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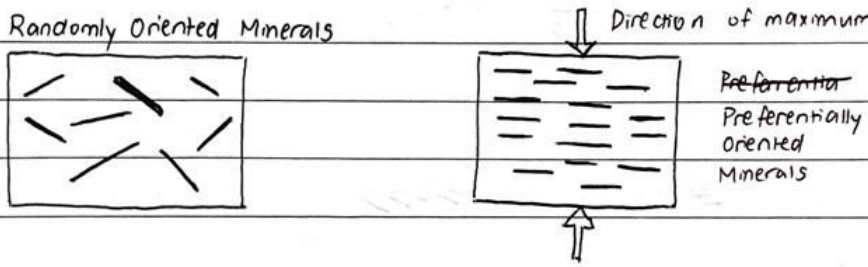
CV2013 Engineering Geology & Soil Mechanics Semester 1 2020-2021

1(a) Jurong Formation Sedimentary Rocks, Bukit Timah Granite, Kallang Formation

(b) Cleavage refers to the tendency of a crystal to split along planar surfaces
Fracture is the tendency of a crystal to break along irregular surfaces other than cleavage planes

(c) Four Surface Processes: Weathering, Erosion, Transportation, Deposition
Two Surface Processes: Burial, Diagenesis

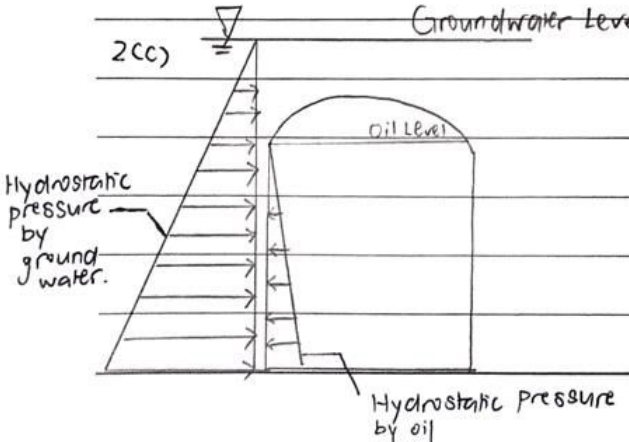
(d) Foliation is the most prominent textural feature of regionally metamorphosed rocks. It refers to a set of flat or wavy parallel cleavage planes produced by deformation of igneous and sedimentary rocks under directed pressure



Other criteria: Metamorphic Grade, Grain size, Banding and Mineralogy

2(b) In compression, the stiffness gradually increases with applied stress or displacement, reaching a limit associated w/ the ~~streg~~ strength of the intact rock.
In tension, no tensile stress can be sustained and hence the displacement increases.
In shear, the stress displacement curve is rather like the complete stress-strain curve for compression of intact rock, except that all failure is localised along the discontinuity.

2(c)



Containment principle: The hydrostatic pressure at cavern depth is sufficient to counterbalance the cavern pressure and confine the stored product in the underground storage cavern. As a result of the groundwater flow into ~~at~~ the cavern, leakage outwards is prevented.

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Q.2.

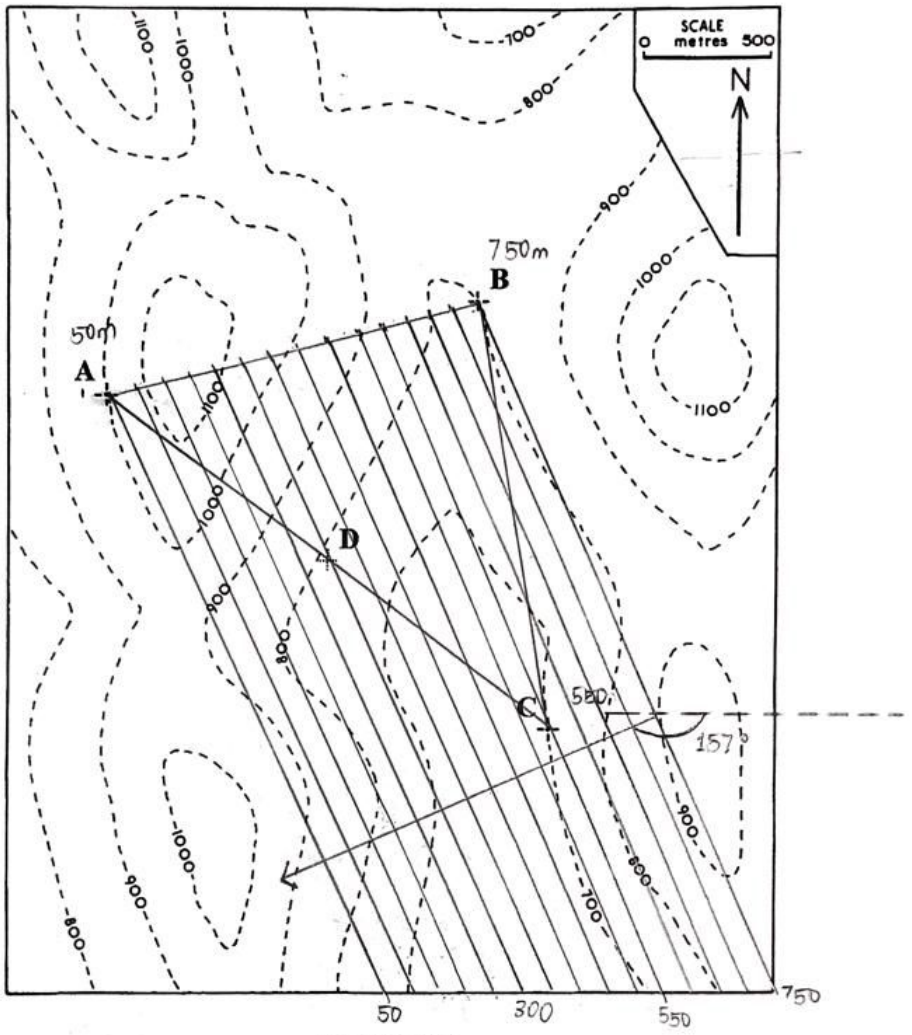
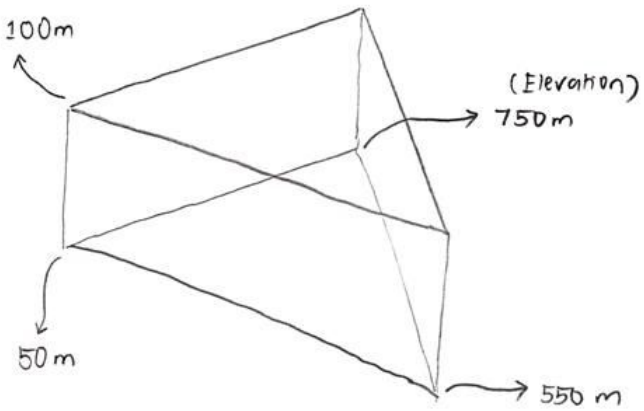


Figure Q2



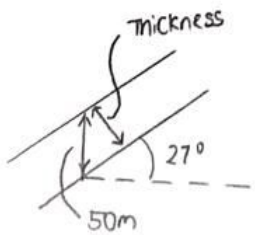
2(a)(i) Dip Direction = 157° + 90° = 247° //

Dip Angle = $\tan^{-1}\frac{\text{Rise}}{\text{Run}} = \tan^{-1}\frac{700}{1389} = 26.7° \approx 27°$ //

(ii) Depth = 790m - 300m = 490m //

(iii) Thickness = $\sin(90° - 27°) \times 50$

= 44.6m //



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Let the total head btwn soil A & Soil B be X

3.(a) $q_A = q_B$

$k_A \left(\frac{3.5-X}{1}\right) A = k_B \left(\frac{X-0}{2}\right) A$

$9.5 k_B (3.5 - X) = k_B \left(\frac{X}{2}\right)$

$33.25 - 9.5X = 0.5X$

$X = \frac{33.25}{10} = 3.325\ m$ //

(b) $i_A = \frac{3.5 - 3.325}{1} = 0.175$ //

$i_B = \frac{3.325 - 0}{2} = 1.6625$ //

(c) ~~Total~~ Total Head @ M_t = 1.6625 m = h

$\Rightarrow h = 1.6625 m$ //

(d) $q_A = k_A i_A A = 9.5(1.0 \times 10^{-4})(0.175) = 0.00016625\ m^3/s$

Time needed in hours = $\frac{1}{0.00016625} \times \frac{1}{3600} = 1.67$ hours //

(e) $\sigma' = \sigma - u$

$= (0.5 \times 10 + 1 \times 18 + ~~1 \times 20~~) - ~~(1.6625 \times 10)~~ \underbrace{(0.6625 \times 10)}_{1.6625 - 1}$

$= 36.375$ kPa //

4(a)(i) Double Dramage $\Rightarrow d = \frac{H}{2} = \frac{2.5/100}{2} = 0.0125$

$T_v = -0.933 \log(1 - U) - 0.085 = 0.848$

$T_v = \frac{C_v t}{d^2} \Rightarrow C_v = \frac{T_v \times d^2}{t}$

$= \frac{0.848 \times 0.0125^2}{60}$

$= 2.2083 \times 10^{-6}$

(ii) $\frac{z}{d} = 1$, $T_v = 0.848$, $U_z \approx 0.84$ (From Isuchrome chart)

$U_z = 1 - \frac{u_e}{u_i}$

$0.84 = 1 - \frac{u_e}{\Delta q}$

$u_e = (0.84 - 1)(-150) = 24$ kPa //

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4-(b)(i) Before Sandfill placement:

Total vertical stress = $2\times16 + 2\times10 = 52$ kPa //

Total Porewater pressure = $4\times10 = 40$ kPa //

Excess pwp = 0 kPa // (Hydrostatic)

Effective vertical stress = $52-40 = 12$ kPa //

After Sandfill placement:

Total vertical stress = $2\times16 + 2\times20 + 3\times18 = 126$ kPa //

Total Porewater pressure = $40 + 74 = 114$ kPa //

Excess porewater pressure = $\Delta q = 2\times20 + 3\times18 - 2\times10 = 74$ kPa //

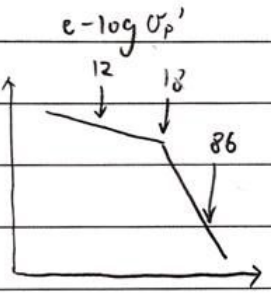
Effective Vertical Stress = $126 - 114 = 12$ kPa //

(ii) When clay has fully consolidated,

u_e = 0 kPa (Back to hydrostatic condition)

Effective Vertical stress = ~~52~~ $12 + 74 = 86$ kPa //

(iii)



$OCR = 1.5 = \frac{\sigma_p'}{\sigma_{vo}'} \Rightarrow \sigma_p' = 1.5\times12 = 18$ kPa

$S_c = \frac{4}{1+1.5} \times \left(0.05 \log\left(\frac{18}{12}\right) + 0.5 \log\left(\frac{86}{18}\right)\right)$

$= 0.557$m //

(iv) Water Level = 8m

porewater pressure = $8\times10 = 80$ kPa, $u_e = 80 - 40 = 40$ kPa

$U_z = 1 - \frac{u_e}{u_i} = 1 - \frac{40}{74} = 0.459 \approx 0.46$

$\frac{z}{d} = 1$

$\Rightarrow$ From Isochrome chart, $T_v \approx 0.35$

$T_v = \frac{C_v t}{d^2}$

$0.35 \times \left(\frac{4}{2}\right)^2 \times \frac{1}{1.25} = 1.12$ years //