EXPERIMENT P

Characteristics of flow under a Radial Gate

OBJECTIVE

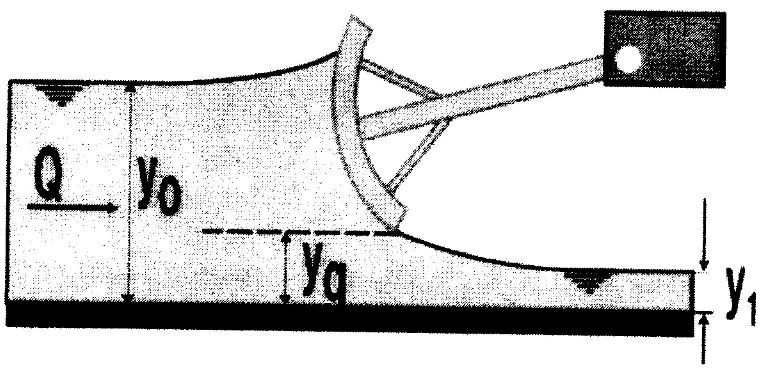
To determine the relationship between upstream head and flowrate beneath a radial gate (Tainter Gate) under different operating conditions and to calculate the discharge coefficient in each condition.

EQUIPMENT SET-UP

Multi-Purpose Teaching Flume, C4

Radial gate assembly, C4-66 (optional accessory)
Hook and point gauge, 300mm scale – 2 required
Stopwatch if measuring flowrate using the volumetric tank (not supplied)

Note: If available, the Pitot tube and manometer, C4-61 (optional accessory) can be used to measure velocity of the water directly.



SUMMARY OF THEORY/BACKGROUND

For an underflow gate with free discharge:

$$Q = C_d \; A \sqrt{2 \, g \, y_0}$$

where:

Q	= Volume flowrate	(m^3s^{-1})
	= Volume/time (using volumetric tank)	
C_d	= Overall coefficient of discharge	(Dimensionless)
A	= Area of the opening	(m^2)
	= b breadth x height of gate opening y_a	
y_0	= Upstream depth of flow	(m)
g	= Gravitational constant	(ms^{-2})

Note: If the downstream side is submerged then y_o is replaced with $(y_o - y_1)$ in the above equation.

PROCEDURE

Clamp the radial gate assembly securely to the sides of the channel then level the flume. Adjust the screw on the top of the gate to create a small gap between the bottom of the gate and the bed of the channel. Gradually open the flow control valve and allow the flow to stabilise without the water flowing over the gate.

With the flow constant, measure and note the values of Q, y_g and y_0. Raise the gate in increments, measuring and noting the values of Q, y_g and y_0 for each step.

The procedure should be repeated with a varying flow and constant y_0 thus obtaining a further set of results.

Stop logs can be added at the discharge end of the channel to submerge the discharge side of the gate. Measurements should include the downstream level in the flume.

RESULTS AND CALCULATIONS

Tabulate your readings and calculations as follows:

Breadth of gate b, =...........(m)

y_0	y_1	y_g	Q	A	C_d

Plot C_d against $\frac{h_a}{h_0}$ for constant Q.

Plot C_d against $\frac{h_a}{h_0}$ for constant h_0.

CONCLUSIONS

Comment on the effects of y_0 and Q on the discharge underneath the gate. Which factor has the greatest effect?

Comment on discrepancies between actual and expected results.