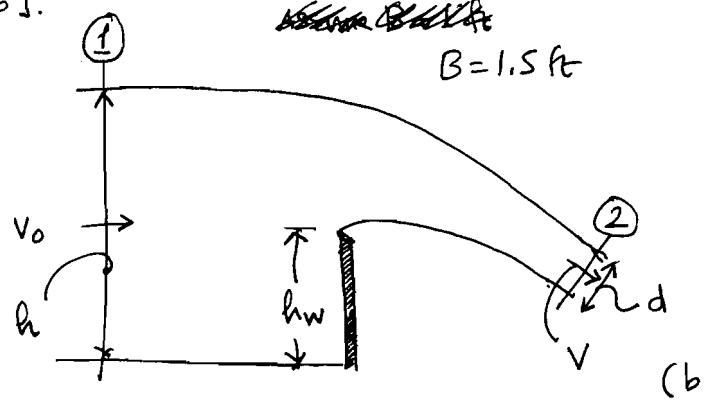
Problems for Chapter 4 Basics of Fluid Flow Assignment #

[6].



$h = 1.5$ ft d = ? (measured)

$V_0 = 0.75$ fps V = ? (calculated)

$h_{real} = 5.2$ cm, $d_{real} = 1.1$ cm

$$\text{scale} = \frac{h}{h_{real}} = \frac{1.5\text{ ft}}{5.2\text{ cm}} = 0.288\ \frac{\text{ft}}{\text{cm}}$$

(b) $d = \text{scale} \times d_{real} = 0.288 \times 1.1 = 0.32$ ft

(a) $(h_w)_{real} = 2.6$ cm $\Rightarrow h_w = \text{scale} \times (h_w)_{real} = 0.288 \times 2.6 = 0.75$ ft

(c) $Q = hBV_0 = dBV \Rightarrow V = \dfrac{hBV_0}{dB} = \dfrac{hV_0}{d} = \dfrac{1.5\text{ ft} \times 0.75\text{ fps}}{0.32\text{ ft}} = 3.51$ fps

(d) $Q = hBV_0 = 1.5\text{ ft} \times 1.5\text{ ft} \times 0.75\text{ fps} = 1.69$ cfs.

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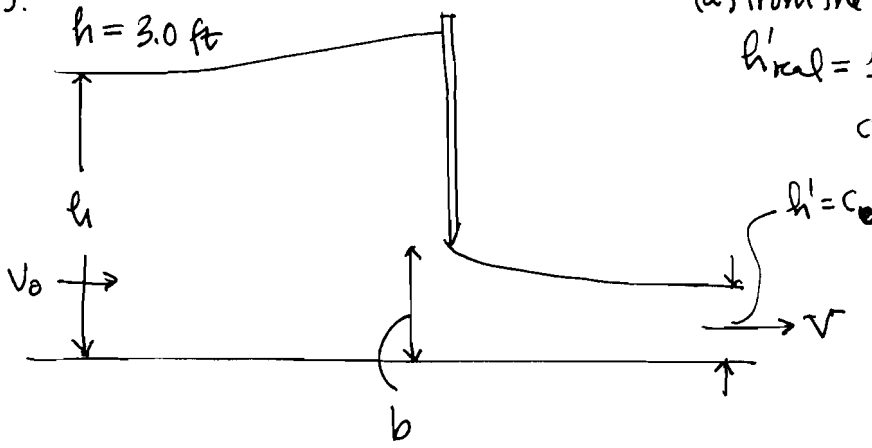
[7]. $V_0 = 0.5$ ft/s

$h = 3.0$ ft



(a) From the figure, $h_{real} = 5.5$ cm

$h'_{real} = 1.1$ cm, $b_{real} = 1.8$ cm

$$C_c = \frac{h'}{b} = \frac{1.1\text{ cm}}{1.8\text{ cm}} = 0.61$$

$$\text{scale} = \frac{h}{h_{real}} = \frac{3\text{ ft}}{5.5\text{ cm}}$$

scale = 0.545455

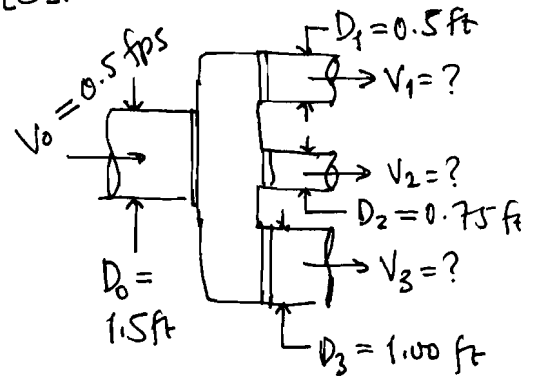
(b) $b = \text{scale} \times b_{real} = 0.545455 \times 1.8 = 0.98$ ft

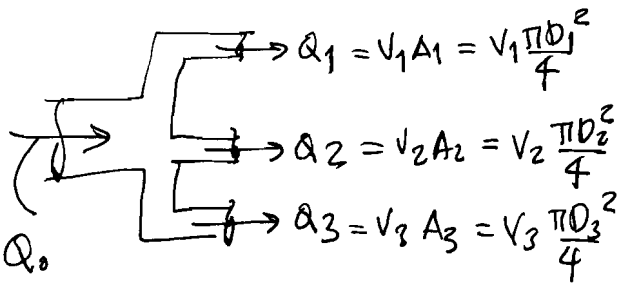
(c) $h' = \text{scale} \times h'_{real} = 0.545455 \times 1.1 = 0.6$ ft

(d) with $B = 2.0$ ft, $Q = hV_0B = (3.0\text{ ft})(0.5\text{ ft})(2.0\text{ ft}) = 3.0$ cfs

(e) $V = \dfrac{Q}{h'B} = \dfrac{3.0\text{ cfs}}{(0.6\text{ ft})(2.0\text{ ft})} = 2.5$ fps.

[8].





$$Q_0 = V_0 A_0 = V_0 \frac{\pi D_0^2}{4} = 0.5 \times \frac{\pi \times 1.5^2}{4}$$

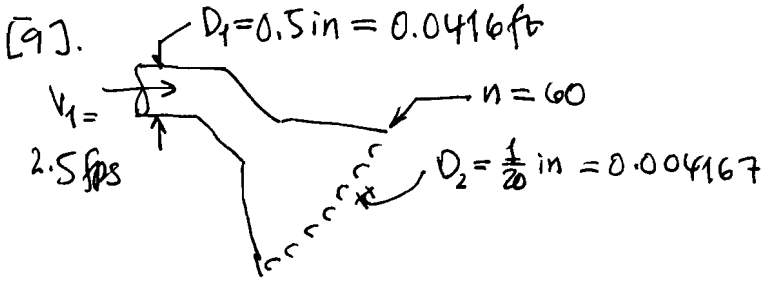
continuity: $Q_0 = Q_1 + Q_2 + Q_3$ $\qquad$ $\underline{Q_0 = 0.8835 \text{ cfs}}$

also given, $Q_1 = Q_2 = Q_3 = Q_0/3 = \frac{0.8835}{3} = 0.2945$ cfs

$$Q_i = V_i \frac{\pi D_i^2}{4} \Rightarrow V_i = \frac{4Q}{\pi D_i^2} = \frac{4 \times 0.2945}{\pi \times D_i^2} = \frac{0.375}{D_i^2}$$

$\underline{Q_1 = \frac{0.375}{0.5^2} = 1.5 \text{ fps}}$, $\underline{Q_2 = \frac{0.375}{0.75^2} = 0.67 \text{ fps}}$, $\underline{Q_3 = \frac{0.375}{1.0^2} = 0.375 \text{ fps}}$

[9].



$$Q_1 = n \cdot Q_2$$

$$V_1 \cdot \frac{\pi D_1^2}{4} = n \cdot V_2 \cdot \frac{\pi D_2^2}{4}$$

$$V_2 = \frac{V_1}{n} \left(\frac{D_1}{D_2}\right)^2$$

$$V_2 = \frac{2.5 \text{ fps}}{60} \left(\frac{1/2}{1/120}\right)^2 = \frac{2.5 \text{ fps}}{60} \times 10^2 = 2.5 \text{ fps} \times \frac{5}{\cancel{60}_{3}} = \frac{2.5 \times 5}{3} \text{ fps} = 4.16 \text{ fps}$$