/m}^2$

$q_u = (17)(22.46) + \frac{1}{2} (17)(2.0)(19.13) = 707.03 \text{ kN/m}^2$

$q_{all} = \frac{q_u}{FS} = \frac{707.03}{4.0} = 176.76 \text{ kN/m}^2$

b) $B = 3.0 \text{ m}$

$L = 3.0 \text{ m}$

$D_f = 1.0 \text{ m}$

$\phi' = 30^\circ$

$c' = 0$

$\gamma = 16.5 \text{ kN/m}^3$

Terzaghi's BC eq. for square footings:

$$q_u = 1.3 c' N_c + q N_q + 0.4 \gamma B N_\gamma$$

For $\phi' = 30^\circ$ from Table $\rightarrow N_q = 22.46 \quad N_\gamma = 19.13$

$q = D_f \times \gamma = 1.0 \times 16.5 = 16.5 \text{ kN/m}^2$

$q_u = (16.5)(22.46) + 0.4 (16.5)(3.0)(19.13) = 749.36 \text{ kN/m}^2$

$q_{all} = \frac{q_u}{FS} = \frac{749.36}{4.0} = 187.34 \text{ kN/m}^2$