Yes, U can!

CV2013 – ENG GEOLOGY & Soil mechanics 2012/13 – sem 1

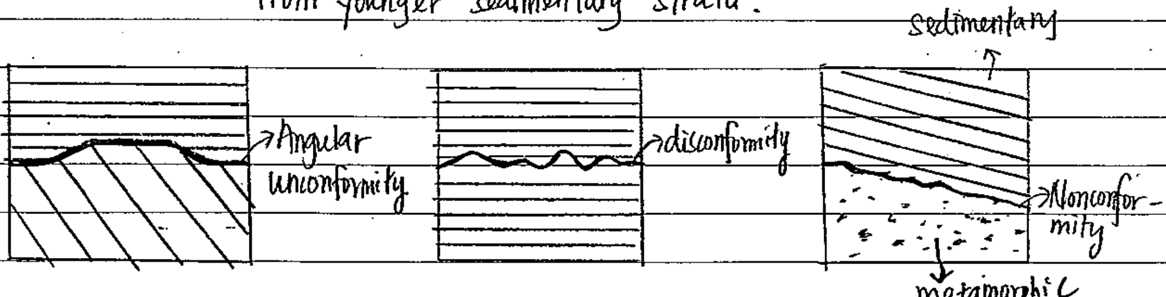
Section A

1. (a) (i) Text (k) (ii)
(b) (iii) (l) (ii)
(c) (ii) (m) (iv)
(d) (ii) (n) (iii)
(e) (iii) (o) (iii)
(f) (i) (p) (ii)
(g) (ii) (q) (iv)
(h) (iv) (r) (ii)
(i) (iii) (s) (iv)
(j) (iv) (t) (iv)

2. (a) Angular unconformity : Tilted or folded sedimentary rocks that are overlain by younger, more flat-lying strata

Disconformity : The strata on either side of the unconformity are essentially parallel. They are difficult to identify because the rocks above and below are similar & there is little evidence of erosion.

Nonconformity : A break separates older metamorphic or intrusive rocks from younger sedimentary strata.

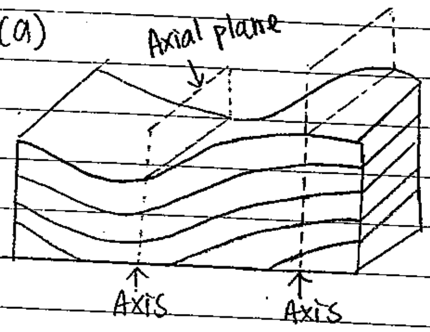


(b) Longer cooling time or slow rate of cooling will result in larger crystals, e.g. Intrusive rocks. Short cooling time or rapid rate of cooling will result in fine crystals, e.g. Extrusive rocks.

- Igneous rocks that form at the surface (rapid rate of cooling) possess a fine-grained texture termed 'aphanitic'.
- Igneous rocks that form when large masses of magma solidify at depth (slow rate of cooling) exhibit coarse-grained texture described as 'phaneritic', intergrown crystals are roughly equal in size.

• Igneous rocks that have large crystals (phenocrysts) embedded in a matrix of smaller crystals (groundmass) are said to have a 'porphyritic' texture. In their cooling history, they are formed due to the mixing of rate of cooling.

3. (a)

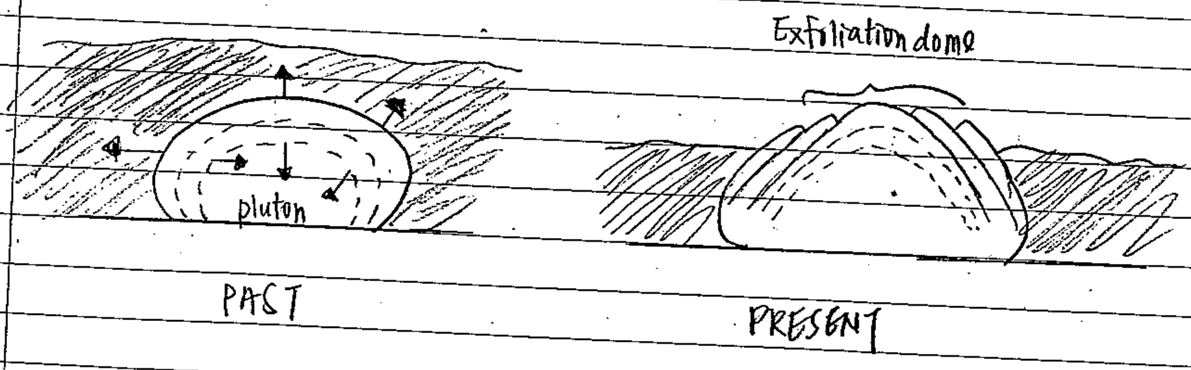


In a unsymmetrical folding structure, the two limbs of a fold meet in a line which is called the 'axis' of the fold. A surface passing through the axis of each bed forms an 'axial plane'.

Anticline is an upfold, in which the two sides or limbs dip outwards from one another. Antiform is an arched fold in which the limbs dip away from each other. The relative age of the rocks forming antiform are NOT known (Geometry) but in an anticline, the core is older than the outer portion. (AGE).

(b) Sheeting joints (exfoliation) are roughly parallel to the land surface and may cause landslides on hillside. The thinner the rock cover, the more pronounced the sheeting. This suggests a connection between the removal of overburden by denudation & the development of sheeting joints.

→ Earth surface is eroded and relieves vertical stress but lateral stress is not reduced proportionally. Therefore vertical stress becomes minimum principal stress and joints form parallel to land surface.



Yes, U can!

4. (a) (i) $h_{pA} = 50$ mm, $Z_A = -30$mm $\therefore h_A = 50-30 = 20$ mm

$h_{pc} = 30$ mm, $Z_c = -30$mm $\therefore h_c = 30-30 = 0$

$q_{AB} = q_{BC}$

$K_{AB}\, i_{AB}\, A_{AB} = K_{BC}\, i_{BC}\, A_{BC}$

$5K_{BC}\, i_{AB} = K_{BC}\, i_{BC}$ [given $K_{AB} = 5K_{BC}$]

$5 i_{AB} = i_{BC}$

$5\left[\frac{h_B - h_A}{L}\right] = \frac{h_c - h_B}{L}$

$5[h_B - 20] = 0 - h_B$

$h_B = 16.67$ mm

(ii) $U_A = h_w \gamma_w$

$= (50\times10^{-3})(9.81)$

$= 0.4905$ kPa

$U_c = h_w \gamma_w$

$= (30\times10^{-3})9.81$

$= 0.2943$ kPa

$h_B = h_{pB} + Z_B$

$16.67 = h_{pB} - 30$

$h_{pB} = 46.67$mm

$U_B = (46.67\times10^{-3})(9.81)$

$= 0.4578$ kPa

(iii) $i_{AB} = \frac{h_A - h_B}{L_{AB}}$

$= \frac{20-16.67}{50}$

$= 0.067$

$i_{BC} = \frac{h_B - h_C}{L_{BC}}$

$= \frac{16.67-0}{50}$

$= 0.33$

(iv) when $H = 20$mm, $h_A = 0$, $h_c = 0$ $\therefore h_B = 0$

$h_B = h_{pB} + Z_B$

$0 = h_{pB} - 30$

$h_{pB} = 30$mm

$U_B = (30\times10^{-3})(9.81)$

$= 0.2943$ kPa

(b) $\gamma = \rho g$

$18.2\times10^3 = \rho \times 9.81$

$\rho = 1855.25$ kg/m^3

$w = 0.146 = \frac{M_w}{M_s}$

$M_w = 0.146 M_s$

let $V = 1$m^3

$\therefore \rho = \frac{M_s + M_w}{V}$

$1855.25 = M_s + 0.146M_s$

$M_s = 1618.89$

Given $G_s = 2.81$

$\therefore \rho_s = 2810$ kg/m^3

$\rho_s = \frac{M_s}{V_s}$

$V_s = 0.5761$

$V_v + V_s = 1$

$V_v = 0.4239$

$\therefore e = \frac{V_v}{V_s} = 0.7358$

$\therefore S_r = \frac{wG_s}{e} = \frac{0.146\times2.81}{0.7358}$

$= 0.5576$

$= 55.76\%$

Yes, U can!

4.(i) Soil A

% fine = 10%
% gravel = 21%
% sand = 69%

As sand fraction > gravel fraction, first letter is S.
As % fine between 5% and 12%, dual symbols.

- Given $C_u = 4.1$ & $C_z = 3.8$ ⇒ not satifying SW requirements, so is SP
- $I_p = LL - PL$, From chart, it is above A-line, so is SC.
  $= 44 - 10$
  $= 34\%$

Ans: Soil A is classified as SP-SC *

Soil B

% fine = 3%
% gravel = 56%
% sand = 41%

- As % gravel > % sand, first letter is G.
- Given $C_u = 6.8$ and $C_z = 2.1$
  so, $1 < 2.1 < 3$ and $6.8 > 4$, so it is well-graded.

Ans: Soil B is classified as GW *

5.(a) For clay layer of finite thickness, factors govern the time rate of consolidation are size of loading and nature of soil.

(b) Prior to the placement:

(i) total stress $\sigma = (3 \times 20) + (4 \times 16) = 124$ kPa

porewater pressure $U_s = 7 \times 9.81 = 68.67$ kPa

Effective stress $\sigma' = \sigma - U_s = 55.33$ kPa

(ii) Immediately after placement:

total stress $\sigma = (3 \times 20) + (4 \times 16) + (5 \times 18) = 214$ kPa

porewater pressure $U_s = 68.67 + (5 \times 18) = 158.67$ kPa

Effective stress $\sigma' = 55.33$ kPa (won't change)

(iii) As OCR = 1.8, $S_c = \frac{H}{1+e_0} C_r \log(\sigma_p'/\sigma_0') + \frac{H}{1+e_0} C_c \log(\sigma_2'/\sigma_p')$

$$= \frac{8}{1+1.2}(0.04)\log\left(\frac{1.8\times 55.33}{55.33}\right) + \frac{8}{1+1.2}(0.15)\log\left(\frac{55.33+5\times 18}{1.8\times 55.33}\right)$$

$$= 0.0371 + 0.0895$$

$$= \underline{\underline{0.1266\text{ m}}}$$

(iv) This is double drainage $\therefore d = \frac{H}{2} = 4\text{m}$

Given $U = 90\%$. $\therefore T_v = 0.848$ (From graph)

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

$$0.848 = \frac{1}{4^2}(1.2)(t)$$

$$t = \underline{\underline{11.31\text{ years}}}.$$

(v) Given $t = 4$ years, $T_v = \frac{1.2\times 4}{4^2} = 0.3$

$z/d = \frac{4}{4} = 1$, From graph, $U_z = 0.39$

$\therefore U_z = 1 - \frac{u_e}{u_i}$ Then, $u = u_s + u_e$

$0.39 = 1 - \frac{u_e}{5\times 18}$ $= 68.67 + 54.9$

$u_e = 54.9$ kPa $= 123.57$ kPa

$$\therefore h_p = \frac{u}{\gamma_w}$$

$$= 123.57/9.81$$

$$= \underline{\underline{12.596\text{ m}}}$$

Ans: Water level will be 12.596 m #.