3.19 Water from a storm drain flows over an outfall onto a porous bed which absorbs the water at a uniform vertical velocity of 8 mm/s, as shown in Fig. P3.19. The system is 5 m deep into the paper. Find the length L of bed which will completely absorb the storm water.

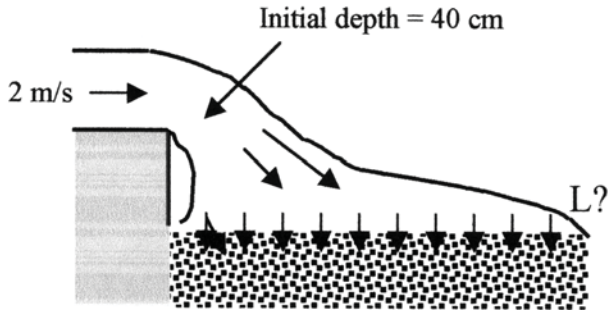

Fig. P3.19

Solution: For the bed to completely absorb the water, the flow rate over the outfall must equal that into the porous bed,

$$Q_1 = Q_{PB}; \quad \text{or} \quad (2\text{ m/s})(0.2\text{ m})(5\text{ m}) = (0.008\text{ m/s})(5\text{ m})L \quad \mathbf{L \approx 50\ m} \quad \textit{Ans.}$$

3.20 Oil (SG-0.91) enters the thrust bearing at 250 N/hr and exits radially through the narrow clearance between thrust plates. Compute (a) the outlet volume flow in mL/s, and (b) the average outlet velocity in cm/s.

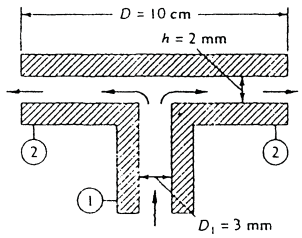

Fig. P3.20

Solution: The specific weight of the oil is $(0.91)(9790) = 8909\text{ N/m}^3$. Then

$$Q_2 = Q_1 = \frac{250/3600\text{ N/s}}{8909\text{ N/m}^3} = 7.8\times10^{-6}\ \frac{\text{m}^3}{\text{s}} = \mathbf{7.8}\ \frac{\mathbf{mL}}{\mathbf{s}} \quad \textit{Ans.}\ \text{(a)}$$

$$\text{But also} \quad Q_2 = V_2\,\pi(0.1\text{ m})(0.002\text{ m}) = 7.8\times10^{-6}, \quad \text{solve for} \quad V_2 = \mathbf{1.24}\ \frac{\mathbf{cm}}{\mathbf{s}} \quad \textit{Ans.}\ \text{(b)}$$
