

53:030 SOIL MECHANICS
Civil & Environmental Engineering
The University of Iowa
FALL SEMESTER, 2001

Homework Assignment # 8

Due Wednesday, 14 November 2001.

From the textbook, solve problems 4.1 – 4.3

Supplemental Problems:

- 1) The table below gives data recorded during an oedometer test in which the stress on a double-drained soil sample was increased from 200 kPa to 400 kPa. The original height of the specimen was 1.75cm, and the initial void ratio of the specimen was 0.684. The specific gravity of the soil grains in this sample is 2.65. Based on this information and the data in the table, estimate the following:
- t_{50} the time required to achieve 50% of the total specimen consolidation;
 - the coefficient of consolidation for the soil sample c_v ;
 - the change in void ratio Δe of the soil sample during consolidation;
 - the incremental compressibility coefficient a_v of the soil specimen; and
 - the estimated permeability k of the soil specimen.

Reading	Time (min)	$\Delta H(\text{mm})$	Reading	Time (min)	$\Delta H(\text{mm})$	Reading	Time (min)	$\Delta H(\text{mm})$
1	0.0	0.0	11	0.927	-0.165	21	84.553	-0.311
2	.034	-.001	12	1.129	-0.172	22	114.556	-0.314
3	.067	-.002	13	1.533	-0.184	23	244.522	-0.316
4	.101	-.013	14	2.534	-0.222	24	644.529	-0.317
5	.135	-.017	15	5.537	-0.251			
6	.169	-.021	16	7.539	-0.258			
7	.203	-.078	17	12.543	-0.279			
8	.321	-0.128	18	24.546	-0.285			
9	.523	-0.143	19	44.548	-0.294			
10	0.725	-0.161	20	64.551	-0.309			

- 2) As an engineer working for an oil company you are tasked with preparing the site in the Figure below for construction of an oil storage tank. The tank will weigh 20,000 tons when full, and will rest on a circular, flexible foundation of radius 75 feet. To minimize the possibility of excessive settlements and rupture of the tank, you are considering pre-loading of the site as shown in the figure. In this plan:
- How many feet of dry pre-loading fill (at $\gamma_f = 113.8 \text{ lbs/ft}^3$) would you need to bring in to the site so that at the center of the clay layer directly beneath the center of the tank $(\Delta\sigma_v)_{\text{fill}} = (\Delta\sigma_v)_{\text{tank}}$? That is, how thick h should the pre-load layer be?

- b) Assuming that you wanted to leave the pre-load layer in place until 90% consolidation of the compressible clay layer is achieved, how long would you need to wait?
- c) What would be the ultimate (100%) consolidation settlement due to the pre-loading?
- d) What would be the average void ratio in the clay layer after 90% consolidation under the pre-load is achieved?

