

14.533 ADVANCED FOUNDATION ENGINEERING

HOMEWORK #3

B.C. Shallow Foundations in/on Soil - Problems

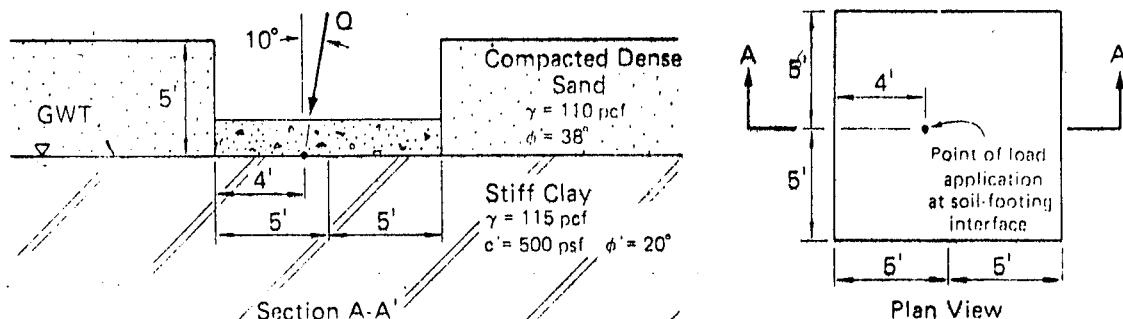
Review Class notes section 4.2.7 – B.C. equation recommended to use by NCHRP report 651. See also Bowles Chapter 4, Bearing Capacity of Foundations. Use the methodology and equation outlined in section 4.2.7 (*NCHRP Report 651*).

Problem 1.

- (a) For the case of a 5 x 5 ft footing, plot the-bearing capacity under centric vertical load as a function of depth of embedment of 0 to 5 ft for two soils ($\gamma = 100$ pcf):
 1. $c = 1000$ psf, $\phi = 0$
 2. $c' = 0$, $\phi' = 30^\circ$
- (b) For the same two soils, plot the effect of square-footing size on bearing capacity at the surface for $B = 1$ ft to $B = 10$ ft.
- (c) For the same two soils and $B = 3$ ft, plot the effect on bearing capacity at the surface of the footing length, from $L = 3$ ft to $L = 20$ ft.
- (d) On the basis of these results, what general statements can you make concerning the bearing capacity of concentrically loaded shallow foundations?

Problem 2.

The point of application and direction for the load applied to a 10 x 10 ft. footing is as shown. Determine the load which can be applied to the footing. (Note: Ignore weight of the footing).

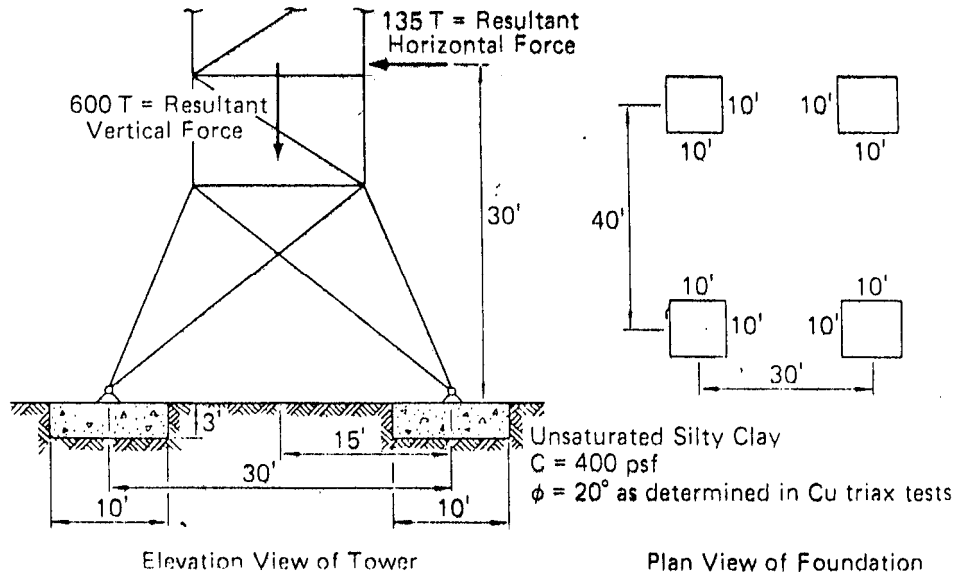


Problem 3.

The electric power transmission tower shown in schematic is to be constructed on a foundation consisting of four individual 10 x 10 ft concrete footings. The resultant forces on the tower are shown in the sketch. The resultant horizontal force includes wind loads and the effects of a broken power cable on one side of the tower. The horizontal load could act in either direction (left or right in the sketch) on the tower. The resultant vertical force includes the weight of the tower (without foundation) as well as cable, ice, and snow loads.

The subsoil consists of a relatively deep deposit of unsaturated silty clay; the groundwater table is below the zone of interest.

Determine the factor of safety against a bearing-capacity failure. For this purpose, you may neglect the effect of the footing thickness on the point of application of the resultant load on the soil, and any lateral resistance on the side of the footing. Concrete weighs 150 pcf. You can assume $C_A = c$ and an equal distribution of horizontal forces among the four foundations.



Problem 4.

Use the computer program "GEOPRO" to solve the problems in the following way:

- Problem 1; calculate for one depth (not zero) for each soil by hand, compare it to the computer output and then (if you are satisfied with the results), calculate the capacities for other depths using the computer. Use the same principle for each of the required distributions. Note the program may use somehow different formulation than that presented in section 4.2.7.
- Problems 2 & 3; compare your hand/spreadsheet calculation to the computer output. Please report if you have any problems.

Problem 5.

A round pier 2m in diameter is built on a fractured cemented shale with unconfined compressive strength $q_u = 18\text{MPa}$. The tests were conducted on 2 inch diameter (4in long) samples while the rock in-situ is fresh but broken by three sets of joints spaced 30cm apart with RQD values of 83%. Evaluate the Bearing Capacity of the foundation using both Goodman's and Carter and Kulhawy's methods.