



# FREDERICK UNIVERSITY

## Department of Mechanical Engineering

### Sluice Gate Flowrate

**Objective:** The flow-rate of water under a sluice gate as shown on the figure is a function of the water depths upstream and downstream of the gate. The purpose of this experiment is to compare the theoretical flow-rate with the experimentally determined flow-rate.

**Equipment:** Flow channel with pump and control valve to provide the desired flowrate in the channel; sluice gate; point gage to measure water depth; float; stop watch.

**Experimental Procedure:** Adjust the vertical position of the sluice gate so that the bottom of the gate is the desired distance,  $a$ , above the channel bottom. Measure the width,  $b$ , of the channel (which is equal to the width of the gate). Turn on the pump and adjust the control valve to produce the desired water depth upstream of the sluice gate. Insert a float into the water upstream of the gate and measure the water velocity,  $V_1$  by recording the time,  $t$ , it takes the float to travel a distance  $L$ . That is, use a point gauge to measure the water depth, upstream of the gate. Adjust the control valve to produce various water depths upstream of the gate and repeat the measurements.

**Calculations:** For each water depth used, determine the flowrate,  $Q$ , under the sluice gate by using the continuity equation  $Q = A_1 V_1 = b z_1 V$ . Use the Bernoulli and continuity equations to determine the theoretical flowrate under the sluice gate:

$$Q = z_2 b \sqrt{\frac{2g(z_1 - z_2)}{1 - (z_2/z_1)^2}}$$

For these calculations assume that the water depth downstream of the gate,  $z_2$ , remains at 61% of the distance between the channel bottom and the bottom of the gate. That is,  $z_2 = 0.61a$ .

**Graph:** Plot the experimentally determined flow-rate,  $Q$ , as ordinates and the water depth, upstream of the gate as abscissas.

**Results:** On the same graph, plot the theoretical flow-rate as a function of water depth upstream of the gate.

