Problem:

A rectangular channel (bottom width b, Manning's roughness coefficient n) flows y_{norm} deep on a slope s.
A suppressed weir (height h_{weir}, weir coefficient C_{weir}) is built across the channel.
Taking the elevation of the bottom of the channel just upstream from the weir to be z_B, estimate (using one reach) the elevation of the water surface at a point "A", H_A, which is L upstream from the weir. (See figure.)

Given:

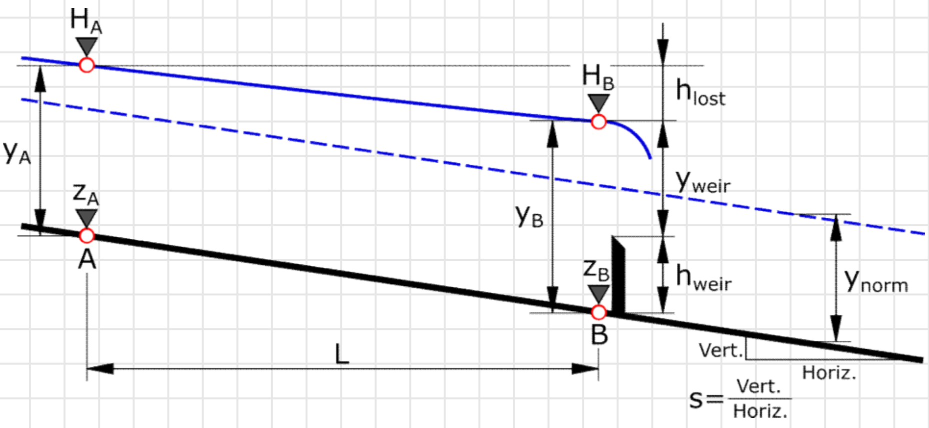
$b = 20\ \text{ft}$ $\quad n = 0.025\ \dfrac{\text{s}}{\text{m}^{\frac{1}{3}}}$

$y_{norm} = 5\ \text{ft}$ $\quad s = \dfrac{14.7}{10000}$

$z_B = 100\ \text{ft}$ $\quad L = 1000\ \text{ft}$

$h_{weir} = 2.45\ \text{ft}$

$C_{weir} = 3.45\ \dfrac{\text{ft}^{\frac{1}{2}}}{\text{s}}$



Solution:

$A = b \cdot y_{norm} = 100\ \text{ft}^2$

$p_w = b + 2 \cdot y_{norm} = 30\ \text{ft}$

$R = \dfrac{A}{p_w} = 3.3333\ \text{ft}$

$v = \dfrac{1}{n} \cdot R^{\frac{2}{3}} \cdot s^{\frac{1}{2}} = 5.0851\ \dfrac{\text{ft}}{\text{s}}$

$Q = A \cdot v = 508.51\ \dfrac{\text{ft}^3}{\text{s}}$

$y_B = 6.009\ \text{ft}$ estimated

$y_{weir} = y_B - h_{weir} = 3.559\ \text{ft}$

$v_B = \dfrac{Q}{b \cdot y_B} = 4.2312\ \dfrac{\text{ft}}{\text{s}}$

Flow over weir is given with following equation:

$$Q_{weir} = C_{weir} \cdot b \cdot \left(\left(y_{weir} + \frac{v_B^2}{2\, g_e} \right)^{\frac{3}{2}} - \left(\frac{v_B^2}{2\, g_e} \right)^{\frac{3}{2}} \right) = 508.5249\ \frac{\text{ft}^3}{\text{s}}$$

$\Delta Q = Q - Q_{weir} = -0.0149\ \dfrac{\text{ft}^3}{\text{s}}$ must be equal to zero satifactory enough, $y_B = 6.009\ \text{ft}$

$z_A = z_B + s \cdot L = 101.47\ ft$

$y_A = 5.43\ ft$ estimated

$A_A = b \cdot y_A = 108.6\ ft^2$

$v_A = \frac{Q}{A_A} = 4.6824\ \frac{ft}{s}$

$v_{average} = \frac{1}{2} \cdot \left(v_A + v_B \right) = 4.4568\ \frac{ft}{s}$

$R_{average} = \frac{\frac{1}{2} \cdot \left(y_A \cdot b + y_B \cdot b \right)}{\frac{1}{2} \cdot \left(b + 2 \cdot y_A + b + 2 \cdot y_B \right)} = 3.6385\ ft$

$h_{lost} = \left(\frac{v_{average} \cdot n}{R_{average}^{\frac{2}{3}}} \right)^2 \cdot L = 1.0047\ ft$

Check Bernoulli's equation:

$H_A = z_A + y_A = 106.9\ ft$

$H_B = z_B + y_B = 106.009\ ft$

$H_A - H_B - h_{lost} = -0.1137\ ft$ must be equal to zero satifactory enough, $y_A = 5.43\ ft$

Thus: $H_A = 106.9\ ft$