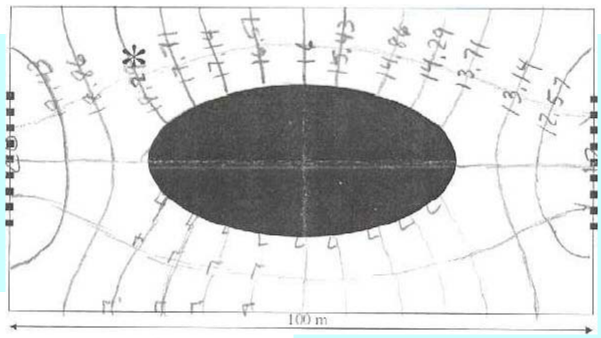
The head in the inlet reservoir on the left is 20 m and the outlet reservoir on the right is 12m. Properties of the sand are: K=1x10-3 m/s. Draw and label a flow net. Calculate the discharge through the system using units of meters and seconds. What is the head at the location of the * at the top of the tank? What is the pressure at that location?



$\frac{8}{14} = 0.57$ contour interval

$4 = n_f$ $\quad q = KH \frac{n_f}{n_d} = 1\times10^{-3}\,\frac{m}{s}\; 8m\; \frac{4}{14} = 2.29\times10^{-3}\,\frac{m^2}{s}$

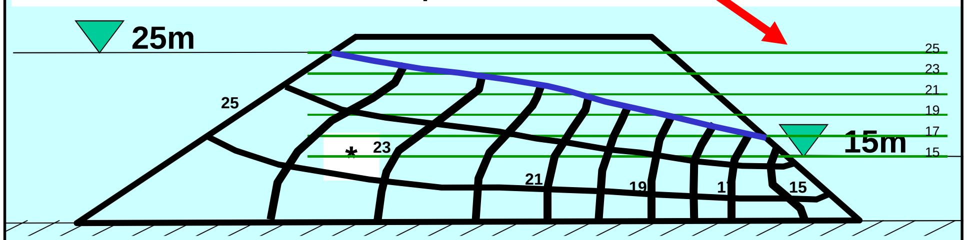
$14 = n_d$ $\quad Q = \text{thickness} * q = 10m\; 2.29\times10^{-3}\,\frac{m^2}{s}$

$\frac{n_f}{n_d} = 0.286$ $\quad = 2.29\times10^{-2}\,\frac{m^3}{s}$

$\sim 18.23m$

$p = \text{Head} - \text{Elevation} = 18.23m - 10m = 8.23m$

K = 0.53m/day
Draw the flow net
Calculate Q = 0.53m/day 10m 2.5 / 10 ~ 1.3 m^2/day
What is the maximum gradient? ~ 1
What are the head and pressure at the *? ~ 23.5m and 8m



We can use the flow net to identify areas where critical gradients may occur and determine the magnitude of the gradient at those locations

- equipotential lines parallel constant head boundaries
-- flow lines parallel no-flow boundaries
-- streamlines are perpendicular to equipotential lines
- equipotential lines are perpendicular to no-flow boundaries
- form squares by intersecting stream and equipotential lines

Stress caused in soil by flow = j = $i\gamma_w$

If flow is upward, stress is resisted by weight of soil

If j exceeds submerged weight of soil, soil will be uplifted

For uplift to occur $j > \gamma_{\text{submerged soil}} = \gamma_t - \gamma_w$

where: γ_t - unit saturated weight of soil

γ_w - unit weight of water

then for uplift to occur:

$$i\,\gamma_w > (\gamma_t - \gamma_w)$$

the critical gradient for uplift then is: $$i_{\text{critical}} = \frac{\gamma_t - \gamma_w}{\gamma_w}$$

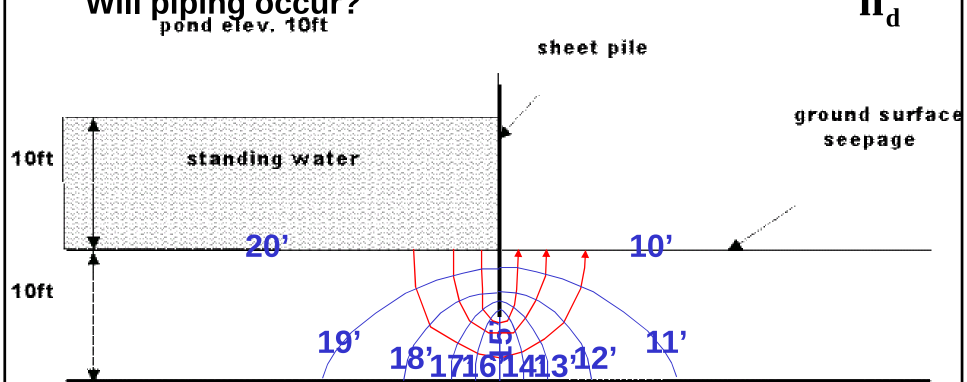
What is the critical gradient for a soil with 30% porosity and a particle density of 2.65 g/cc (165 lb/ft^3)?

γ_t = 0.7 (165 lb/ft^3) + 0.3 (62.4 lb/ft^3) = (134 lb/ft^3)

$$i_{\text{critical}} = \frac{134\text{ lb/ft}^3 - 62.4\text{ lb/ft}^3}{62.4\text{ lb/ft}^3} = 1.15$$

What is the flux under the sheet pile wall if K=2ft/day? Will piping occur?

$$Q = q_A n_f = KH\frac{n_f}{n_d}$$



Q = KH(n_f/n_d) = 2 ft/d 10ft 4/10 = ~ 8 ft^3/day

Using: γ_t = 0.7 (165 lb/ft^3) + 0.3 (62.4 lb/ft^3) = (134 lb/ft^3)

$$i_{\text{critical}} = \frac{134\text{ lb/ft}^3 - 62.4\text{ lb/ft}^3}{62.4\text{ lb/ft}^3} = 1.15$$

gradient is ~1.0 at the critical location, so it looks OK

What could change that? How could you correct it?