Course No: CVL 2402
Course Title: Foundation Engineering
Date: 11/1/2017
No. of Questions: (3)
Time: 2 hr
Using Calculator (Yes)

University of Palestine

Final Exam
First Semester
2016/2017
Total Grade: 50

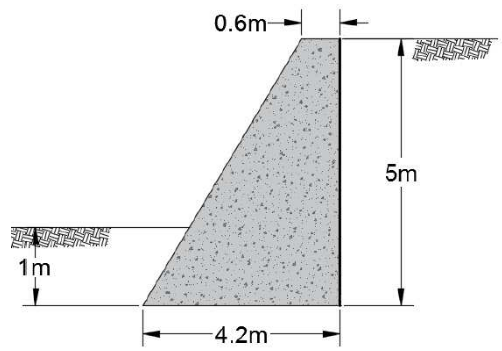
Instructor Name: Dr. Sari Abusharar
Student No.: ________________
Student Name: ______________
College Name: Engineering
Dep. / Specialist: Civil Engineering
Using Dictionary (No)

Answer All Questions

50

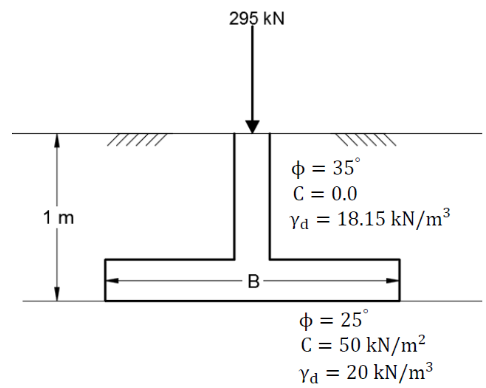
First Question 20/50

A gravity retaining wall shown in the figure below is required to retain 5 m of soil. The backfill is a granular soil with unit weight, γ =18 kN/m^3, and friction angle of ϕ=30^o. The existing soil below the base has the following properties: γ=19 kN/m^3, ϕ=26^o and c = 40 kN/m^2. The wall is embedded 1m into the existing soil. Determine the stability (overturning, sliding, bearing capacitty) of the wall assuming that there is no friction between the soil and the wall. Take K_1=K_2 = 2/3.



Second Question	**10/50**

Determine the size of square footing to carry net allowable load of 295 KN with FS=3. Use Terzaghi equation assuming general shear failure.

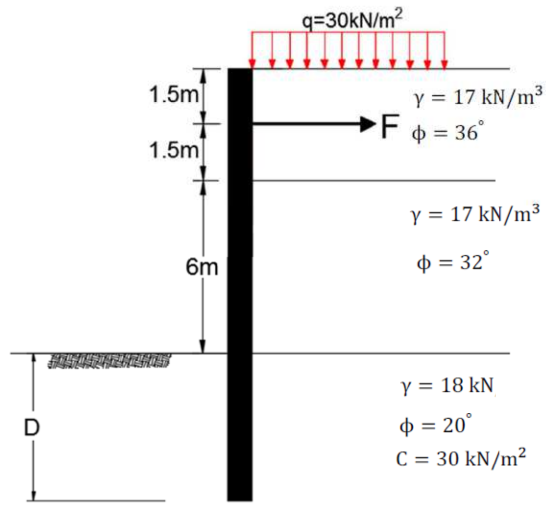


Course No: CVL 2402	**University of Palestine**	**Instructor Name:** Dr. Sari Abusharar
Course Title: Foundation Engineering		**Student No.:** ________________
Date: 11/1/2017		**Student Name:** ______________
No. of Questions: (3)	**Final Exam**	**College Name:** Engineering
Time: 2 hr	**First Semester**	**Dep. / Specialist:** Civil Engineering
Using Calculator (Yes)	**2016/2017**	**Using Dictionary** (No)
	Total Grade: 50	

Third Question **20/50**

An anchored sheet-pile bulkhead is shown below. Use the free earth support method to:

a. Draw the lateral earth pressure distribution with depth.
b. Determine the theoretical depth of embedment, D.
c. Calculate the anchor force per unit length of the sheet-pile wall.
d. Calculate the maximum moment



Course No: CVL 2402 **Course Title:** Foundation Engineering **Date:** 11/1/2017 **No. of Questions:** (3) **Time:** 2 hr **Using Calculator** (Yes)	**University of Palestine** **Final Exam** **First Semester** **2016/2017** **Total Grade: 50**	**Instructor Name:** Dr. Sari Abusharar **Student No.:** ________________ **Student Name:** ______________ **College Name:** Engineering **Dep. / Specialist:** Civil Engineering **Using Dictionary** (No)

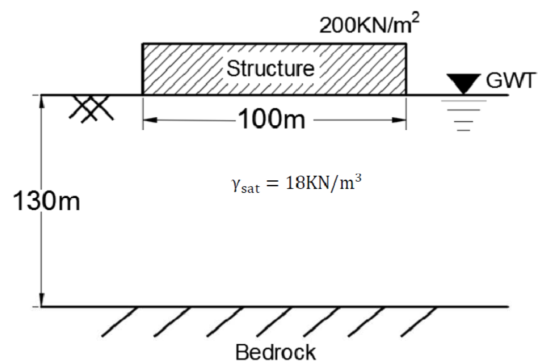
هذا الجزء خاص بالطلاب الذين تغيبوا عن الامتحان النصفي الثاني

First Question	**15/15**

A. Mark each of the following statements True (T) or False (F)

1.	When the area ratio is 10% or less, the sample generally is considered to be disturbed.	
2.	A recovery ratio of unity indicates the presence of fractured rock.	
3.	Samples obtained by a thin-walled tube sampling method are less disturbed than samples obtained by split-spoon sampling method.	
4.	The net allowable bearing capacity increases by increasing the depth of embedment.	
5.	Disturbed soil samples cannot be used for consolidation, hydraulic conductivity, or shear strength tests.	

B. Site investigation is to be made for a structure of 100 m length and 100 m width. The soil profile is shown below, if the structure is subjected to 200 KN/m^2, what is the approximate depth of borehole (Assume γ_w=10KN/m^3).



End of Questions
Good Luck

Useful Formulae

Stress Calculation using 2V:1H Method

$$\Delta\sigma = \frac{q_o \times B \times L}{(B+z)(L+z)}$$

$$q_u = 1.3c'N_c + qN_q + 0.4\gamma BN_\gamma \quad \text{(square foundation)}$$

Table 3.1 Terzaghi's Bearing Capacity Factors—Eqs. (3.4), (3.5), and (3.6) a From Kumbhojkar (1993)

ϕ'	N_c	N_q	N_γ[a]	ϕ'	N_c	N_q	N_γ[a]
0	5.70	1.00	0.00	26	27.09	14.21	9.84
1	6.00	1.10	0.01	27	29.24	15.90	11.60
2	6.30	1.22	0.04	28	31.61	17.81	13.70
3	6.62	1.35	0.06	29	34.24	19.98	16.18
4	6.97	1.49	0.10	30	37.16	22.46	19.13
5	7.34	1.64	0.14	31	40.41	25.28	22.65
6	7.73	1.81	0.20	32	44.04	28.52	26.87
7	8.15	2.00	0.27	33	48.09	32.23	31.94
8	8.60	2.21	0.35	34	52.64	36.50	38.04
9	9.09	2.44	0.44	35	57.75	41.44	45.41
10	9.61	2.69	0.56	36	63.53	47.16	54.36
11	10.16	2.98	0.69	37	70.01	53.80	65.27
12	10.76	3.29	0.85	38	77.50	61.55	78.61
13	11.41	3.63	1.04	39	85.97	70.61	95.03
14	12.11	4.02	1.26	40	95.66	81.27	115.31
15	12.86	4.45	1.52	41	106.81	93.85	140.51
16	13.68	4.92	1.82	42	119.67	108.75	171.99
17	14.60	5.45	2.18	43	134.58	126.50	211.56
18	15.12	6.04	2.59	44	151.95	147.74	261.60
19	16.56	6.70	3.07	45	172.28	173.28	325.34
20	17.69	7.44	3.64	46	196.22	204.19	407.11
21	18.92	8.26	4.31	47	224.55	241.80	512.84
22	20.27	9.19	5.09	48	258.28	287.85	650.67
23	21.75	10.23	6.00	49	298.71	344.63	831.99
24	23.36	11.40	7.08	50	347.50	415.14	1072.80
25	25.13	12.72	8.34				

[a]From Kumbhojkar (1993)

Table 3.3 Bearing Capacity Factors

ϕ'	N_c	N_q	N_γ	ϕ'	N_c	N_q	N_γ
0	5.14	1.00	0.00	26	22.25	11.85	12.54
1	5.38	1.09	0.07	27	23.94	13.20	14.47
2	5.63	1.20	0.15	28	25.80	14.72	16.72
3	5.90	1.31	0.24	29	27.86	16.44	19.34
4	6.19	1.43	0.34	30	30.14	18.40	22.40
5	6.49	1.57	0.45	31	32.67	20.63	25.99
6	6.81	1.72	0.57	32	35.49	23.18	30.22
7	7.16	1.88	0.71	33	38.64	26.09	35.19
8	7.53	2.06	0.86	34	42.16	29.44	41.06
9	7.92	2.25	1.03	35	46.12	33.30	48.03
10	8.35	2.47	1.22	36	50.59	37.75	56.31

$$FS_{(\text{overturning})} = \frac{\Sigma M_R}{\Sigma M_o}$$

$$FS_{(\text{sliding})} = \frac{(\Sigma V)\tan(k_1\phi_2') + Bk_2c_2' + P_p}{P_a\cos\alpha}$$

$$FS_{(\text{bearing capacity})} = \frac{q_u}{q_{\max}}$$

$$e = \frac{B}{2} - \frac{\Sigma M_R - \Sigma M_o}{\Sigma V}$$

$$q_{\substack{\text{toe}\\ \text{heel}}} = \frac{\Sigma V}{B}\left(1 \pm \frac{6e}{B}\right)$$

$$q_u = c_2' N_c F_{cd} F_{ci} + q N_q F_{qd} F_{qi} + \tfrac{1}{2}\gamma_2 B' N_\gamma F_{\gamma d} F_{\gamma i}$$

where

$$q = \gamma_2 D$$

$$B' = B - 2e$$

$$F_{cd} = F_{qd} - \frac{1 - F_{qd}}{N_c \tan\phi_2'}$$

$$F_{qd} = 1 + 2\tan\phi_2'(1 - \sin\phi_2')^2\frac{D}{B'}$$

$$F_{\gamma d} = 1$$

$$F_{ci} = F_{qi} = \left(1 - \frac{\psi^\circ}{90^\circ}\right)^2$$

$$F_{\gamma i} = \left(1 - \frac{\psi^\circ}{\phi_2'^\circ}\right)^2$$

$$\psi^\circ = \tan^{-1}\left(\frac{P_a\cos\alpha}{\Sigma V}\right)$$