Mid Fall Term Exam for IPSE of CSE, 2014				19th, Nov., Wednesday				From: 18:15, To:19:45
Subject	Instructor	Department, Year		Answer	Separate	Reference	Reference tools are not allowed without admission.	1. Nothing 2. Free 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).

(1) A 1.50 (kg) of dry soil is poured into a Eureka can and displaces 600 (cm^3) of water (see Fig. 1). **Find the density of soil particles ρ_s (g/cm^3).**

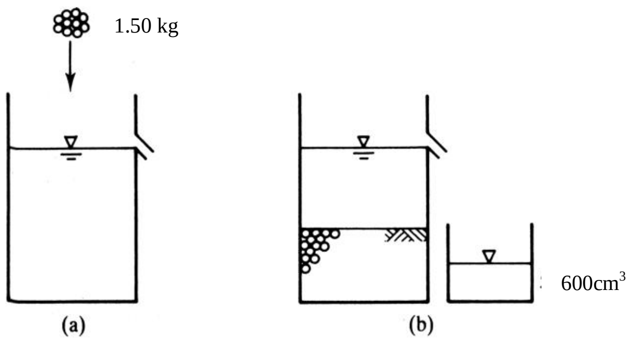

Fig.1

A 160 (g) of the same dry soil is poured uniformly into an empty impermeable metal container and occupied 180 (cm^3) (see Fig.2). The area of the inside cross section of the container is A=30.0 (cm^2). **Find the void ratio *e* of the dry soil in the container.**

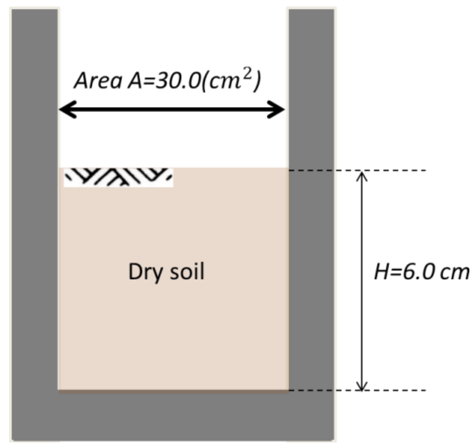

Fig.2

(2) Table 1 shows the results of the density test and water contents test of soil.
Find the density of soil particle ρ_s(g/cm^3), wet density of soil ρ_t(g/cm^3), water content *w*(%), dry density of soil ρ_d(g/cm^3), void ratio *e* and saturation ratio S_r(%).

Table 1

Types of test	Results	
Density of grains	Volume of the soil particle	11.00 cm^3
Water content	Mass of the wet specimen and container	92.50 g
Wet density	Mass of the specimen and container after drying at 105°C	78.90 g
	Mass of the container	49.30 g
	Volume of the wet specimen	26.20 cm^3

(3) Fig. 2 shows the state of stresses in an element of soil. (Positive shear stress and angles indicate counterclockwise direction.)

1) **Calculate the maximum and minimum principal stresses σ$_1$(kPa)and σ$_3$(kPa).**

2) **Calculate the angle α(degrees) formed by the plane of the maximum principal stress and the horizontal plane.**

3) The angle between plane A and horizontal plane within an element of soil is +45 degrees as shown in Fig. 2. **Calculate normal and shear stresses σ$_A$(kPa) and τ$_A$(kPa) acting on the plane A.**

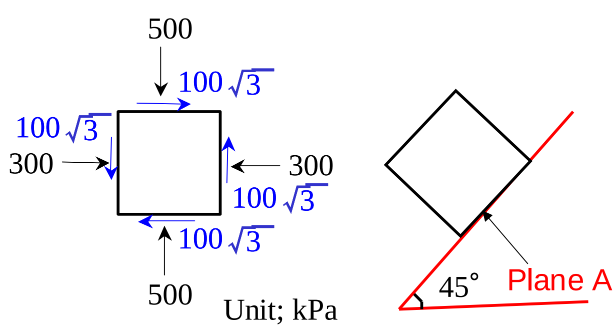

Fig.2

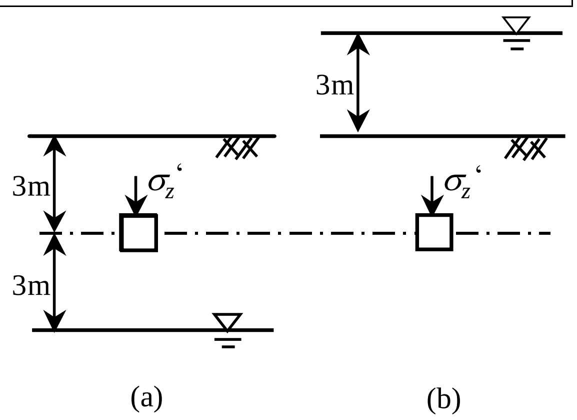

Fig.3

(4) The clay deposit in Fig.3 has unit weight γ_{sat}=20(kN/m^3) and the soil remains saturated if the pore pressures become negative.

1) When water table is 6 m below ground level as shown in Fig.3(a), **find the normal effective stress σ'$_{zA}$(kN/m^2) at a depth of 3m.**

2) When water table is 3 m above ground level as shown in Fig.3(b), **find the normal effective stress σ'$_{zB}$(kN/m^2) at a depth of 3m.**

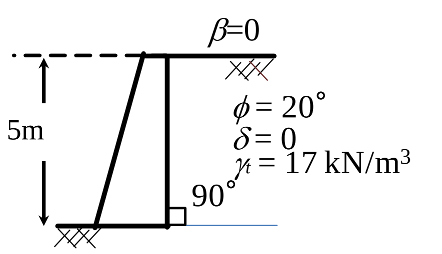

Fig.4

(5) 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.4. 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°.

(15)

19th, November, 18：15～19：45

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

Student ID ______—____ Name ______________ Mark ________

Question No. (1)

$$\rho_s = \frac{1500(g)}{600(cm^3)} = 2.5(g/cm^3),$$

$$v_s = \frac{160(g)}{2.5(g/cm^3)} = 64(cm^3),\ v_v = 180 - 64 = 116(cm^3),\ e = \frac{116}{64} \doteqdot 1.81$$

10×2=20

Question No. (2)

$$\rho_s = \frac{78.90 - 49.30}{11.00} \doteqdot 2.69(g/cm^3),\qquad \rho_t = \frac{92.50 - 49.30}{26.20} = 1.65(g/cm^3),$$

$$w = \frac{92.50 - 78.90}{78.90 - 49.30} \times 100 \doteqdot 45.9(\%),\quad \rho_d = \frac{78.90 - 49.30}{26.20} \doteqdot 1.138(g/cm^3),$$

$$e = \frac{26.20 - 11.00}{11.00} = 1.38,\qquad Sr = \frac{92.50 - 78.90}{26.20 - 11.00} \times 100 = 89.5(\%)$$

3×6+2=20

Question No. (3)

$$(1)\sigma_1 = 600(kPa), \sigma_3 = 200(kPa),$$

$$(2) 2\alpha = +60^\circ \quad \alpha = +30^\circ \ ,$$

$$(3)\sigma_A = 400 + 100\sqrt{3}(kPa),$$

$$\tau_A = 100(kPa)$$

4×5=20

Question No. (4)

$$(1)\sigma_{zA} = 20.0 \times 3 = 60(kN/m^2),\quad u_A = -29.4(kN/m^2), \sigma'_{zA} = 60 - (-29.4) = 89.4(kN/m^2),$$

$$(2)\sigma_{zB} = 9.81 \times 3 + 20.0 \times 3 = 89.4(kN/m^2), u_B = 9.81 \times 6 = 58.9(kN/m^2),$$

$$\sigma'_{zB} = 89.4 - 58.9 = 30.5(kN/m^2),$$

10×2=20

Question No. (5)

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

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