Fall Term End Exam for IPSE of CSE, 2013				30th, Jan., Thursday				From: 13:00, To:14:30
Subject	Instructor	Department, Year		Answer	Separate	Reference	Reference tools are not allowed without admission.	1. Free 2. Nothing (3.) Partly allowed ・~~Textbook~~・~~Reference book~~ ・Calculator ・~~Dictionary~~ ・~~Others~~〔 〕
Soil Mechanics	H.Akagi	Civil & Env.	2					

Student ID		Name		Mark	

Answer all questions (1)～(5) on the separate answer sheet. The density of water is ρ_w=1.00(g/cm^3) and the water unit weight is γ_w=9.81(kN/m^3). Specific volume of soil $v=V/V_s$ and void ratio of soil $e=V_v/V_s$, in which V is the volume of soil, V_v is the void volume of soil and V_s is the volume of soil particle.

(1) In a stage of an oedometer test of clay specimen, the total stress was raised by 100kPa. The clay specimen was initially 20 mm thick and it was drained from both ends. The consolidation properties of the clay are given as follows, c_v = 2(m^2/year) and m_v = 5×10^{-4}(m^2/kN). Find the following values. The relationship between the time factor T_v (=$c_v t/H^2$, H: Drainage path) and the degree of consolidation U_t at time t is given by the following equation. $U_t = 2\sqrt{T_v/3}$

(a) **The final settlement of specimen S_f (mm)**, after the consolidation is complete.

(b) **The elapsed time t(min.)** from the loading, when the settlement is 0.50mm.

(c) **The time factor T_v , the degree of consolidation U_t** and **the magnitude of settlement S_t(mm)**, after 10(min.) from the loading have passed.

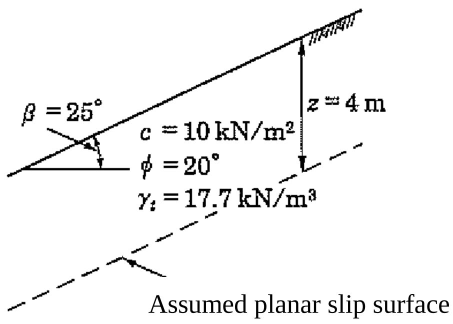

Fig.1

(2) Fill the blanks **(a)** to **(j)** with appropriate values.

1) A drained triaxial compression test was carried out with a sample of saturated clay. The cell pressure was held constant at σ_3=300kPa during the test. At the start of the test, pore pressure was u_0=100kPa, total volume of sample was V_0=196.0cm^3 and specific volume value was v_0=2.20. When the axial stress is σ_1=400kPa, the total volume is V=190.0cm^3. In this situation, pore pressure is ***u*= (a)kPa** and specific volume value is ***v* = (b)** and void ratio is ***e* = (c)**. The average stress is ***p'*=(d)kPa** and deviation stress is ***q'*=(e)kPa**.

2) An undrained triaxial compression test was carried out with a sample of saturated clay. The cell pressure was held constant at σ_3=300kPa. At the start of the test, pore pressure was u_0=100kPa, total volume of sample was V_0=196.0cm^3 and specific volume value was v_0=2.20. When the axial stress is σ_1=350kPa, pore pressure is u= 165kPa. In this situation, the total soil volume is ***V*=(f)cm^3** and specific volume value is ***v* = (g)** and void ratio is ***e* = (h)**. The average stress is ***p'*=(i)kPa** and deviation stress is ***q'*=(j)kPa**.

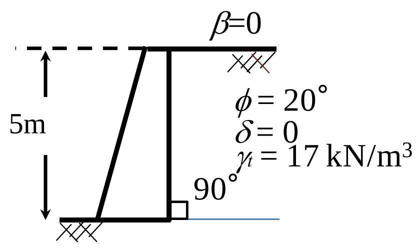

Fig.2

(3) Calculate **the safety factor F_s** of the slope against planar slip surface as shown in Fig.1. The assumed planar slip surface is located at the depth of 4m.

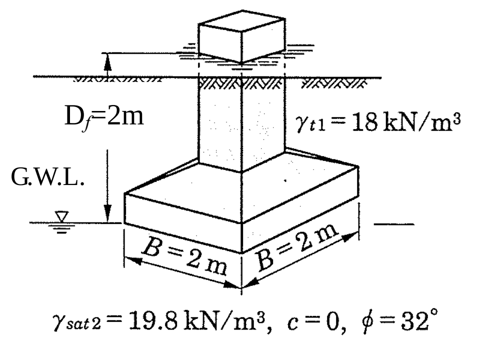

Fig.3

(4) Calculate **the force due to active earth pressure P_A(kN/m)** and **the force due to passive earth pressure P_P(kN/m)** acting on the retaining wall shown in Fig.2. The friction angle of soil behind the wall is φ= 20° and the unit weight of soil is γ_t=17.0kN/m^3. The friction angle of wall surface is δ = 0°.

(5) Fill the blanks **(a)** to **(f)** with appropriate values.

The ultimate and allowable bearing capacities are calculated for the foundation in Fig.3. The foundation shape is square. Then, shape factors α and β are 1.3 and 0.4, respectively. The bearing factors N_c, N_q and N_γ are obtained from Table 1 as **(a)**, **(b)** and **(c)**, respectively. The water table is located at the level of the base of foundation. Then, γ_{t2}' is **(d)kN/m^3** , when γ_w is 9.81kN/m^3.The ultimate bearing capacity q_c is **(e) kN/m^2**.

When the factor of safety F_s is equal to 3, the allowable bearing capacities q_a is **(f) kN/m^2**.

Table 1 Bearing factors (N_q^*=N_q+2)

ϕ	N_c	N_γ	N_q	N_q^*
0°	5.3	0	1.0	3.0
5°	5.3	0	1.4	3.4
10°	5.3	0	1.9	3.9
15°	6.5	1.2	2.7	4.7
20°	7.9	2.0	3.9	5.9
25°	9.9	3.3	5.6	7.6
28°	11.4	4.4	7.1	9.1
32°	20.9	10.6	14.1	16.1
36°	42.2	30.5	31.6	33.6
40°以上	95.7	114.0	81.2	83.2

$$q_c = \alpha c N_c + \gamma_{t1} D_f N_q + \beta \gamma_{t2}' B N_\gamma \text{ (kN/m}^2\text{)}$$

30th, January, 13：00～14：30

International Program, Department of Civil and Environmental Engineering
Answer sheet for Fall Term End Exam, Soil Mechanics, 2013

Student ID ____________ — ______ Name ________________________ Mark __________

(1)

(a) $S_f = m_v \times op \times H = 5 \times 10^{-4}(m^2/kN) \times 100(kN/m^2) \times 0.02(m) = 1(mm)$

(b) $U_t = 0.5(mm)/1(mm) = 0.5,\quad T_v = 3 \times \left(\frac{0.5}{2}\right)^2 = 0.1875,\quad t = \frac{0.1875 \times (0.01)^2(m^2)}{\frac{2}{60 \times 24 \times 365}\left(\frac{m^2}{min}\right)} = 4.9(mm)$

(c) $T_v = \frac{\frac{2}{60 \times 24 \times 365}\left(\frac{m^2}{min}\right) \times 10(min)}{(0.01)^2(m^2)} = 0.38,\quad U_t = 2\sqrt{\frac{0.38}{3}} = 0.71,\quad S_t = 0.71 \times 1(mm) = 0.71(mm)$

(2)

(a)	100	(b)	2.13	(c)	1.13	(d)	233
(e)	100	(f)	196.0	(g)	2.20	(h)	1.20
(i)	152	(j)	50				

(3)

$\sigma = \gamma_t \cdot Z \cdot \cos^2\beta \quad \tau = \gamma_t \cdot Z \cdot \cos\beta \cdot \sin\beta$

$$F_s = \frac{\tau_f}{\tau} = \frac{c + \gamma_t \cdot Z \cdot \cos^2\beta \cdot \tan\varphi}{\gamma_t \cdot Z \cdot \sin\beta \cdot \cos\beta} = \frac{10 + 17.7 \times 4 \cdot \cos^2 25^\circ \cdot \tan 20^\circ}{17.7 \times 4 \cdot \cos 25^\circ \cdot \sin 25^\circ} = \frac{31.2}{27.1} \fallingdotseq 1.15$$

(4)

$$P_A = \frac{1}{2} \times \gamma_t \cdot H^2 \times \tan^2\left(45^\circ - \frac{\varphi}{2}\right) = \frac{1}{2} \times 17.0 \times 5^2 \times \tan^2(45^\circ - 10^\circ) = 104(kN/m)$$

$$P_p = \frac{1}{2} \times \gamma_t \cdot H^2 \times \tan^2\left(45^\circ + \frac{\varphi}{2}\right) = \frac{1}{2} \times 17.0 \times 5^2 \times \tan^2(45^\circ + 10^\circ) = 433(kN/m)$$

(5)

(a)	20.9	(b)	14.1	(c)	10.6	(d)	9.99
(e)	592.3	(f)	221.4				

4×24+4＝100