

## Experiment No.5 : Bend losses

### Objective:

To compare the loss of head of 90° sharp and easy bend.

### Theory:

The flow in a piping system may be required to pass through a variety of fittings and abrupt changes in area. Additional head losses are encountered primarily as a result of flow separation which is termed as minor losses. The minor loss is of following types:

1. Pipe entrance or exit
2. Sudden / Gradual expansion or contraction
3. Bends or elbows
4. Valves

The minor head loss may be expressed as

$$h_m = K \frac{\bar{V}^2}{2} \quad (3.1)$$

The constant 'K' is different for different type of minor loss. Further,  $h_m$  is the head loss and  $\bar{V}$  is the average velocity.

A bend or curve in a pipe, always introduce a loss larger than the simple straight pipe friction loss, due to flow separation on the curved wall and a swirling secondary flow.

For easy 90° bends in turbulent flow:

$$K \approx 0.388 \alpha \left( \frac{R}{d} \right)^{0.84} \text{ Re}_D, \text{ where } \alpha = 0.95 + 4.42 * \left( \frac{R}{d} \right)^{-1.96} \geq 1$$

The bend loss for sharp bends would be larger as compared to easy bends because of larger separation. Figure 1 gives the resistance coefficients (K) for easy bends for different bend angles at  $\text{Re} = 20,000$ .

### Given Data

1. Tank Area (A)= 2ft × 2ft
2. Pipe Diameter d =2.54×10<sup>-2</sup> m<sup>2</sup>
3. Specific gravity of Manometric liquid (S<sub>me</sub>) = 1.6

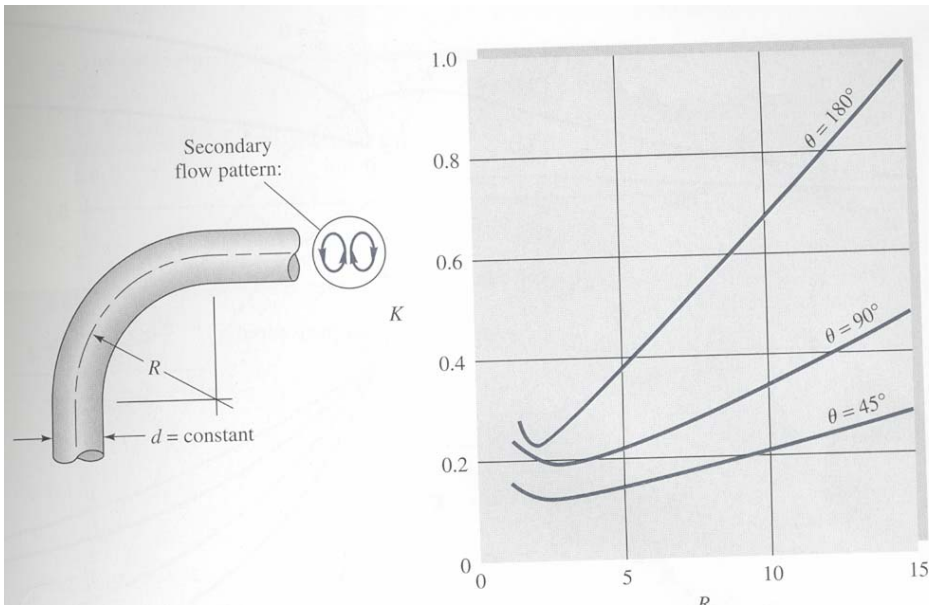


Figure 1 Resistance or loss coefficients for smooth walled 45°, 90° and 180° bends at  $Re_d = 20,000$ .

**Observations:**

S.NO	Level of water Rise (h)	Time for collecting water	Easy Bend (r =)			Easy Bend (r =)			Sharp Bend		
			X <sub>1</sub>	X <sub>2</sub>	$\Delta p/\rho g$	X <sub>1</sub>	X <sub>2</sub>	$\Delta p/\rho g$	X <sub>1</sub>	X <sub>2</sub>	$\Delta p/\rho g$

**Graphs to be plotted**

For all bends

1.  $h_{me}$  vs  $\bar{V}^2/2g$  and  $h_{ms}$  vs  $\bar{V}^2/2g$  on one graph paper
2.  $\log h_{ms}$  vs  $\log \bar{V}$  and determine the value of  $K_e$  and  $n$  graphically for  $h_{me} = K_e \bar{V}^n$
3.  $\log h_{ms}$  vs  $\log \bar{V}$  and determine the value of  $K_s$  and  $n$  graphically for  $h_{ms} = K_s \bar{V}^n$

**Discussion**

1. Discuss the physical significance of the experiment?
2. Show with the help of Buckingham Pi Theorem the dependence of  $K_e$  and  $K_s$  on other factors.
3. Explain why  $K_e$  and  $K_s$  are not equal.