มหาวิทยาลัยสงขลานครินทร์
คณะวิศวกรรมศาสตร์

การสอบปลายภาค ประจำภาคการศึกษาที่ 1 **ปีการศึกษา 2552**

สอบวันที่ 8 ตุลาคม 2552 **เวลา 9:00-12:00 น**

วิชา 220-524 Waste Geotechnics **ห้องสอบ ห้องหัวหุ่น**

ชื่อ..... รหัส.....

<u>คำชี้แจง</u>

1. ข้อสอบมี 4 ข้อ 100 คะแนน ให้ทำทุกข้อ
2. อนุญาตให้นักศึกษานำเครื่องคิดเลขเข้าห้องสอบได้
3. **ไม่**อนุญาตให้นักศึกษานำเอกสารใดๆ เข้าห้องสอบ <u>ยกเว้น</u> Note ในกระดาษ A4 **จำนวน 1 แผ่น**

ออกข้อสอบโดย ผศ. ดร. ธนิต เฉลิมยานนท์

Problem 1: Laboratory Hydraulic Conductivity (30 points)

A falling head test was conducted to determine hydraulic conductivity of a clayey soil to be used in landfill liner construction. The soil sample had a diameter of 10.2 cm and height of 11.59 cm. The bottom of soil sample was located about 80 cm below the bottom of the standpipe (or burette). The inside diameter of standpipe was 0.60 cm. The top of the standpipe (reading = "0 cm") was 120 cm higher than the bottom of standpipe (reading = "120 cm"). The falling head test was conducted by filling up the water in the standpipe to about the top reading and allowing the water to flow through the soil sample for approximately 24 hrs. In the next day, the standpipe reading was made and the weight of effluent water was measured. Thus, the water in the standpipe was refilled to the top of the standpipe again. This process was made repeatedly until required hydraulic conductivity of the soil sample was obtained. Test results are tabulated in Table 1. Determine the hydraulic conductivity of the soil sample and also show your calculation such that the hydraulic conductivity obtained was acceptable.

Table 1. Laboratory Hydraulic Conductivity Results

Date and Time	Burette Reading (cm)	Water Out (gm)
7/9/2009 8:55	0.3	0.0
8/9/2009 8:24	83.6	23.3
8/9/2009 8:24	0.0	0.0
9/9/2009 7:22	81.5	24.0
9/9/2009 7:22	1.2	0.0
10/9/2009 7:20	84.1	23.8
10/9/2009 7:20	1.3	0.0
11/9/2009 9:28	87.9	25.0
11/9/2009 9:28	0.5	0.0
12/9/2009 9:39	82.2	23.6
12/9/2009 9:39	1.0	0.0
14/9/2009 7:00	121.9	35.6
14/9/2009 7:00	0.6	0.0
15/9/2009 7:57	85.0	23.6

Problem 2: Two-Stage Borehole Test (20 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 15 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)
27/4	8:18	183.5	4/5	7:21	183.5
29/4	7:45	158.8	4/5	14:32	171.3

Problem 3: Veneer Analysis (30 points)

A liner system consists of (from top to bottom): sand (LCS), geotextile, geonet, geomembrane, and compacted clay liner (CCL). 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 = 25°, GT-GN = 22°, GN-GM = 15°, GM-CCL = 25°, and sand (internal) = 32°. The undrained shear strength of the CCL is 25 kPa. The slope is 20° and the length of the slope is 45 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? If the design depth of the trench is 1.0 m, determine a run-out length (L_{RO}) that would give a factor of safety of 3.0. Note that the trench is backfilled with sand.

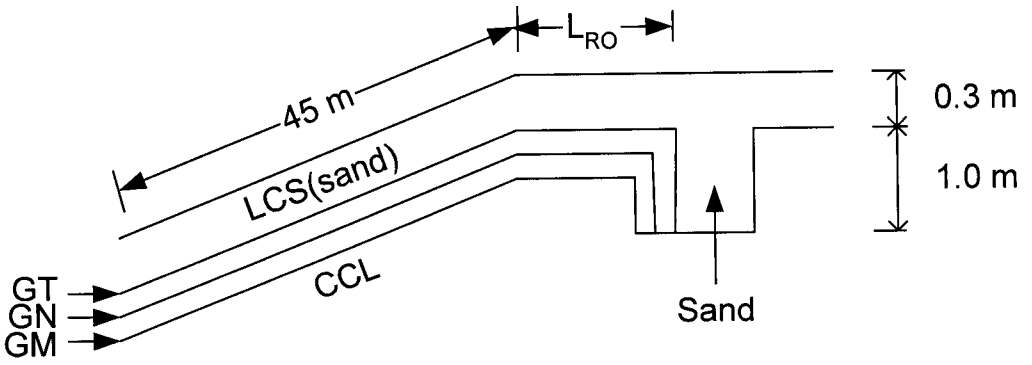

Fig. 1. Veneer analysis of landfill liner and leachate collection systems

Problem 4: Leachate collection system (20 points)

A landfill being designed is 120 m wide and 240 m long. A pipe system in a leachate collection system has D (Lateral pipe) = 20 cm, Lp = 60 m, L = 40 m, and S = 1:200. Other parameters are: q_i = 2000 mm/yr, K = 5×10^{-3} cm/s, $\beta = 4°$. The total height and the unit weight of the waste in the landfill are expected to be 40 m and 12 kN/m^3, respectively. You are asked to check the validity of this design. Please show your calculations.