**5.18** Two rivers merge to form a larger river as shown in Fig. P5.18. At a location downstream from the junction (before the two streams completely merge), the nonuniform velocity profile is as shown and the depth is 6 ft. Determine the value of $V$.
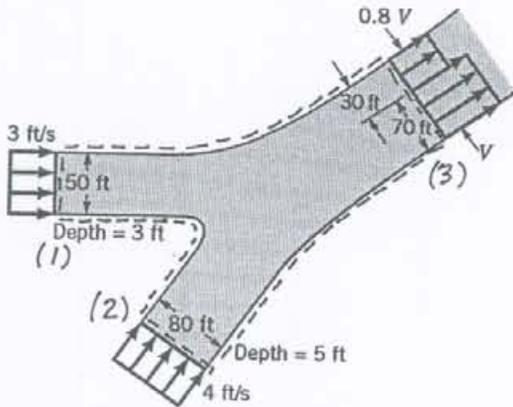


**■ FIGURE P5.18**

Use the control volume shown within broken lines in the sketch above. We note that $\dot{m} = \rho A V$ and from the conservation of mass principle we get

$$\dot{m}_1 + \dot{m}_2 = \dot{m}_3 = \dot{m}_{0.8V} + \dot{m}_V$$

Thus

$$\rho A_1 V_1 + \rho A_2 V_2 = \rho A_{0.8V}\, 0.8V + \rho A_V V$$

and

$$V = \frac{A_1 V_1 + A_2 V_2}{A_{0.8V}(0.8) + A_V} = \frac{(50ft)(3ft)\left(3\frac{ft}{s}\right) + (80ft)(5ft)\left(4\frac{ft}{s}\right)}{(30ft)(6ft)(0.8) + (70ft)(6ft)}$$

$$V = \underline{\underline{3.63}}\ \frac{ft}{s}$$