Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2021/2022

COURSE NAME	:	GEOLOGY ENGINEERING
COURSE CODE	:	BFC 21303
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JANUARY / FEBRUARY 2022
DURATION	:	3 HOURS
INSTRUCTIONS	:	1. ANSWER **ALL** QUESTIONS.
		2. THIS FINAL EXAMINATION IS AN **ONLINE** ASSESSMENT AND CONDUCTED VIA **CLOSE BOOK**.

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

Q1 A road cutting 60 m deep is driven through a sequence of granite rock. The rock slope face cutting in the direction of 80^0 and dip angle 70^0. The rock slope has been mapped and analysed. **Table Q1** summarized the data of discontinuity sets, slope geometry and rock parameters.

(a) Analyse the entire rock slope failure modes using **Figure Q1(a)** with its criterion based on **Table Q1(a)**.

(6 marks)

(b) Calculate the factor of safety for the planar failure mode using the formula in **Figure Q1(b)** when the tension crack is completely filled with water. Calculate the required anchor bars to stabilize the rock slope to factor of safety 2.0.

(6 marks)

(c) Calculate the factor of safety for wedge failure mode using the formula in **Figure Q1(c)** when the tension crack is completely filled with water.

(8 marks)

(d) Recommend a new rock slope dip angle in order to avoid potential any rock slope failure modes and predict the consequences of the recommendation.

(5 marks)

Q2 (a) List **THREE (3)** information that could be obtained from the boring operation and explain **TWO (2)** limitations of boring test in the site investigation.

(5 marks)

(b) Discuss **FIVE (5)** advantages of geophysics survey in civil and environmental investigation.

(10 marks)

(c) Explain the outcome from the ultrasonic velocity rock test that commonly carried out on core samples in the laboratory.

(5 marks)

(d) The directional angle of force towards schistosity affects the rock strength. Explain this statement.

(5 marks)

Q3 (a) Discuss **FIVE (5)** evidences that indicate the lithosphere is fragmented and moving relatively apart.

(5 marks)

(b) Select the physical characteristics of mineral that directly influence the rock strength. Justify your selection.

(5 marks)

(c) Igneous rock is solidified magma either on the surface or subsurface. Discuss the differences between gabbro and rhyolite.

(5 marks)

(d) Discuss the comparison between the clastic and chemical sedimentary rocks.

(5 marks)

(e) Discuss the comparison between schist and quartzite of metamorphic rocks.

(5 marks)

Q4 (a) Two boreholes were drilled at two locations denoted as BH1 and BH2 as shown in **Figure Q4(a)**. Rock coring at length of 1500 mm for each borehole. Calculate the rock quality designation, the total core recovery and the solid core recovery for BH1 and BH2.

(6 marks)

(b) Sketch the typical weathering profile for igneous rock formation

(6 marks)

(c) Explain the fault and fold that influencing the shape the earth's topography.

(5 marks)

(d) Feldspars rarely found as a river sand. Explain this statement

(4 marks)

(e) Cenozoic era is less than 2 million years and its sediment deposits known as Quaternary. Discuss the distribution of Quaternary deposit in Peninsular Malaysia.

(4 marks)

- END OF QUESTIONS –

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Table Q1: Parameter of granite rock slope

Parameters	Values
Joint set 1 (dip direction/dip angle)	275°/60°
Joint set 2 (dip direction/dip angle)	070°/46°
Joint set 3 (dip direction/dip angle)	140°/70°
Slope face dip direction	80°
Slope face angle (slope angle)	70°
Upper slope face dip direction	90°
Upper slope face angle	0°
Height of slope / wedge	60 m
Unit weight of the rock	25 kN/m^3
Depth of tension crack	3 m
Unit weight of water	9.81 kN/m^3
The cohesion of all discontinuities	100 kPa
Friction angle for all discontinuities	20°
Inclined angle of anchor (Ω) = (ψ_T)	20°
Bars for Y25	10 ton = 100 kN

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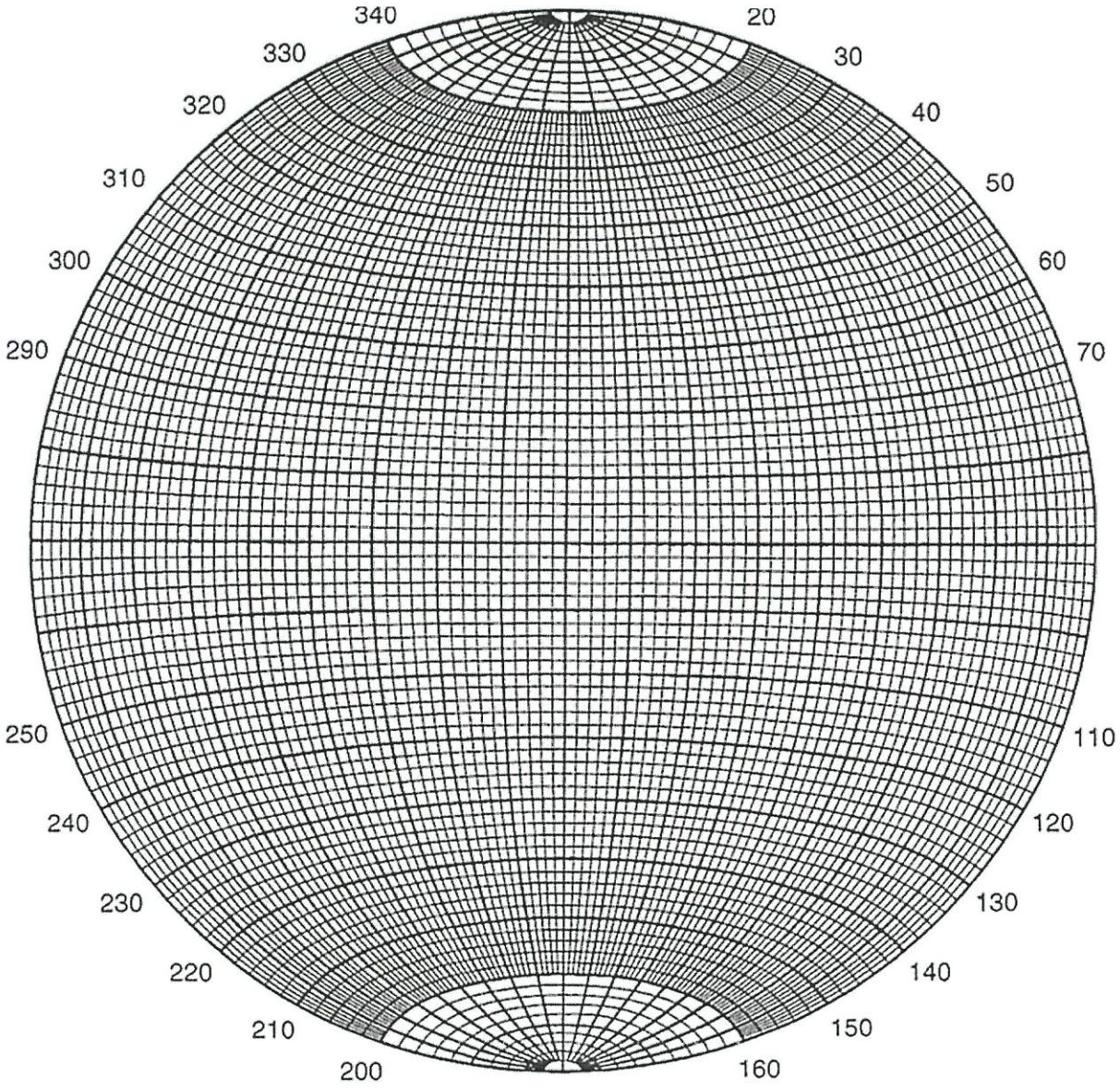

Figure Q1(a): Equatorial equal-area stereo-net marked in 2° intervals

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Table Q1(a): Parameter of granite rock slope

Modes of failure	Criteria are met
Circular	i. Very weak material, highly jointed or fractured or weak soil ii. Homogenous soil
Planar	i. The dip direction of the joint must be laid within $\pm 20^0$ from the slope dip direction. ii. $\psi_f > \psi_p > \phi$ (slope angle> plane angle > friction angle) iii. Release surfaces must be present to define the lateral boundaries of the slide.
Wedge	i. $\psi_f > \psi_i > \phi$ (slope angle > the intersection angle of 2 joints > friction angle)
Toppling	i. The dip direction of the joint must be laid between $\pm 10°$ in the opposite direction of the slope dip direction. ii. $(90^0 - \psi_f) + \phi \leq \psi_t$

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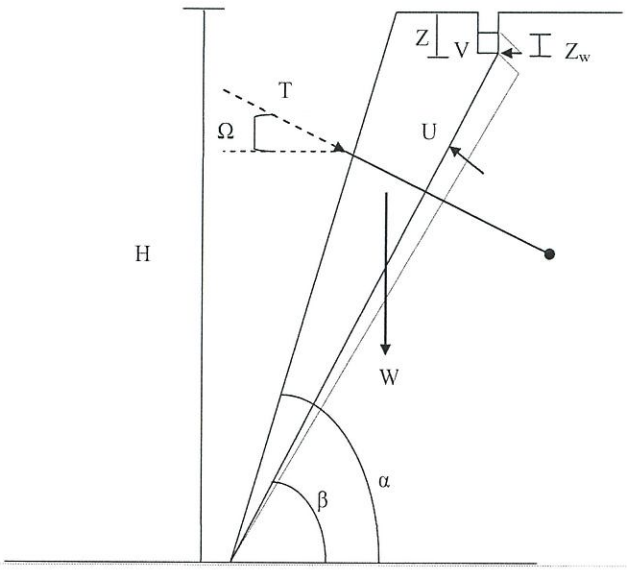

Given:

$$\textbf{FOS} = \frac{cA + (W\cos\beta - U - V\sin\beta + T\sin(\Omega+\beta))\tan\phi}{W\sin\beta + V\cos\beta - T\cos(\Omega+\beta)}$$

A= failure plane area
c = cohesion
W = weight of failure block
β =failure plane angle
H = height of plane
T = tension of anchor
γ_r= unit weight of rock
A = (H-Z).cosec β

ϕ = friction angle
U = vertical water pressure
V = horizontal water pressure
α = slope angle
Z = tensional cracks
Ω = inclined angle of anchor
γ_w= unit weight of water

$$W = \tfrac{1}{2}\gamma_r H^2\left[\left(1-\left(\tfrac{Z}{H}\right)^2\right)\cot\beta - \cot\alpha\right]$$

$U = \tfrac{1}{2}\gamma_w.Z_w.(H-Z).\text{cosec}\,\beta$

$V = \tfrac{1}{2}\gamma_w.Z_w^2$

$$\text{cosec}\beta = \frac{1}{\sin\beta} \quad \sec\beta = \frac{1}{\cos\beta} \quad \cot\beta = \frac{1}{\tan\beta}$$

Figure Q1(b): Planar failure mode formula

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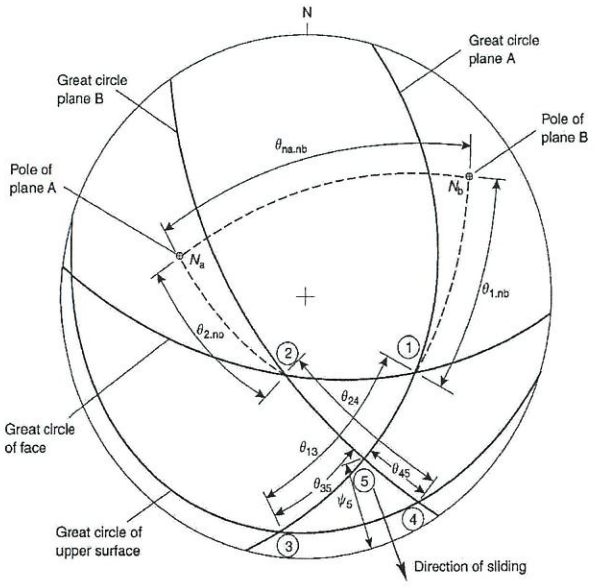

Given:

$$Fos = \frac{3}{\gamma H_t}(C_a.X + C_b.Y) + (A - \frac{\gamma_w}{2\gamma}.X)Tan\phi_a + (B - \frac{\gamma_w}{2\gamma}.Y)Tan\phi_b$$

C_a = Cohesion
H_t = height of wedge
ψ_b = dip angle for plane b
γ = unit weight of rock
ϕ_b = Friction angle
ψ_a = dip angle for plane a
ψ_5= dip angle for wedge intersection
γ_w = unit weight of water

X, Y, A, B is factor which depend upon the geometry of wedge

$$X = \frac{Sin\theta_{24}}{Sin\theta_{45}Cos\theta_{2.na}} \quad Y = \frac{Sin\theta_{13}}{Sin\theta_{35}Cos\theta_{1.nb}} \quad A = \frac{Cos\psi_a - Cos\psi_b Cos\theta_{na.nb}}{Sin\psi_5.Sin^2\theta_{na.nb}}$$

$$B = \frac{Cos\psi_b - Cos\psi_a Cos\theta_{na.nb}}{Sin\psi_5.Sin^2\theta_{na.nb}}$$

Figure Q1(c): Wedge failure mode formula

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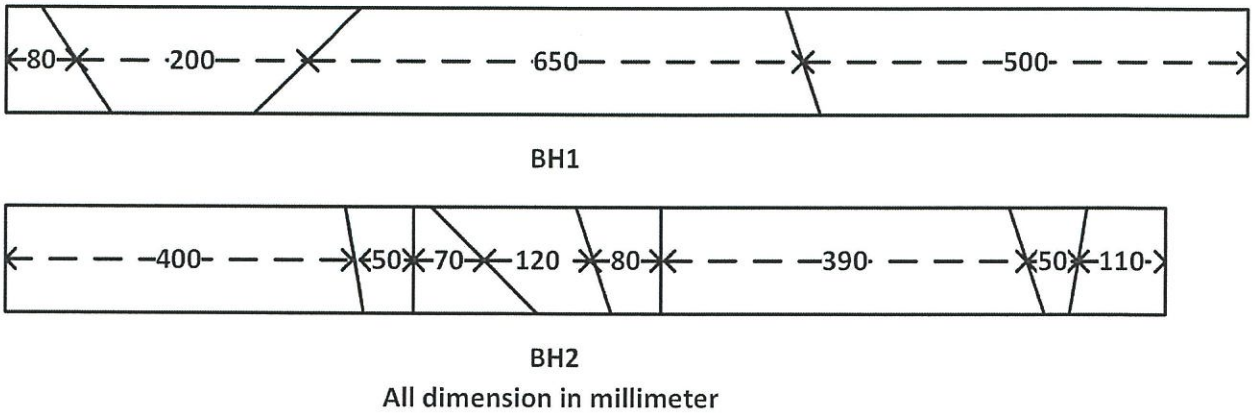

Figure Q4(a): Borehole samples denoted as BH1 and BH2