PROBLEM 15-56

Given → A hydraulic jump occurs in a wide, rectangular channel. If the depths upstream and downstream are .5 ft and 10 ft, respectively, what is the discharge per foot of width of channel?

Find → Discharge per foot of width of channel.

Solution →

Using hydraulic jump equation →

$$y_2 = \frac{y_1}{2}\left[\sqrt{1+8Fr_1^2}-1\right]$$

$$\Rightarrow 10 = \frac{.5}{2}\left[\sqrt{1+8Fr^2}-1\right]$$

$$\Rightarrow Fr = 14.14$$

Froude Number equation →

$$Fr = \frac{q}{\sqrt{gy_1^3}} \Rightarrow 14.14 = \frac{q}{\sqrt{32.2(.5)^3}}$$

$$\Rightarrow \boxed{q = 28.37 \text{ ft}^2/\text{s}}$$

Discussion → We use the hydraulic jump equation and the given upstream and downstream depths to solve for the Froude number. Then, we use the Froude Number to solve for the discharge per foot of width of channel.