

Fall Term End Exam for IPSE of CSE, 2014				29th, Jan., Thursday			From: 9:00, To:10:30	
Subject	Instructor	Department, Year		Answer	Separate	Reference	Reference tools are not to be used without permission.	1. Free 2. Nothing 3. Partly permitted •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 $\rho_w=1.00(\text{g/cm}^3)$ and the water unit weight is $\gamma_w=9.81(\text{kN/m}^3)$. 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, $c_v = 2(\text{m}^2/\text{year})$ and $m_v = 5 \times 10^{-4}(\text{m}^2/\text{kN})$. Find the following values. The relationship between the time factor $T_v (=c_v t/H^2, H: \text{Drainage path})$ and the degree of consolidation U_t at time t is given by the following equation. $U_t = 2\sqrt{T_v/3}$

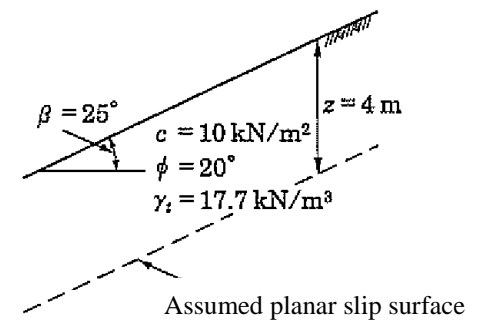


Fig.1

- (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_f (mm), after 10(min.) from the loading have passed.

(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 $\sigma_3=300\text{kPa}$ during the test. At the start of the test, pore pressure was $u_0=100\text{kPa}$, total volume of sample was $V_0=196.0\text{cm}^3$ and specific volume value was $v_0=2.20$. When the axial stress is $\sigma_1=400\text{kPa}$, the total volume is $V=190.0\text{cm}^3$. In this situation, pore pressure is $u=(\text{a})\text{kPa}$ and specific volume value is $v=(\text{b})$ and void ratio is $e=(\text{c})$. The average stress is $p'=(\text{d})\text{kPa}$ and deviation stress is $q'=(\text{e})\text{kPa}$.

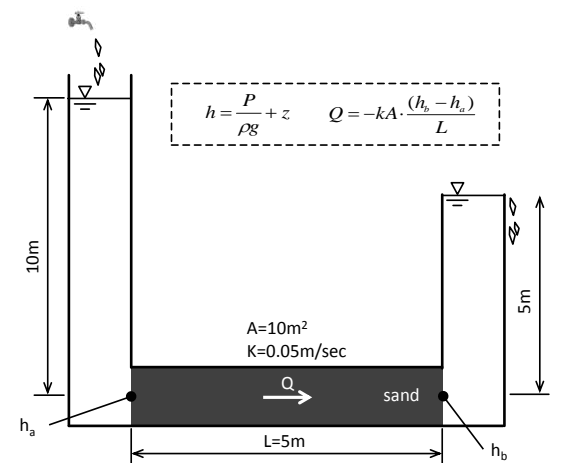


Fig.2

2) An undrained triaxial compression test was carried out with a sample of saturated clay. The cell pressure was held constant at $\sigma_3=300\text{kPa}$. At the start of the test, pore pressure was $u_0=100\text{kPa}$, total volume of sample was $V_0=196.0\text{cm}^3$ and specific volume value was $v_0=2.20$. When the axial stress is $\sigma_1=350\text{kPa}$, pore pressure is $u=165\text{kPa}$. In this situation, the total soil volume is $V=(\text{f})\text{cm}^3$ and specific volume value is $v=(\text{g})$ and void ratio is $e=(\text{h})$. The average stress is $p'=(\text{i})\text{kPa}$ and deviation stress is $q'=(\text{j})\text{kPa}$.

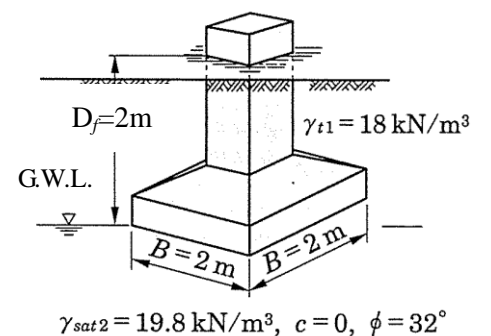


Fig.3

(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.

(4) Fig.2 shows the one-dimensional water flow in the sand specimen. Datum line of potential water head z is at the mid height of the sand specimen.

Find the total water head $h_a(\text{m})$, $h_b(\text{m})$ and water flow volume $Q(\text{m}^3/\text{s})$.

(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/m³, when γ_w is 9.81kN/m³. The ultimate bearing capacity q_c is (e) kN/m².

When the factor of safety F_s is equal to 3, the allowable bearing capacities q_a is (f) kN/m².

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

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

International Program, Department of Civil and Environmental Engineering
Answer Sheet for Fall Term End Exam, Soil Mechanics, 2014

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(1)	<p>(a) $S_f = 5 \times 10^{-4}(\text{m}^2/\text{kN}) \times 100(\text{kN}/\text{m}^2) \times 10(\text{mm}) = 1(\text{mm})$</p> <p>(b) $0.5 = 2 \sqrt{\frac{T_v}{3}} \therefore T_v = 0.1875, \quad C_u = 2(\text{m}^2/\text{year}) = 2 \left(\frac{10^6 \text{mm}^2}{365 \times 24 \times 60 \text{min}} \right) = 3.81(\text{mm}^2/\text{min})$</p> <p>$t = 0.1875 \times 10^2(\text{mm}^2)/3.81(\text{mm}^2/\text{min}) = 4.92(\text{min})$</p> <p>(c) $T_v = \frac{3.81(\text{mm}^2/\text{min}) \times 10(\text{min})}{10^2(\text{mm}^2)} = 0.381, \quad U_t = 2 \sqrt{\frac{0.381}{3}} = 0.713, \quad S_t = 0.713 \times 1(\text{mm}) = 0.713(\text{mm})$</p>							
(2)	(a)	100	(b)	2.13	(c)	1.13	(d)	233.3
	(e)	100	(f)	196.0	(g)	2.20	(h)	1.20
	(i)	151.7	(j)	50	/			
(3)	<p>$\sigma = 17.7 \times 4 \times \cos^2 25^\circ = 58.2(\text{kN}/\text{m}^2), \quad \tau = 17.7 \times 4 \times \cos 25^\circ \times \sin 25^\circ = 27.1(\text{kN}/\text{m}^2)$</p> <p>$F_s = \frac{10 + 58.2 \times \tan 20^\circ}{27.1} = 1.15$</p>							
(4)	<p style="text-align: center;">$h_a = 10(\text{m}), h_b = 5(\text{m})$</p> <p style="text-align: center;">$Q = -0.05(\text{m}/\text{s}) \times 10(\text{m}^2) \times \frac{5(\text{m}) - 10(\text{m})}{5(\text{m})} = 0.5(\text{m}^3/\text{s})$</p>							
(5)	(a)	20.9	(b)	14.1	(c)	10.6	(d)	9.99
	(e)	592.3	(f)	221.4	/			

(1) 4×5=20 (2) 2×10=20 (3) 20 (4) 5×3+5=20 (5) 3×6+2=20