

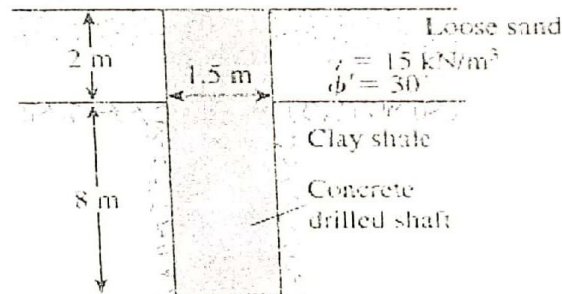
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DEPARTMENT OF CIVIL ENGINEERING
CLASS TEST ON CE-4131(2)

27-12-2017

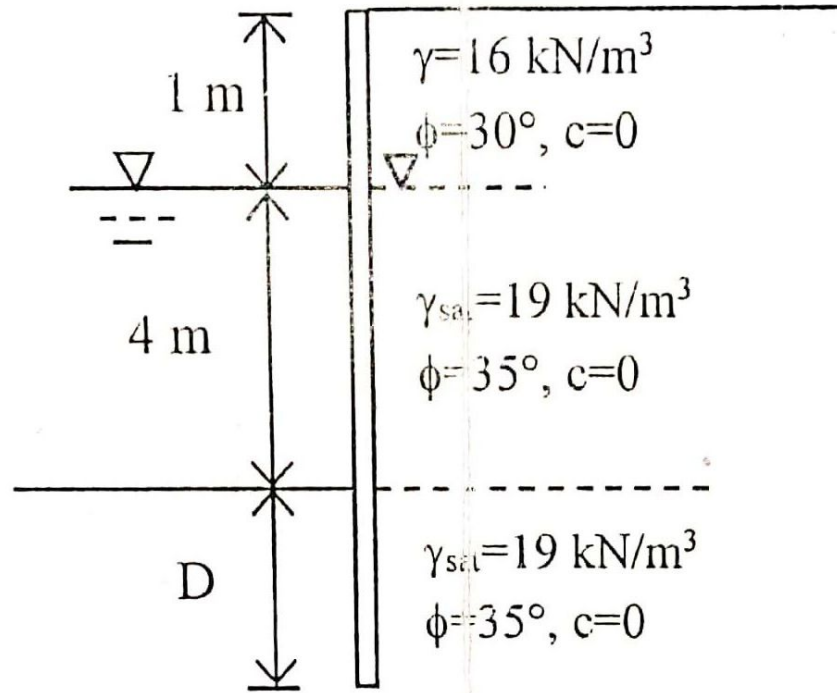
Time: 20 min.

Q.1 A drilled shaft extending into clay shale. Given: q_u (clay shale) = 1.81 MN/m^2 . Considering the socket to be rough, estimate the allowable load-carrying capacity of the drilled shaft. Use $FS = 4$.



Q.2 A drilled shaft is to be constructed without bell in a clay stratum. Given; $L_1 = 10 \text{ m}$, $D_s = 1.5 \text{ m}$, $L_2 = 6.0 \text{ m}$, $c_{u(1)} = 110 \text{ kN/m}^2$, $c_{u(2)} = 120 \text{ kN/m}^2$, $\gamma_1 = 16 \text{ kN/m}^3$ and $\gamma_2 = 18 \text{ kN/m}^3$. Determine; (a) The net ultimate point bearing capacity. (b) The ultimate skin resistance. (c) The working load, Q_w ($FS = 3$).

CT-01 CE4131 CE/RUET

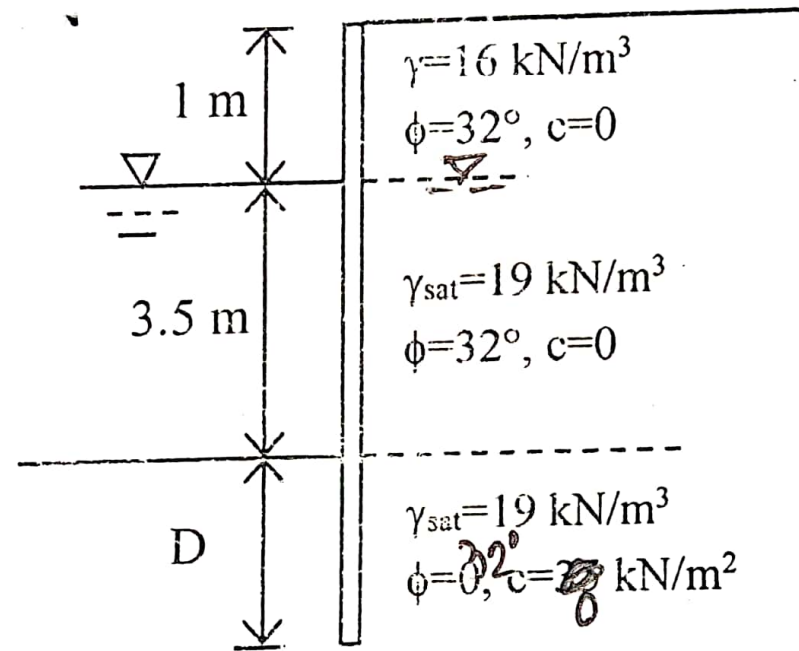


A cantilever sheet pile wall is shown in above figure.

Determine: (i) D_{act} (ii) M_{max} (iii) S if $\sigma_{\text{all}} = 160 \text{ MN/m}^2$

6.995

CT-01 CE431 CE/RUET



A cantilever sheet pile wall is shown in above figure. Determine: (i) D_{theory} (ii) Pressure Diagram with value (iii) Location of M_{max} (iv) M_{max} (v) S if $\sigma_{\text{all}} = 160 \text{ MN/m}^2$

CE 4131
Geotechnical Engineering - III

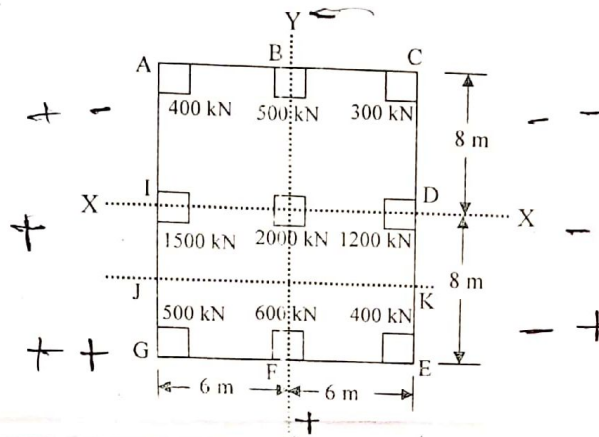
Full Marks: 72

Time: 3 Hours

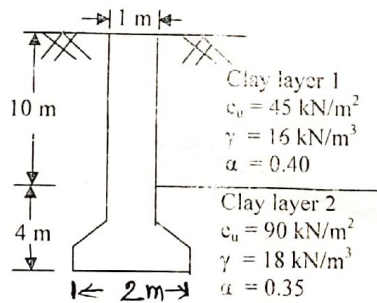
- N.B.:-**
- (i) Answer SIX questions, taking THREE from each section.
 - (ii) Figure in the margin indicates full marks.
 - (iii) Use separate answer script for each section.
 - (iv) Assume reasonable value for any data missing.

SECTION-A

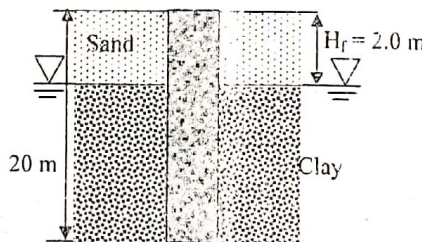
- Q.1(a) What is raft foundation? At what situation do you suggest shallow foundation instead of pile foundation? 4.00
 (b) The plan of a mat foundation with 9 columns are shown in figure below. Assuming that the mat is rigid, determine the soil pressure distribution. All the columns are of the size 0.6 m x 0.6 m. Draw the S.F. and B.M. diagrams for the strip EGJK. 8.00



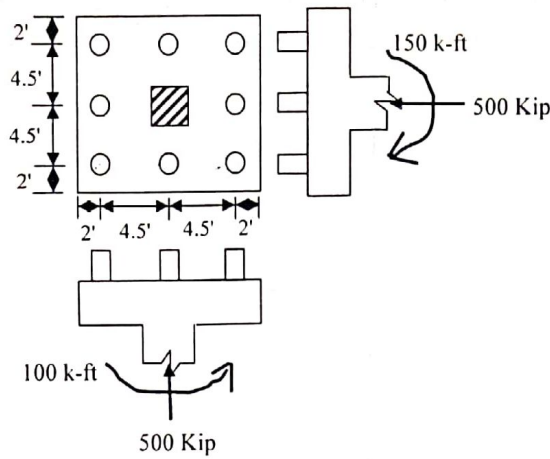
- Q.2(a) How can you determine the ultimate capacity of group piles in saturated clay? Explain. 4.00
 (b) Determine allowable load for the drilled shaft constructed in a clay deposit as shown in Figure below. Use factor of safety = 3.0. 8.00



- Q.3(a) A square concrete pile (30 cm side) 13 m long is driven into coarse sand ($\gamma = 18 \text{ kN/m}^3$, $N_{60} = 15$). Determine the allowable load (FS = 3.0). 6.00
 (b) The pile is circular in cross-section with a diameter of 0.305 m. The water table coincides with the top of the clay layer. Determine the negative skin friction. Give, $\gamma_r = 16 \text{ kN/m}^3$, $H_r = 2.0 \text{ m}$, $\phi' = 35^\circ$, $\gamma_{\text{sat}} = 17.5 \text{ kN/m}^3$, $L = 20 \text{ m}$ and $\delta' = 0.7\phi$. 6.00

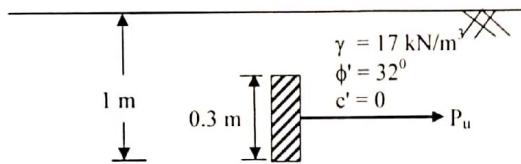


- Q.4(a) Write short notes on: (i) Laterally loaded piles (ii) Group efficiency of piles. 4.00
 (b) A pile cap is subjected to axial and biaxial moment as shown in figure below. Design the pile cap using $f'_c = 3.0 \text{ ksi}$ and $f_y = 60 \text{ ksi}$. Use pile diameter = 18" and column size = 24" x 24". 8.00

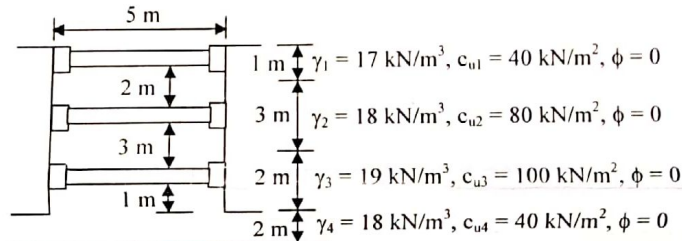


SECTION-B

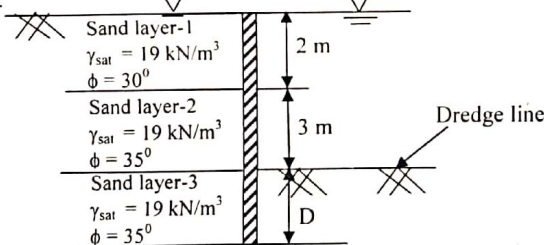
Q.5(a) A single anchor slab is shown in figure below. Calculate the ultimate holding capacity of the anchor slab if the width is (i) 0.3 m and (ii) 0.6 m. Center to center spacing, $S' = \alpha$. 3.00



Q.6(b) For the braced cut shown in figure below, determine (i) strut loads (ii) section modulus of wale (iii) section modulus of sheet pile. The struts are placed 4 m c/c in the plan. Use $\sigma_{all} = 180 \text{ MN/m}^2$. 9.00



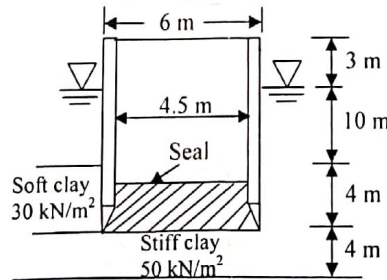
Q.6(a) A sheet pile penetrating into sand is shown in figure below. Compute the depth of embedment of sheet pile. 7.00



(b) Derive expressions for Anchor Sheet pile of calculating the depth of embedment and anchor force in sandy soil using free earth support method. 5.00

Q.7(a) What is the tilting of Caisson? Enumerate the causes of tilting of Caisson. State the measures of correcting the tilting of Caisson. 6.00

(b) An open Caisson is shown in figure below. Determine the thickness of the seal that will enable complete dewatering. 6.00



Q.8(a) Explain how you will check the stability of cellular cofferdam for sliding and overturning considering TVA method. 4.00

(b) A 3.0 Mg vertical compressor foundation system is operated at 45 Hz. The soil at the site is medium stiff clay the c_u of which is $4.2 \times 10^4 \text{ kN/m}^2$. Determine the natural frequency and magnification factor. Assume, $M_s = 0.25 m_f$. The base area of foundation is 3.0 m^2 . Consider, $D = 0$. 4.00

(c) For a given soil and sheet pile, out of Free Earth Support Method and Fixed Earth Support Method, which will give larger depth of embedment. Explain. 4.00

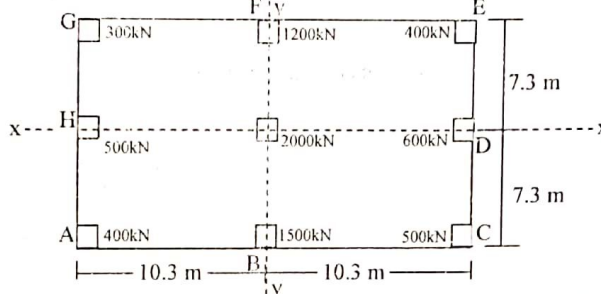
Full Marks: 72

Time: 3 Hours

- N.B.:-**
- (i) Answer SIX questions, taking THREE from each section.
 - (ii) Figure in the margin indicates full marks.
 - (iii) Use separate answer script for each section.
 - (iv) Assume reasonable value for any data missing.

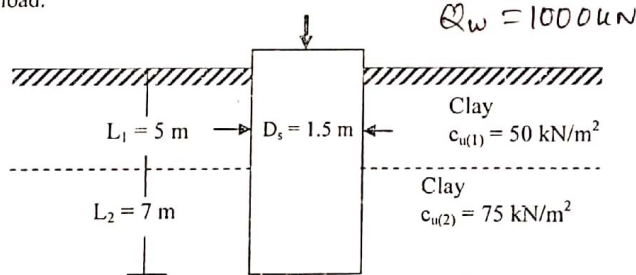
SECTION-A

- Q.1(a) Where do you provide a mat foundation? Discuss the procedure for the design of a mat foundation. 4.00
- (b) The plan of a mat foundation with 9 columns is shown in figure below. Assuming that the mat is rigid, determine the soil pressure distribution. All the columns are of the size 0.6 m x 0.6 m. 8.00

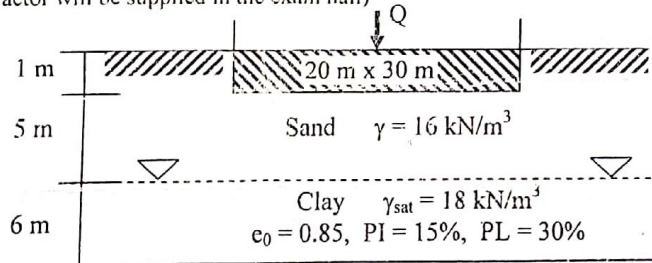


- Q.2(a) What is the basic difference between a drilled shaft and a caisson? What are the conditions in which a drilled shaft is more suitable than a caisson? 5.00
- (b) An open caisson 16 m deep has external and internal diameters of 8 m and 6 m respectively. If the water level is 2 m below the top of the well and depth of the base below the scour level is 5 m, determine the minimum thickness of the seal that will enable complete dewatering of the caisson. Assume $f_c = 2000 \text{ kN/m}^2$, $\gamma_c = 24 \text{ kN/m}^3$ and allowable perimeter shear of 650 kN/m^2 . 7.00

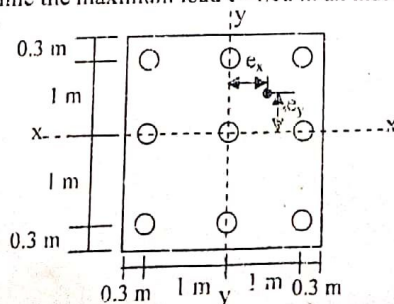
- Q.3(a) How do you determine the load bearing capacity of drilled shaft based on settlement? 4.00
- (b) A drilled shaft without a bell as shown in figure below. Assume that $E_p = 20 \times 10^6 \text{ kN/m}^2$, $C_p = 0.03$, $\xi = 0.65$, $\mu_s = 0.3$, $E_s = 12000 \text{ kN/m}^2$ and $Q_{ws} = 0.8Q_w$. Estimate the total settlement of the drilled shaft at working load. 8.00



- Q.4(a) A mat foundation 20 m x 30 m in plan as shown in figure below. The total load carried on the mat is $150 \times 10^3 \text{ kN}$. Calculate the consolidation settlement at the centre of the mat foundation. (Griffith's influence factor will be supplied in the exam hall) 6.00



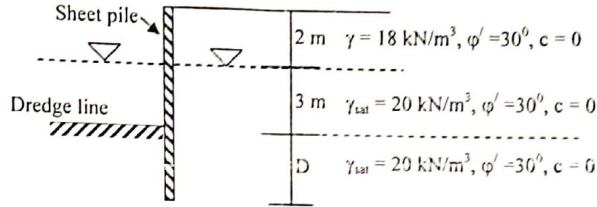
- (b) A pile group consisting of 9 piles is subjected to a load of 4 MN with eccentricity $e_x = 0.3 \text{ m}$ and $e_y = 0.4 \text{ m}$. Determine the maximum load carried in an individual pile. 6.00



SECTION-B

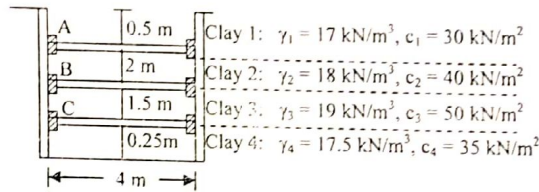
- MR } Q.5(a) Define: (i) Forced vibration, (ii) Mass-spring system, and (iii) Damping ratio. 3.00
 (b) Explain with figures different types of machine foundations. Discuss the reinforcement requirement of machine foundation. 4.00
 (c) A machine foundation weighs 70 kN and has a spring constant $K = 135000 \text{ kN/m}$. Assuming the damping coefficient, C of the system as equal to 210 kN-sec/m , determine: (i) whether the system is over damped, under damped or critically damped, (ii) the logarithmic decrement, (iii) the ratio of two successive amplitude, and (iv) damped natural frequency. 5.00

- SP } Q.6(a) A cantilever sheet pile wall is shown in figure below. Compute the depth of embedment of the sheet pile. 8.00



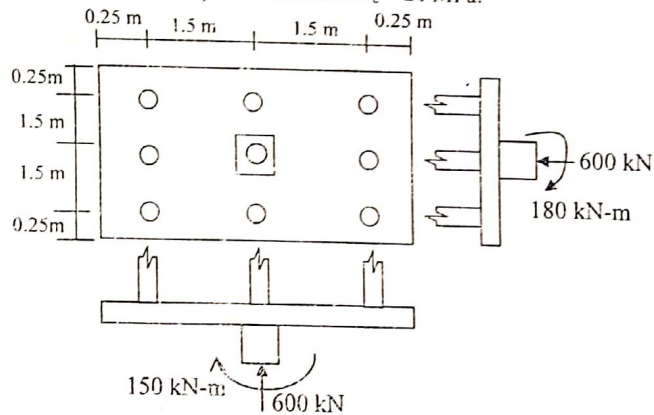
- (b) Discuss the design procedure of anchor sheet pile in clayey soil using free earth support method. 4.00

- Q.7(a) A braced cut is shown in figure below. (i) Draw the earth pressure envelope, (ii) Determine the strut loads at A, B, C, (iii) Determine the section modulus of the sheet pile section required, and (iv) Determine the design section modulus for the wales at level B. The struts are placed at 3 m c/c in the plan. $\sigma_{all} = 170 \text{ MN/m}^2$. 9.00

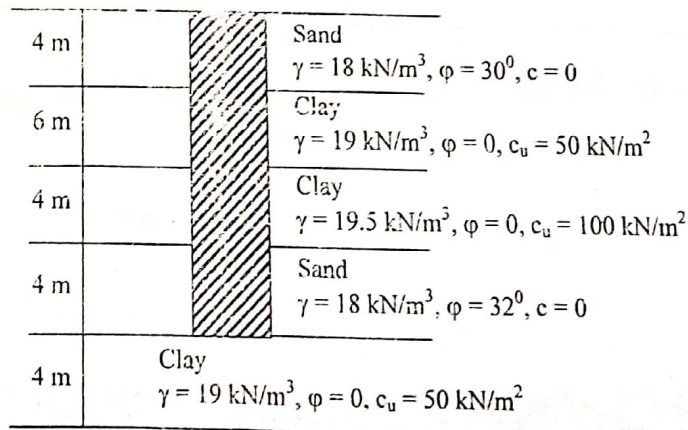


- (b) Draw a typical section of braced cut and discuss its different components. 3.00

- PC } Q.8(a) A pile cap is shown in figure below. Design the pile cap using USD method. Column size = 500 mm x 400 mm, pile dia = 300 mm. Assume $f_y = 500 \text{ MPa}$ and $f_c = 20 \text{ MPa}$. 8.00



- (b) Estimate the ultimate bearing capacity of the single pile as shown in figure below. Dia of pile = 20 inch. Type of pile = Driven pile. Assume $\delta = 0.7\phi$. Necessary graph will be supplied. 4.00



Geotechnical Engineering - III

Full Marks: 70

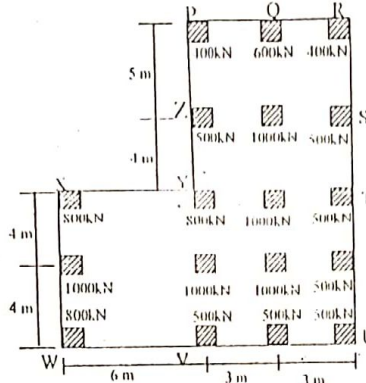
27.5

Time: 3 Hours

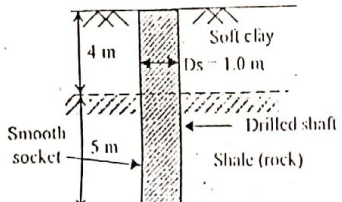
- N.B.:-
- (i) Answer SIX questions, taking THREE from each section.
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 - (iii) Use separate answer script for each section.
 - (iv) Assume reasonable value for any data not given.

SECTION-A

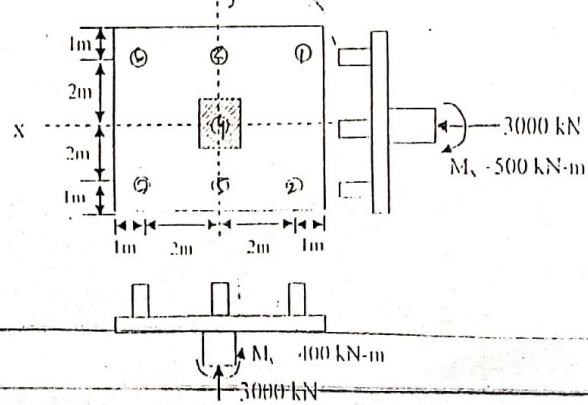
- Q.1(a) What are different types of raft foundation? Discuss the procedure for the design of a raft foundation. 4.67
- (b) The plan of a mat foundation is shown in figure below. Determine the soil pressure at points P, Q, R, S, T, U, V, W, X, Y and Z. Assume the column size = 0.50m x 0.50m. 7.00



- Q.2(a) What is the basic difference between a drilled pier and a caisson? What are the conditions in which a drilled pier is more suitable than caisson? 5.67 (4) (2.5)
- (b) A drilled shaft 1.0 m diameter has a total depth of 15 m. The diameter of bell is 2.0 m and its height is 1.0 m. If $c_u = 80 \text{ kN/m}^2$, $\gamma = 20 \text{ kN/m}^3$ and $\alpha = 0.3$, determine the allowable load (FS = 3.0). 6.00 (6) (3)
- (c) How do you determine the ultimate capacity of group piles in saturated clay? Discuss. 5.67 (7)
- (d) A drilled shaft extending into a shale (rock) formation as shown in figure below. For the intact rock cores, given $q_u = 4.0 \text{ MN/m}^2$. Calculate the allowable load bearing capacity of the drilled shaft. Use FS = 3.0. Assume a smooth socket for side resistance. 6.00 (2)



- Q.3(a) Write short notes on:
- (i) Compensated foundation
 - (ii) Batter Piles
 - (iii) Anchored Sheet Pile wall
- (b) A pile cap is shown in figure below. Design the pile cap with details reinforcement using $f_c = 25 \text{ N/mm}^2$, $f_s = 400 \text{ N/mm}^2$, column size = 0.50 m x 0.50 m and pile diameter = 500 mm. 8.67 (8)



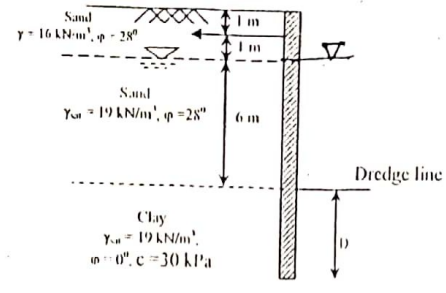
2.9.5

SECTION-B

SP

Q.6(a) Describe the free earth support method for the analysis of an anchored sheet pile wall.
 (b) An anchored sheet pile bulkhead is shown in figure below. Use free earth method, determine; (i) Depth of embedment, D (ii) Anchor force per unit length of the sheet pile wall.

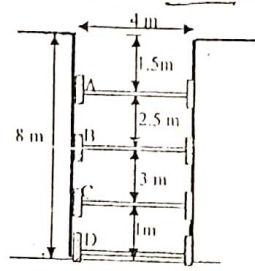
5.67 (5)
 6.00 (5.5)



- Q.6(a) A concrete pile 40 cm diameter, 9.0 m long is driven through a 6 m thick layer of silty sand ($\phi = 20^\circ, \gamma = 17 \text{ kN/m}^3$) overlying a dense layer of sand ($\phi = 35^\circ, \gamma = 19.5 \text{ kN/m}^3$). If the water table is at the ground surface, estimate the safe load (FS = 3). Take $k = 0.1$ and $\delta = 0.7\phi$. 6.00
- (b) A 2.5 Mg vertical compressor foundation system is operated at 40 Hz. The soil at the site is medium stiff clay ($e_u = 4 \times 10^1 \text{ kN/m}^2$). Determine the natural frequency and the magnification factor, assuming $m_s = 0.2 m_f$. Take base area is 2.5 m^2 . Take $D = 0$. 5.67

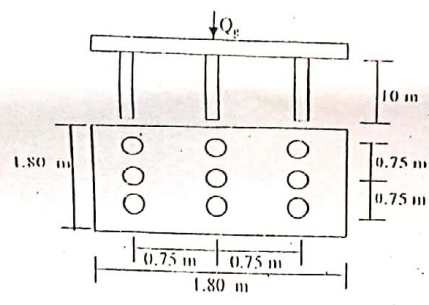
Q.7(a) Describe the various components of a pneumatic caisson with the help of a sketch. 3.67 (2)

(b) For the braced cut shown in figure below, draw the earth pressure envelope. Determine the loads in struts A, B, C, D. The spacing of struts is 2.5 m. Take $\gamma = 18 \text{ kN/m}^3$ and $c = 30 \text{ kN/m}^2$. 8.00



Q.8(a) A pile group consists of 9 friction piles of 30 cm diameter and 10 m depth driven in clay ($c_u = 100 \text{ kN/m}^2, \gamma = 20 \text{ kN/m}^3$) as shown in figure below. Determine the safe load for the group (FS = 3, $\alpha = 0.6$). 5.67 (5.5)

PF



(b) Compare diaphragm cellular coffer dams with circular coffer dams. 2.00 (1)

(c) Describe the equivalent beam method for the analysis of an anchored sheet pile. 4.00 (3)



CE 431
Geotechnical Engineering-III

Full marks: 70

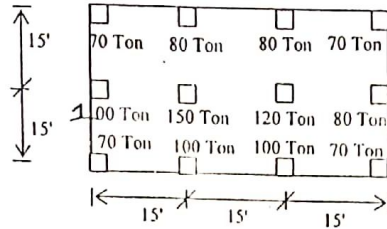
Time: 3 Hours

- N.B:-
- (i) Answer any SIX questions, taking THREE from each section.
 - (ii) Figure in the margin indicate full marks.
 - (iii) Use separate answer script for each section.
 - (iv) Assume reasonable value for any data missing.
 - (v) Necessary graph will be supplied.

SECTION-A

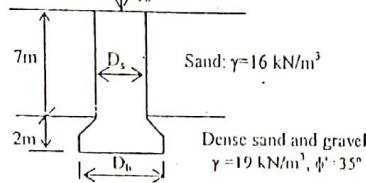
Q.1 (a) What is shallow foundation? At what situation do you suggest shallow foundation instead of deep foundation? Explain. 3.67

(b) A mat foundation is shown in figure below. Design the mat with details reinforcement using conventional rigid method. Given $f'_c = 3000$ psi, $f_y = 60000$ psi, $q_{all} = 1.0$ Ton/ft², column size = 18" x 12". 8.00



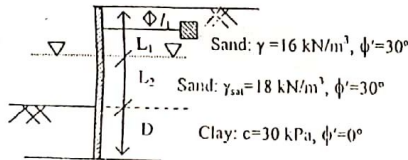
Q.2 (a) How can you determine load bearing capacity of drilled shafts in granular soil? Discuss. 4.67

(b) A soil profile is shown in figure below. A point bearing drilled shaft with a bell is placed in a layer of dense sand and gravel. Determine the allowable load the drilled shaft could carry. Given $D_s = 1.0$ m, $D_b = 1.80$ m, $F_s = 3.0$, $\phi' = 35^\circ$ and $E_s = 500$ Pa. 7.00

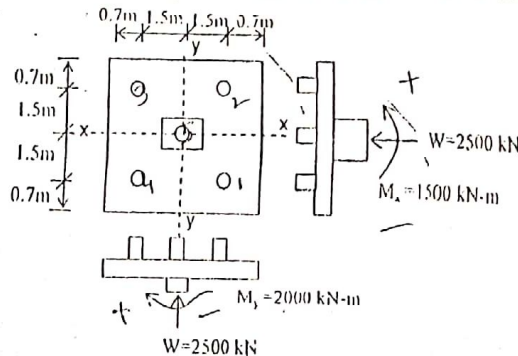


Q.3 (a) Discuss Fixed Earth Support method for penetration of sheet pile wall in sandy soil. 5.67

(b) An anchored sheet pile wall is shown in figure below. Given $L_1 = 2$ m, $L_2 = 6$ m, $l_1 = 1$ m, $\gamma = 16$ kN/m³, $\gamma_{sat} = 18$ kN/m³, $\phi' = 30^\circ$ and $c = 30$ kPa. Use free earth support method. (i) Determine the theoretical depth of embedment, D (ii) Calculate the anchor force per unit length of the sheet pile wall. 6.00



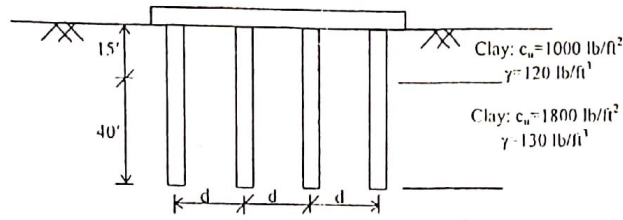
Q.4 (a) A pile cap is subjected to axial load and biaxial moment as shown in figure below. Design the pile cap with detail reinforcement using $f'_c = 20$ N/mm², $f_y = 415$ N/mm². Column size = 500 mm x 750 mm and diameter of pile = 450 mm. 8.00



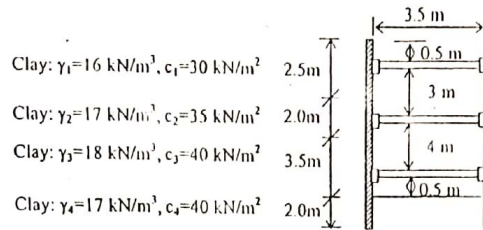
(b) What is Rowe moment reduction theory? Describe the significance of moment reduction in the design of Anchored sheet pile walls. 3.67

SECTION-B

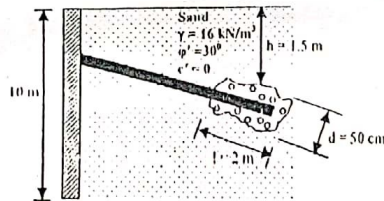
- Q.5 (a) A 10 m long concrete pile, 30 cm diameter is driven into a medium dense sand ($\phi = 30^\circ$, $\gamma = 20 \text{ kN/m}^3$). Estimate the safe load if FS = 3.0. 3.00
- (b) A section of a 3 x 4 group pile in layered saturated clay is shown in figure below. The piles are square in cross-section (15 in x 15 in). The center to center spacing, d of piles is 36 inch. Determine the allowable load-bearing capacity of the group pile if FS = 4. 5.00



- (c) How would you estimate ultimate point bearing capacity of a pile in sand using Janbu's Method. 3.67
- Q.6 (a) A braced cut is shown in figure below. Assuming, $\sigma_{all} = 170 \text{ MN/m}^2$, (i) Draw the earth pressure envelop (ii) Determine the strut loads (iii) Determine the section modulus of the sheet pile section required (iv) Determine the design section modulus for the wales at level B. The struts are placed at 3.5 m c/c in plan. 8.00



- (b) Explain the bottom leave of a cut in clay. 3.67
- Q.7 (a) In a test block of the size 1.5 m x 1.0 m x 0.75 m, resonance occurs at a frequency of 20 cycles per second in the vertical vibration. Determine the coefficient of elastic uniform compression if the mass of oscillator is 70 kg and the force produced by it at 15 cycles per second is 1200 N. Also compute the maximum amplitude at 15 cycles per second. 6.00
- (b) What are the advantages and disadvantages of pneumatic caissons over open caissons? 2.67
- (c) What are the different types of raft foundation? Discuss the procedure for the design of a raft foundation. 3.00
- Q.8 (a) "The load-bearing capacity of a bored pile is smaller than that of an equivalent driven pile"-justify the statement. 2.67
- (b) What is negative skin friction? What is its effect on the pile? 3.00
- (c) What are different types cellular cofferdams? Describe the design procedure of cellular cofferdams. 3.00
- (d) A tieback is shown in figure below. Determine the ultimate resistance of the tiebacks. 3.00



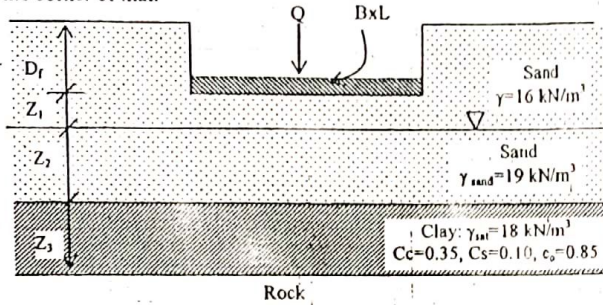
Full marks: 70

Time: 3 Hours

- N.B:-**
- (i) Answer any **SIX** questions, taking **THREE** from each section.
 - (ii) Figure in the margin indicate full marks.
 - (iii) Use separate answer script for each section.
 - (iv) Assume reasonable value for any data missing.

SECTION-A

Q.1(a) A mat foundation is shown in figure below. Given: $L=12\text{ m}$, $B=10\text{ m}$, $D_f=2.0\text{ m}$, $Q=30\text{ MN}$, $Z_1=2\text{ m}$, $Z_2=2\text{ m}$, $Z_3=5\text{ m}$ and preconsolidation pressure $\sigma'_c=100\text{ kPa}$. Calculate consolidation settlement under the corner of mat. 6.00

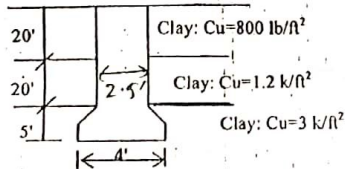


(b) Determine the net ultimate bearing capacity of mat foundation with the following field test data. 5.0

Depth (m)	Field value of N_{60}
1.5	8
3.0	12
4.5	10
6.0	8
7.5	14
9.0	12
10.5	14

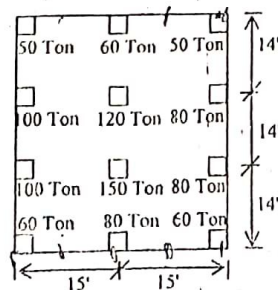
Assume, $D_f=1.5\text{ m}$, $\gamma=16\text{ kN/m}^3$ and allowable settlement=5.0 cm

Q.2 (a) How can you determine load bearing capacity of drilled shaft based on settlement? Explain. 5.5
(b) A drilled shaft in a cohesive soil is shown in figure below. Use Reese and O'Neill's method to determine (i) The ultimate load-bearing capacity (ii) The load-carrying capacity for an allowable settlement of 0.5 inch. 6.0



Q.3 (a) What is mat foundation? At what situation do you suggest mat foundation instead of individual column footing? Discuss 3.67

(b) A mat foundation is shown in figure below. Design the mat using conventional rigid method. Given: $f_c=3\text{ ksi}$, $f_y=60\text{ ksi}$, $q_{all}=2.0\text{ ksf}$. Column size=15" x 15". 8.00



Q.4 (a) What are cellular cofferdams? Why circular cell is generally preferable to the other cellular types of cofferdams?

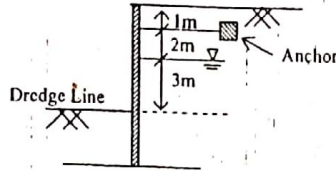
(b) Describe the design procedure of cellular cofferdams.

(c) The resonance of a test block $2\text{ m} \times 1\text{ m} \times 1\text{ m}$ occurred at 25 cycles/sec in the vertical direction. The other data are as follows: Weight of oscillator = 62 kg, vertical unbalanced force = 0.5 tones, unit weight of soil = 1.7 t/m^3 . Calculate the apparent mass of soil.

SECTION-B

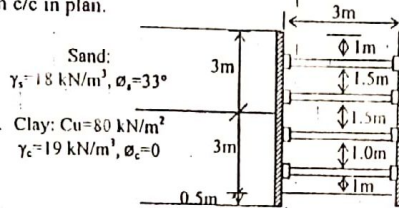
Q.5 (a) What are different types of sheet pile walls? Draw the sketches showing the pressure distribution.

(b) Compute the embedment length and the pull in the anchor rod for the sheet pile structure shown in figure below. The soil of the backfill and that below the dredge line is same, having the following properties: $\phi = \phi' = 30^\circ$, $c = 0$, $\gamma_{\text{sat}} = 20\text{ kN/m}^3$, $\gamma = 18\text{ kN/m}^3$. Use free earth support method.

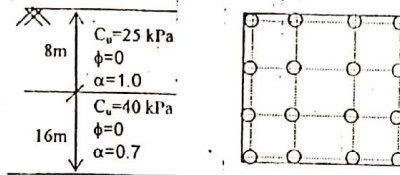


Q.6 (a) Write down the function of the followings: (i) Wales (ii) Strut (iii) Lagging (iv) Soldier Beam.

(b) A braced cut is shown in figure below. Assuming $\sigma_{\text{ult}} = 160\text{ MN/m}^2$, (i) Draw the earth pressure envelop, (ii) Determine the strut loads, (iii) Determine the section modulus of wales. Note, the struts are placed at 3 m c/c in plan.



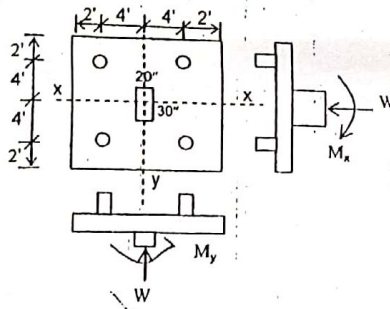
Q.7 (a) A group of 16 piles (4 in each row) was installed in a layered clay soil deposits as shown in figure below. The diameter of each pile is 500 mm and their c/c distance is 1 m. The length of pile group is 18 m. Estimate the safe load capacity of the group with a factor of safety of 2.5.



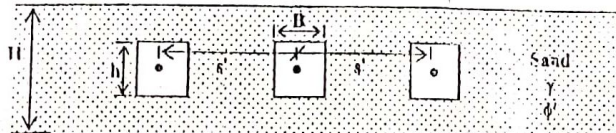
(b) Describe the significance of pile load test.

(c) How would you estimate the load carrying capacity of an open caisson?

Q.8 (a) A pile cap is subjected to axial load $W = 400\text{ kip}$ and moment $M_x = 150\text{ kip-ft}$, $M_y = 100\text{ kip-ft}$ as shown in figure below. Design the pile cap using $f'_c = 3\text{ ksi}$, $f_y = 60\text{ ksi}$. Column size = $20'' \times 30''$, diameter of pile = $20''$.



(b) The anchor plates are placed in a row with center to center spacing s' as shown in figure below. Given $B = h = 0.5\text{ m}$, $s' = 1.5\text{ m}$, $H = 1.0\text{ m}$, $\gamma = 18\text{ kN/m}^3$ and $\phi' = 30^\circ$. Determine the ultimate resistance for each anchor plate. The anchor plates are made of concrete and have thickness of 0.15 m .



CE 431
Geotechnical Engineering-III

Full Marks: 70

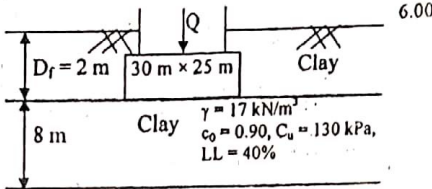
Time: 3 Hours

N.B.:-

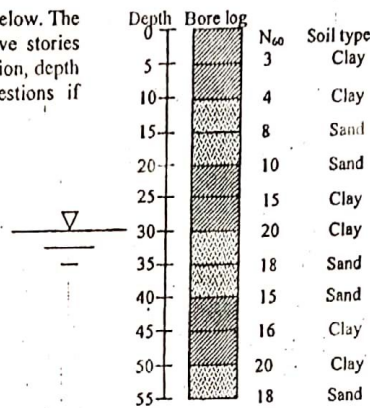
- (i) Answer SIX questions, taking THREE from each section.
- (ii) Figure in the margin indicates full marks.
- (iii) Use separate answer script for each section.
- (iv) Assume reasonable value for any data not given.

SECTION-A

Q.1(a) What is compensated foundation? A mat foundation of dimension 30 m × 25 m is shown in figure below and carried a dead load and live load on the mat is $Q = 100000$ kN. Determine the factor of safety against bearing capacity failure and settlement of the clay layer.

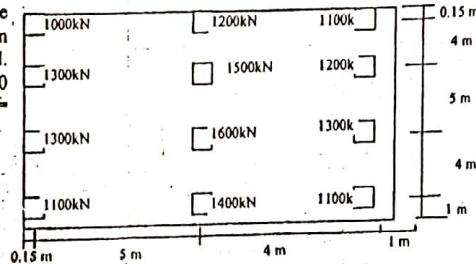


(b) A bore log of a subsoil exploration is shown below. The total dead and live load on a column of five stories building is 90 tons. Select the type of foundation, depth and size of foundation. Make some suggestions if needed.



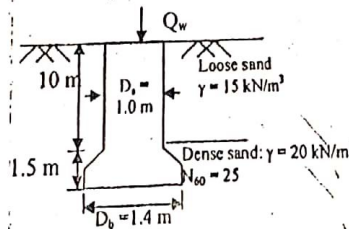
Q.2(a) Describe in brief, different types of mat foundation.

(b) A mat foundation is shown in figure below. Design the mat foundation using the conventional rigid method. Given that, $f_c = 15$ MPa, $f_y = 280$ MPa, $q_u = 15$ MPa, Column size = 30 cm × 30 cm.



Q.3(a) How can you determine the load bearing capacity of drilled shafts in clay? Explain.

(b) A drilled shaft is shown in figure below. The uncorrected average standard penetration number (N_{60}) with in the distance of $2D_b$ below the base of the shaft is 25. Determine the ultimate load carrying capacity of drilled shaft.

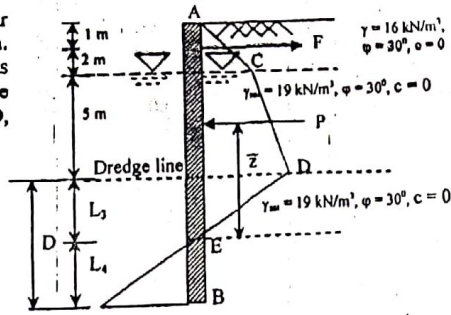


Q.4(a) How can you determine the ultimate capacity of group piles in saturated clay? Discuss.

(b) The allowable working load on a prestressed concrete pile 20 m long that has been driven into sand is 500 kN. The pile is circular in shape with $D = 350$ mm. Skin resistance carries 300 kN of the allowable load, and point bearing carries the rest. Use $E_p = 21 \times 10^6$ kN/m², $E_s = 25 \times 10^3$ kN/m², $\mu_s = 0.35$ and $\xi = 0.62$. Determine the settlement of the pile.

SECTION-B

Q.5(a) A anchor sheet pile wall with a granular soil backfill and penetrating sand is shown. The net pressure distribution is shown as well. Determine the following using free earth support method: (i) P (ii) L_3 , (iii) D, (iv) F, (v) \bar{z} , (vi) p.

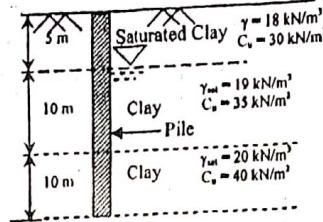


6.00

(b) Describe the Rowe's moment reduction for anchor sheet pile walls penetrating sand.

5.67

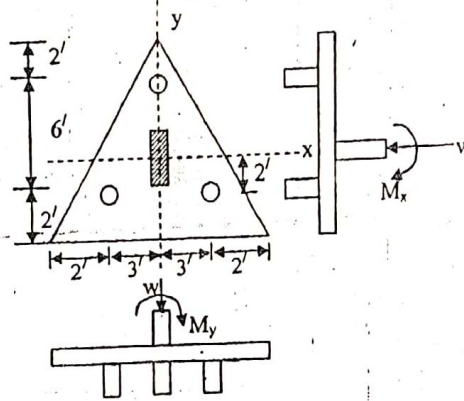
Q.6(a) A driven pile in clay is shown in figure below. (i) Calculate the net point bearing capacity. (ii) Calculate the skin resistance using α and λ method.



5.67

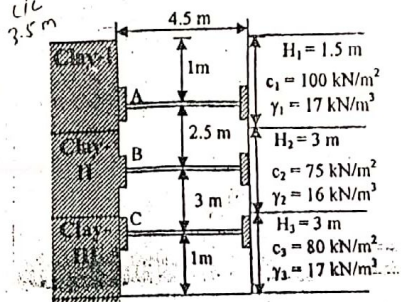
(b) A pile cap is subjected to axial load and moment as shown in figure below. Design the pile cap using $f'_c = 3000$ psi, $f_y = 60000$ psi. Column size = 15 inch \times 30 inch, Dia of pile = 18 inch.

Note that column load $w = 240$ kip, $M_y = 100$ k-ft, $M_x = 80$ k-ft.



6.00

Q.7(a) A braced cut in clay is shown in figure below. Given $H = 7.5$ m, $H_1 = 1.5$ m, $c_1 = 100$ kN/m², $\gamma_1 = 17$ kN/m³, $H_2 = 3.0$ m, $c_2 = 75$ kN/m², $\gamma_2 = 16$ kN/m³, $H_3 = 3.0$ m, $c_3 = 80$ kN/m² and $\gamma_3 = 17$ kN/m³. Assume that $\sigma_{all} = 170$ MN/m². (i) Determine the sheet pile section modulus, (ii) Find the section modulus of the wales at level B.



6.00

(b) Following is the variation of N_{60} with depth in a granular soil deposit. A concrete pile 9 m long (0.305 m \times 0.305 m in cross section) is driven into sand and fully embedded in the sand. Estimate the allowable load carrying capacity of the pile (Q_{all}). Use Meyerhof's equations and FS = 3.0

Depth (m)	1.5	3.0	4.5	6.0	7.5	9.0	10.5	11.0	12.5	14.0
N_{60}	4	8	7	5	16	18	21	24	20	19

5.67

Q.8(a) Mention the application of caissons.

3.67

(b) Differentiate between (i) damped and un-damped vibration, (ii) Viscous and non-viscous damping.

4.00

(c) Write note on: (i) Laterally loaded pile and (ii) Negative skin friction.

4.00

THE-END

CE 431
Geotechnical Engineering-III

Full Marks: 70

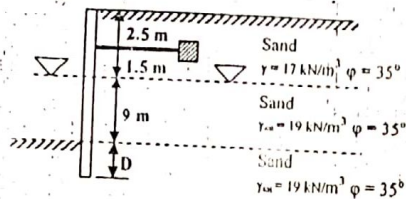
Time: 3 Hours

N.B.:-

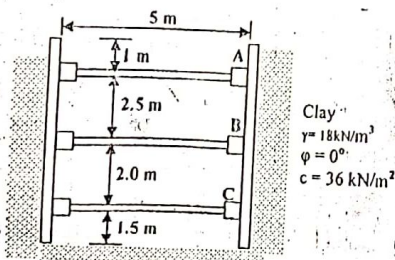
- (i) Answer SIX questions, taking THREE from each section.
- (ii) Figure in the margin indicates full marks.
- (iii) Use separate answer script for each section.
- (iv) Assume reasonable value for any data not given.

SECTION-A

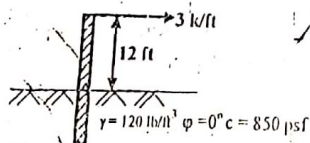
- Q.1(a) An anchor sheet pile bulkhead is shown in figure below. i) Calculate theoretical value of the depth of embedment ii) Draw the pressure distribution diagram iii) Determine the anchor force per unit length of wall. Use the free earth support method. 9.00



- (b) Differentiate between anchor sheet pile wall and cantilever sheet pile wall. 2.67
- Q.2(a) How can you analyze the factor of safety of braced excavation against bottom heave? Explain. 3.67
- (b) The cross section of a long braced cut is shown in figure below. (i) Draw the earth pressure envelope (ii) Determine the strut loads at level A, B and C. (iii) Determine the section modulus of the sheet pile section required (iv) Determine a design section modulus for the wall at level B. The struts are placed at 3 m, center to center, in the plan. Use $\sigma_{all} = 165 \times 10^3 \text{ kN/m}^2$. 8.00



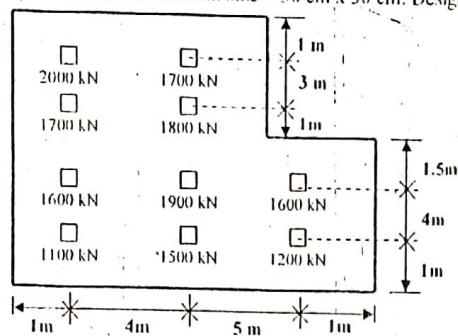
- Q.3(a) What is a tie back? How do you determine the ultimate resistance of a tie back? 3.00
- (b) Derive the relationship for computing the depth of embedment of a cantilever sheet pile wall in clayey soil. 4.00
- (c) A free cantilever sheet pile wall penetrating into clay is shown in figure below. Determine the theoretical depth of embedment and maximum moment. 4.67



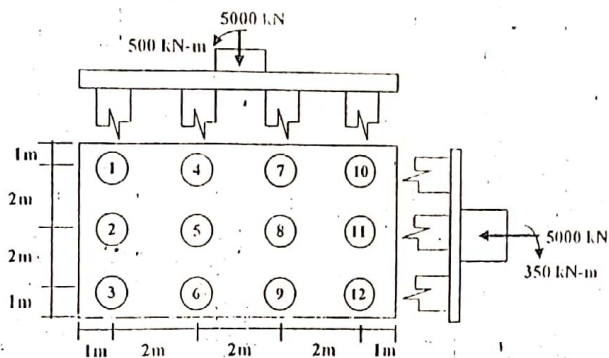
- Q.4(a) Define the followings: (i) Damped vibration (ii) Resonance (iii) Mass-spring system. 3.00
- (b) Discuss the design criteria for reinforcement and construction details of a machine foundation. 4.67
- (c) The total mass of a machine and a rigid base-foundation is 100 kg. Calculate the vertical and horizontal natural frequencies. Given that shear modulus of soil = 25, Poisson's ratio = 0.30, area of base = 6 m². 4.00

SECTION-B

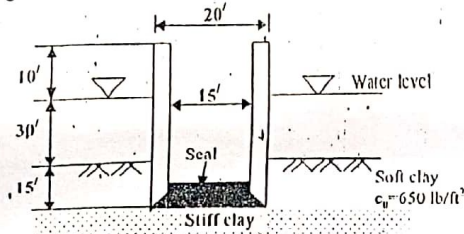
- Q.5(a) In what condition mat foundation should be used rather than the individual footing? 1.67
 (b) Suppose you are going to design a mat foundation as shown in figure below using the data $f'_c = 15$ MPa and $q_u = 15$ MPa and column size = 30 cm x 30 cm. Design the mat foundation. 10.00



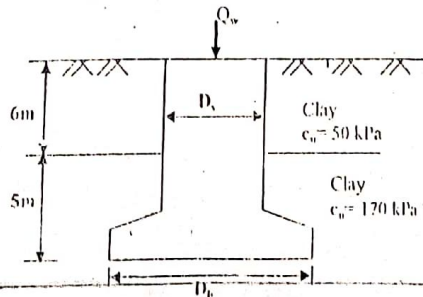
- Q.6(a) What is a pile cap? What are the assumptions made in the design of a pile cap? 3.67
 (b) A pile cap is subjected to axial load and moments as shown in figure below. Design the pile cap using $f'_c = 18$ MPa and $f_y = 400$ MPa. The size of column is 30 cm x 40 cm and diameter of each pile is 40 cm. Use WSD method. 8.00



- Q.7(a) Write short notes on (i) Vibroflotation (ii) Stone columns (iii) Wick drains and (iv) Pneumatic cassion. 6.00
 (b) An open cassion (circular) is shown in figure below. Determine the thickness of the seal that will enable complete dewatering. 5.67



- Q.8(a) Discuss the advantages of diaphragm type cellular cofferdam over circular type cellular cofferdam. 3.00
 (b) Write down the requirements of filling materials to be used in circular cofferdam. 3.00
 (c) A drilled shaft with a bell is to be constructed as shown in figure below. Given $f'_c = 20$ MPa, $Q_w = 1.2$ MN and FS = 2.5. Design the shaft and the bell. 5.67



1.112

CF-111
 Geotechnical Engineering - III

Full Marks: 70

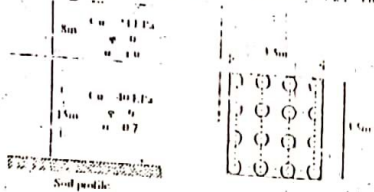
Time: 3 Hours

- S.R.L.:
- (i) Answer SIX questions, taking THREE from each section.
 - (ii) Figure in the margin indicates full marks.
 - (iii) Use separate answer script for each section.
 - (iv) Assume reasonable value for any missing data.

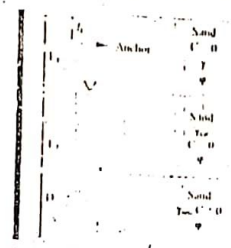
SECTION A

pile foundation

- (a) Classify piles based on their function. 2.00
- (b) Differentiate between cast in place and precast piles. 1.67
- (c) A group of 16 piles (4 in each row) was installed in a layered clay soil deposit as shown in Figure below. The diameter of each pile is 50 cm and their vertical spacing is 1m. The length of pile group is 18m. Estimate the safe load bearing capacity of the group with a factor of safety of 2.5. The adhesion factor is given. 6.00



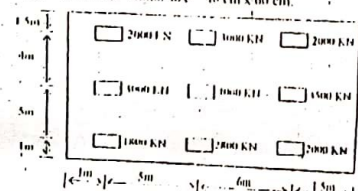
- (d) Derive the Terzaghi's Eqn. for the depth of embedment of an anchor sheet pile penetrating into granular soil by Free Earth support method. 4.67
- (e) An anchor sheet pile wall is shown in Figure below. Given $c_u = 5m, \gamma = 20kN/m^3, \phi = 30^\circ, \tau = 16kN/m^2, \sigma_v = 18kN/m^2$ and $q_u = 10^7$. 7.00



- (i) Calculate the theoretical value of the depth of embedment D.
- (ii) Draw the pressure distribution diagram.
- (iii) Determine the anchor force per unit length of the wall base (Free Earth Support method).

Mat Foundation

- (a) How does the soil exploration report help a civil engineer? 3.67
- (b) The foundation plan of a six storied building is shown in Figure below. Design the mat foundation using $C_u = 25 MPa, f_c = 500 MPa, q_u = 120 kPa$. Column size = 40 cm x 60 cm. 8.00



Sheet pile

- (a) Write down the design procedure of anchored sheet pile wall using equivalent beam method. 4.67
- (b) A machine foundation weighs 60 kN and has a spring constant $K = 15,000 kN/m$. Assuming the damping coefficient, C of the system is equal to $500 kN \cdot sec/m$, determine (i) whether the system is over damped, under damped or critically damped, (ii) the logarithmic decrement, and the ratio of two successive amplitude. 7.00

$D_b = 1.4 m$

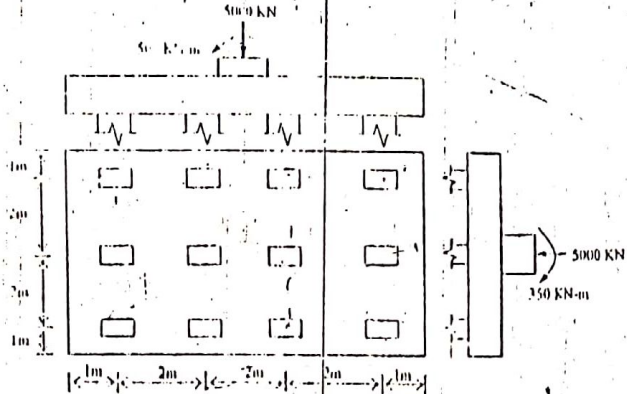
- Q.4(a) How can you determine the ultimate capacity of group piles in saturated clay? Discuss. 5.67
- (b) The allowable working load on a prestressed concrete pile 20 m long that has been driven into sand is 500 kN. The pile is circular in shape with $D = 350 mm$. Skin resistance carries 300 kN of the allowable load, and point bearing carries the rest. Use $E_p = 21 \times 10^6 kN/m^2, E_s = 25 \times 10^3 kN/m^2, \mu_s = 0.35$ and $E = 0.62$. Determine the settlement of the pile. 6.00

SECTION - B

pile foundation

- 5(a) Write short notes on (i) Negative skin friction (ii) Laterally loaded piles.
 (b) A pile cap is subjected to axial load and moments as shown in Figure below. Design the pile cap using $f_c = 18 \text{ MPa}$ and $f_s = 400 \text{ MPa}$. The size of each column = $30 \text{ cm} \times 45 \text{ cm}$.

4.00
7.67

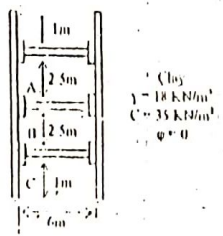


braced cut

- 6(a) What are the components of braced cut?
 (b) The cross-section of a long braced cut is shown in Figure below. The struts are placed at 3m center to center. (i) Draw the earth pressure envelope (ii) Determine the strut loads at levels A, B and C. (iii) Determine the section modulus of stiff pile section required. Use $\sigma_{all} = 110 \text{ MN/m}^2$.

2.00
7.67

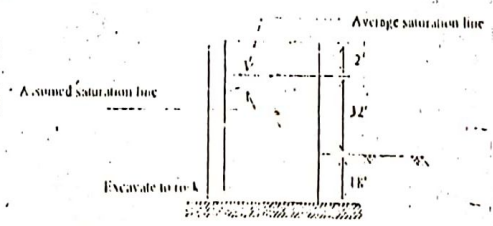
Steel



cofferdam

- Q.7(a) What are the possible types of failure to be analyzed for a circular cofferdam?
 (b) Design a diaphragm cofferdam cell. Assume the cell saturation line to be as shown in Figure below. Use $\gamma_{sat} = 140 \text{ pcf}$ of clear sand and gravel. Given, $\gamma_{sat} = 65 \text{ pcf}$, $\phi_{int} = 30^\circ$ both saturated and clamp, interlock friction = 0.3, $K_v = 0.11$.

3.00
8.67



caisson

- Q.8(a) Write short notes on: (i) Pneumatic caisson (ii) Wick drains (iii) Vibroflotation and (iv) Stone columns.
 (b) An open caisson (circular) is shown in the Figure below. Determine the thickness of the wall that will enable complete dewatering.

6.00
7.67

