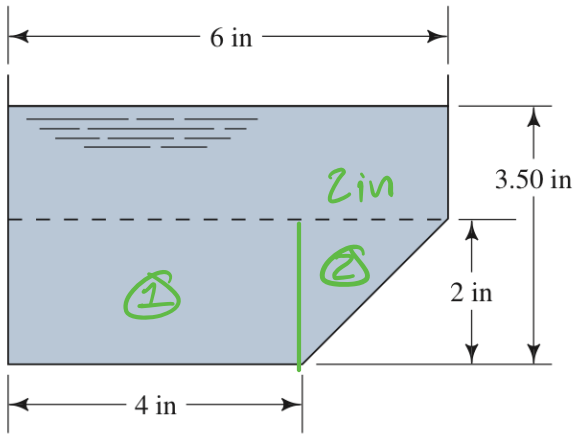
Tyler Crose 10/15/24

Homework 2.3

Ch 14 - [6, 15, 21, 36]

Question 6

Compute the hydraulic radius for the section.



Water Flows at a depth of 2.0in.

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

$$A = \frac{1}{2} b_2 h_2 + b h_1 = \frac{1}{2}(2)(2) + (2)(4) = 10\,in^2$$

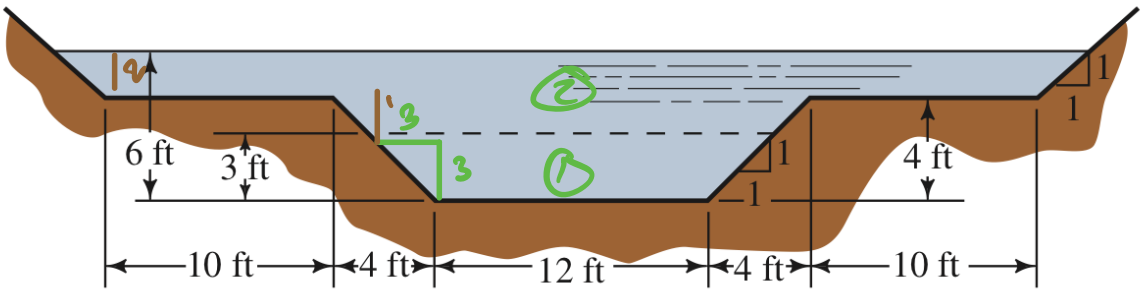
$$hyp_2 = \sqrt{b_2^2 + h_2^2} = \sqrt{(2)^2 + (2)^2} = 2.828\,in$$

$$WP = 2b_1 + 2h_1 + b_2 + h_2 + hyp_2 = 2(4) + 2(2) + (2) + (2) + (2.828)$$

$$WP = 18.83\,in$$

$$R = \frac{10\,in^2}{18.83\,in} = \boxed{0.531\,in}$$

Question 15



$n = 0.04 \quad S = 0.00015$

Determine the normal discharge for depths of 3 and 6ft.

$$Q = \frac{1.49}{n} A S^{\frac{1}{2}} R^{\frac{2}{3}}$$

$$A_1 = \left[\tfrac{1}{2}(3)(3)\right]2\ ft^2 + 3(12)\ ft^2 = 45 ft^2$$

$$WP_1 = \left(\sqrt{(3)^2+(3)^2}\right)2 + 12 = 20.49 ft$$

$$R_1 = \frac{A_1}{WP} = \frac{45 ft^2}{20.49 ft} = 2.197 ft$$

$$Q_1 = \frac{1.49}{0.04}(45 ft)(0.00015)^{\frac{1}{2}}(2.197)^{\frac{2}{3}} = \boxed{2.05\ ft^3/s}$$

$$WP_2 = WP_1 + \left(\sqrt{1^2+12}\right)2 + 2(10) + \left(\sqrt{2^2+2^2}\right)2$$

$$WP_2 = 48.97 ft^2$$

$$A_2 = A_1 + \left[\tfrac{1}{2}(1)(1)\right]2 + 12(1) + 40(2) + \left[\tfrac{1}{2}(2)(2)\right]2$$

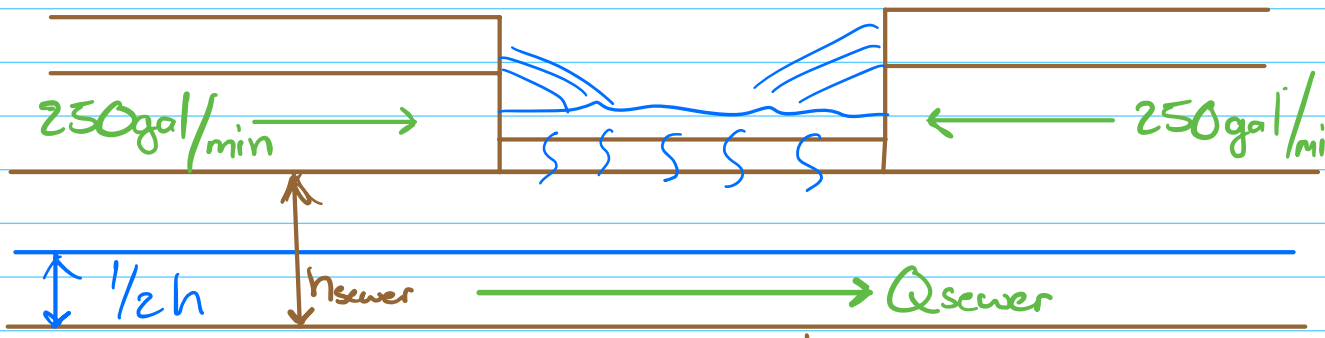
$$A_2 = 142 ft^2$$

$$R_2 = \frac{A_2}{WP_2} = \frac{142\,ft^2}{48.97\,ft} = 2.900\,ft$$

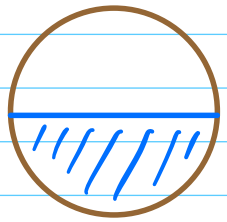
$$Q_2 = \frac{1.49}{n} A S^{\frac{1}{2}} R^{\frac{2}{3}} = \frac{1.49}{0.04} (142\,ft^2)(0.00015)^{\frac{1}{2}}(2.900\,ft)^{\frac{2}{3}}$$

$$Q_2 = \boxed{131.73\,ft^3/s}$$

Question 21



$Q_{sewer} = 500 gal/min = 1.114 ft^3/s$



$S_{sewer} = 0.01$

$n = 0.017$

$$Q = \frac{1.49}{n} A S^{\frac{1}{2}} R^{\frac{2}{3}} \qquad R = \frac{A}{WP}$$

Find the height of the sewer to be half full and move 500gal/min.

$$A = \frac{1}{2}\pi r^2 = \frac{1}{2}\pi (h)^2$$

$$WP = \frac{1}{2} C_{sewer} = \frac{1}{2}(2\pi r) = \pi h$$

$$R = \frac{A}{WP} = \frac{\frac{1}{2}\pi h^2}{\pi h} = \frac{1}{2}h$$

$$Q = \frac{1.49}{n} A S^{\frac{1}{2}} R^{\frac{2}{3}}$$

$$1.114 ft^3/s = \frac{1.49}{0.017}(0.01)^{\frac{1}{2}} A R^{\frac{2}{3}}$$

$$0.1271 = A R^{\frac{2}{3}} = \left(\frac{1}{2}\pi h^2\right) \cdot \left(\sqrt[3]{\frac{1}{2}h^2}\right)$$

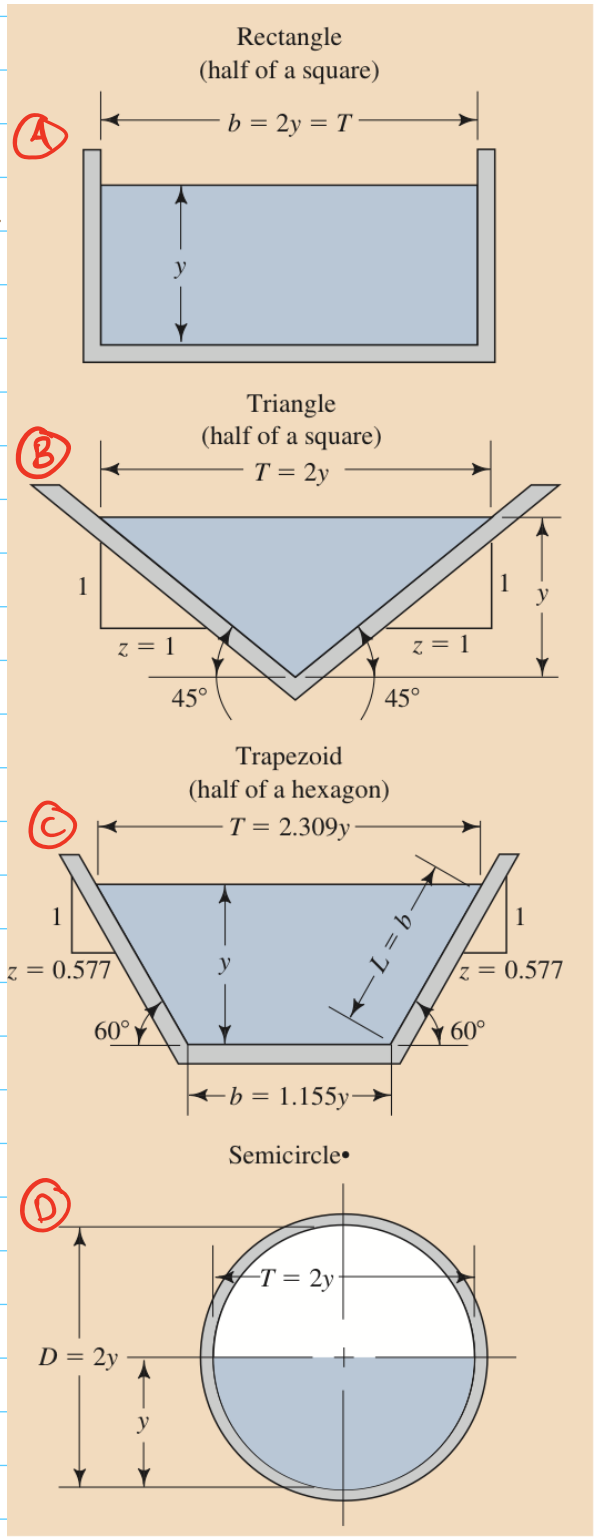
$$h = 0.4632 ft$$

Question 36

$Q = 1.25\ ft^3/s$

$v = 2.75\ ft/s$

Design channel cross sections for each of the shapes shown. Which is the most efficient for open channels?



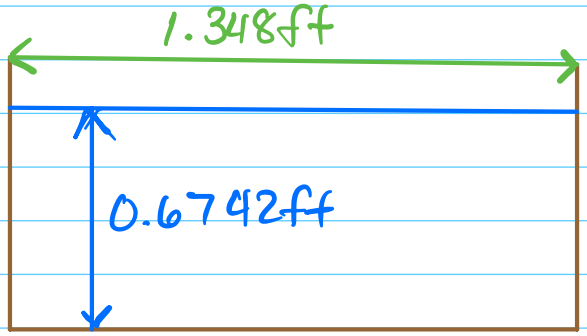
(A) $Q = \frac{1.49}{n} A S^{\frac{1}{2}} R^{\frac{2}{3}}$

$A = \frac{Q}{v} = \frac{1.25\ ft^3/s}{2.75\ ft/s} = 0.4545\ ft^2$

$A = 2.0y^2 \qquad y = \sqrt{\frac{1}{2}A}$

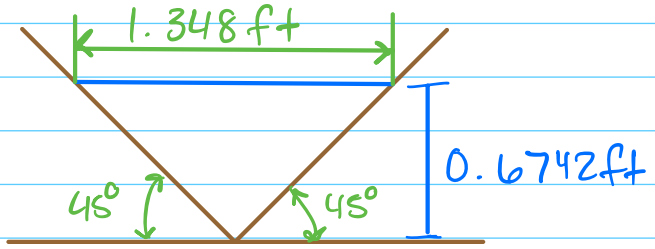
$y = \sqrt{\frac{1}{2}(0.4545\ ft)} = 0.6742\ ft$

$\therefore$



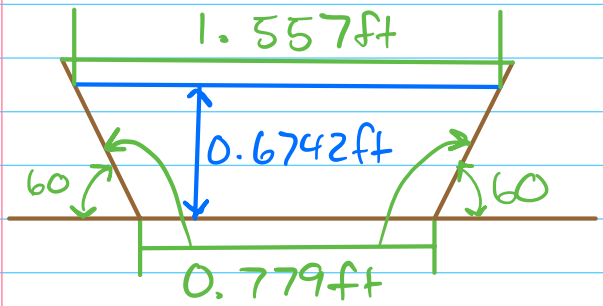
(B) $A = 0.4545\ ft^2$

$y = 0.6742\ ft$



(C) $A = 0.4545 ft^2$

$y = 0.6742 ft$



(D) $A = 0.4545 ft^2$

$y = 0.6742 ft$