| Mid Fall Term Exam for IPSE of CSE, 2012 | | | | 21st, Nov., Wednesday | | | | From: 18:15, To:19:45 |
|---|---|---|---|---|---|---|---|---|
| Subject | Instructor | Department, Year | | Answer | Separate | Reference | Reference tools are not allowed without admission. | 1. Nothing<br>2. Free<br>3. Partly allowed<br>・~~Textbook~~・~~Reference book~~<br>・Calculator<br>・~~Dictionary~~<br>・~~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(g/cm$^3$) and the water unit weight is $\gamma_w$=9.8(kN/m$^3$).**

**(1)** A 1.62 (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 $\rho_s$ (g/cm$^3$).**

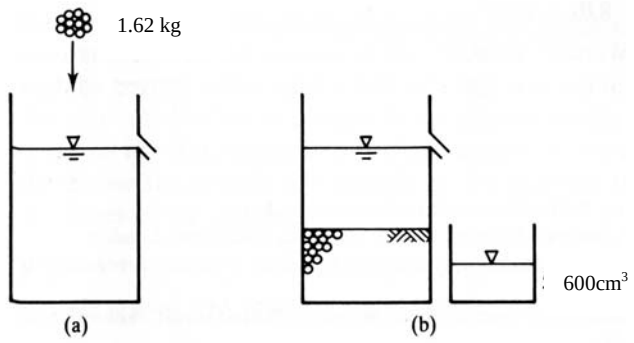


Fig.1

A 162 (g) of the same dry soil is poured uniformly into an empty impermeable metal container 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.**

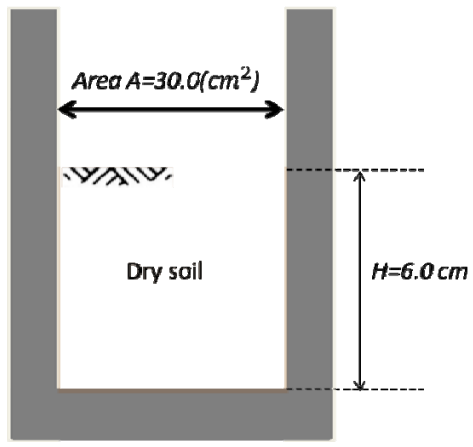


Fig.2

**(2)** Table 1 shows the results of the density test and water contents test of soil.

**Find the density of soil particle $\rho_s$(g/cm$^3$), wet density of soil $\rho_t$(g/cm$^3$), water content *w*(%), dry density of soil $\rho_d$(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 | 11.06 cm$^3$ |
| Water content | Mass of the wet specimen and container | 92.58 g |
| Wet density | Mass of the specimen and container after drying at 105°C | 78.95 g |
| | Mass of the container | 49.32 g |
| | Volume of the wet specimen | 26.22 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 $\sigma_1$(kPa)and $\sigma_3$(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 $\sigma_A$(kPa) and $\tau_A$(kPa) acting on the plane A.**

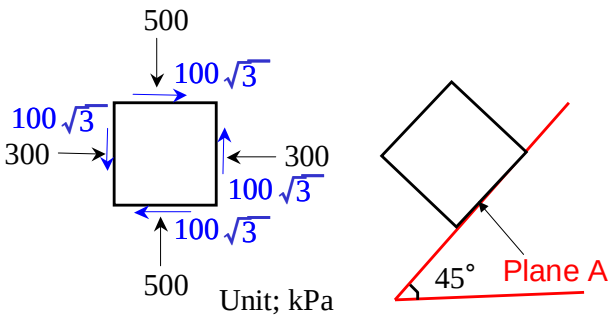


Fig.2

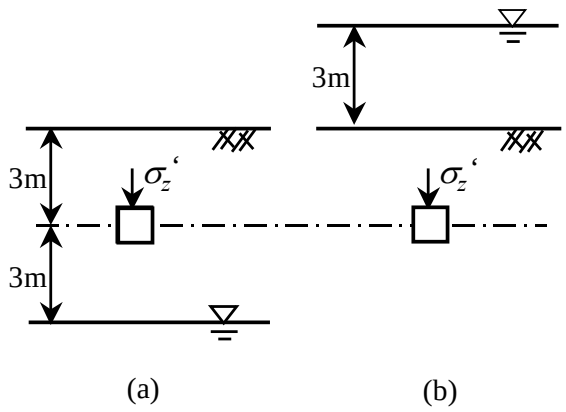


Fig.3

**(4)** The deep clay deposit in Fig.3 has unit weight $\gamma_{sat}$=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 $\sigma'_{zA}$(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 $\sigma'_{zB}$(kN/m$^2$) at a depth of 3m.**

**(5)** Fig.4 shows the one-dimensional water flow in the sand specimen. Datum line of potential water head *z* is at the central depth of the sand specimen.

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

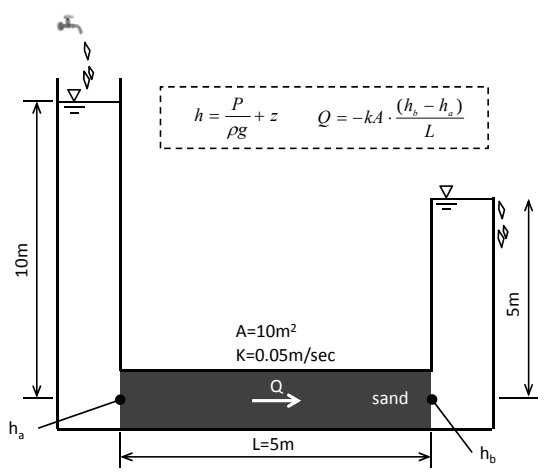


Fig.4

End of questions.

( 10 )

21st, November, 18：15～19：45

International Program, Department of Civil and Environmental Engineering

Answer sheet for Mid Fall Term Exam, Soil Mechanics, 2012

Student ID _____ — _____ Name _____ Mark _____

Question No. (1)

$$\rho_s = \frac{1620(\mathrm{g})}{600(\mathrm{m}^3)} = 2.7(\mathrm{g/cm}^3),\quad e = \frac{v_v}{v_s} = \frac{120}{60} = 2.0$$

Question No. (2)

$$\rho_s = 2.68(\mathrm{g/cm}^3), \rho_t = \frac{92.58 - 49.32}{26.22} = 1.65(\mathrm{g/cm}^3), w = \frac{m_w}{m_s} \times 100 = 46.0(\%),$$

$$\rho_d = \frac{m_s}{V} = 1.13(\mathrm{g/cm}^3), e = \frac{V_v}{V_s} = 1.37, Sr = \frac{13.63}{15.16} \times 100 = 89.9(\%)$$

Question No. (3)

$$(1)\sigma_1 = 600(\mathrm{kPa}), \sigma_3 = 200(\mathrm{kPa}),\ (2)\alpha = +30(^\circ),\ (3)\sigma_A = 400 + 100\sqrt{3} = 573.2(\mathrm{kPa}),$$
$$\tau_A = 100(\mathrm{kPa})$$

Question No. (4)

$$(1)\sigma'_{zA} = 20.0 \times 3 - (-9.8 \times 3) = 89.4\ (\mathrm{kN/m2}),$$
$$(2)\sigma'_{zB} = 9.8 \times 3 + 20.0 \times 3 - 9.8 \times 6 = 30.6(\mathrm{kN/m2})$$

Question No. (5)

5×18+10

$$h_a = 10(\mathrm{m}), h_b = 5(\mathrm{m}), Q = 0.05 \times 10 \times \frac{10-5}{5} = 0.5(\mathrm{m}^3/\mathrm{s})$$