Losses in Pipe Flows

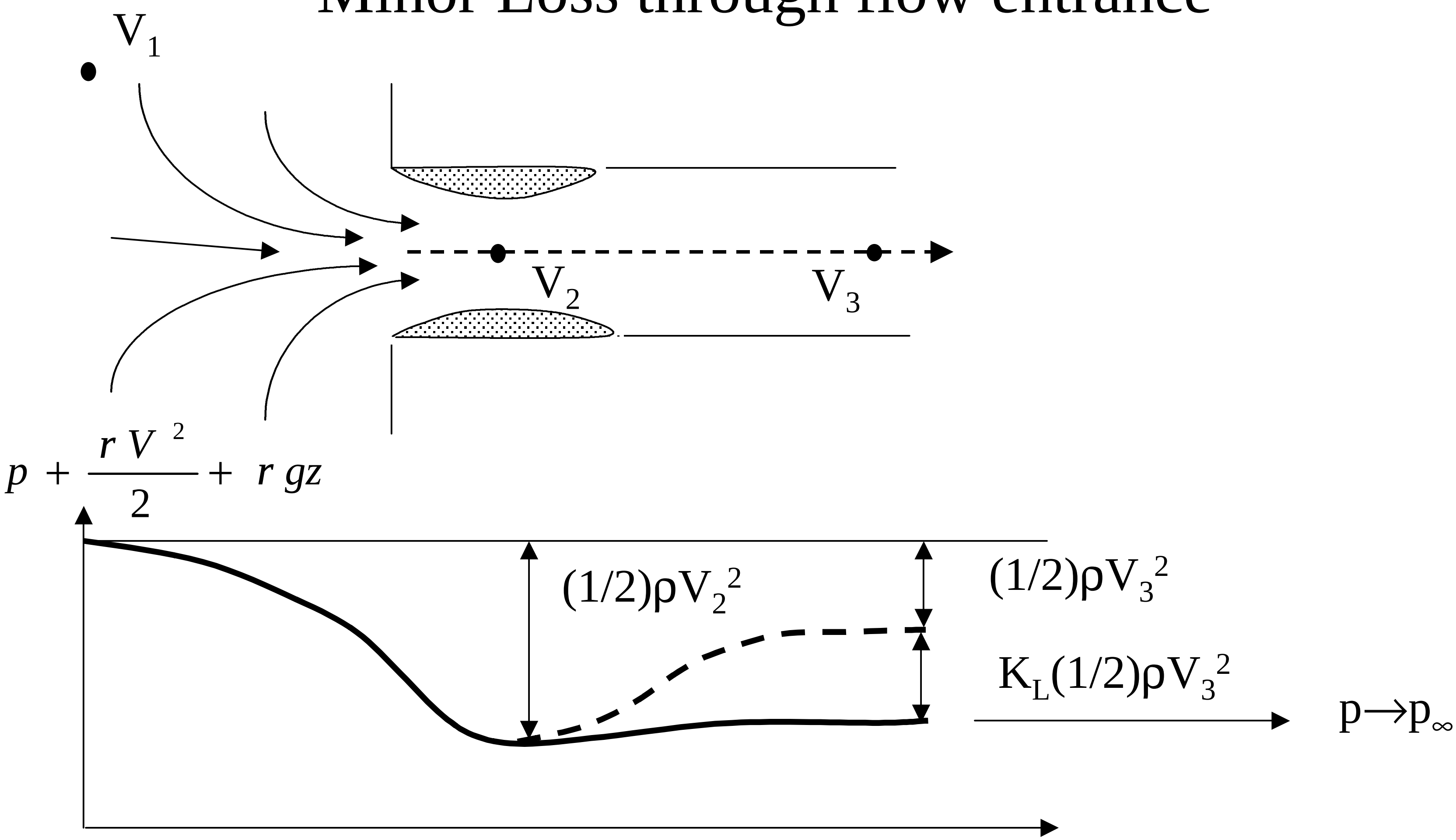
Major Losses: due to friction, significant head loss is associated with the straight portions of pipe flows. This loss can be calculated using the Moody chart or Colebrook equation. $\frac{1}{\sqrt{f}} = -2.0\log\left(\frac{e/D}{3.7} + \frac{2.51}{\text{Re}\sqrt{f}}\right)$, valid for nonlaminar range

Minor Losses: Additional components (valves, bends, tees, contractions, etc) in pipe flows also contribute to the total head loss of the system. Their contributions are generally termed minor losses.

The head losses and pressure drops can be characterized by using the loss coefficient, K_L, which is defined as $K_L = \frac{h_L}{V^2/2g} = \frac{\Delta p}{\frac{1}{2}\rho V^2}$, so that $\Delta p = K_L \frac{1}{2}\rho V^2$

One of the example of minor losses is the entrance flow loss. A typical flow pattern for flow entering a sharp-edged entrance is shown in the following page. A vena contracta region if formed at the inlet because the fluid can not turn a sharp corner. Flow separation and associated viscous effects will tend to decrease the flow energy and the phenomenon is complicated. To simplify the analysis, a head loss and the associated loss coefficient are used in the extended Bernoulli's equation to take into consideration of this effect as described in the next page.

Minor Loss through flow entrance



$$\text{Extended Bernoulli's Equation}: \frac{p_1}{g} + \frac{V_1^2}{2g} + z_1 - h_L = \frac{p_3}{g} + \frac{V_3^2}{2g} + z_3, h_L = K_L \frac{V_3^2}{2g}$$

$$p_1 = p_3 = p_\infty, V_1 \approx 0, V_3 = \frac{1}{\sqrt{1+K_L}} (\sqrt{2g(z_1 - z_3)}) = \sqrt{\frac{2}{1+K_L} gh}$$