National Exams December 2018

16-Civ-B19, Foundation Engineering

3 hours duration

NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit a clear statement of any assumptions made with the answer paper.
2. This is an OPEN BOOK examination. Candidates can bring **ONE textbook** of their choice. The textbook can have notations listed on the margins but no loose notes are permitted; **plus ONE aid sheet** 8.5" X 11" hand-written on both sides containing notes and formulae.
3. Please answer all 5 (FIVE) questions. All questions carry equal weight.
4. For non-numeric questions, clarity and organization of the answer are important.
5. Any non-communicating calculator is permitted.
6. The exam has six pages including this one. Please check that your exam has all pages.

Shallow Foundation

Q.1
Briefly discuss the following, using diagrams or equations whenever possible:

a. Ultimate Limit state and serviceability limit state for shallow foundations

b. Overburden pressure, and distribution of stress increase within the supporting soil due to a shallow foundation's load

(5 points)

A square foundation is 5 ft x 5 ft in plan. The soil supporting the foundation has a friction angle of $\varphi = 20^0$ and c = 320 lb/ft^2. The unit weight of soil, γ, is 115lb/ft^3.

(a) Determine the allowable gross load on the foundation with a factor of safety (FS) of 4. Assume that the depth of foundation (D_f) is 3 ft and that the general shear failure occurs in the soil. (5 Points)

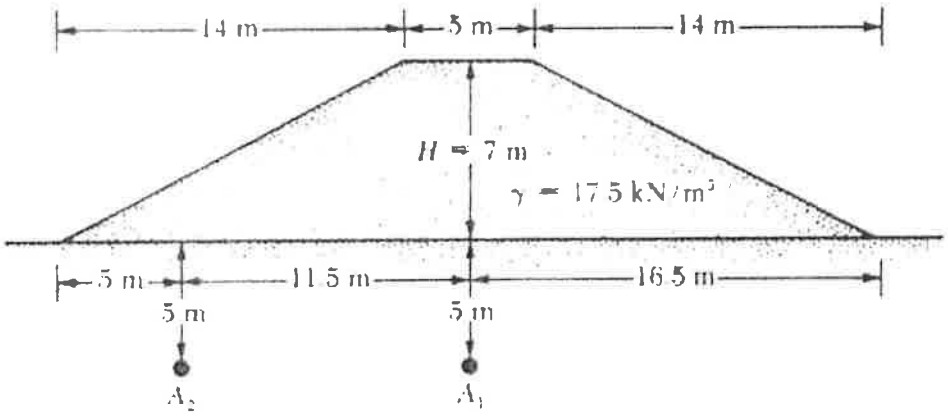
(b) Determine the net allowable load for the foundation if the factor of safety is 5. (5 points)

(c) Determine the net allowable load for the foundation if the FS_{shear} = 1.5.

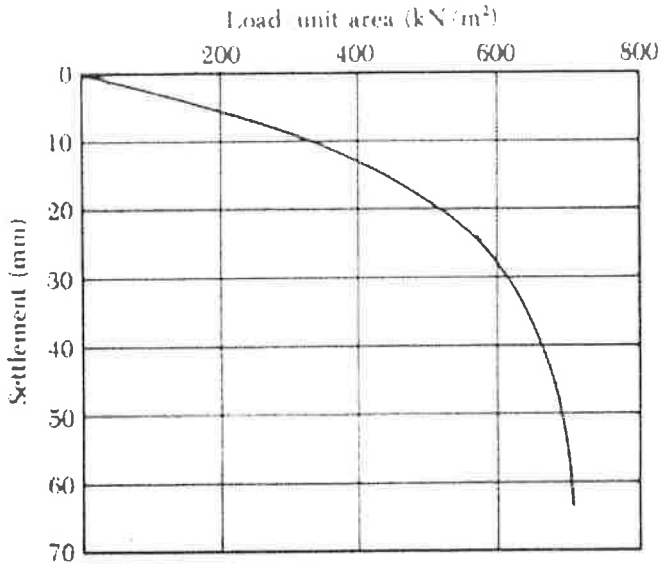
(5 points)

Q.2

(a) An embankment is shown in figure below. Determine the stress increase under the embankment at points A_1 and A_2. (10 points)

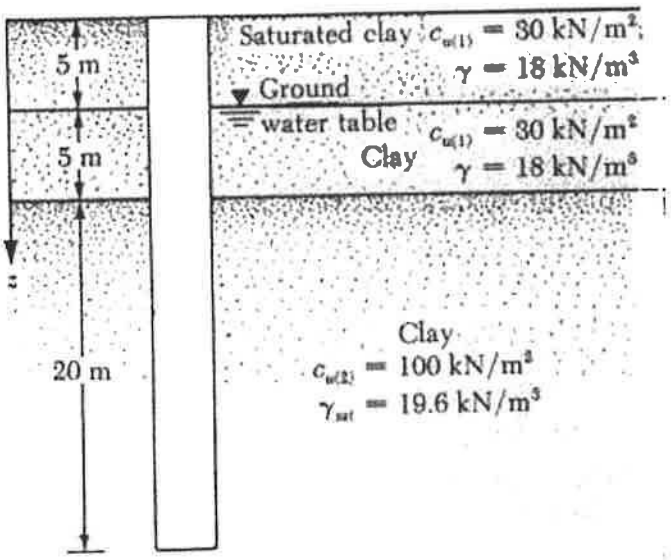


(b) The results of a plate load test in a sandy soil are shown in the figure below. The size of the plate is 0.305m x 0.305m. Determine the size of the square column foundation that should carry a load of 2500 kN with a maximum settlement of 25 mm. (10 points)



Pile Foundation

Q.3
(a) Identify and briefly discussed the major conditions that require pile foundation. ((5 points)



(b) A driven pipe pile in clay is shown in Figure above. The pipe has an outside diameter of 400 mm and wall thickness of 6.25 mm.

I. Calculate the net point bearing capacity.
II. Calculate the skin resistance
III. Estimate the net allowable pile capacity. Use FS = 4.

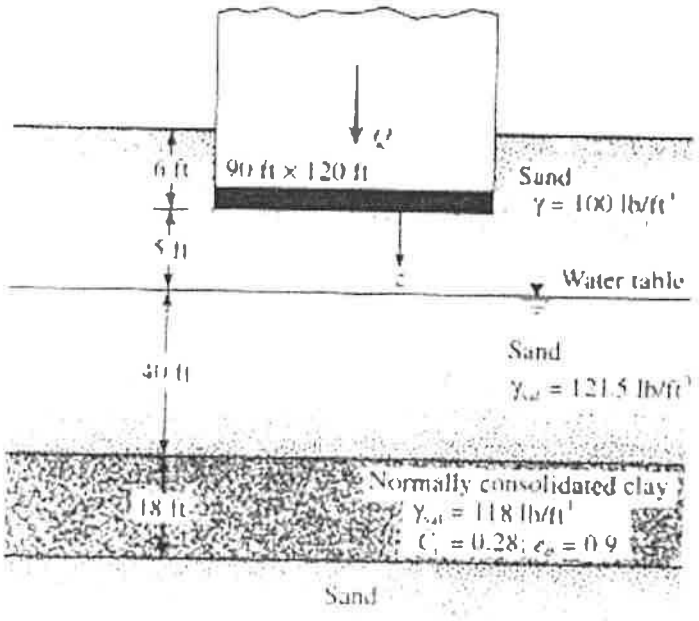
(15 points)

Mat Foundation

Q.4
(a) Identify different types of mat foundations and the circumstances where a mat foundation is required. (4 points)

(b) Determine the net ultimate bearing capacity of a mat foundation of size 40 ft x 35 ft. constructed on saturated clay with c_u = 18250 lb/ft^2 and D_f = 6.0 ft. (5 points)

(c) Consider a mat foundation 75 ft x 100 ft in plan as shown in figure below. The total dead and live load on the mat is 40 x 10^3 kips. Estimate the consolidation settlement at the centre of the foundation. (11 points)



Group Piles

Q.5
The section of a 3 x 4 group pile is a layered clay is shown in figure below. The piles are square in cross section (14 in x 14 in). The centre to centre spacing, d, of the piles is 35 in.

(a) Determine the allowable load-bearing capacity of the pile group. (12 points)
(b) Determine the efficiency of the pile group using any method of your choice. (8 points)

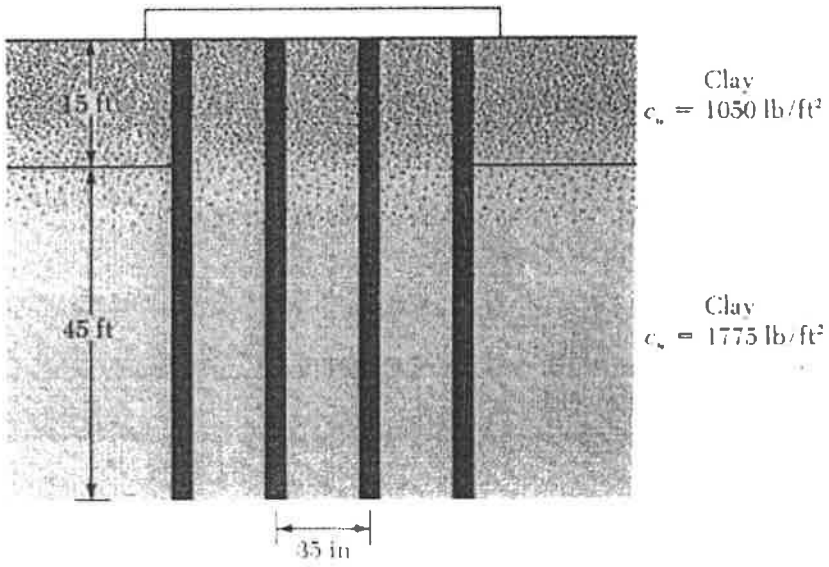


Figure: The pile Group

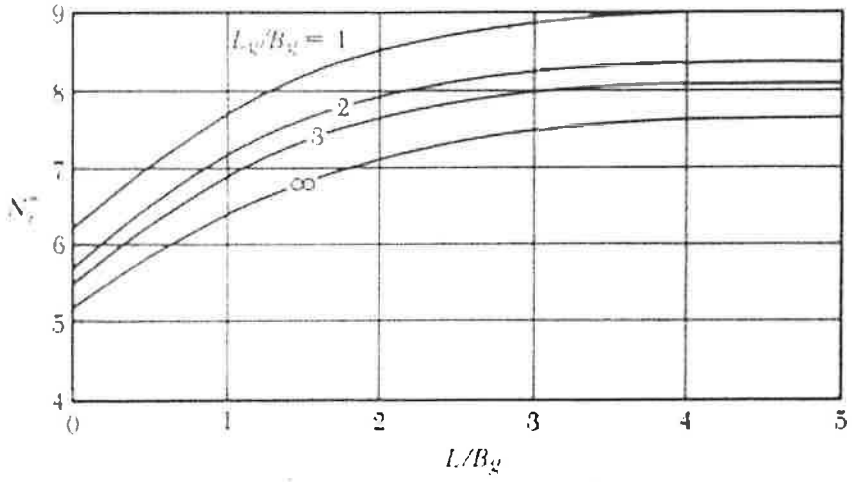


Figure: Variation of N_c^*

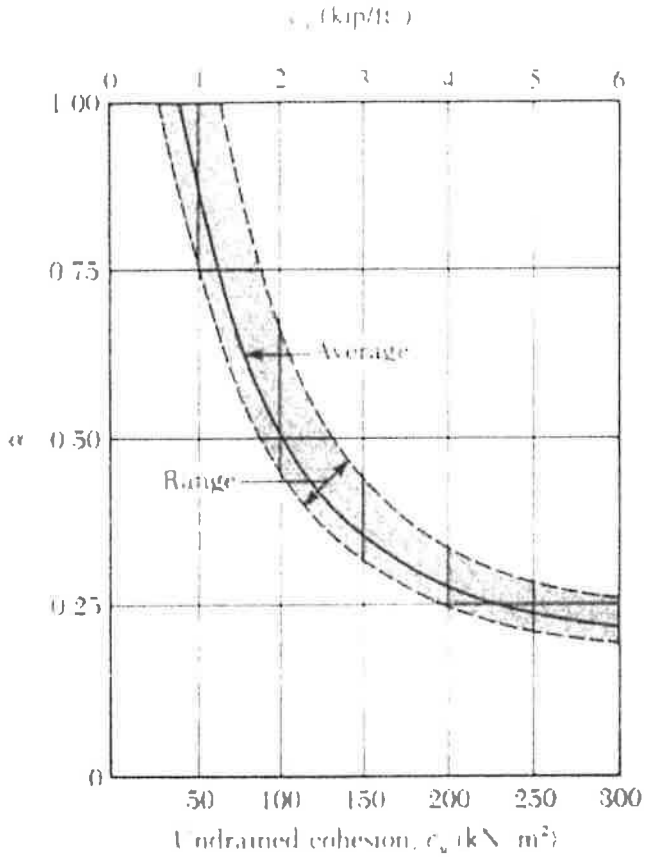


Figure: Variation of α with undrained cohesion of clay