

Center for Geotechnical Engineering Science
Department of Civil Engineering, College of Engineering and Applied Science
University of Colorado Denver

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Part II Midterm Examination for CE4738-3 Intermediate Foundation Engineering
(Spring 2016; 3/17/2016)

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Part II In-class open book (total 50 points)

Problem 1 (10 points) A series of Standard Proctor compaction tests was performed on a soil with a specific gravity of 2.68 with the following results:

Water contents (%)	Moisture density (lbs/ft ³)
10	98
13	106
16	119
18	125
20	129
22	128
25	123

Determine: 1) maximum dry density; 2) optimum moisture content; 3) the dry density for field compaction for 95% relative compaction; 4) the range of field compaction moisture for 95% relative compaction; and 5) To bring the water content from the field water content of 8% of the borrow material to the minimum water content required for field compaction, how many percent of water is required? 6) How was the relative compaction of 95% selected?

Problem 2 Building Foundations (10 points):

1 (5 points) A 40-story high hotel building is scheduled for construction on Miami Beach shoreline. A building of this height is considered critically important. The dry unit weight of the subsoil is 120 pcf and saturated unit weight is 135 pcf and the water table at the building site is 20 feet below the ground surface. The field exploration program shows that the subsoil is a very thick sandy soil with the blow count as shown in Problem 14.31. At depth greater than 25 feet the blow count is very high, like 50. What type of foundation would you recommend for this 40-story structure and why?

2 (5 points) A 4-story motel building not too far from the hotel building is also being planned. In the preliminary feasibility study, it was assumed that the same subsoil conditions as at the hotel site and square footings are recommended. The biggest column load was estimated as 50 kips in the middle of the building. What is the size of this square footing? The effective friction angle of the soil is estimated at 33°.

Problem 3 (20 points) Two adjacent 3' x 3' square columns of an industrial building were each to carry a heavy load: the exterior column carries 200 kips and the interior column 350 kips. The undrained shear strength of the clayey foundation soil, C_u , is 3000psf. The water table is very deep and not of concern and the unit weight of soil is 130 pcf. The bearing capacity factors, $N_c = 5.14$, $N_q = 1$ and $N_r = 0$. The rigidity index is 20. If a factor of safety of 3 is used, and the column center-to-center distance is 20 feet, and the distance between the center to exterior edge of the exterior column is not to exceed 4 feet. 1) if square footings are used, find their dimensions. Any comments? 2) if the compression index, C_c , evaluated from consolidation tests equals 0.23, the swell (or rebound) index 0.08 and the clay is heavily overconsolidated, evaluate the footing settlements at design loads, 3) if a trapezoidal footing is used instead, and the total footing length is not to exceed 25 feet, determine its dimensions, 4) draw shear and moment diagrams, 5) determine the design shear force and design moment, 6) determine percent steel requirement, if the Grade 60 steel bars are used.

Problem 4 (10 points) Earthquake-induced soil liquefaction assessment (10 point) Subsurface exploration program at a site in Oakland, California gives the following Standard Penetration blow counts in clean sand with less than 10 percent fines: at 2-ft depth, N is 12; at 6-ft, N is 14; at 10-ft depth, N is 12; at 14-ft depth, N is 9; at 19-ft depth, N is 15; and at 25-ft depth, N is 17. The above clean sand is underlain by a heavily overconsolidated clayey shale with blow count higher than 50. The water table is at 10-ft depth, the sand density above water table is 115 pcf and the saturated sand density is 120 pcf. 1) perform the field blow count correction; 2) find average blow counts at different depths; 3) seismic probability map indicates the peak ground acceleration of 0.35 g for a magnitude 7.5 earthquake. Use Eq. 14.26 and Figures 14.23 and 14.24(a), determine if the site would suffer the earthquake-induced liquefaction, 4) what could happen to a building if it is founded on shallow foundations at 6-ft depth? 5) how can the situation be remedied?