3-7 Given: Constant head permeameter $A = 78.5\,cm^2$, $L = 23\,cm$, $\Delta h = 3.4\,cm$, $V = 50\,cm^3$, $t = 35\,sec$

Find: (A) K in cm/sec & ft/d
(B) k @ T = 15°C
(C) Name soil type from K

(A) $K = \frac{VL}{A t h}$

$K = \frac{(50\,cm^3)(23\,cm)}{(78.5\,cm^2)(35\,s)(3.4\,cm)}$

$K = 1.1 \times 10^{-1}\ cm/sec$ $\left(\frac{1\,ft}{30.5\,cm}\right)\left(\frac{86400\,sec}{d}\right)$

$K = 320\ ft/d$

(B) $K = \frac{k\gamma}{\mu} = \frac{k\rho g}{\mu}$

$k = \frac{K\mu}{\rho g}$ @ T = 15°C $\rho = 0.999099\ g/cm^3$, $\mu = 0.011404\ g/s\,cm$

$k = \frac{(1.1 \times 10^{-1}\,cm/s)(0.011404\,g/s\,cm)}{(0.999099\,g/cm^3)(981\,cm/s^2)}$

$k = 1.3 \times 10^{-4}\ cm^2$

(C) Soil Type
Table 3.7 $K = 0.11\ cm/sec \Rightarrow$ well sorted sand, glacial outwash or gravel

10

3-10 | Given: Aquifer $S_y = 0.24$. Tabulated decline

Area	Surface (mi^2)	Decline (ft)	ΔV (ft^3)
A	12.5	1.33	1.11×10^8
B	15.8	0.185	1.17×10^8
C	23.8	3.98	6.34×10^8
D	9.56	2.34	1.50×10^8
E	12.3	4.44	3.687×10^8
F	7.22	0.34	1.64×10^7

Find: Total volume of water in decline

$$V = S_y A \Delta h = 0.24\ (A\ mi^2)(\Delta h\ ft)\left(\frac{5280\ ft}{1\ mi}\right)^2$$

$$= 6.69 \times 10^6\ A \Delta h$$

Sectable

$$V = \Sigma \Delta V = 1.39 \times 10^9\ ft^3 \qquad (31900\ ac\text{-}ft)$$

3-13 Given: Confined aquifer $S_s = 4.033 \times 10^{-3}\ m^{-1}$, $n = 0.274$

$\beta = 4.6 \times 10^{-10}\ m^2/N$

Find: (i) α for aquifer skeleton

(ii) Δb if $\Delta h = 15\ m$ & $b = 40\ m$

(i) $S_s = \rho_w g (\alpha + n\beta)$

$\alpha = \dfrac{S_s}{\rho_w g} - n\beta$

$= \dfrac{(4.033 \times 10^{-3}\ m^{-1})\ \frac{1\ kg\,m/s^2}{1\ N}}{(998.2\ kg/m^3)(9.81\ m/s^2)} - 0.274\left(4.6 \times 10^{-10}\ \frac{m^2}{N}\right)$

$\boxed{\alpha = 4.12 \times 10^{-7}\ m^2/N}$

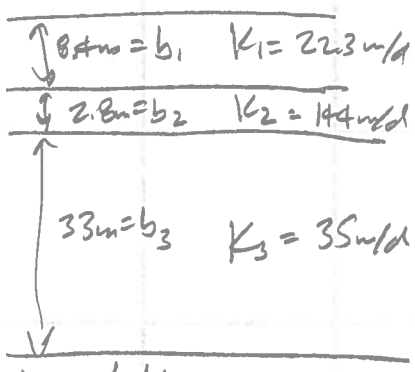
(ii) $\alpha = \dfrac{db/b}{\gamma\, dh}$

$db = \alpha\, b\, \gamma\, dh$

$= (4.12 \times 10^{-7}\ m^2/N)(40\ m)(998.2\ kg/m^3)(9.81\ m/s^2)(15\ m)\dfrac{1\ N}{1\ kg\,m/s^2}$

$\boxed{db = 2.42\ m}$

3.6 Given: Aquifer as Figure



Find: $K_{h_{avg}}$ & $K_{V_{avg}}$

$$K_{h_{avg}} = \sum_{m=1}^{n} \frac{K_{hm} b_m}{b}$$

[5]

$$= \frac{(8.4\,m)(22.3\,m/d) + (2.8\,m)(144\,m/d) + (33\,m)(35\,m/d)}{8.4\,m + 2.8\,m + 33\,m}$$

$$K_{h_{avg}} = 39\ m/d$$

$$K_{V_{avg}} = \frac{b}{\sum_{m=1}^{n} \frac{b_m}{K_{Vm}}}$$

[5]

$$= \frac{44.2\,m}{\frac{8.4\,m}{22.3\,m/d} + \frac{2.8\,m}{144\,m/d} + \frac{33\,m}{35\,m/d}}$$

$$K_{V_{avg}} = 33\ m/d$$

10

3-17 Given: Grain-size analysis in handout

Find: K by Hazen method

Hazen $K = C d_{10}^2$ $\quad d_{10}$ (cm)

$d_{10} = 0.024\text{ mm}\left(\frac{1\text{ cm}}{10\text{ mm}}\right) = 0.0024\text{ cm}$

Soil is 81% sand, most less than 1 mm

10 Can choose fine sand w/ appreciable fines $C = 40 \text{ to } 80 \rightarrow 60$
or very fine sand, poorly sorted $C = 40 \text{ to } 80 \rightarrow 60$

$K = 60\,(0.0024\text{ cm})^2$

$K = 3.5 \times 10^{-4}\text{ cm/sec}$

3-18 Given: Grain-size analysis as in 3-17

Find: effective grain size & C_u

$d_{10} = 0.024\text{ mm} = d_{eff}$

$C_u = \frac{d_{60}}{d_{10}}$

10 $d_{60} = 0.62\text{ mm}$

$C_u = \frac{0.62\text{ mm}}{0.024\text{ mm}}$

$C_u = 26$