Course No: CVL 2402
Course Title: Foundation Engineering
Date: 28/11/2017
No. of Questions: (3)
Time: 1 hr
Using Calculator (Yes)

University of Palestine

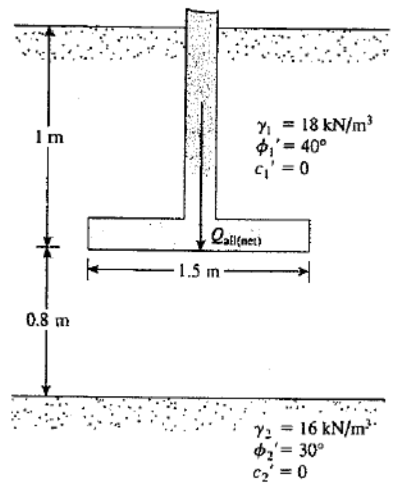
Midterm Exam
First semester
2017/2018
Total Grade: 15

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

Answer All Questions

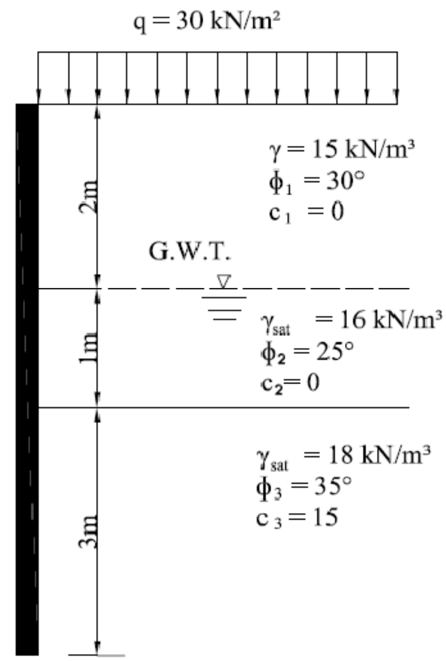
First Question	5/15

A square foundation on a layered sand as shown below. Determine the net allowable load that the foundation can support using a FS = 4.



Second Question	**5/15**

Determine the Rankine passive force per unit length of the wall.



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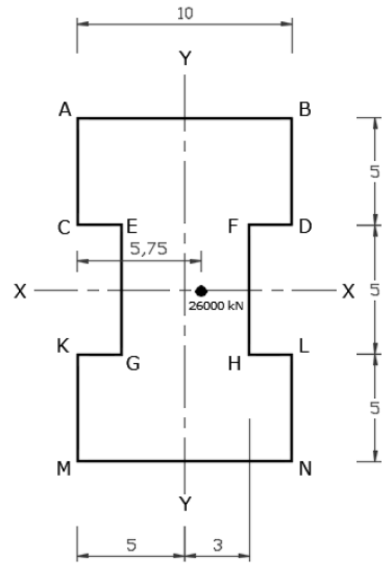
Third Question 5/15

Calculate the base pressure at the points: A, D, F, G and M indicated below the mat foundation as shown in the below figure. Total vertical load acting on the foundation is 26000 kN and its location is shown in the figure.



(All dimensions are in meters)

End of Questions
Good Luck

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Useful Formulae

For Stronger Soil Underlain by Weaker Soil

$$q_u = q_b + \left(1 + \frac{B}{L}\right)\left(\frac{2c'_a H}{B}\right) + \gamma_1 H^2\left(1 + \frac{B}{L}\right)\left(1 + \frac{2D_f}{H}\right)\left(\frac{K_s \tan\phi'_1}{B}\right) - \gamma_1 H \le q_t$$

$$q_b = c'_2 N_{c(2)} F_{cs(2)} + \gamma_1 (D_f + H) N_{q(2)} F_{qs(2)} + \frac{1}{2}\gamma_2 B N_{\gamma(2)} F_{\gamma s(2)}$$

$$q_t = c'_1 N_{c(1)} F_{cs(1)} + \gamma_1 D_f N_{q(1)} F_{qs(1)} + \frac{1}{2}\gamma_1 B N_{\gamma(1)} F_{\gamma s(1)}$$

$$q_1 = c'_1 N_{c(1)} + \tfrac{1}{2}\gamma_1 B N_{\gamma(1)} \qquad q_2 = c'_2 N_{c(2)} + \tfrac{1}{2}\gamma_2 B N_{\gamma(2)}$$

For Weaker Soil Underlain by Stronger Soil

$$q_u = q_t + (q_b - q_t)\left(\frac{H}{D}\right)^2 \ge q_t$$

$$q_t = c_1 N_{c(1)} F_{cs(1)} + \gamma_1 D_f N_{q(1)} F_{qs(1)} + \frac{1}{2}\gamma_1 B N_{\gamma(1)} F_{\gamma s(1)}$$

$$q_b = c_2 N_{c(2)} F_{cs(2)} + \gamma_2 D_f N_{q(2)} F_{qs(2)} + \frac{1}{2}\gamma_2 B N_{\gamma(2)} F_{\gamma s(2)}$$

$D \approx B$ for loose sand and clay
$D \approx 2B$ for dense sand

Meyerhoff equation

$$q'_u = c' N_c F_{cs} F_{cd} F_{ci} + q N_q F_{qs} F_{qd} F_{qi} + \tfrac{1}{2}\gamma B' N_\gamma F_{\gamma s} F_{\gamma d} F_{\gamma i}$$

$$q = \frac{Q}{A} \pm \frac{M_y x}{I_y} \pm \frac{M_x y}{I_x}$$

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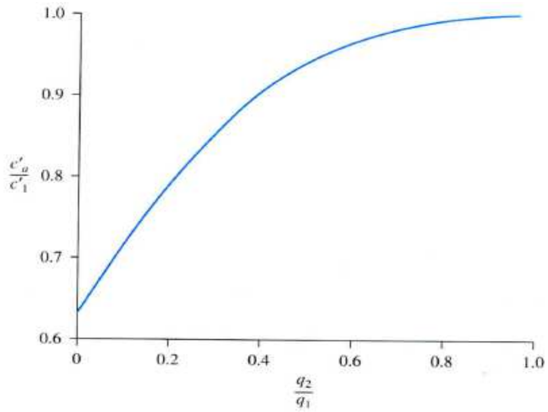

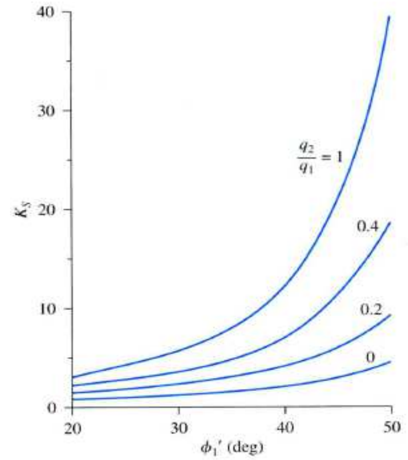

Table 3.3 Bearing Capacity Factors

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
11	8.80	2.71	1.44	37	55.63	42.92	66.19
12	9.28	2.97	1.69	38	61.35	48.93	78.03
13	9.81	3.26	1.97	39	67.87	55.96	92.25
14	10.37	3.59	2.29	40	75.31	64.20	109.41

Factor	Relationship	Reference
Shape	$F_{cs} = 1 + \left(\frac{B}{L}\right)\left(\frac{N_q}{N_c}\right)$	DeBeer (1970)
	$F_{qs} = 1 + \left(\frac{B}{L}\right)\tan\phi'$	
	$F_{\gamma s} = 1 - 0.4\left(\frac{B}{L}\right)$	
Depth	$\frac{D_f}{B} \le 1$	Hansen (1970)
	For $\phi = 0$:	
	$F_{cd} = 1 + 0.4\left(\frac{D_f}{B}\right)$	
	$F_{qd} = 1$	
	$F_{\gamma d} = 1$	
	For $\phi' > 0$:	
	$F_{cd} = F_{qd} - \frac{1 - F_{qd}}{N_c \tan\phi'}$	
	$F_{qd} = 1 + 2\tan\phi'(1 - \sin\phi')^2\left(\frac{D_f}{B}\right)$	
	$F_{\gamma d} = 1$	