CIVL 4151
Spring 2015
Homework 7

1. Prior to placement of a fill covering a large area at a site, the thickness of a compressible soil layer was 10 m. Its original *in situ* void ratio was 1.0. At some point in time after the fill was constructed, it was found that the *in situ* void ratio had dropped to 0.8. Estimate the settlement of the soil layer at that point in time.

2. The following data was obtained during a laboratory consolidation test on a normally consolidated clay with $e_0 = 0.860$:

Pressure (kPa)	Void Ratio
20	0.858
40	0.855
80	0.849
160	0.830
320	0.785
640	0.696
1280	0.602

   (a) Plot the data on arithmetic axes and determine the coefficient of compressibility a_v for the stress increment from 160 to 320 kPa.
   (b) Plot the data on semi-logarithmic axes and use Casagrande's procedure to determine the most likely value for the preconsolidation stress σ'_c. For convenience, assume the point of maximum curvature is at $\sigma' = 160$ kPa.
   (c) Use Schmertmann's method to find the field value for the compression index C_c.

3. The data shown on the next page was obtained from a laboratory consolidation test on an OC clay. The initial void ratio is 0.725 and the initial overburden stress is $\sigma'_0 = 130$ kPa.

   (a) Plot the data on semi-logarithmic axes and use Casagrande's procedure to determine the most likely value for the preconsolidation stress σ'_c. For convenience, assume the point of maximum curvature is at $\sigma' = 160$ kPa.
   (b) Calculate the overconsolidation ratio
   (c) Determine the field compression index C_c using Schmertmann's procedure.
   (d) If this test is representative of a 12 m thick clay layer, compute the settlement of that layer if an additional stress of 220 kPa is added.

4. Assume the clay layer in the previous problem is *doubly drained* and the coefficient of consolidation over the stress range of 130-220 kPa is $c_v = 9.1 \times 10^{-8}$ m^2/sec.

   (a) Find the degree of consolidation 5 years after the additional load is applied at depths of 0, 3, 6, 9, and 12 m within the layer.
   (b) Find the average degree of consolidation at that same point in time and use it to determine how much settlement has occurred at that point in time.

Data for Problem 3

Pressure (kPa)	Void Ratio
10	0.723
20	0.722
40	0.719
80	0.711
160	0.692
320	0.653
640	0.586
320	0.586
160	0.590
80	0.601
160	0.598
320	0.594
640	0.581
1280	0.507
2560	0.425
5120	0.342
1280	0.352
320	0.369
80	0.393
20	0.415

5. Repeat Problem 4 assuming the clay layer is *singly drained*.

6. A foundation for an electrical transformer has a plan area of 6 m × 3 m and carries a load of 2200 kN. The soil profile is shown below. Estimate the primary consolidation settlement of the footing using the 2:1 method.