CV 2013 Engineering Gedogy and Soil Mechanics
Sem. 1 2016/17

1 a i The three types of plate boundaries are defined by the direction of the movements of plates in relation to each other : divergent, convergent and transform-fault.

At divergent boundaries ↔ , plates move apart and new litosphere is created resulting in plate area to increase.
Two types of divergent are oceanic plate separation (oceanic - oceanic divergent) which often create mid-ocean ridged that results in active volcanism and earthquake and Continental plate separation which often rift valleys.

At convergent boundaries →← , plates collide ~~to~~ each other where one plate (denser one) is subdued by another plate and is recycled back into the mantle , resulting in plate area to decrease
Three types of convergent boundaries are ocean-ocean convergent which a oceanic trench, ocean-continent convergent which often form volcano and trench and continent-continent convergent forming mountains (folding of plates)

At transform-fault ⇅ boundaries, plates slide horizontally past to each other. it often occurs in divergent boundary along mid-atlantic ridges. It often forms faults.

ii According to the plate tectonic theory, the marine life carcass were deposited on the seabed in which sedimentation occurs, turning it to fossils on the seabed. The plate tectonic movement (oceanic-oceanic convergent) results in the folding of the sea floor bed, resulting the plate to experience uplift, exposing them above the water surface. It then forms a mountain with further foldings and erosion exposed the fossils.

↳ From the textbook.

b; Factors affecting rates of rock weathering

1. Properties of Parent rocks
   1. Mineral solubility in water (stability)
   2. Rock structure (massive or fractured)
2. Climate
   1. rainfall (heavy or low)
   2. Temperature (hot or cold)
3. Presence of soil and vegetation
   1. Thickness of soil layer (none or thick)
   2. Organic content
   3. Length of exposure

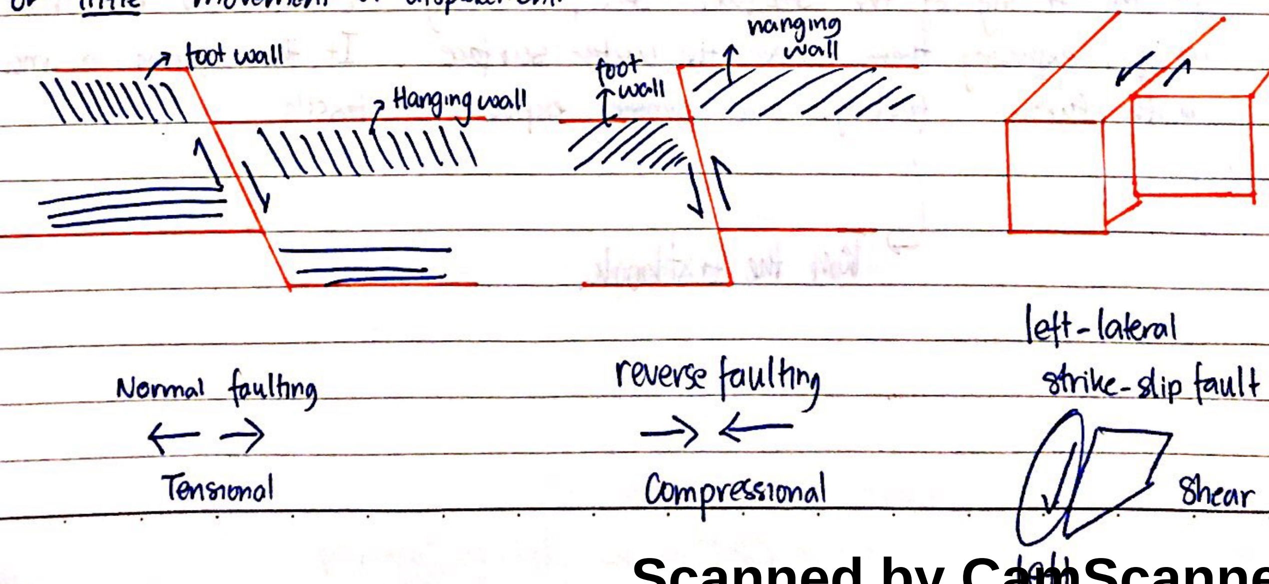
Factors affecting rate of soil formation

1. bedrock composition (easy to be weathered or not)
2. Climate (rainfall and temperature)
3. topography (slope)
4. Organism (breaking rocks by absorbing minerals of rocks)
5. time.

ii Residual soil is when the product of rock weathering remains at their original location while transported soil is when the weathering products are transported and deposited to other location.

c; Fault is a surface across which rock formations have been displaced while joints are cracks or breaks in rock along which there is no or little movement or displacement.

ii



2.

Impt note: there might be a rescale of the diagram.

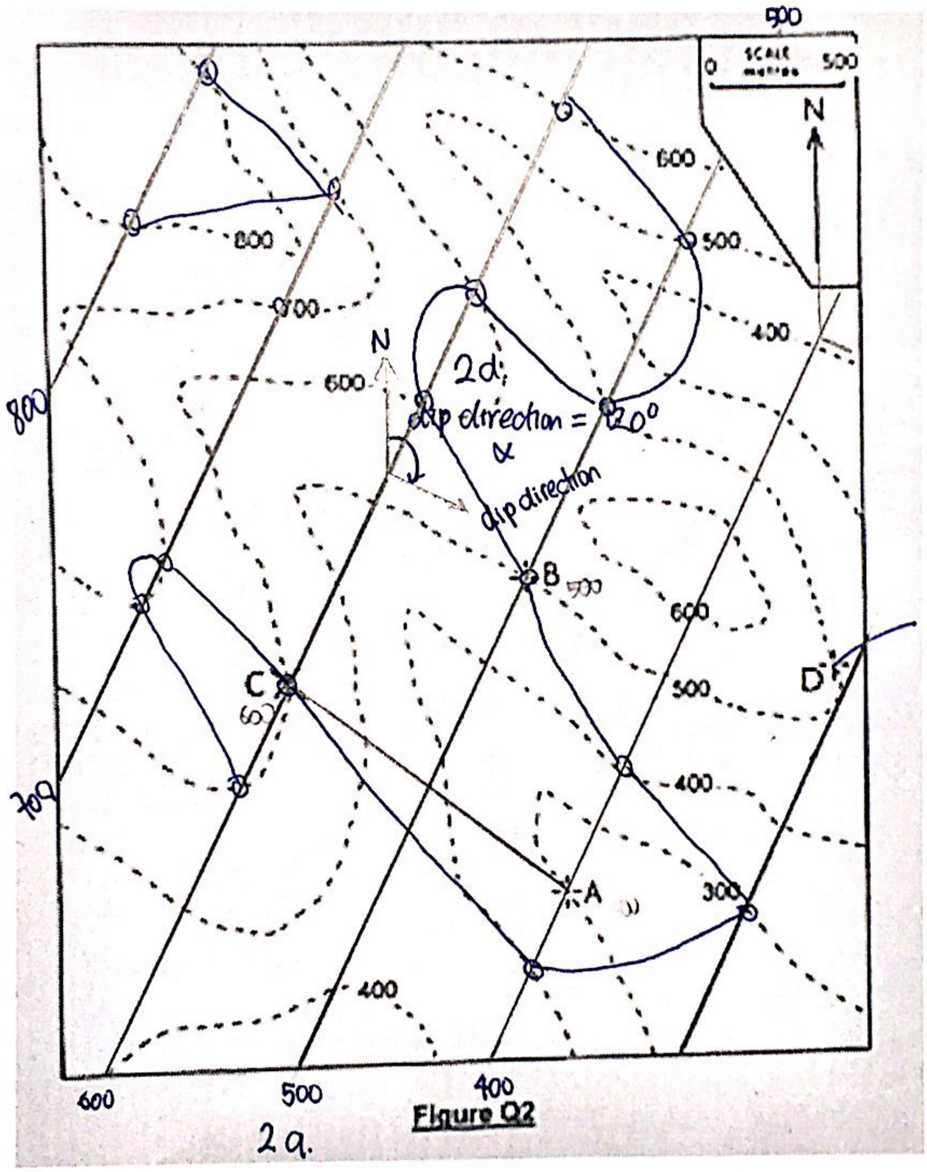


Figure Q2

2a.

1.5 cm : 500 m

1 cm : 333.33m

1.9 cm : 633.33 m

320m

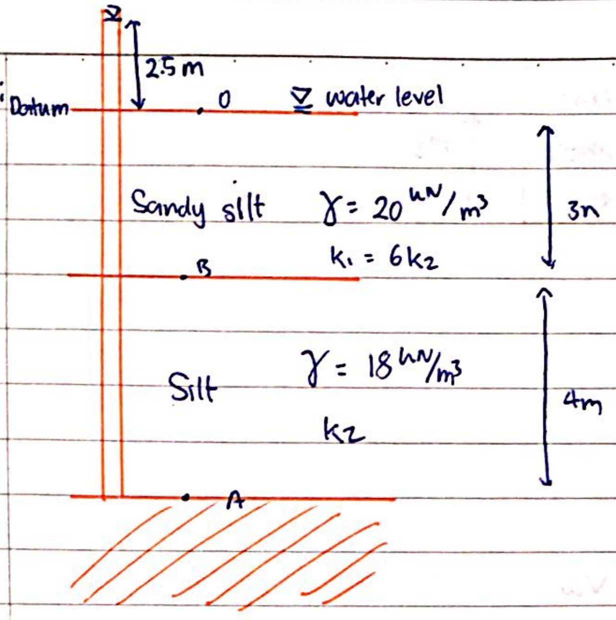
2d.

dip angle $\psi = \tan^{-1}\left(\frac{drop}{run}\right)$

$= \tan^{-1}\left(\frac{100}{633.33}\right)$

$= 8.97°$

3a:



$u_A = \gamma_w \cdot h_{pA}$

$= 10(2.5+3+4) = 95$

$\sigma_A = 3(20) + 4(18) = 132$

$\sigma_A' = \sigma_A - u_A = 37$

$h_A = h_{pA} + z_A$

$= (4+3+2.5) - (4+3) = 2.5$

Q at B is the same, $Q_{AB} = Q_{BO}$

$$k_2 \frac{(h_A - h_B)}{4} A = k_1 \frac{(h_B - 0)}{3} A$$

$$k_2 \frac{(2.5 - h_B)}{4} = 6k_2 \frac{(h_B)}{3}$$

$$2.5 - h_B = 8h_B$$

$$9h_B = 2.5 \rightarrow h_B = 0.2778$$

$$h_B = h_{pB} + z_B \rightarrow 0.278 = h_{pB} - 3$$

$$h_{pB} = 3.278$$

$u_B = \gamma_w \cdot h_{pB} = 32.78$

$\sigma_B = 3(20) = 60$

$\sigma'_B = \sigma_B - u_B = 27.2$

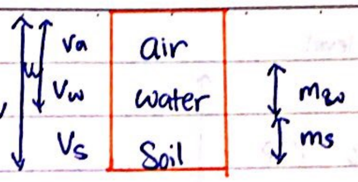
ii $q = \frac{Q}{A} = 97 \times 10^{-3}\ m^3/m^2\ day = k_1 \frac{(h_B - 0)}{3}$

$k_1 = 1.0476\ m/day = 1.2125 \times 10^{-5}\ m/s$

$k_2 = \frac{1}{6} k_1 = 2.02083 \times 10^{-6}\ m/s$

b $\omega = \frac{W_w}{W_s} = 15\% = 0.15$

$S_r = \frac{V_w}{V_v} = 0.48$



$G_s = 2.70$

$\rho_w = 1.0$

Find ρ_{total}, $\rho_{s\,dry}$, e

let $V = 1\ m^3$

$\rho_w = \frac{m_w}{V_w} = 1 \Rightarrow m_w = V_w$

$\rho_s = G_s \rho_w = 2.7 = \frac{m_s}{V_s}$

$m_s = 2.7 V_s = 2.7(1 - V_v)$

$\frac{m_w}{0.15} = 2.7(1 - V_v)$

$V_w = 0.405(1 - V_v)$

$0.48 V_v = 0.405 - 0.405 V_v$

$V_v = 0.4576\ m^3$

$V_s = 1 - V_v = 0.5424\ m^3$

$V_w = 0.21967\ m^3$

$m_s = 2.7 V_s = 1.4644$

$\rho_{dry} = \frac{m_s}{V} = 1.464$

$\rho_{total} = \frac{M}{V} = \frac{1.464 + 0.21967}{1} = 1.684$

$e = V_v / V_s = 0.8437$

easier method.

$\gamma_d = \frac{G_s \gamma_w}{1 + \frac{G_s \omega}{S_r}}$

$\gamma = \gamma_d (1 + \omega)$

c Soil A

% Fine = 9% $w_L = 34$ $C_u = 5.1$

% Sand = 56% PL = 10 $C_z = 2.1$

% Gravel = 35% $I_p = 24$

% Sand = 56% → S

% Fine = 9% → dual symbol.

SP-SC (Above A line & doesnt satisfy SW requirement)

Soil B

% Fine = 3% $C_u = 5.8$

% Sand = 31% $C_z = 4.1$

% Gravel = 66%

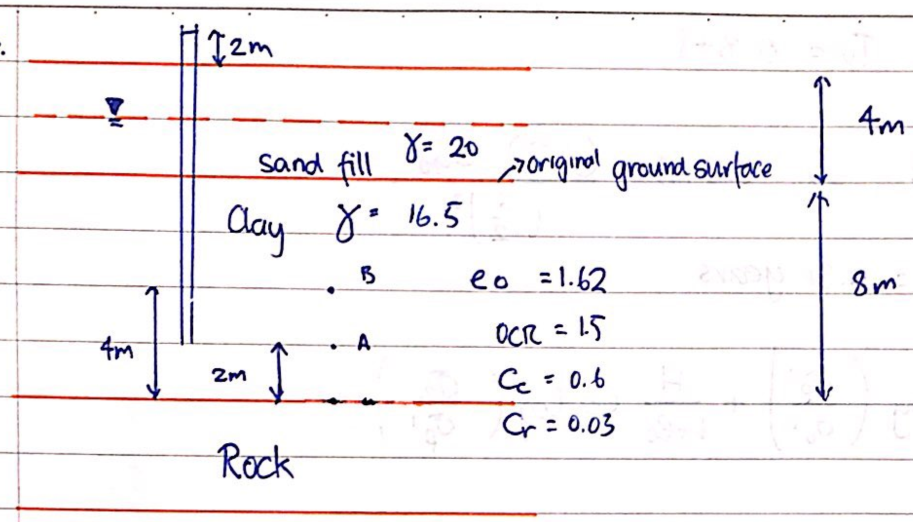
% Gravel = 66% → G

% Fine = 3% → GW or GP

check C_u, C_z

GP

4.



a $\sigma_A = 4(20) + 6(16.5) = 179$

$u_A = 12(10) = 120$

$\sigma_A' = 59$ kPa

b i $u_i = \Delta\sigma_v = 4(20) = 80$

before placement of the sand

σ_A' before $= \sigma_A$ before $- u_A$ before

$= 2(10) + 6(16.5) - 8(10)$

$= 29$

Use point A to find C_v:

$\Delta\sigma_A' = 30$ kPa

$\Delta\sigma_v = u_e + \Delta\sigma_v'$

$80 = u_e + 30$

$u_e = 50$

$U_z = 1 - \frac{u_e}{u_i} = 1 - \frac{50}{80} = 0.375$

$\frac{z}{d} = \frac{6}{\frac{8}{2}}$ → 6: always measured from top layer; $\frac{8}{2}$ → double drainage

$\frac{z}{d} = 1.5$

Using isochrones graph, $T_v = 0.15$

$T_v = \frac{C_v \cdot t}{d^2} \Rightarrow 0.15 = \frac{(C_v)(2)}{(\frac{8}{2})^2} \Rightarrow C_v = 1.2$

For point B, $\frac{z}{d} = 1$, $T_v = 0.15 \Rightarrow U_z = 0.14 = 1 - \frac{u_{eB}}{u_i}$

$u_{eB} = 68.8$

$\Delta\sigma_{vB} = u_{eB} + \Delta\sigma_{vB}'$

$\Delta\sigma_{vB}' = 11.2$

σ_{vB}' before loading $= 2(10) + 4(16.5) - 6(10) = 26$.

σ_{vB}' present $= 26 + 11.2 = 37.2$

b ii For $u = 90\%$, $T_v = 0.848$

$$T_v = \frac{c_v t}{d^2} \Rightarrow 0.848 = \frac{(1.2)\, t_{90}}{(\frac{8}{2})^2}$$

$t_{90} = 11.31$ years

iii $$S_c = \frac{H}{1+e_0} C_r \log\left(\frac{\sigma_p'}{\sigma_0'}\right) + \frac{H}{1+e_0} C_c \log\left(\frac{\sigma_z'}{\sigma_p'}\right)$$

σ_B' before loading = 26 kPa

$$OCR = \frac{\sigma_p'}{\sigma_{B0}'} \Rightarrow 1.5 = \frac{\sigma_p'}{26}$$

$\sigma_p' = 33$ kPa

σ_B' final = 26 kPa + $\Delta\sigma_v$

= 26 + 80 = 106 kPa

$$S_c = \frac{8}{1+1.62} \times 0.03 \times \log\left(\frac{33}{26}\right) + \frac{8}{1+1.62} \times 0.6 \times \log\left(\frac{106}{33}\right)$$

= 0.9379 m

c If impermeable, single drainage, $d = H = 8m$

$$T_v = \frac{(1.2)(2)}{(8)^2} = 0.0375$$

$z/d = 6/8 = 0.75$

From isochrones, $U_z = 0.02 = 1 - \frac{u_e}{u_i}$

$u_e = 0.98\, u_i = 78.4$

$\Delta\sigma_v = u_e + \Delta\sigma_v'$

$\Delta\sigma_v' = 80 - 78.4 = 1.6$

σ_B' present = σ_B' past + $\Delta\sigma_v'{}_B$

= 26 + 1.6

= 27.6

"May the Force be with you"

Jason Hutomo