Spring Term Exam for IPSE of CSE, 2016				28th, July, Thursday				From: 15:00, to: 16:30
Subject	Instructor	Department, Year		Answer	Separate	Reference	Reference tools are not allowed without permission.	1. Nothing 2. Free (3) Partly allowed ・~~Textbook~~ ・~~Reference book~~ ・Calculator ・~~Dictionary~~ ・~~Others~~ [ ]
Geotechnical engineering	H. Akagi	Civil & Env.	2					

Student ID		Name		Mark	

Please answer **all** of the following questions in answer sheet.

Engineering Geology questions **********

Question 1: Three types of rock mass movement are shown in Fig. 1. Select proper movement pattern out of given words and (Buckling, Rock slip, Toppling) name each one?

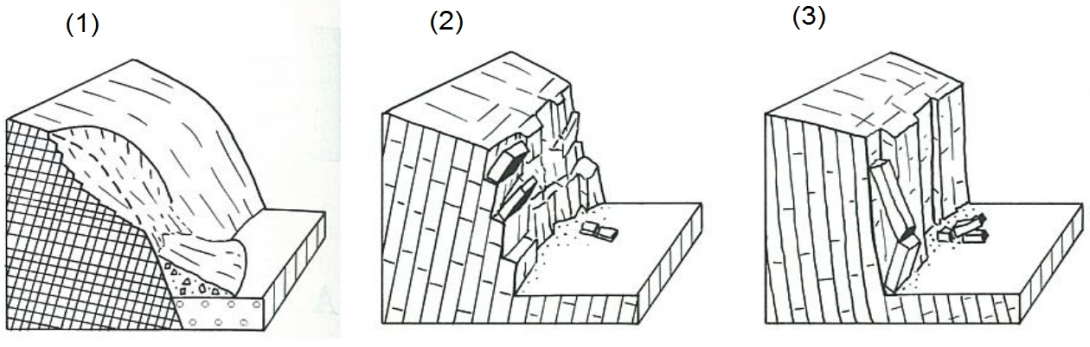


Fig. 1. Different types of rock mass movement

Question 2: Briefly explain the difference between debris flow and land slide?

Question 3: Three type of rocks are listed as below. Explain how do they form?

Group 1: Igneous rock

Group 2: Sedimentary rock

Group 3: Metamorphic rock

Question 4: Fig. 2 shows four geological borehole. The line on the side of each geological borehole shows N value (value by which the hardness of the ground is shown). Make geological section map (draw geological layers) from these four geological columnar section in answer sheet.

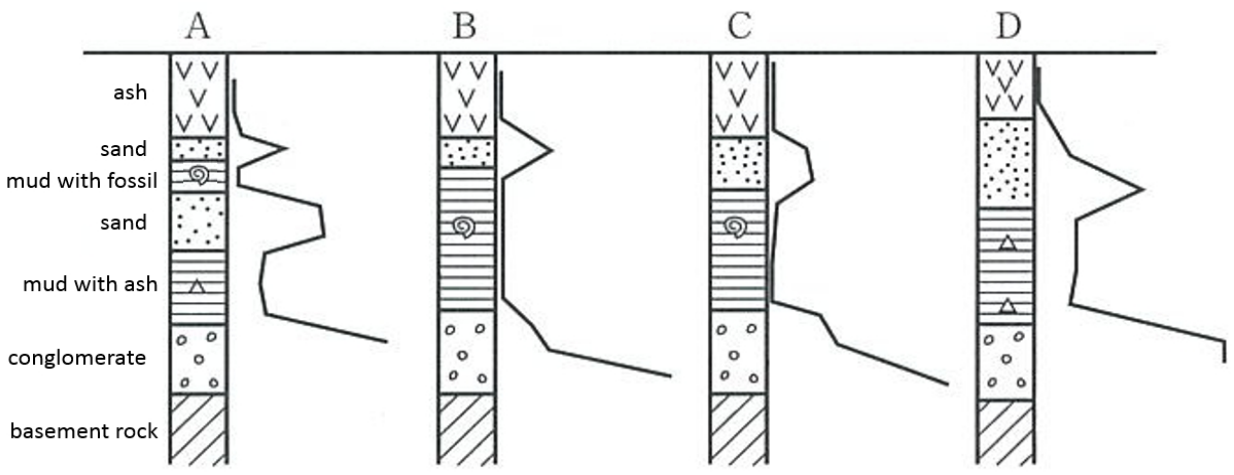


Fig. 2: Geological boreholes.

Question 5: Physical weathering and chemical weathering are two process for rock disintegration. Determine the type of process for each of the following items (Physical weathering OR chemical weathering)?

a. Hydration
b. Wetting and drying
c. Freezing and thawing
d. Oxidation-Reduction
e. Action of organisms
f. Plant roots

Tunnel Engineering questions **********

Question 6: What are three main type of tunnel construction methods?

Question 7: Fig. 3, demonstrates a rectangular shape tunnel with external width and height of 10 m and 6 m is excavated in the ground with an overburden of 4 m. The tunnel is excavated (in the direction perpendicular to paper) within dry stiff clay with unit weight (γ) of 20 kN/m^3, and internal friction angle of $\emptyset = 30^o$. If coefficient of lateral earth pressure at rest is $K_0 = 1 - \sin \emptyset$, calculate following items:

a) Vertical stress on tunnel crown (σ_v) ?

b) Horizontal stress at the level of tunnel crown (σ_{h1}) ?

c) Horizontal stress at the level of tunnel bottom (σ_{h2}) ?

d) Vertical total force on tunnel crown per 1 meter along tunnel direction (F_V)?

e) Horizontal total force on tunnel side per 1 meter along tunnel direction (F_h)?

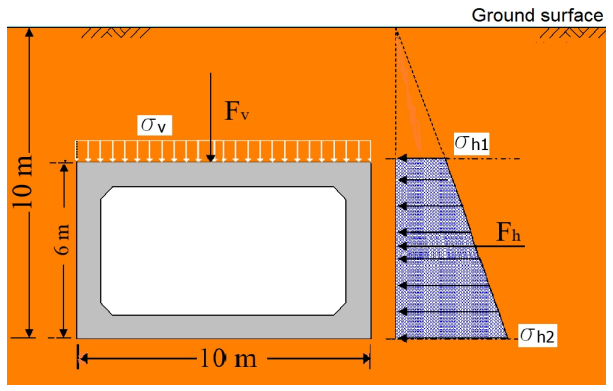


Fig. 3: Rectangular shape tunnel

Question 8: Describe advantages and disadvantages of the cut and cover tunnel method.

Earthquake Engineering questions **********

Question 9: Fill out blank spaces in the following statements with given words.

High stiffness houses have (1)…… (shorter, longer) period, and Soft ground has a (2) …… (shorter, longer) period.

If the thickness of soft layer is deep, displacement response tends to (3) …… (increase, decrease), but acceleration response tends to (4) …… (increase, decrease).

Soil liquefaction is the phenomena that (5) …….. (loose, dense) sand loses their strength due to (6) …… (increase, decrease) of pore water pressure during an earthquake.

Question 10: Based on Fig. 4 configuration, determine the critical height of a cut in the normally consolidated clay. The internal friction angle ($\emptyset$) of the clay is 0.

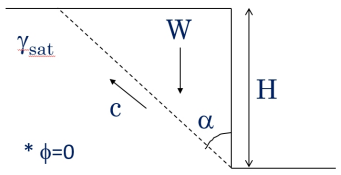


Fig. 4: Critical height of a cut in clayey soil.

Question 11: Figure 5 shows the response spectra for the Kobe and Tohoku earthquake. The seismic damage on railway viaducts whose natural periods were around 0.5 (sec), was severe in the Kobe Earthquake but limited in the Tohoku Earthquake.

Please explain the reason of this briefly.

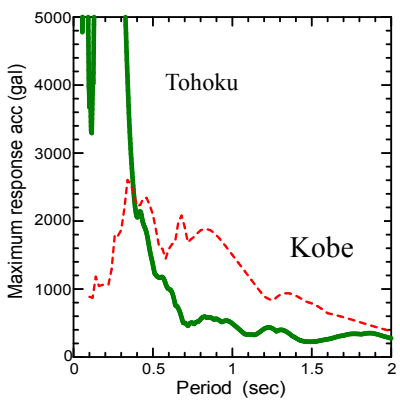


Fig. 5: Spectra for the Kobe and Tohoku earthquake.

End of questions.

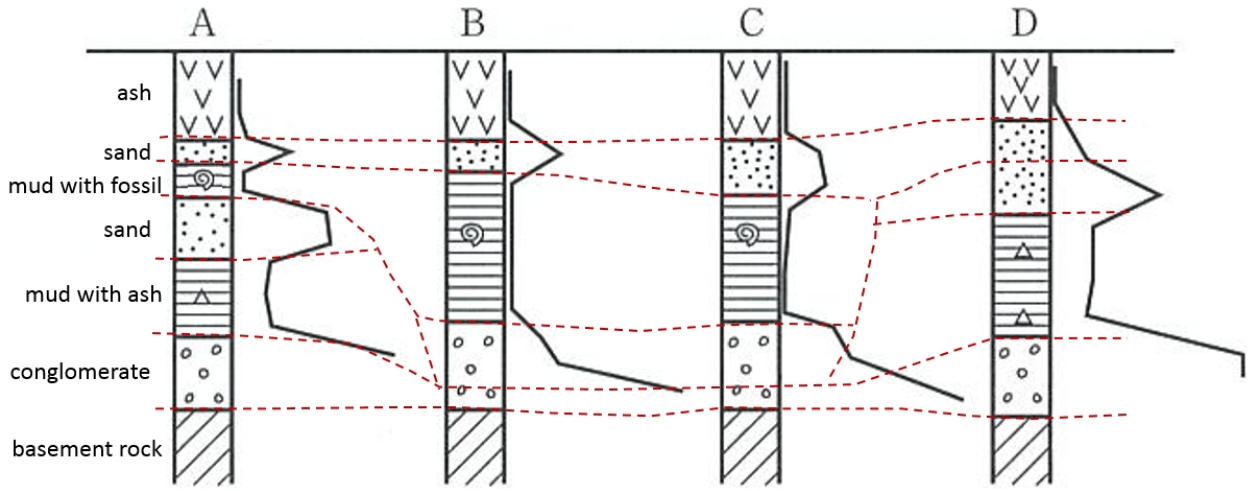
(100)

28th, July, 15 : 00～16 : 30

International Program, Department of Civil and Environmental Engineering

Answer sheet for Spring Term Exam, Geotechnical Engineering, 2016

Student ID _____ Name _____ Mark _____

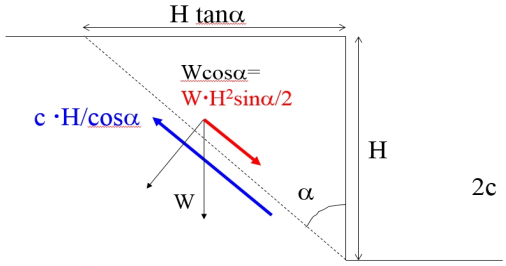
Answer of Question No. 1	6/100
(1) Rock slip (2) Toppling (3) Buckling	
Answer of Question No. 2	6/100
Debris flow is movement of debris in mountain stream with a large amount of water while land slide is rapid downward movement of a mass of soil on a slope.	
Answer of Question No. 3	9/100
Igneous rock is formed through the cooling and solidification of magma or lava. Sedimentary rocks are formed by the deposition of material. Metamorphic rocks are formed by transformation of existing rock types.	
Answer of Question No. 4	7/100
	
Answer of Question No. 5	12/100
a. Chemical b. Physical c. Physical d. Chemical e. Physical f. Physical	
Answer of Question No. 6	6/100
NATM, Cut and cover, Shield tunnelling	
Answer of Question No. 7	15/100
a) Vertical stress: $\sigma_v = 20 \times 4 = \gamma_t h =$ 80 kPa b) $K_0 = 1$ - sin (30) = 0.5, Horizontal stress: $\sigma_{h1} = k_0 \gamma_t h_1 = 0.5 \times 20 \times 4 = 40$ kPa c) Horizontal stress: $\sigma_{h2} = k_0 \gamma_t h_2 = 0.5 \times 20 \times 10 = 100$ kPa d) Force on tunnel crown: $F_v = \sigma_v A = 80 \times 10 \times 1 = 800$ kN e) Force on tunnel side $F_h = \sigma_h A = ((100 + 40) \times 6 /2) \times 1 = 420$ kN	
Answer of Question No. 8	6/100

Advantages: It is economical, fast, and visible so that one can understand the situation. One can change plan or tunnel shape during construction.
Disadvantages: vibration, noise, dust, longer construction time, larger construction area, may block traffic in ground surface.

Answer of Question No. 9	12/100

1- shorter, 2- longer, 3-increase, 4-decrease, 5-loose, 6-increase.

Answer of Question No. 10	15/100



$$Fs=\frac{c\cdot H/\cos\alpha}{\gamma_{sat}\cdot H^2\sin\alpha/2}=\frac{2c}{\gamma_{sat}H\sin\alpha\cos\alpha}=\frac{4c}{\gamma_{sat}H\sin 2\alpha}$$

$$\alpha=45^\circ \rightarrow \min(Fs)=\frac{4c}{\gamma_{sat}H}=1.0 \Rightarrow H_f=\frac{4c}{\gamma_{sat}}$$

Answer of Question No. 11	6/100

Natural period of Tohoku Earthquake was very short and approximately 0.3 second.
Natural period of railway viaducts were around 0.5 (sec) greater than 0.3 (sec) and they did not vibrate strongly. That's why damages were limited.