



First Semester Examination
2020/2021 Academic Session

February 2021

EAG141 – Geology for Civil Engineers

Duration : 1 hour

Please check that this examination paper consists of **SEVEN (7)** pages of printed material including appendix before you begin the examination.

Instructions : This paper contains **THREE (3)** questions. Answer **TWO (2)** questions.

All questions **MUST BE** answered on a new page.

1. A construction project at the hillside area is currently under the earthwork stage. Prior to the earthwork, preliminary site investigation found six regions of rock that possibly have the same mineral. The strength test on Rock F also reveals it is high strength and very stable, as it forms an almost 90° slope at the west side. During excavation, it is found Rock A is rich with graphite, whereas Rock B is rich with biotite (**Figure 1**). As part of the sustainable construction plan, the drywall used in this construction is made from biotite naturally available from the site.

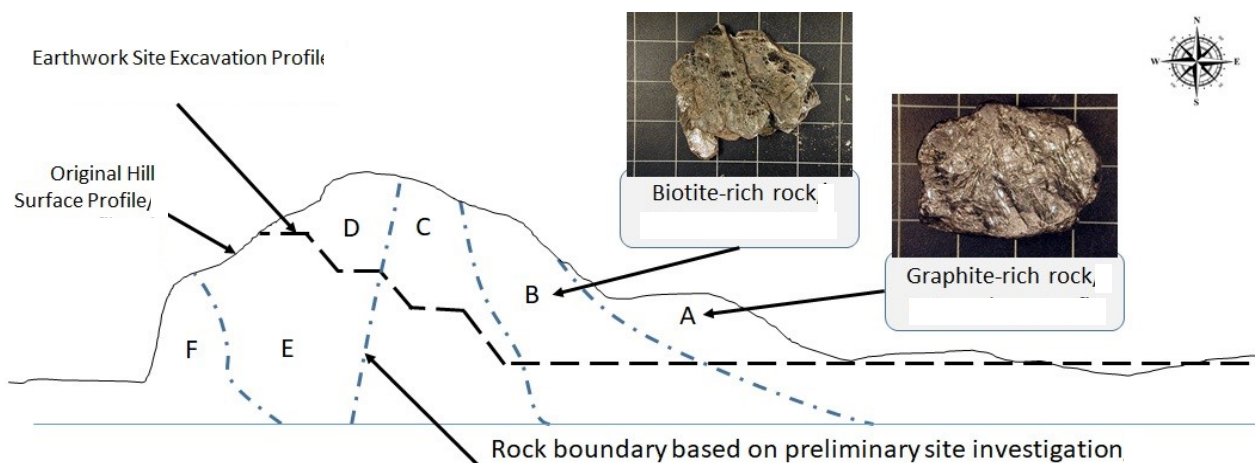


Figure 1

- (a). Identify the mineral group of graphite and give **ONE (1)** example of another group and its mineral.
- [6 marks]
- (b). Three identification tools were brought to the site during site investigation work: a mohr hardness set, a flashlight, and a black streak plate. With the help of a sketch, explain the method to identify the mineral, either Graphite or Biotite, based on the **TWO (2)** most suitable tools for a 5 mm thin rock sample. **Table 1** shows the material classification information.

[24 marks]

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Table 1

Classification	Graphite	Biotite (Dark Mica)
Color	Black	Black
Streak	Black	White to gray
Diaphaneity	Opaque	Thin sheets are transparent to translucent, and books are opaque
Mohs Hardness	1 to 2	2.5 to 3

- (c). Based on the site investigation's latest sample study, only Rock B and Rock D are biotite-rich rock. In contrast, Rock C is the same as Rock F. Since the earthwork starts from the east toward the west side of the hill, this finding affects the drywall manufacturing timeline. It is because initially, it is expected Rock C is also a biotite-rich rock. Discuss **TWO (2)** safety aspect and the implication if the excavation work sequence changed from Rock B – Rock C – Rock D to Rock B – Rock D – Rock C.

[20 marks]

2. Complex engineering projects including large dams require extensive reconnaissance. The study of geological relationships is therefore of major importance, with emphasis on the characteristics of the geological structures. The structural geology has a great deal in contributing to the engineering projects, and knowledge of structural geology setting is essential for safe design of these projects. **Figure 2** shows the geological section across the Gotvand dam region. The Gotvand or Upper Gotvand dam as the highest rock fill dam in Iran is located in the north of Khuzestan Province. The main purpose of the project is the production of (4250 GWh) hydroelectric energy. The action of Lahbari and Pir-Ahmad thrust faults in the south and north of the dam site, respectively, caused severe compression resulted in tight folding of the Agha-Jari layers. **Figure 3** shows the active fault zone at dam site.

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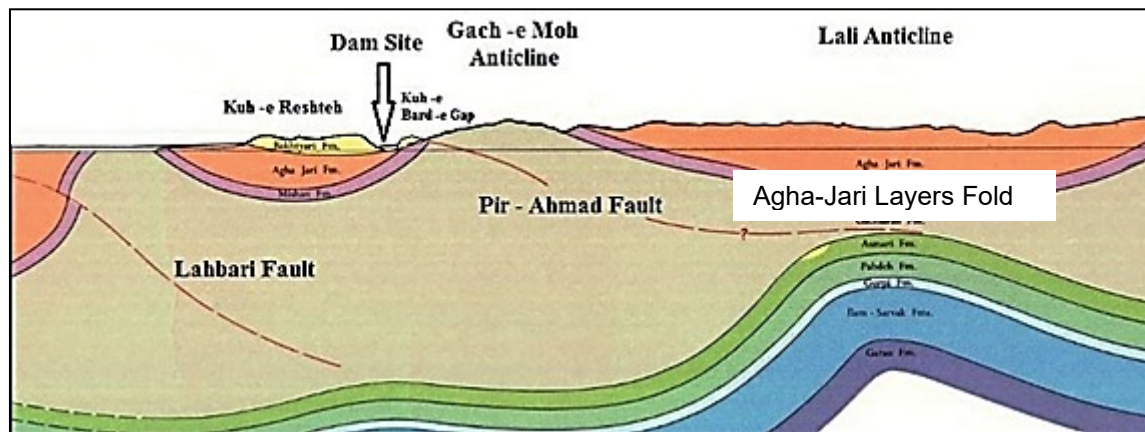


Figure 2: Geological section across the Gotvand dam region

- (a). Explain the direction of the force and the plate movement associated with normal fault, reverse fault, and thrust fault, with the aid of the sketches.

[20 marks]

- (b). As shown in **Figure 2**, the action of Pir-Ahmad thrust faults of the dam site will cause compression of the folding of Agha-Jari layers. Discuss the transformation from overturned fold to overthrust fold with the help of sketches of both folds together with the line of axial plane axis.

[20 marks]

- (c). The lithology underlying dam is a metamorphic rock called gneiss. This rock type is known relatively impermeable.

- (i). What is the aquifer(s) terminology related to the impermeable body of rock?

[2 marks]

- (ii). Describe the aquifer(s) terminology base on your answer in (i)

[4 marks]

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- (iii). Interpret the impact on the stability of the dam site base on the gneiss rock found underground.

[4 marks]

3. The Kuala Lumpur-Singapore HSR is a strategic project between Malaysia and Singapore's Governments aimed at facilitating a 90-minute journey time between Kuala Lumpur and Singapore. The project is expected to enhance business ties and bring the people of both countries closer together. In order to make a thorough assessment of emerging risks, it is essential to understand the geological conditions and the potential foundation of rail infrastructure, which is highly engineering sensitive. Malaysia consists of a wide range of rock types, from the sands and silts of the coastal plains to the Main Range's granite. As shown in **Appendix** , the proposed HSR route starting from Kuala Lumpur will pass through a carboniferous area consisting mainly of limestone, granite in the Seremban area and to the south through the limestone and sandstone areas. The HSR route from Melaka to Nusajaya lies in the southern boundary of the coastal area, which corresponds to marine and continental deposits' geological profile. Mostly the soil conditions are clay, silt, and peat. Based on the geological inputs given;

- (a). Describe the two most critical geological conditions' characteristics and examine the geological condition's potential risk related to the engineering design along the HSR alignment from Kuala Lumpur to Nusajaya with sketches. Also, discuss the answer by considering topography's influence and the challenging geological conditions to climate change in the next 50 years.

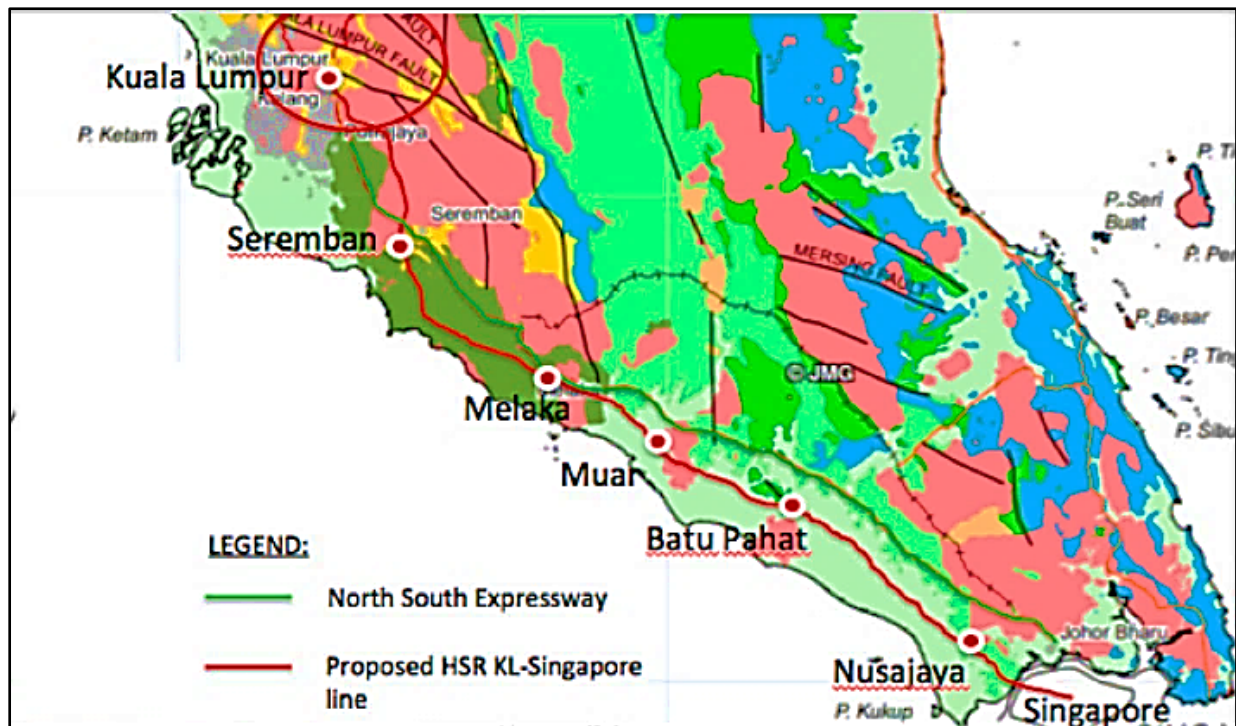
[30 marks]

- (b). Assuming a megaquake will occur along the Sunda Megathrust in the next 50 years, thus, studying local site effects is an essential part of assessing strong ground motions, seismic hazard, and engineering seismology along the HSR alignment. Describe two crucial local geologic factors that affect the level of shaking experienced in earthquakes. Identify the geological conditions that might experience the highest shaking or amplification level and justify your answer.

[20 marks]

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APPENDIX



QUATERNARY	Marine and continental deposits; clay, silt, sand, peat with minor gravel. Basal of Early Pleistocene age in the Kuantan area.
TERTIARY	Isolated continental basin deposits of Late Tertiary age, shale sandstone, conglomerate and minor coal seams. Volcanics in the Segamat area.
JURASSIC-CRETACEOUS	Continental deposits of thick, cross-bedded sandstone with subordinate conglomerate and shale/mudstone. Volcanics are locally present.
TRIASSIC	Interbedded sandstone, siltstone and shale; widespread volcanics, mainly tuffs of rhyolitic to dacitic composition in Central Peninsular. Limestone prominent in lower part of the succession. Conglomerate and chert are locally prominent.
PERMIAN	Phyllite, slate and shale with subordinate sandstone and schist. Prominent development of limestone throughout the succession. Volcanics, mainly rhyolitic to andesitic in composition are widespread.
CARBONIFEROUS	Phyllite, slate, shale and sandstone; argillaceous rocks are commonly carbonaceous. Locally prominent development of limestone. Volcanics of acid to intermediate composition are locally present.
DEVONIAN	Phyllite, schist and slate; limestone and sandstone are locally prominent. Some interbeds of conglomerate, chert and rare volcanics.
ORDOVICIAN-SILURIAN	Schist, phyllite, slate and limestone. Minor intercalations of sandstone and volcanics.
CAMBRIAN	Sandstone with subordinate siltstone, shale and minor conglomerate
PERMIAN-JURASSIC	Intrusive rocks, mainly granite with minor granodiorite.

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