

2.14) contd.

Conservation of mass requires:

$$\dot{m}_{\text{in}} = \dot{m}_{\text{out}}$$

Or, since the flow is incompressible:

$$\dot{q}_{\text{in}} = \dot{q}_{\text{out}}$$

where $\dot{q}$ is the volume flow rate. This yields:

$$\dot{q}_{\text{inlet}} + \dot{q}_{\text{in}} = \dot{q}_{\text{outlet}} + \dot{q}_{\text{out}}$$

$$1.0 \frac{\text{m}^3}{\text{s}} + \int_0^1 0.3x^2 dx = \int_0^1 0.5(1-x) dx + \dot{q}_{\text{outlet}}$$

$$\dot{q}_{\text{outlet}} = 1.0 \frac{\text{m}^3}{\text{s}} + 0.3 \frac{x^3}{3} \bigg|_0^1 - 0.5x \bigg|_0^1 + 0.5 \frac{x^2}{2} \bigg|_0^1$$

$$\dot{q}_{\text{outlet}} = 0.85 \frac{\text{m}^3}{\text{s}}$$

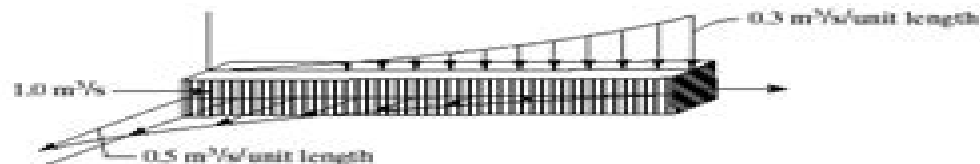
and the velocity at the outflow is:

$$V_{\text{outlet}} = \dot{q}_{\text{outlet}} / \rho A = 0.85 \text{ m}^3 / \text{s} / (977.8 \text{ kg} / \text{m}^3 \cdot 0.1 \text{ m}^2)$$

$$V_{\text{outlet}} = 0.087 \text{ m} / \text{s}$$

2.15)

Given: The same duct as in Problem 2.14.



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Wai-Fah Chen, Lian Duan



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