King Saud University
College of Engineering
Department of Civil Engineering

CE 480 Soil Mechanics
Assignment # 6

Problem # 1

Prove that the failure plane is inclined at an angle ($\theta_f = 45 + \phi/2$) to the major principal plane. Assume that Mohr-Coulom failure criterion is valid. Using:

i) Analytical solution.

ii) Mohr's circle and simple geometry.

Problem # 2

In a shear box test on a clay soil the shear load was applied immediately after the normal load. The following results were obtained:

Test #	1	2	3	4
Normal stress (kN/m^2)	120	230	340	450
Shear stress (kN/m^2)	133	150	168	186

i) Determine the shear strength parameters: c and ϕ.

ii) Determine the principal stresses at failure and the orientations of the principal planes for test #2.

iii) Determine the orientation of the plane of maximum shear stress at failure, and the maximum shear stress and the normal stress on that plane for test #4.

iv) If an undrained triaxial test were to be carried out on the same soil at a cell pressure of 150 kN/m^2, what would be the expected deviator stress at failure?

v) If an unconfined compression test were to be carried out on the same soil, what value would be obtained for the cohesion.

Problem # 3

Using the triaxial test apparatus, a soil sample was first consolidated at a cell pressure of 600 kN/m^2 under a maintained back pressure of 300 kN/m^2. Then with the drains closed the cell pressure was raised to 720 kN/m^2, resulting in the pore pressure increasing to 415 kN/m^2. Following this the axial load was raised to give an increase in deviator stress of 550 kN/m^2 , while the cell pressure remained constant, the pore pressure reading was 562 kN/m^2. Calculate the pore pressure coefficients **B** and **A**.

Problem #4

The results shown below were obtained at failure in a series of consolidated-undrained triaxial compression tests, with pore water pressure measurement, on specimens of a saturated clay.

Test #	Cell pressure (kN/m^2)	Deviator stress (kN/m^2)	Pore water pressure (kN/m^2)
1	150	192	80
2	300	341	154
3	450	504	222

a) Plot the total and effective Mohr circles for each test, and determine the Mohr-Coulomb strength parameters in terms of both total and effective stresses.

b) If the normal effective stress on a plane through the clay deposit is 400 kN/m^2, what is the shear strength along that plane.

Problem #5

During a consolidated-undrained triaxial test, the following data were obtained:

Change in length of sample (mm)	0	0.75	1.50	3.0	6.0	9.10	10.6
Deviator stress (kN/m^2)	0	120	200	280	360	420	460
Pore pressure (kN/m^2)	0	103	153	92	215	232	248

The cell pressure is 250 kN/m^2 and the original length of the saturated sample is 76 mm.

a) Plot the variation of $\Delta\sigma$ with the axial strain of the sample.

b) Plot the variation of the pore pressure coefficient **A** with the axial strain of the sample, stating the value at failure.