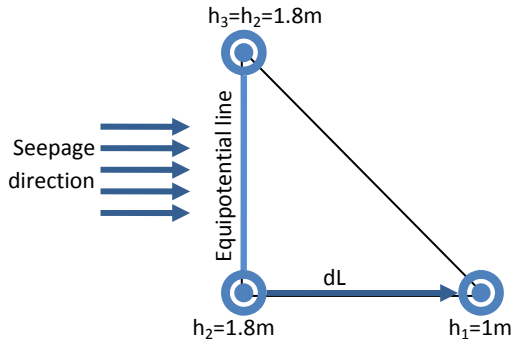
Example 8-3: Determine the velocity profile for the seepage of water across an aquifer of coarse sand, and the flow rate of water across a 1m² CV surface. Data from three wells is available.

Well	X location (m)	Y location (m)	Ground elevation above sea level (m)	Distance from ground to water surface (m)
1	100	0	200	4
2	0	0	200	3.2
3	0	100	200	3.2

The properties of coarse sand are: K = 41 m/d and η = 0.34.

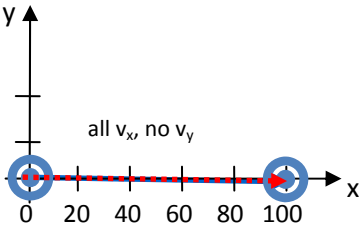


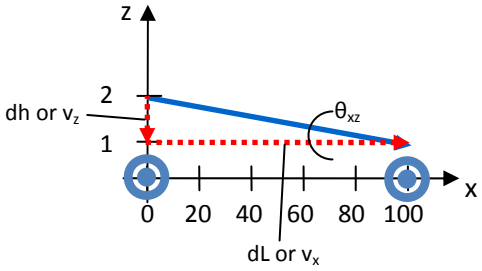
The field data indicates that the three wells are dug at the 3 corners of a right triangle. Since the ground elevation is constant, the heads of each well are determined relative to a datum that is the same distance from the surface for all three wells. Choosing a datum of 5m below ground, then the heads in each well are: h_1 = 5-4 = 1m, h_2 = 5-3.2 = 1.8m and h_3 = 5-3.2 = 1.8m. Wells 2 and 3 have the same head and therefore the equipotential line is drawn between them. Seepage occurs perpendicular to this line.

The velocity is: $$v' = \frac{K}{\eta}\frac{dh}{dL} = \frac{41\,m/day}{0.34}\frac{(1.8\text{-}1)m}{100m} = 0.965\,m/day$$

And the steady uniform flow rate is: $$Q = v'A = 0.965\,m/day \times 1\,m^2 = 0.965\ \ m^3/day$$

The directional velocity profile has only 2 components and is based on the tan^{-1} of the hydraulic gradient.





$$\theta_{xz} = \tan^{-1}(dh/dl) = \tan^{-1}\left(\frac{(1.8\text{-}1)\,m}{100\,m}\right) = 0.008$$

$$v_z' = v'\sin(\theta_{xz}) = 0.965 \times \sin(0.008) = 0.0077\ m/day$$

$$v_x' = v'\cos(\theta_{xz}) = 0.965 \times \cos(0.008) = 0.965\ m/day$$

$$\hat{v}' = \left(0.965\hat{i} - 0.0077\hat{k}\right) m/day$$