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241 batch (MUSFIK)

Daffodil International University
B.Sc. in Civil Engineering
Final Examination, Summer - 2026

Course Code: CE 333	Course Title: Foundation Engineering	
Section: A & B	Level-Term: 3-2	Teacher's Initial: MLE
Full Marks: 40	Date: August 22, 2026	Time: 2.0 Hours

Note: There are four questions in total; answer all. Right hand margin indicates full marks.

1. a) An eccentrically loaded continuous foundation is shown in Figure 1.a. If the load eccentricity is 0.2 m, determine the net allowable load per unit length of the foundation with a safety factor of 3.0. Use Meyerhof's effective area method. *[CO3, C3]* [05]

   b) Proportion the trapezoidal combined foundation as shown in Figure 1.b. Assume that the soil supporting the footing has a net allowable pressure of 120 kN/m^2. *[CO3, C3]* [05]

2. a) It is proposed to construct an 8-story building on the soil profile shown in Figure 2.a. The building requires a basement and will be supported on a 15 m × 20 m mat foundation carrying a total load of 48,000 kN. The mat is to be designed as a partially compensated foundation. Determine the required foundation depth to satisfy the basement requirement while achieving a factor of safety of 3.0 against bearing capacity failure. *[CO3, C3]* [05]

   b) Using the information from Question 2.a, estimate the primary consolidation settlement at the center of the same mat foundation. Is the computed settlement within the safe limit? *[CO3, C3]* [05]

3. a) Determine the group allowable load (Q_{ga}) with a safety factor of 2.5 for the concrete driven circular piles as shown in Figure 3.a. The diameter of each pile is D = 0.35 m and center-to-center (d) is 1.0 m. *[CO3, C3]* [05]

   b) Determine the maximum load that can be allowed on the 450 mm diameter concrete driven pile shown in Figure 3.b, with a factor of safety of 3. Use the α method for determining the skin friction. *[CO3, C3]* [05]

4. a) An embankment has to be constructed on an existing clay layer using uniform sand to a height of 6 m with a side slope of 1V:1.5H as shown in the Figure 4.a. A firm base underlies the embankment at a depth of 3 m below the ground surface. Analyze the stability of the side slope against failure. Use the attached graph and a scale of 1 grid equal to 0.2 m for drawing the slope. *[CO5, C4]* [07]

   b) Describe slurry construction method of bored pile. *[CO4, C2]* [03]

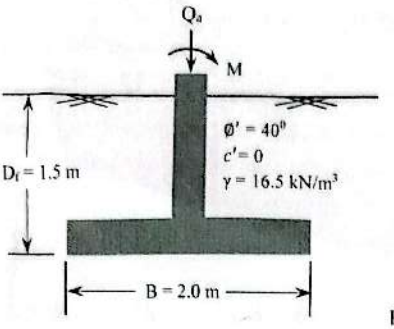


Figure 1.a

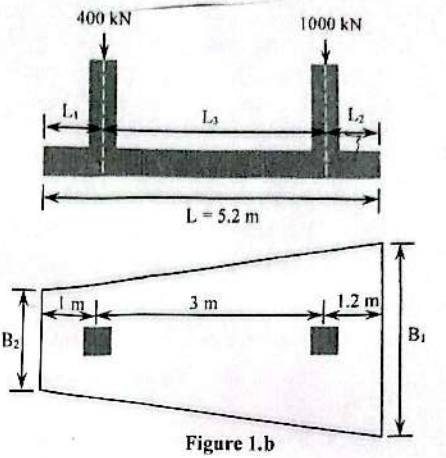


Figure 1.b

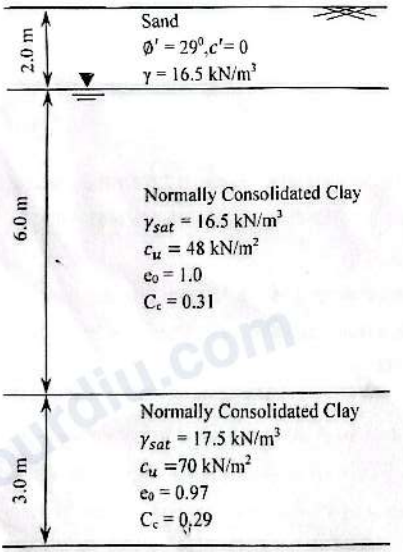
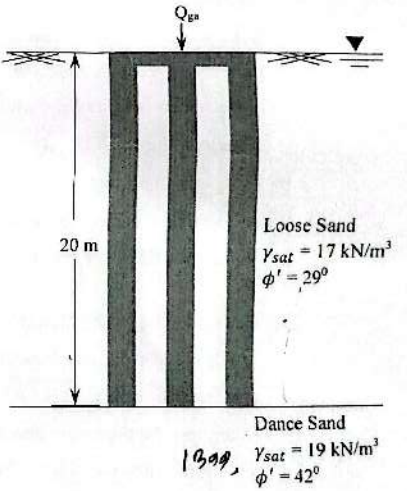


Figure 2.a



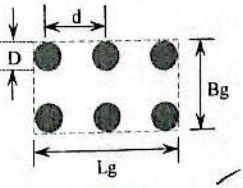


Figure 3.a

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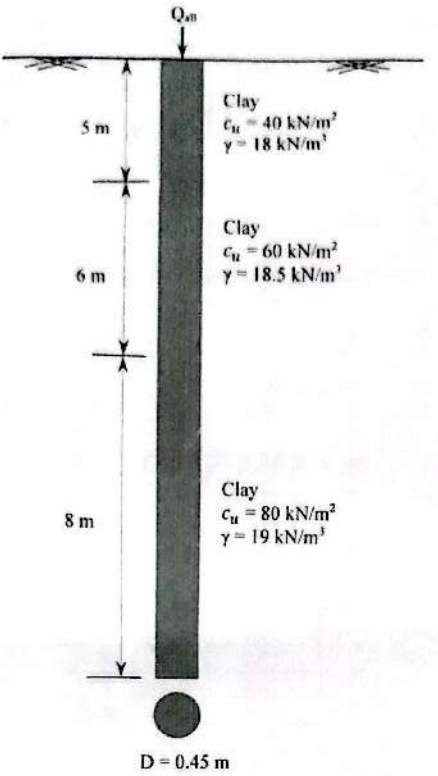


Figure 3.b

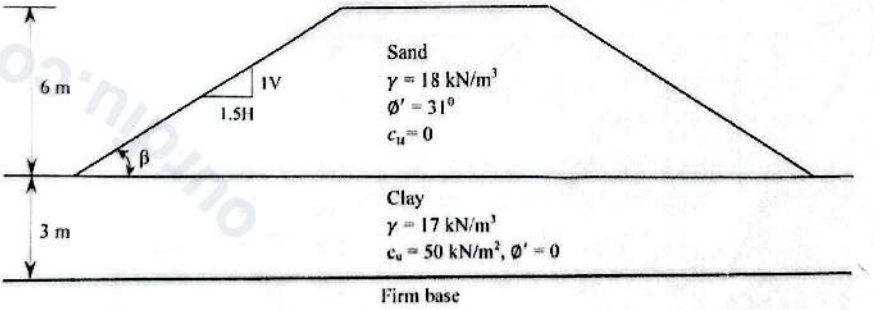


Figure 4.a

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Necessary equations and data:

$$I_4 = \frac{2}{\pi}\left[\left(\frac{m_1 n_1}{\sqrt{1+m_1^2+n_1^2}} \times \frac{1+m_1^2+2n_1^2}{(1+n_1^2)(m_1^2+n_1^2)}\right) + \left(sin^{-1}\frac{m_1}{\sqrt{m_1^2+n_1^2}\sqrt{1+n_1^2}}\right)\right]$$

Where, $m_1 = L/B$, $n_1 = 2z/B$

Equation for primary consolidation settlement (normally consolidated clay)

$$S_c = \frac{C_c H}{1+e_0} log\left(\frac{\sigma_0' + \Delta\sigma'}{\sigma_0'}\right)$$

$$Q_u = c_u N_c A_p + \alpha \overline{c_u} A_s$$

$$Q_u = q' N_q^* A_p + K \overline{\sigma_0'} \tan\delta' A_s \quad (Q_p \le A_p 0.5 P_a N_q^* \tan\emptyset')$$

Table: Variation of adhesion factor (α)

$\frac{c_u}{P_a}$	α	$\frac{c_u}{P_a}$	α
0.1	1	1.2	0.42
0.2	0.92	1.4	0.4
0.3	0.82	1.6	0.38
0.4	0.74	1.8	0.36
0.6	0.62	2	0.35
0.8	0.54	2.4	0.34
1	0.48	2.8	0.34

Note: P_a = atmospheric pressure $\approx$ 100 kN/m^2 or 2000 lb/ft^2

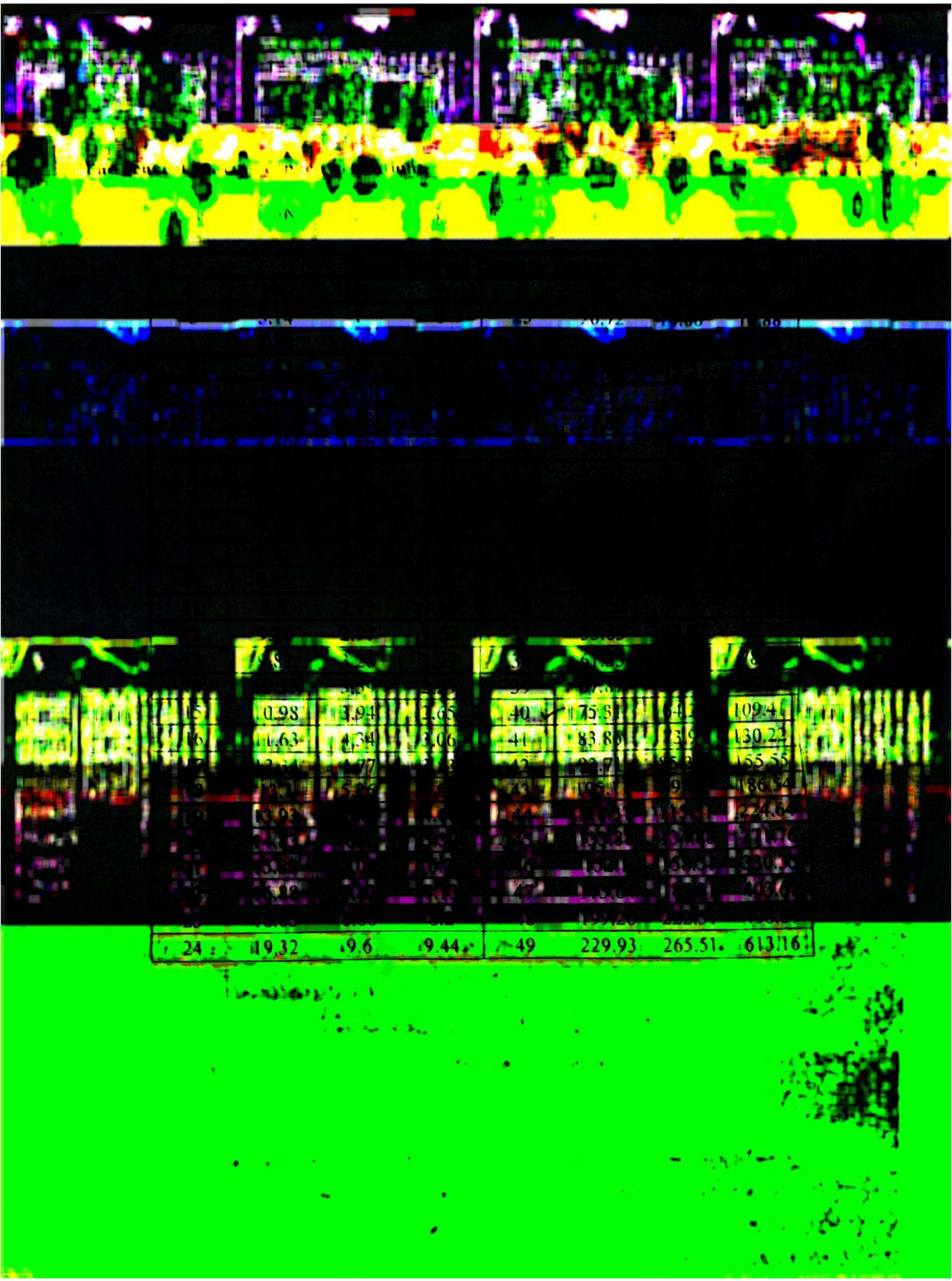
Table: Variation of N_q^* with $\emptyset'$.

$\emptyset'$	N_q^*	$\emptyset'$	N_q^*	$\emptyset'$	N_q^*	$\emptyset'$	N_q^*
20	12.4	27	34	34	115	41	420
21	13.8	28	39.7	35	143	42	525
22	15.5	29	46.5	36	168	43	650
23	17.9	30	56.7	37	194	44	780
24	21.4	31	68.2	38	231	45	930
25	26	32	81	39	276		
26	29.5	33	96	40	346		

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Table: Shape, Depth, and Inclination Factors

Shape Factors	Depth Factors	Inclination factors
$F_{cs} = 1 + \left[\left(\frac{B}{L}\right) \times \left(\frac{N_q}{N_c}\right)\right]$ $F_{qs} = 1 + \left[\left(\frac{B}{L}\right) \times tan\phi'\right]$ $F_{\gamma s} = 1 - \left[0.4 \times \left(\frac{B}{L}\right)\right]$	$\frac{D_f}{B} \leq 1; and\ \phi' = 0$ $F_{cd} = 1 + \left[0.4 \times \left(\frac{D_f}{B}\right)\right]$ $F_{qd} = F_{\gamma d} = 1$ $\frac{D_f}{B} \leq 1; and\ \phi' \geq 0$ $F_{qd} = 1 + \left[2 \times tan\phi'(1 - sin\phi')^2 \left(\frac{D_f}{B}\right)\right]$ $F_{cd} = F_{qd} - \left[\frac{1 - F_{qd}}{N_c \times tan\phi'}\right]$ $F_{\gamma d} = 1$ $\frac{D_f}{B} \geq 1; and\ \phi' = 0$ $F_{cd} = 1 + \left[0.4 \times \underbrace{tan^{-1}\left(\frac{D_f}{B}\right)}_{\text{radian}}\right]$ $F_{qd} = F_{\gamma d} = 1$ $\frac{D_f}{B} \geq 1; and\ \phi' \geq 0$ $F_{qd} = 1 + \left[2 \times tan\phi'(1 - sin\phi')^2 \times \underbrace{tan^{-1}\left(\frac{D_f}{B}\right)}_{\text{radian}}\right]$ $F_{cd} = F_{qd} - \left[\frac{1 - F_{qd}}{N_c \times tan\phi'}\right]$ $F_{\gamma d} = 1$	$F_{ci} = F_{qi} = \left(1 - \frac{\beta^0}{90}\right)^2$ $F_{\gamma i} = \left(1 - \frac{\beta^0}{\phi'}\right)^2$