Example Problem 4A-10_1, Pipe Velocity and Time

Determine V_{design} and T_{pipe} given:

Pipe diameter: D = 15 in. (1.25 ft.)

Pipe length: L = 275 ft.

Average slope: S = 0.008

Q_{design} = 3.22 ft^3/s

n = 0.013

Solution:

1. Determine the pipe capacity using Equation 4A-10_1 (Section 4A-10):

$$Q_{full} = \pi\left(\frac{K_u}{n}\right)\left(\frac{D^{2.67}}{4^{1.67}}\right)\sqrt{S} = \pi \times \frac{1.49}{0.013} \times \left(\frac{1.25^{2.67}}{4^{1.67}}\right) \times \sqrt{0.008} = 5.77 \text{ ft}^3/\text{s}$$

2. Determine full flow velocity:

$$V_{full} = \frac{Q_{full}}{A} = \frac{5.77}{\pi \times \left(\frac{1.25}{2}\right)^2} = 4.70 \text{ ft/s}$$

4. Use the Flow Elements Chart (Section 4A-10) to determine the partial flow velocity, V_{design}:

$$\frac{Q_{design}}{Q_{full}} = \frac{3.22}{5.77} = 0.56$$

$$\frac{V_{design}}{V_{full}} = 1.03$$

$$V_{design} = \frac{V_{design}}{V_{full}} \times V_{full} = 1.03 \times 4.70 = 4.84 \text{ ft/s}$$

5. Determine the time in the pipe using Equation 4A-5_3:

$$T_{pipe} = \frac{L}{60V} = \frac{275}{60 \times 4.84} = 0.95 \text{ min. (round to 1 min.)}$$

Discussion:

Round T_{pipe} to the nearest minute. If T_{pipe} is less than 0.50 minutes, T_{pipe} can be ignored.