มหาวิทยาลัยสงขลานครินทร์
คณะวิศวกรรมศาสตร์

การสอบปลายภาค ประจำภาคการศึกษาที่ 2 **ปีการศึกษา** 2548
สอบวันที่ 22 **กุมภาพันธ์** 2549 **เวลา** 09:00-12:00 **น**
วิชา 220-524 Waste Geotechnics **ห้องสอบ ห้องหัวหุ่น**

ชื่อ..... รหัส.....

คำชี้แจง

1. ข้อสอบมี 5 ข้อ 110 คะแนน ให้ทำทุกข้อ
2. อนุญาตให้นักศึกษานำเครื่องคิดเลขเข้าห้องสอบได้
3. **ไม่**อนุญาตให้นักศึกษานำเอกสารใดๆ เข้าห้องสอบ ยกเว้นกระดาษ A4 **เขียนด้านเดียว**

ออกข้อสอบโดย ผศ. ดร. ธนิต เฉลิมยานนท์

Problem 1: Compaction Design (15 points)

Hydraulic conductivity tests were conducted on specimens of a moderate plastic clay prepared with reduced (RP), standard (SP), and modified (MP) proctor efforts. Results of the tests are summarized in the following table. Develop an acceptable zone for compaction control that will achieve hydraulic conductivity less than 10^{-7} cm/s. Note that to obtain the requirement of shear strength and desiccation, the water content should be greater than 8% and following equation

$$\gamma_d > 0.05w + 19.0$$

where γ_d is in kN/m^3 and w is in percent.

W(%)	γ_d (kN/m^3)	CE	K (cm/s)	W(%)	γ_d (kN/m^3)	CE	K (cm/s)
8.0	16.9	RP	2.1e-6	11.3	20.0	SP	3.2e-8
10.1	18.0	RP	7.5e-7	15.0	18.6	SP	9.4e-8
13.3	18.6	RP	9.8e-8	3.6	19.7	MP	4.2e-7
14.5	18.5	RP	8.1e-8	6.0	20.6	MP	9.4e-8
16.5	17.7	RP	2.3e-7	9.0	21.2	MP	3.2e-8
17.8	17.2	RP	5.3e-7	11.2	20.8	MP	1.1e-8
5.4	19.0	SP	5.7e-7	12.6	20.1	MP	1.8e-8
8.6	20.1	SP	7.8e-8				

Problem 2: Falling Head-Rising Tail Hydraulic Conductivity Test (20 points)

A falling head-raising tail hydraulic conductivity test was conducted to verify a clayey soil to be used in landfill liner construction. The soil specimen had a diameter of 10 cm and height of 12 cm. The test was performed using flexible wall permeameter with a cell pressure of 320 kPa, an applied influent pressure of 300 kPa, and an applied effluent pressure of 280 kPa. The top of the influent burette (reading = "0 cm") was 25 cm higher than the bottom of the effluent burette (reading = "25 cm"). Both influent and effluent burette had cross-sectional area of 5.0 cm^2. Test results are tabulated in Table 1.

Table 1. Laboratory Hydraulic Conductivity Results

Time	Inflow Burette, (cm)	Outflow Burette, (cm)	Comment
27/8 10:07	15.0	15.0	Steady
30/8 10:07	20.0	10.0	State

Determine: (1) the average back pressure, (2) the effective stress at the influent and effluent ends of the specimen, (3) the average effective stress, (4) back pressure saturation and explain how it was performed on this specimen, and (5) the hydraulic conductivity.

Problem 3: Two-Stage Borehole Test (25 points)

A two-stage borehole test was conducted to measure a field hydraulic conductivity of a clay liner. The casing had an inside diameter of 10 cm and the standpipe had an inside diameter of 1.0 cm. The zero reading on the standpipe was located at the bottom of the borehole. The borehole extension was 18 cm long. Data collected from stage 1 and stage 2, at steady state, are shown in Table 2. Determine the vertical and horizontal hydraulic conductivities of the clay liner.

Table 2. Two-Stage Borehole Test Results

Stage 1			Stage 2		
Date	Time	Reading (cm)	Date	Time	Reading (cm)
2/10	9:11	78.3	15/10	11:35	83.9
2/10	16:00	74.5	15/10	14:32	79.8

Problem 4: Veneer Stability (30 points)

A liner system consists of (from top to bottom): sand (LCS), geotextile, geonet, geomembrane, and compacted clay liner. The tensile strength values of the geotextile, geonet, geomembrane are 75, 50, and 50 kN/m, respectively. The interface and internal friction angles are as follows: sand-GT = 23°, GT-GN = 29°, GN-GM = 12°, GM-CCL = 25°, and sand (internal) = 30°. The slope is 18° and the length of the slope is 60 m. The unit weight of sand is 16 kN/m^3. Determine the tension in each goesynthetic layer. Do these materials have adequate tensile capacity? Can these layers be adequately anchored with an anchor trench (0.6 m wide and 1.0 m deep) and a run-out length of 1.0 m. The trench is backfilled with sand.

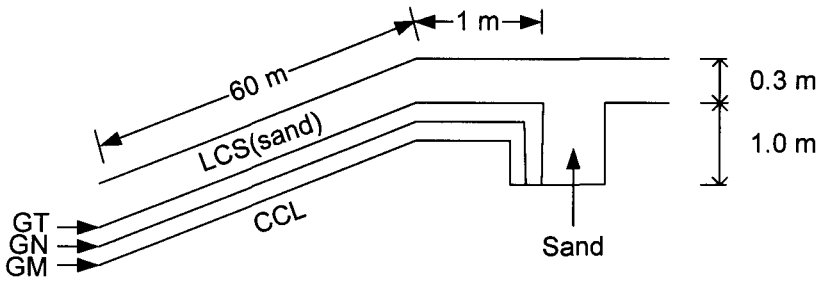

Fig. 1. Cross section of the landfill liner

Problem 5: Leachate Collection System (20 points)

A landfill being designed is 100 m long and 100 m wide. A pipe system in a leachate collection system has Lp = 50 m, 2L = 25 m, q_i = 1000 mm/yr, K = 1x10^{-3} cm/s, β = 2.86°, and S = 1:200. γ_{waste} = 10 kN/m3, height of waste = 10 m. Determine T_{max}. Is this T_{max} acceptable? Also design the sizes of lateral pipe and header pipe. Make sure that the pipes (Class 4, PS = 70 kPa) deform within an acceptable range.