

1.59

1.59 A layer of water flows down an inclined fixed surface with the velocity profile shown in Fig. P1.59. Determine the magnitude and direction of the shearing stress that the water exerts on the fixed surface for $U = 2$ m/s and $h = 0.1$ m.

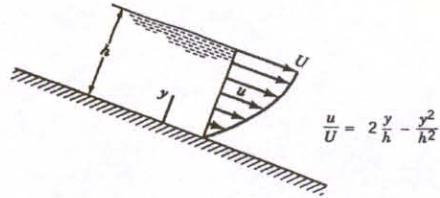


FIGURE P1.59

$$\tau = \mu \frac{du}{dy}$$

$$\frac{du}{dy} = U \left(\frac{2}{h} - \frac{2y}{h^2} \right)$$

Thus, at the fixed surface ($y=0$)

$$\left(\frac{du}{dy} \right)_{y=0} = \frac{2U}{h}$$

so that

$$\begin{aligned} \tau &= \mu \left(\frac{2U}{h} \right) = \left(1.12 \times 10^{-3} \frac{\text{N}\cdot\text{s}}{\text{m}^2} \right) (2) \left(\frac{2 \frac{\text{m}}{\text{s}}}{0.1 \text{m}} \right) \\ &= \underline{\underline{4.48 \times 10^{-2} \frac{\text{N}}{\text{m}^2} \text{ acting in direction of flow}}} \end{aligned}$$