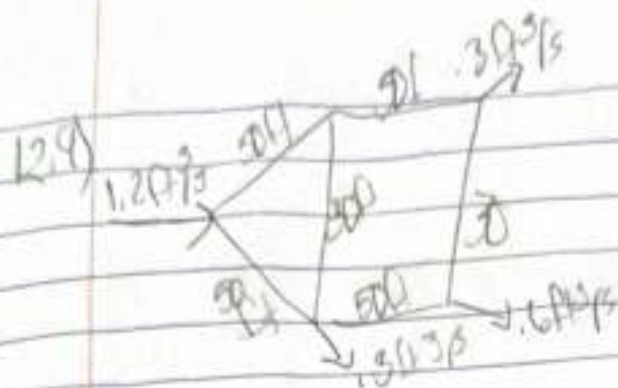


$$\begin{aligned} Q_1 &= .594 \text{ @ } 3/5 \\ Q_2 &= .606 \text{ @ } 3/5 \\ Q_3 &= .145 \text{ @ } 3/5 \\ Q_4 &= .449 \text{ @ } 3/5 \\ Q_5 &= .451 \text{ @ } 3/5 \\ Q_6 &= .149 \text{ @ } 3/5 \end{aligned}$$



data
 $\frac{D}{2}$ in schedule 40
 $D = 0.2683$
 $A = 0.03321 \text{ m}^2$
 $g = 32.2$

$$h = KQ^2 = \frac{fL}{D} \frac{V^3}{2g} = \frac{fLQ^2}{D^5 A^3}$$

50 ft $K = \frac{fL}{D^5 A^3} = \frac{f(50)}{(0.2683)^5 (32.2)^3 (0.03321)^3} = 3410 \text{ ft}$

300 ft $K = \frac{f(300)}{(0.2683)^5 (32.2)^3 (0.03321)^3} = 2046 \text{ ft}$

$$D/c = \frac{0.2683}{1.5 \times 10^4} = 1.377$$

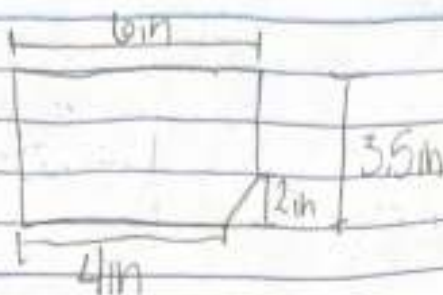
$$N_R = \frac{VD}{\nu} = \frac{QD}{A\nu} = \frac{Q(0.2683)}{0.03321 (1.1 \times 10^{-5})} = 5.114 \times 10^5$$

$$f = \frac{0.25}{\left(\log \left(\frac{1}{3.75(1.377)} + \frac{5.74}{N_R^{0.4}} \right) \right)^2}$$

$$Q_1 + Q_2 = Q_3 + Q_4 = 7 + 1 = 8 \text{ ft}^3/\text{s}$$

$N_{R1} = 2.5 \times 10^5$	$f_1 = 0.0197$	$K_1 = 67.1$
$N_{R2} = 3.98 \times 10^5$	$f_2 = 0.0191$	$K_2 = 66$
$N_{R3} = 5.114 \times 10^5$	$f_3 = 0.0233$	$K_3 = 47.65$
$N_{R4} = 2.045 \times 10^5$	$f_4 = 0.02$	$K_4 = 68.2$
$N_{R5} = 2.96 \times 10^5$	$f_5 = 0.0197$	$K_5 = 67.2$
$N_{R6} = 0.114 \times 10^5$	$f_6 = 0.025$	$K_6 = 47.65$

14.6

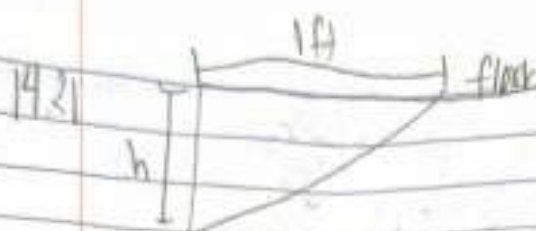


$$R = \frac{A}{WP}$$

$$A = \frac{6(3.5) - (1/2(2)(2))}{1.2^2} = 0.132 \text{ ft}^2$$

$$WP = \frac{3.5}{12} + \frac{4}{12} + 0.214 \frac{1.5}{12} = 0.986 \text{ ft}$$

$$R = \frac{0.132 \text{ ft}^2}{0.986 \text{ ft}} = 0.134 \text{ ft}$$



date
 slope = 1 /
 $Q = 500 \text{ g.p.m.} = 1.1 \text{ ft}^3/\text{s}$
 $n = 0.013$

$$Q = \left(\frac{1.48}{n} \right) A R^{2/3} \text{ g.p.m.}$$

$$A R^{2/3} = \frac{nQ}{1.485^{1/2}} = \frac{0.013(1.1)}{1.48(0.01)^{1/2}} = 0.31$$

$$A R^{2/3} = \frac{\pi D^2}{8} \left(\frac{D}{4} \right)^{2/3} = \frac{\pi D^{4/3}}{20.11} = 0.156 D^{4/3}$$

$$0.31 = 0.156 D^{4/3}$$

$$D = \left(\frac{0.31}{0.156} \right)^{3/4} = 1.67 \text{ ft}$$

14.36



$$A = 2.0y^2 = 0.45$$

$$y = 0.47 \text{ ft}$$

$$T = b = 2y = 0.95 \text{ ft}$$

$$W_p = 4y = 1.9 \text{ ft}$$

$$r = y/2 = 0.24 \text{ ft}$$

data

$$Q = 1.25 \text{ ft}^3/\text{s}$$

$$v = 2.75 \text{ ft/s}$$

$$A = Q/v = 0.45 \text{ ft}^2$$

$$v$$

table 14.3

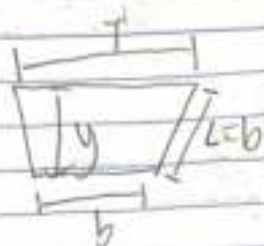


$$A = y^2 = 1.45 = 0.67 \text{ ft}^2$$

$$T = 2y = 1.35 \text{ ft}$$

$$W_p = 0.83y = 1.9 \text{ ft}$$

$$r = 0.35y = 0.24 \text{ ft}$$



$$A = 1.73y^2 = \sqrt{\frac{.45}{1.73}} = 0.51 \text{ ft}^2$$

$$L = b = 1.53y = 0.59 \text{ ft}$$

$$T = 2.36y = 1.19 \text{ ft}$$

$$W_p = 3.46y = 1.78 \text{ ft}$$

$$r = y/2 = 0.26 \text{ ft}$$



$$A = \frac{1}{2} \pi y^2 = \sqrt{\frac{.45(2)}{\pi}} = 0.54 \text{ ft}^2$$

$$T = b = 2y = 0.27 \text{ ft}$$

$$W_p = \pi y = 1.7 \text{ ft}$$

$$r = y/2 = 0.27 \text{ ft}$$

15.9



data

5m k type copper

$$A_1 = 0.125 \text{ ft}^2$$

$$b = 0.4064 \text{ ft}$$

$$v = 58.16 \text{ ft/s} \quad 77^\circ \text{F}$$

$$v_m = 844.816 \text{ ft/s}$$

$$Q = 700 - 1000 \text{ gal/min}$$

$$= 1.56 - 2.23 \text{ ft}^3/\text{s}$$

$$C = .96$$

$$g = 32.2 \text{ ft/s}^2$$

$$V_{max} = \frac{Q_{max}}{A} = \frac{2.23 \text{ ft}^3/\text{s}}{0.125 \text{ ft}^2} = 17.7 \text{ ft/s}$$

$$A_2 = \frac{A_1}{\sqrt{\frac{2gh \left(\frac{v_m}{v} \right) (C_{max})}{V_{max}^2} + 1}}$$

$$= \frac{0.125 \text{ ft}^2}{\frac{2(32.2 \text{ ft/s}^2)(.675)(\frac{844.8}{58})}{17.7^2} + 1}$$

$$= 0.079 \text{ ft}^2$$

$$A = \frac{\pi d^2}{4}$$

$$d = \sqrt{\frac{A(4)}{\pi}} = \sqrt{\frac{0.079(4)}{\pi}}$$

$$= 0.31 \text{ ft}$$

15.15



data

 $T = 60^\circ\text{F}$ $h = 0.24 \text{ in}$ $\gamma = 61.7 \text{ lb/ft}^3$ $\gamma_{\text{air}} = 0.0685 \text{ lb/ft}^3$ $g = 32.2 \text{ ft/s}^2$

$$V = \sqrt{\frac{2gh(\gamma/g - \gamma)}{\gamma}} = \sqrt{\frac{2(32.2)(.24/12)(61.7 - 0.0685)}{(0.0685)}}$$

$$\approx 34.05 \text{ ft/s}$$