CIE 444 – SOIL MECHANICS

EXAM No. 1

Date: November 27, 2007

Before you start solving the problems, please read the problem questions carefully and take note of the following:

1- You have two hours to complete this exam.

2- The exam is closed book.

3- Make sure you understand the problem question clearly before you start solving.

4- Be concise, clear and logical in your answers and computations. Justify any assumptions if needed. Points will be deducted for answers that are not supported by proper calculations.

5- Make sure to answer all questions on this booklet.

6- Where needed, take the unit weight of water γ_w=10 kN/m^3 and g=10m/sec^2

7- Conversion factor: 1m^3 = 264 gallons, 1N = 1kg.m/sec^2

GOOD LUCK!

NAME:_____

Q1:	(20pts)
Q2:	(30pts)
Q3:	(15pts)
Q4:	(35pts)
Total:	(100pts)

QUESTION 1: (20pts)
Answer by True (T) or False (F) and correct the statement where needed.

( ) A flow net is the graphical representation of the flow lines.

( ) The relationship between the plastic index and the plastic limit of a soil gives us the plasticity chart.

( ) There are only two types of particle arrangement in clays: dispersed and aggregated.

( ) The Atterberg limits are a basic measure of the nature of coarse-grained soils.

( ) Clays exhibit the property of dilatancy. They can be visually differentiated from silts.

( ) From the handout on Quick Sand (Ref. *Europhysicsnews, Issue No.4, Vol 37*), the authors describe the natural quicksand as a mixture of sand, salt water, and clay.

( ) All soils passing sieve #200 are clays.

( ) The seepage velocity is always greater than the discharge velocity.

( ) Marine clays are very stable due to the large double-layer and the lack of salt water.

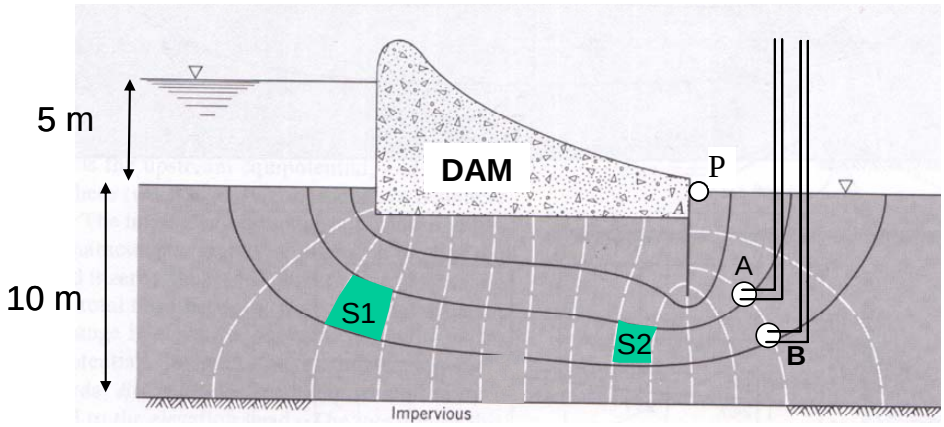
( ) Kaolinites are very well behaved clays as opposed to smectites.

QUESTION 2: (30pts)

Based on the flow net shown below answer the following:

a) What is the flow per unit depth underneath the dam? (5pts)
b) Comparing squares S1 and S2: across which of the two is the flow rate greater? Across which is the hydraulic gradient greater? Explain. (10pts)
c) Clearly draw the elevation (include calculation of height) to which the water would rise in the two piezometers located at A and B. (10pts)
d) What is factor of safety against a quick condition at point P? (Based on the exit gradient calculation). (5pts)

$k_{soil} = 3 \times 10^{-5}$ cm/s



QUESTION 3: (15 pts)

A container of saturated soil weighed 113.27g before it was placed in an oven, and 100.06g after it remained in the oven overnight. The container weighs 49.31g. The specific gravity of the soil is 2.80.

Determine the void ratio, porosity, and water content of the original soil sample.

QUESTION 4: (35pts)

In a borrow pit for an embankment, the soil is found to have the following characteristics:

water content (w.c.)=15%
void ratio e = 0.60
specific gravity of soil solids $G_s = 2.70$

The soil will be used to construct a compacted embankment having a finished volume of 50,000m^3. The soil is excavated by a shovel and dumped on trucks which have a 5m^3 capacity each. When loaded to capacity, each truck will contain, on average, a net mass of soil plus water of 4250kg. The trucks then dump their load on the fill, the soil is broken up and spread, and a sprinkler adds water until the water content reaches 18%. After thorough mixing, the material is compacted until the dry unit weight is 17.3 kN/m^3.

Answer the following questions:

a) How many capacity trucks loads are required to construct this fill. (10pts)
b) After completion, what is the expected volume of the pit from which the soil was removed. (10pts)
c) How many gallons of water need to be added per truck load (assuming no loss by evaporation during hauling and handling) (10pts)
d) If the embankment later becomes saturated (and does not change volume), what will be its saturation water content? (5pts)

Where necessary, make use of the phase diagram.