

Spring Term Exam for IPSE of CSE, 2019				1 <sup>st</sup> , August, Thursday		From: 9:00 to 10:30	
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 these 3 sheets.

**Engineering Geology questions**

**Question 1:** Fig. 1 shows a topographic map of a site. (a) Which diagram on the right hand side (1, 2, 3, or 4) best represents the topographic profile along a straight line from point A to B? (b) Which side of Center Hill in Fig. 1 has the steepest slope? (North, East, South, or West). (10 points).

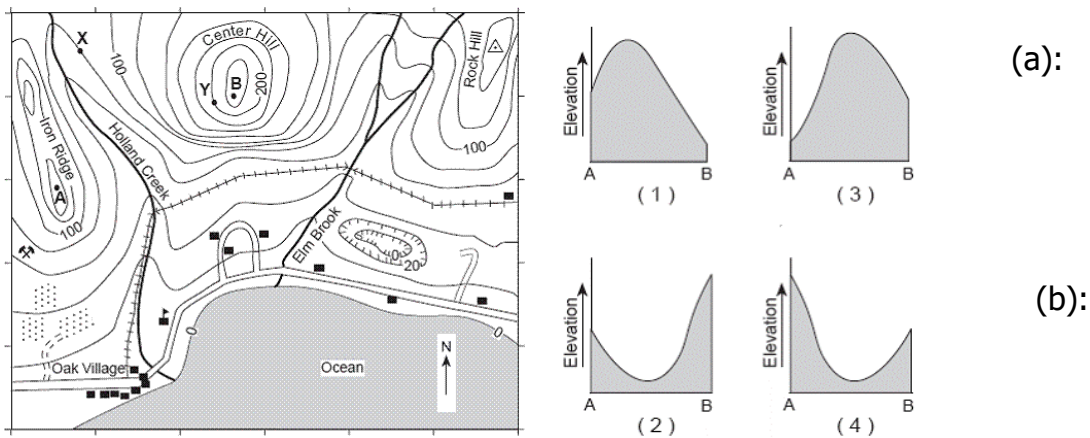
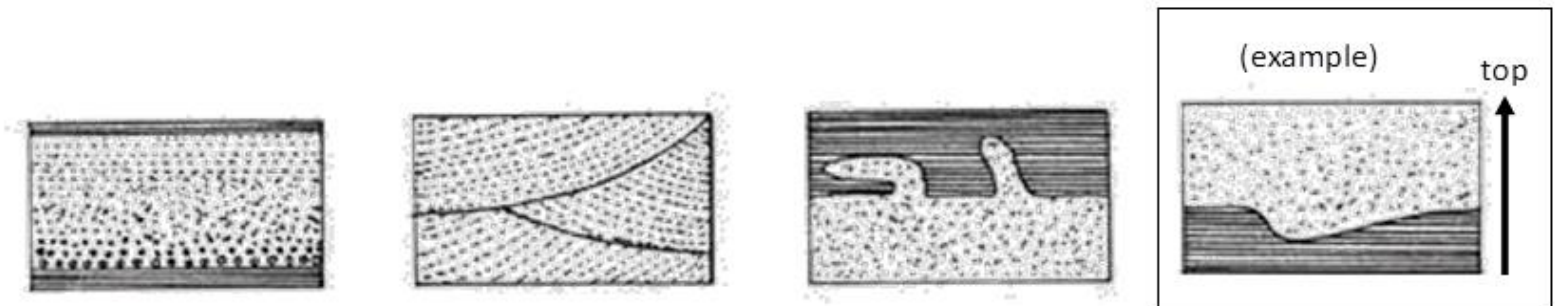


Fig. 1: Topographic map

**Question 2:** Judge the top and bottom of following three stratums by an arrow. An example is shown on the right. (6 points).



**Question 3:** Three type of rocks are listed as below. Explain how does each of them form briefly? (12 points)

Type 1: Igneous rock

Type 2: Sedimentary rock

Type 3: Metamorphic rock

**Question 4:** Figure 2 shows the stratum conditions at the two points of A and B. Describe the order of forming stratum at points A and B including granite and the fault. (8 points)

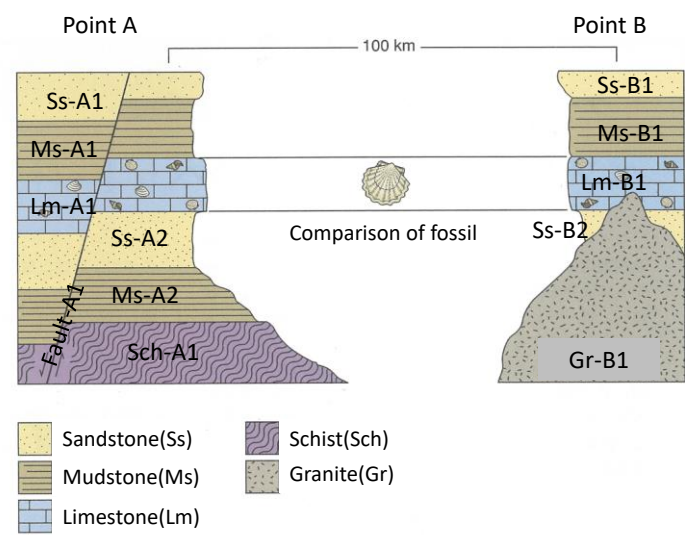
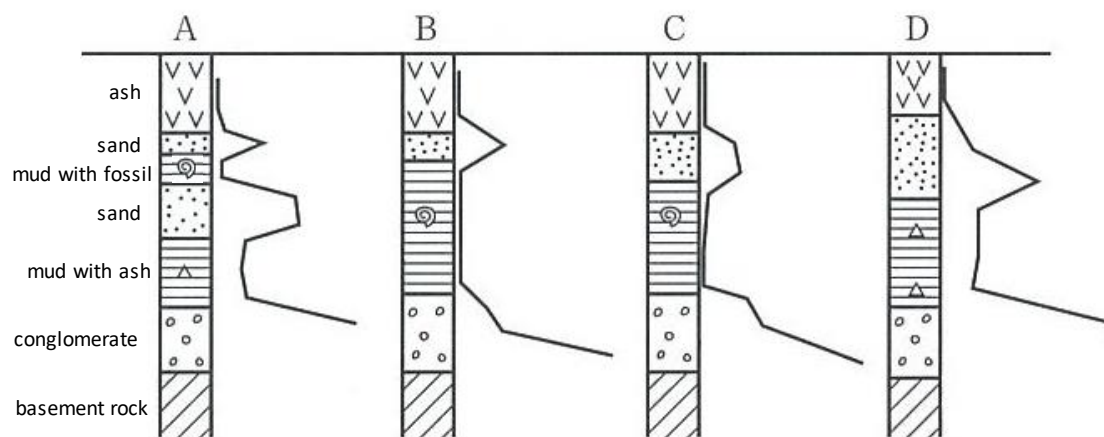


Fig. 2. Stratum conditions at the two points of A and B

**Question 5:** Following Figure shows four geological columnar section obtained by the boring exploration in the alluvial plain. The line on the side of each geological columnar section shows N value (value by which the hardness of the ground is shown). Make geological section map from these four geological columnar section. (6 points)



**Tunnel Engineering questions**

**Question 6:** Explain three types of tunnel construction methods respectively, Names, Methods, Merits, Weak points. (15 points)

**Question 7:** Describe what happened in the ground and the mechanism about the face collapse on the following figure (5 points).



**Question 8:** Table 1 lists some of the design conditions that should be considered during tunneling construction. For each of the following design conditions, name at least ONE problem that may happen. (The first row of the Table shows an example.) (12 points)

Table 1: Design conditions during tunneling construction

Design conditions	Problem events
Example: Neighboring construction	Example answer: Influence on adjacent structure
1- Shallow overburden	
2- Under the urban area	
3- At the deep ground	
4- Under the water	

**Earthquake Engineering questions**

**Question 9:** Fill out blank spaces in the following statements with given words. (12 points)

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. 3 configuration and shown parameters, determine the critical height of a cut in the normally consolidated clay. The internal friction angle ( $\phi$ ) of the clay is 0. (9 points)

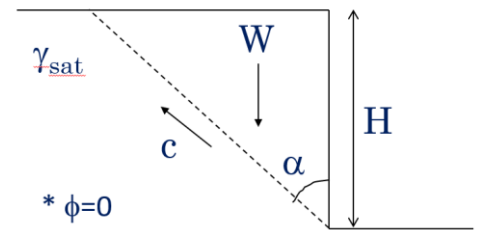


Fig. 3: Critical height of a cut in clayey soil.

**Question 11:** Figure 4 shows the response spectra for the Kobe earthquake and the 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. (5 points)

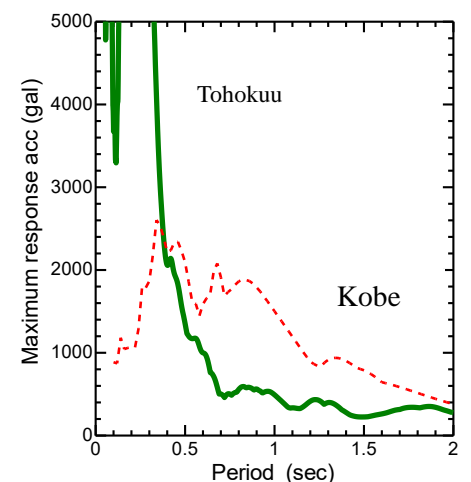


Fig.4

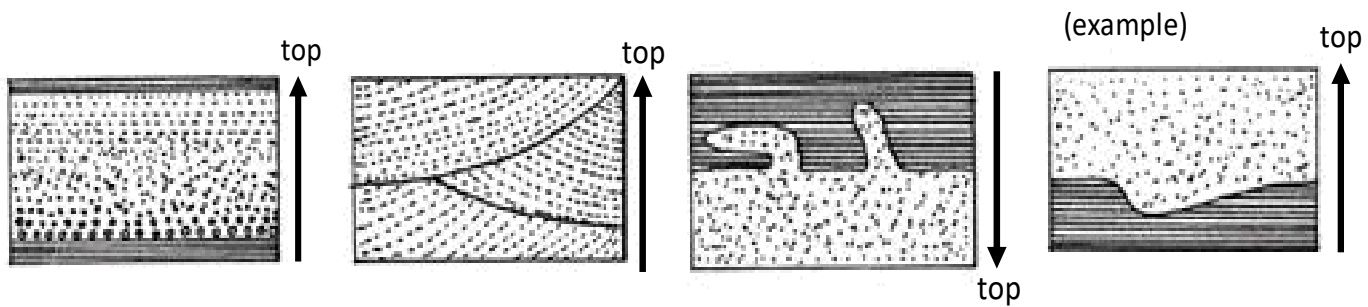
**End of questions.**

**Engineering Geology questions**

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**Question 1: Number 2, South**

**Question 2:** Judge the top and bottom of each of given three stratum. An example is also shown on the right. (6 points)



**Question 3:** Three type of rocks are listed as below. Explain how do each of them form briefly? (10 points)

**Group 1: Igneous rock**

Igneous rock is formed through the cooling and solidification of magma or lava.

**Group 2: Sedimentary rock**

Sedimentary rocks are formed by the deposition of material.

**Group 3: Metamorphic rock**

Metamorphic rocks are formed by transformation of existing rock types.

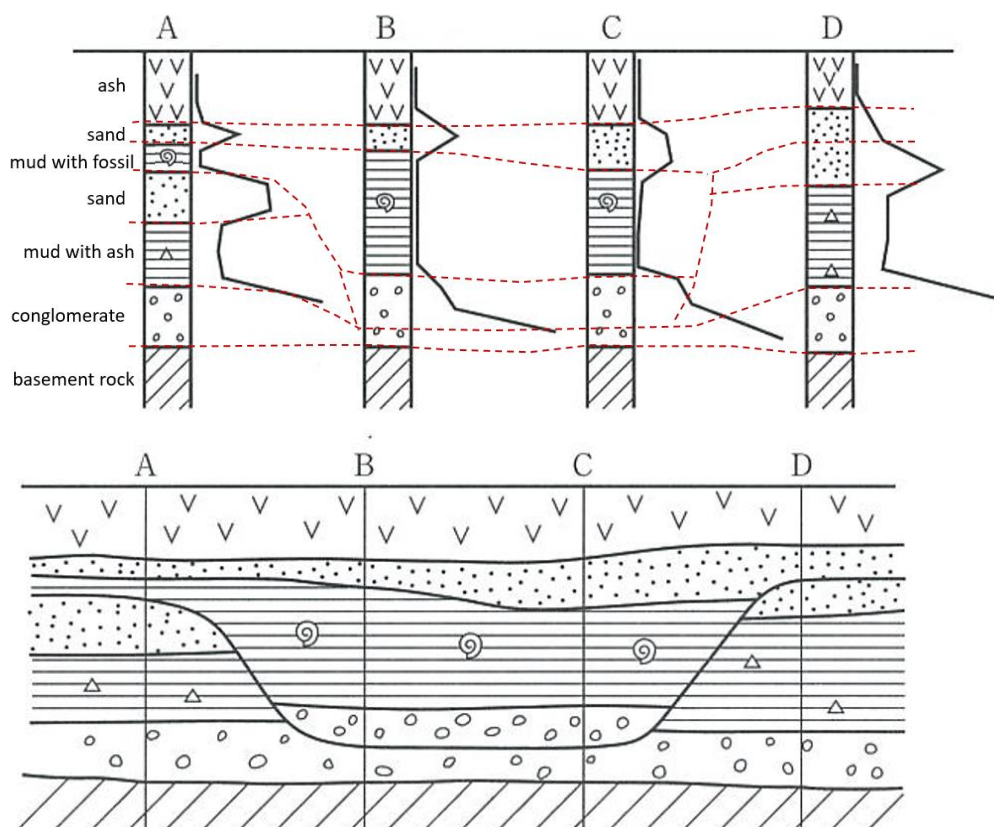
**Question 4:** Figure 2 shows the stratum conditions at the two points of A and B. Describe the order of forming stratum at points A and B including granite and the fault. (8 points)

1) Ss-A2=Ss-B2, Lm-A1=Lm-B1, Ms-A1=Ms-B1, Ss-A1=Ss-B1

2) Sch-A1 -> Ms-A2 -> (Ss-A2=Ss-B2) -> (Lm-A1=Lm-B1) -> (Ms-A1=Ms-B1) -> (Ss-A1=Ss-B1) -> Fault-A1

We can understand that the Gr-B1 intruded after (Lm-A1=Lm-B1), but cannot decide the order of occurrence among Gr-B1 intrusion, (Ms-A1=Ms-B1) sedimentation, (Ss-A1=Ss-B1) sedimentation and fault activity.

**Question 5:**



## Tunnel Engineering questions

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### Question 6:

Shield tunnelling method: TBM is used and the segment ring is used to support the ground.

NATM: Primary lining is produced by spray concrete.

Mountain tunnelling method: Bracing is used to tunnel support.

### Question 7:

The tunnel is excavated in loose sand under water table. Because of high water pressure, water starts to pour down and loosen the ground in front of tunnel. At the top and around the tunnel, sand started to pour into tunnel. On the other hand, by decreasing pore water pressure, effective stress increases and face of tunnel become unstable and collapse.

### Question 8:

Table 1: Design conditions during tunneling construction

Design conditions	Problem events
Example: Neighboring construction	Example answer: Influence on adjacent structure
1- Shallow overburden	Surface subsidence, collapse, unsymmetrical pressure
2- Under the urban area	Surface subsidence, influence on adjacent structure, decline of groundwater level
3- At the deep ground	High pressure of seepage water, increase of earth pressure
4- Under the water	Huge volume of seepage water

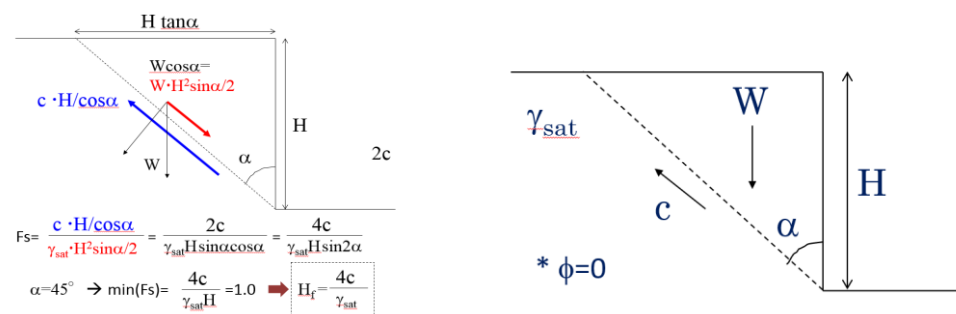
## Earthquake Engineering questions

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### Question 9:

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

### Question 10:



**Question 11:** Natural period of Tohoku Earthquake was very short and approximately 0.3 second. Natural period of railway viaducts was around 0.5 (sec) greater than 0.3 (sec) and they did not vibrate strongly. That's why damages were limited.

End of questions.