University of Technology
Building and Construction Eng. Dept.
Final Exam – First Attempt – 2010/2011

Subject : Soil Mechanics **Class: 3rd stage**
Branch : All Branches **Time : 3 Hours**
Date : 30 /5/ 2011

Note: Answer five questions only

Q1 : A. The total volume of a soil specimen is 80000 mm³ and it weighs 145 g. The dry weight of the specimen is 128 g, and the specific gravity of soil solids is 2.68. Find:

(a) water content (b) void ratio (c) porosity (d) degree of saturation
(e) saturated unit weight (f) dry unit weight (g) water content when the soil becomes fully saturated.

B. A soil sample has 60 % passing a sieve with an opening equal to 20 mm, 30 % passing a sieve with an opening equal to 4.75 mm, and 10 % passing a sieve with an opening equal to 0.075 mm. The plastic limit is 12 % and the liquid limit is 40 %. Find coefficient of curvature (C_c) and coefficient of uniformity (C_u) , also classify the soil according to the USCS.

Q2: A. Given an element with stresses indicated in figure below, find:

1. The major and minor principal stresses and the planes on which they act.
2. The stresses on a plane inclined at 30° from the horizontal (plane A-A).
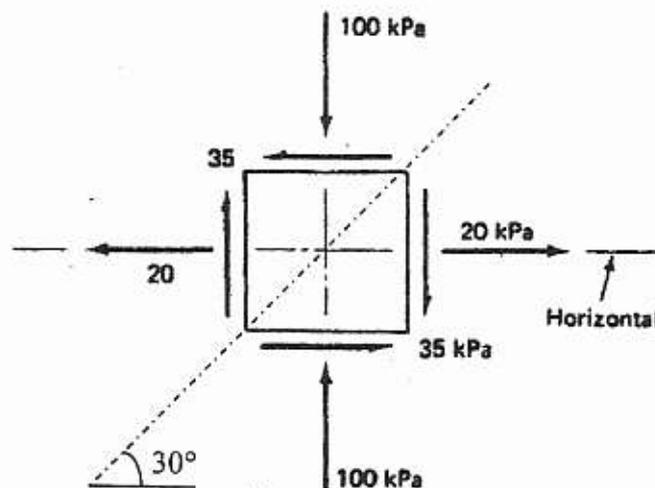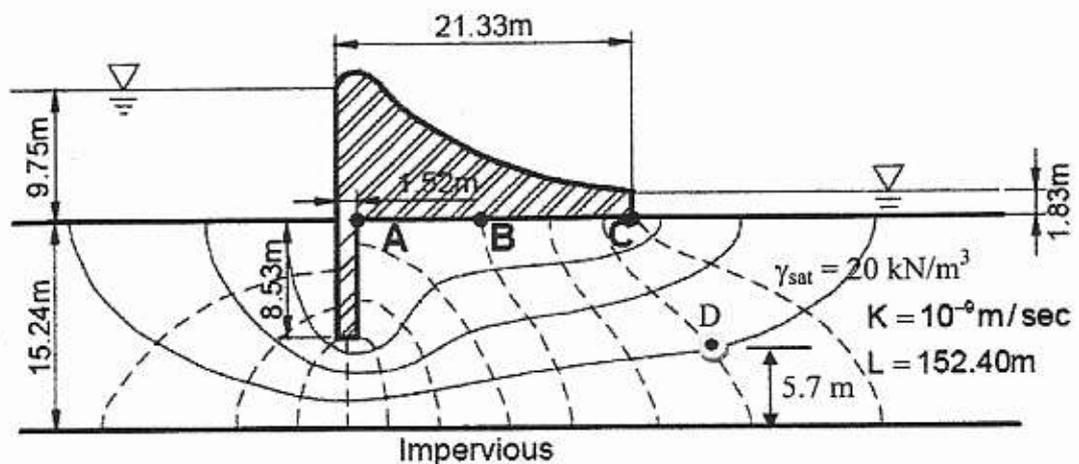

B. Answer **three** of the following:

1. What is a CH soil?
2. What are the Atterberg limits?
3. Define the hydraulic gradient.
4. What is the major difference in shape between sand particles and clay particles?

Q3: A. A saturated specimen of cohesionless sand was tested under drained conditions in a triaxial compression test apparatus and the sample failed at a deviator stress of 482 kN/m^2 and the plane of failure made an angle of 60° with the horizontal. Find the magnitudes of the principal stresses.

What would be the magnitudes of the deviator stress and the major principal stress at failure for another identical specimen of sand if it is tested under a cell pressure of 200 kN/m^2?

B. For the dam shown in figure below, determine:
1) The pore water pressure at A, B, and C.
2) The flow rate under the dam.
3) The effective stress at point D.

21.33m

9.75m

15.24m

8.53m

1.52m

A   B   C

$\gamma_{sat} = 20$ kN/m^3

$K = 10^{-9}$ m/sec

D

$L = 152.40$m

5.7 m

1.83m

Impervious

Q4: In a consolidation test, a clay specimen initially 25 mm thick attains 90% consolidation in 10 minutes. In the field, the clay stratum from which the specimen was obtained has a thickness of 6 m and is sandwiched between two sand layers. A structure (fill) constructed on this clay experienced an ultimate settlement of 200 mm.
1. Estimate the settlement at the end of 100 days after construction.
2. Find the pore pressure at the middle of the clay layer after 6 months due to a fill load of 100 kN/m^2 if the water table was at the ground surface.

Q5: A. If the initial stress conditions in a soil sample are $\sigma_v = 100$ kPa and $\sigma_h = 50$ kPa, draw the stress paths for σ_v being held constant while:
(a) σ_h increases to 100 kPa.
(b) σ_h decreases to 0 kPa.

B. A rigid retaining wall of 6 m height shown in the figure (Q5.b) has two layers of backfill. The top layer to a depth of 1.5 m is sandy clay having $\phi = 20°$, $c = 12.15$ kN/m^2 and $\gamma = 16.4$ kN/m^3. The bottom layer is sand having $\phi = 30°$, $c = 0$, and $\gamma = 17.25$ kN/m^3.

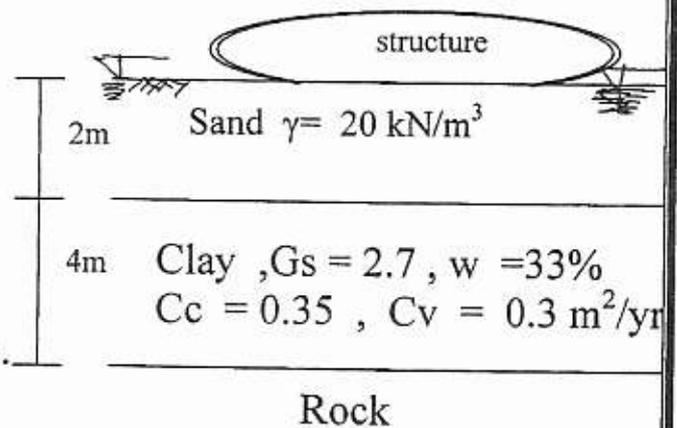Determine the total active earth pressure acting on the wall and draw the pressure distribution diagram.

Figure Q 5 (b)

GL

Sandy clay
$\phi = 20°$
$c = 12.15$ kN/m^2
$\gamma = 16.4$ kN/m^3

1.5 m
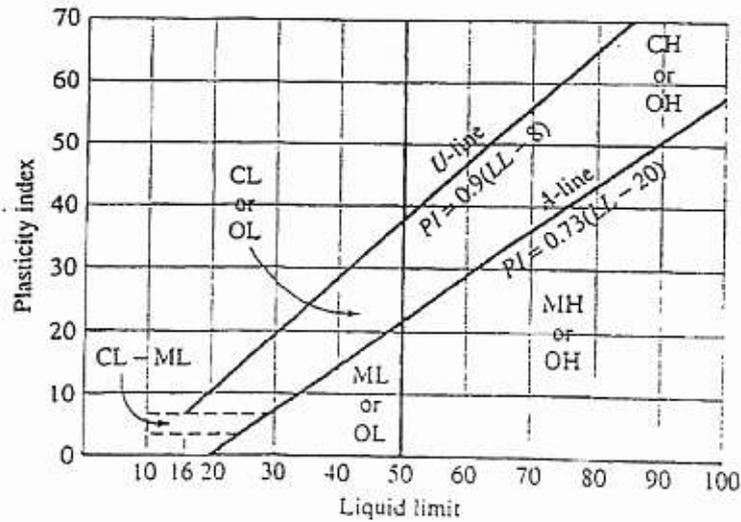
6 m

$\gamma = 17.25$ kN/m^3
$\phi = 30°$, $c = 0$

Sand
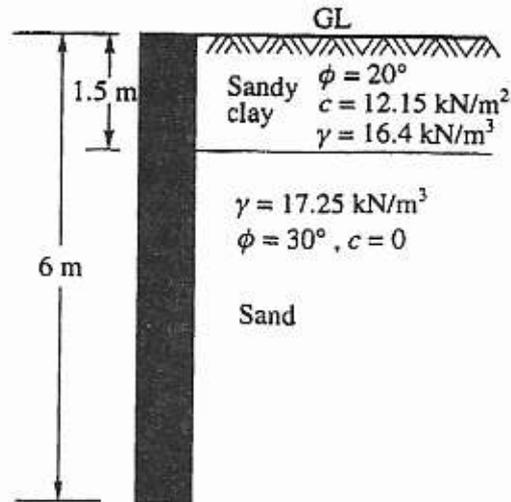
Q6:

For the soil profile shown, if the increase in the total vertical stress at the middle of the clay layer due to the surface loading is 25 kN/m^2. Find :

a) final consolidation settlement.

b) final water content (at the end of consolidation).

c) time required for 40% consolidation.

structure

2m   Sand $\gamma = 20$ kN/m^3

4m   Clay ,Gs $= 2.7$, w $=33\%$
     Cc $= 0.35$, Cv $= 0.3$ m^2/yr

Rock

Some useful information's:

$$Tv = \frac{Cv\,t}{d^2}$$

$$\gamma = \frac{Gs(1+w)}{1+e}\gamma_w$$

For N.C.C. $\qquad S_{cf} = \frac{Cc}{1+e}Hlog\frac{P_\circ + \Delta P}{P_\circ}$

For O.C.C.

if $P_\circ + \Delta P \le P_C$ then $S_{cf} = \frac{Cr}{1+e}Hlog\frac{P_\circ + \Delta P}{P_\circ}$

if $P_\circ + \Delta P > P_C$ then use :

$$S_{cf} = \frac{Cr}{1+e}Hlog\frac{P_c}{P_\circ} + \frac{Cc}{1+e}Hlog\frac{P_\circ + \Delta P}{P_c}$$

$$O.C.R = \frac{P_c}{P_\circ}$$

$$T_v = \frac{\pi}{4}U_{av}^2 \qquad \text{for } U_{av} \le 60\%$$

$$T_v = 1.781 - 0.933\log(100 - U_{av}) \qquad \text{for } U_{av} > 60\%$$