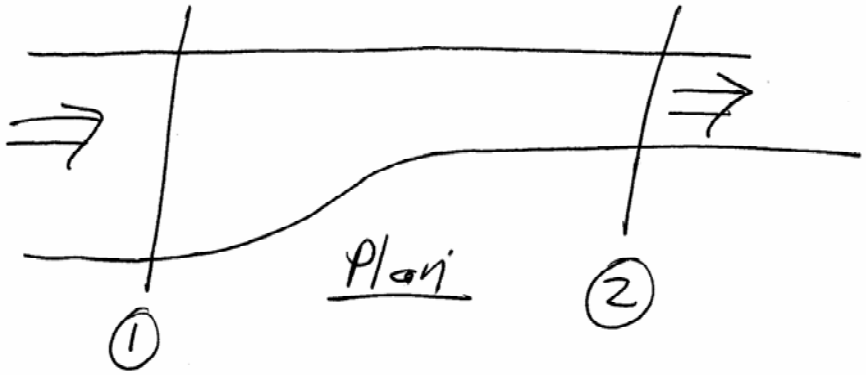
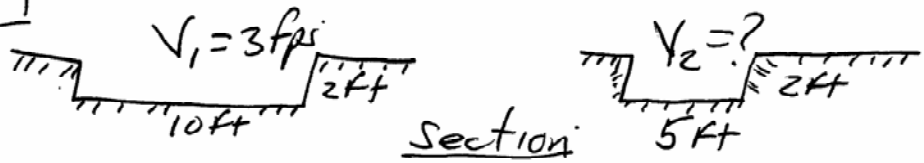
CIEG 440 Water Resources Eng'g.

Continuity, Momentum Equation

$Q = A_1 V_1 = A_2 V_2$



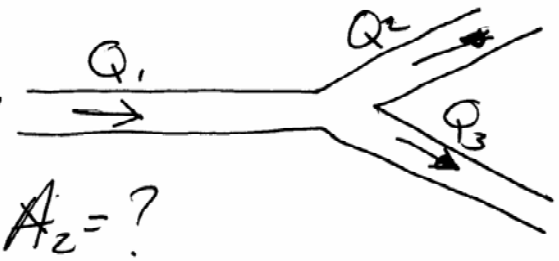
Ex. 1



$Q = 2(10)(3\text{fps}) = 2(5)(V_2)$

$V_2 = 60/10 = 6$ fps

Ex. 2



$Q_1 = 100$ cfs, $A_1 = 20$ sf, $V_1 = ?$

$Q_2 = 40$ cfs, $V_2 = 8$ fps, $A_2 = ?$

$Q_3 = ?$, $A_3 = 20$ sf, $V_3 =$

$Q_1 = Q_2 + Q_3$

$100 cfs = 40 + Q_3$, $Q_3 = 60 fps$

so $V_3 = \frac{60}{20sf} = 3 fps.$

Forces

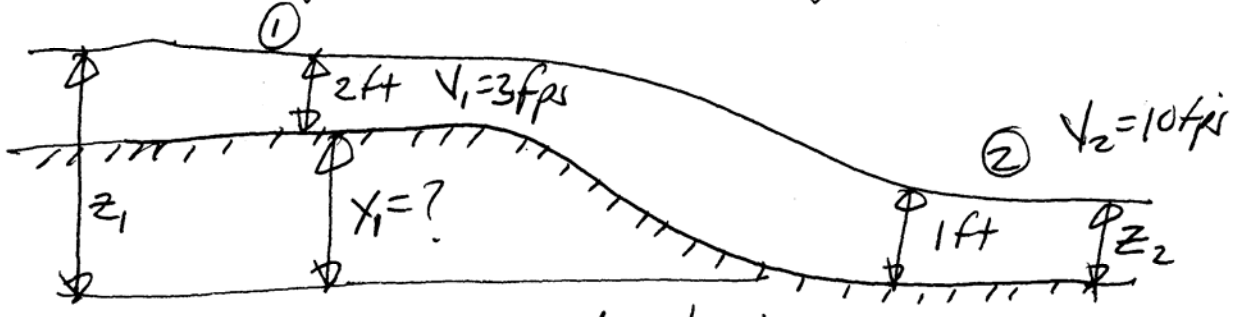
$F = \rho Q (V_1 - V_2)$

$= \left(62.4 \frac{lb}{ft^3}\right)\left(60 \frac{ft^3}{sec}\right)(3 fps - 6 fps)$

$F = 11,232 \ lb/sec^2$

Bernoulli Equation

$$\frac{V_1^2}{2g} + \frac{P_1}{\gamma} + z_1 = \frac{V_2^2}{2g} + \frac{P_2}{\gamma} + z_2$$



$z_1 = Y_1 + 2$ $P_1 = P_2 = 0$, atmosphere

$z_2 = 1$

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$$\frac{(3)^2}{2(32.2)} + 0 + (y_1 + 2) = \frac{(10)^2}{2(32.2)} + 0 + 1\,ft$$

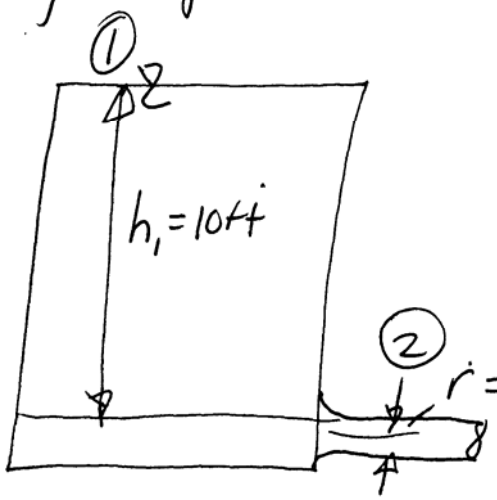
$$0.14 + y_1 + 2 = 2.55$$

$$2.14 + y = 2.55$$

$$y = \underline{0.41\,ft}$$

Nozzle or orifice flow

$$\frac{V_1^2}{2g} + \frac{p_1}{\gamma} + z_1 = \frac{V_2^2}{2g} + \frac{p_2}{\gamma} + z_2$$



$V_1 = 0$

$p_1 = p_2 = 0$

$z_2 = 0$

$z_1 = h_1 = 10ft$

$$Q = AV$$
$$= \pi(1)^2(25.37)$$
$$= 79.7\,cfs$$

$$0 + 0 + h_1 = \frac{V_2^2}{2g} + 0 + 0$$

$$V_2 = \sqrt{2gh} = \sqrt{2(32.2)(10}$$

Pressure (Static)

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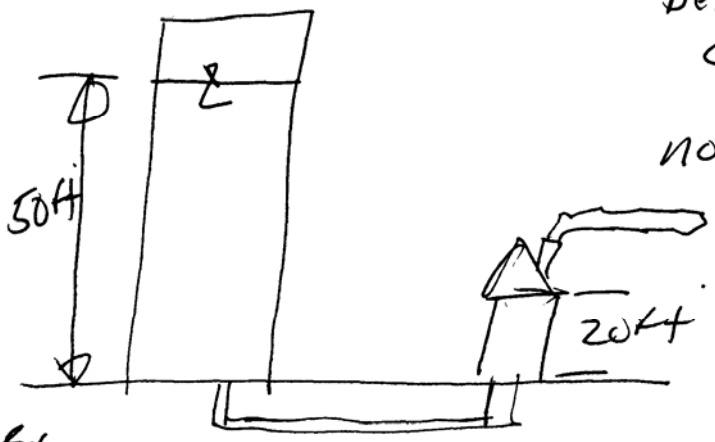
$p = \gamma h$

10 state standards = 35psi.

Delaware public service commission = 25psi

no pipe losses



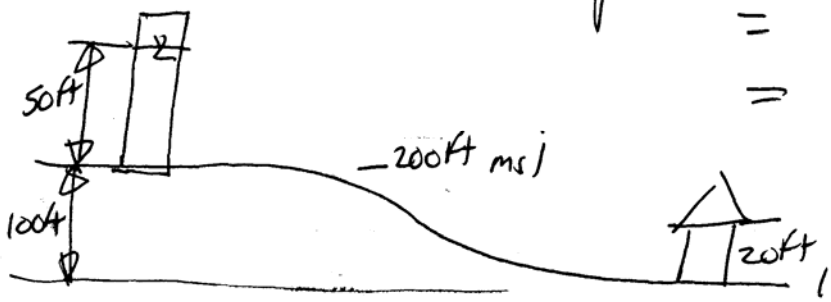
Ex.

① $p = (62.4\ lb/ft^3)(50\ ft) = 3120\ psf\left(\frac{1ft}{12in}\right)^2$
$= 21.7\ psi$

② $p = (62.4)(50-20) = 1872\ psf\left(\frac{1ft}{12in}\right)^2$
$= 13\ psi$

③ $p = 62.4(100-20) = 4992\ psf = 34.7\ psi$

④

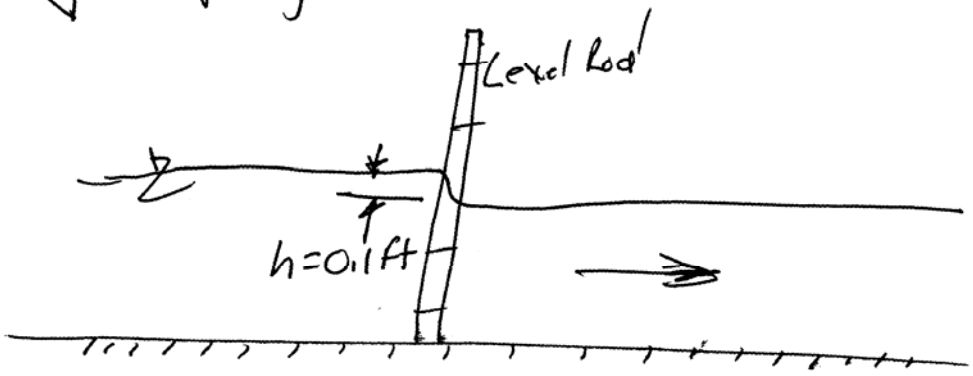


$p = \gamma h = 62.4(150-20)$
$= 8112\ psf$
$= 56\ psi$

56psi

Velocity of Stream

$V = \sqrt{2gh}$



$V = \sqrt{2(32.2)(0.1)}$

$= 2.5$ fps.