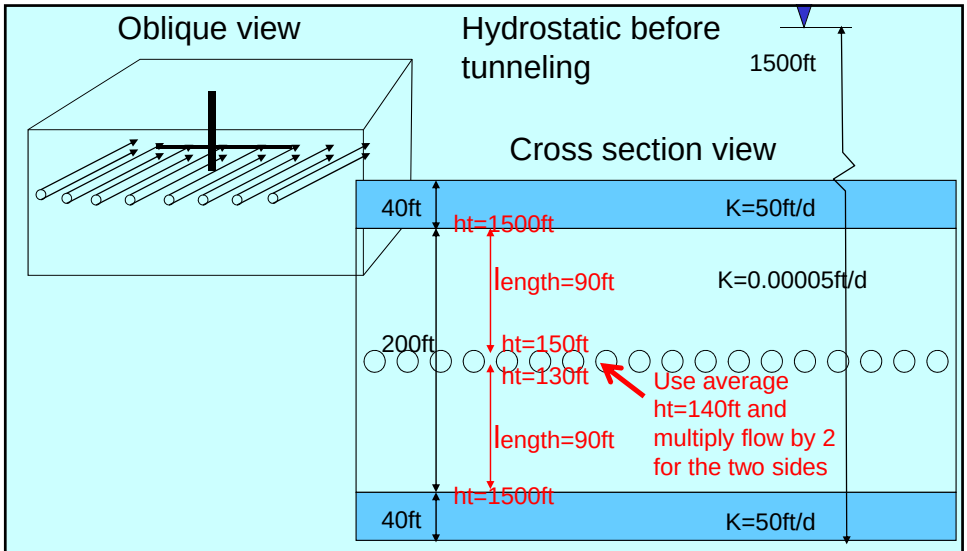
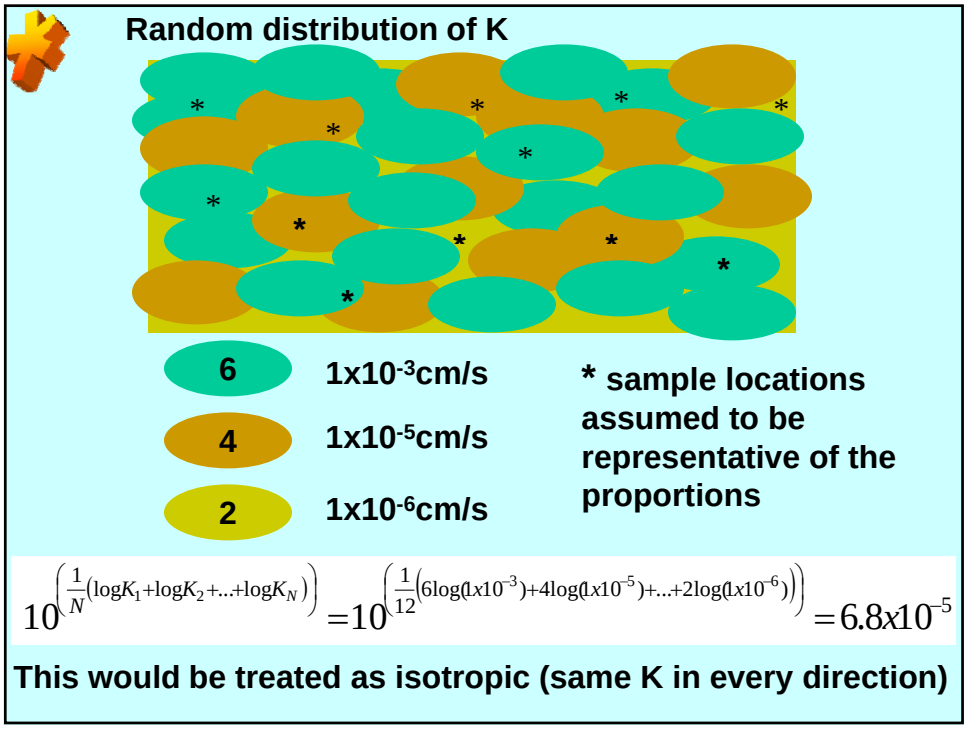


$Q = KiA = 5x10^{-5}\ \frac{ft}{day}\ \frac{1500\text{-}140\ ft}{90ft}\ 1ft1ft\ 2sides = 1.5x10^{-3}\ \frac{ft^3}{day\ ft^2}$

If the repository was 2000ftx1000ft then

$Q = 1.5x10^{-3}\ \frac{ft^3}{day\ ft^2}\ 2000ft\ 1000ft \sim \frac{3000ft^3}{day} \sim 2\ \frac{ft^3}{minute} = 16\ \frac{gallons}{minute}$

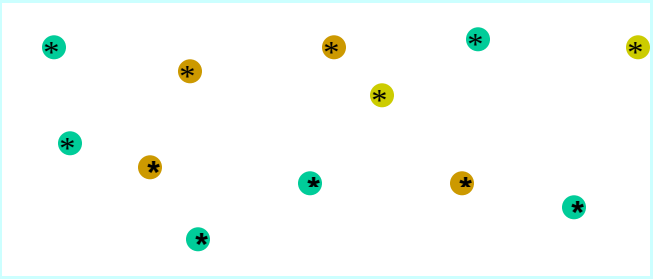
What about the local flow to each tunnel? It will make no difference.



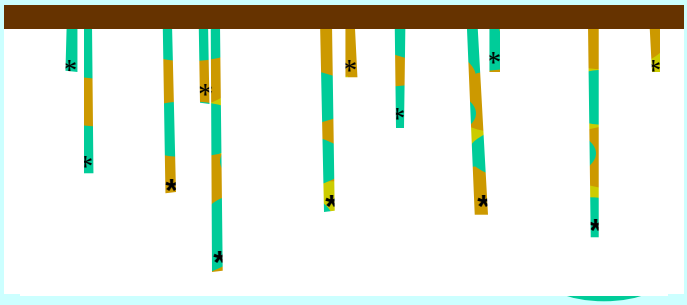
$$10^{\left(\frac{1}{N}\left(\log K_1+\log K_2+\ldots+\log K_N\right)\right)} = 10^{\left(\frac{1}{12}\left(6\log(1x10^{-3})+4\log(1x10^{-5})+\ldots+2\log(1x10^{-6})\right)\right)} = 6.8x10^{-5}$$

This would be treated as isotropic (same K in every direction)

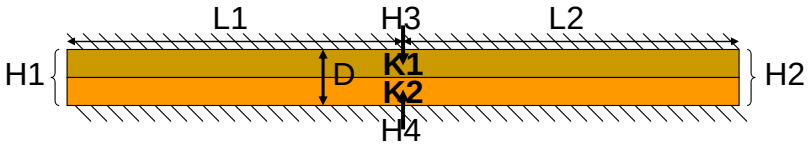
Realize you would only know the values shown



You might have clues based on lithology

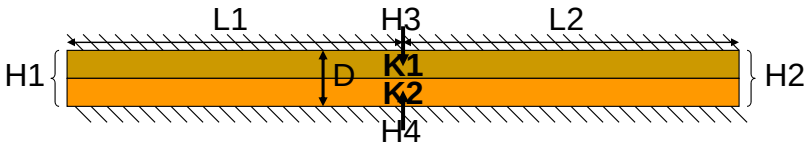


Calculate Flow and Heads between boundaries



H1 = 20cm
H2 = 10cm
K1 = 1cm/sec
K2 = 0.2cm/sec
L1 = 30cm
L2 = 30cm
D = 2cm
Q @ H2 = ??
H3 = ??, H4 = ??

Calculate Flow and Heads between boundaries



H1 = 20cm
H2 = 10cm
K1 = 1cm/sec
K2 = 0.2cm/sec
L1 = 30cm
L2 = 30cm
D = 2cm
Q @ H2 = ??
H3 = ??, H4 = ??

K_{eq} = Weighted Aritmetic Average $= \dfrac{1cm\,1\dfrac{cm}{\sec} + 1cm\,0.2\dfrac{cm}{\sec}}{2cm} = 0.6\dfrac{cm}{\sec}$

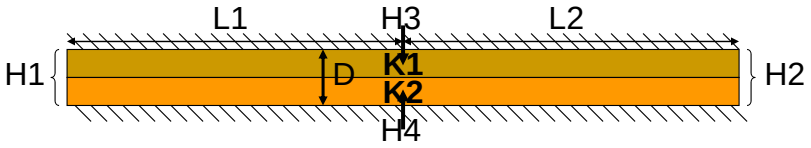
$Q = KiA$, no width is given so calculate per unit width

$Q = 0.6\dfrac{cm}{\sec}\dfrac{20cm - 10cm}{60cm}2cm = 0.1\dfrac{cm}{\sec}2cm = 0.2\dfrac{cm^2}{\sec}$ per unit width

by inspection gradient is linear,
and $H_3 = H_4$
and they are at the midpoint

$H_3 = H_4 = \dfrac{20cm - 10cm}{2} + 10cm = 15cm$

Calculate Flow and Heads between boundaries



H1 = 20cm
H2 = 10cm
K1 = 1cm/sec
K2 = 0.2cm/sec
L1 = 30cm
L2 = 30cm
D = 2cm
Q @ H2 = ??
H3 = ??, H4 = ??

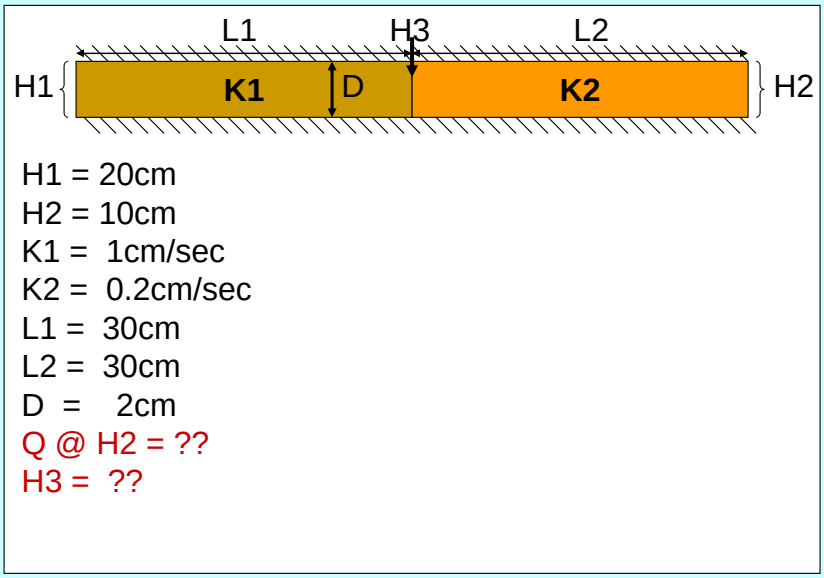
OR : head loss from H1 to H3 $\quad V = Ki = K\dfrac{\Delta h}{\Delta l}$ so $\Delta h = \dfrac{V\Delta l}{K}$

Use proper combination:
All equivalent V and K
Or all layer 1 V and K
Or all layer 2 V and K

$\Delta h = \dfrac{V\Delta l}{K} = \dfrac{0.1\dfrac{cm}{\sec}30cm}{0.6\dfrac{cm}{\sec}} = 5cm$

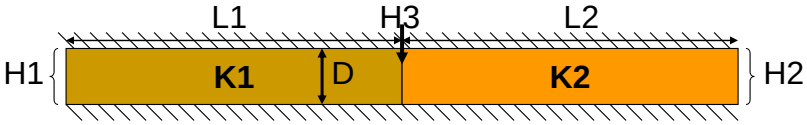
$H3 = H1 - \Delta h = 20cm - 5cm = 15cm$

Calculate Flow and Heads between boundaries



H1 = 20cm
H2 = 10cm
K1 = 1cm/sec
K2 = 0.2cm/sec
L1 = 30cm
L2 = 30cm
D = 2cm
Q @ H2 = ??
H3 = ??

Calculate Flow and Heads between boundaries



H1 = 20cm
H2 = 10cm
K1 = 1cm/sec
K2 = 0.2cm/sec
L1 = 30cm
L2 = 30cm
D = 2cm
Q @ H2 = ??
H3 = ??

$$K_{eq} = \frac{60cm}{\frac{30cm}{1\frac{cm}{\sec}} + \frac{30cm}{0.2\frac{cm}{\sec}}} = 0.33\frac{cm}{\sec}$$

Velocity

$Q = VA = KiA$, no width is given so calculate per unit width

$$Q = \left(0.33\frac{cm}{\sec}\frac{20cm - 10cm}{60cm}\right)2cm = \left(0.05555\frac{cm}{\sec}\right)2cm = 0.11\frac{cm^2}{\sec} \text{ per unit width}$$

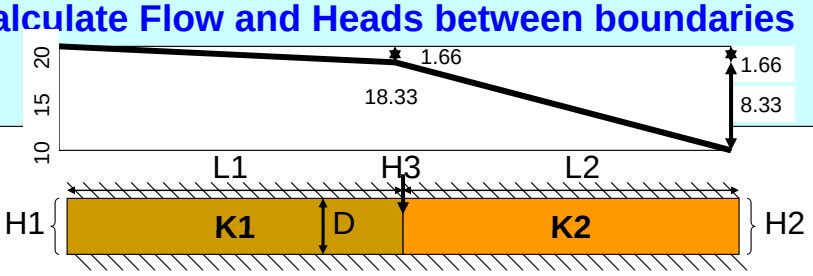
head loss from H1 to H3 $V = Ki = K\frac{\Delta h}{\Delta l}$ so $\Delta h = \frac{V\Delta l}{K}$

$$\Delta h = \frac{V\Delta l}{K} = \frac{0.0555\frac{cm}{\sec}30cm}{1\frac{cm}{\sec}} = 1.66cm$$

K for path length of interest

$$H3 = H1 - \Delta h = 20cm - 1.66cm = 18.33cm$$

Calculate Flow and Heads between boundaries



H1 = 20cm
H2 = 10cm
K1 = 1cm/sec
K2 = 0.2cm/sec
L1 = 30cm
L2 = 30cm
D = 2cm
Q @ H2 = ??
H3 = ??

Confirm by calculating from the other side

head loss from H3 to H2 $V = Ki = K\frac{\Delta h}{\Delta l}$ so $\Delta h = \frac{V\Delta l}{K}$

Velocity

$$\Delta h = \frac{V\Delta l}{K} = \frac{0.0555\frac{cm}{sec}\,30cm}{0.2\frac{cm}{sec}} = 8.33cm$$

K for path length of interest

$$H3 = H2 + \Delta h = 10cm + 8.33cm = 18.33cm$$

Review keys for homework from September 13 exercises 6c 6d 6e

Remember to continually work on your cheat sheets

And

Work the sample exam problems