School of Civil Engineering at the University of Queensland

CIVL4120/7020 Advanced open channel hydraulics and design - TUTORIALS

The course is a professional subject in which the students are expected to have a sound knowledge of the basic principles of continuity, energy and momentum, and understand the principles of fluid flow motion. The students should have completed successfully the core course Introduction to Fluid mechanics (CIVL3130) and have solid knowledged in the core course Catchment Hydraulics (CIVL3140).

Past course results demonstrated a very strong correlation between the attendance of tutorials during the semester, the performances at the end-of-semester examination, and the overall course result.

Revision - Open Channel Flows

1. Considering a broad-crested weir, draw a sketch of the weir in a rectangular horizontal channel. What is the main purpose of a broad-crest weir ?

A broad-crested weir is installed in a horizontal and smooth channel of rectangular cross-section. The channel width is 10 m. The bottom of the weir is 1.5 m above the channel bed. The water discharge is 11 m^3/s and the upstream water depth is 2.235 m. (1) Compute the depth of flow downstream of the weir (in absence of downstream control), assuming that critical flow conditions take place at the weir crest. (2) Calculated the horizontal, sliding force acting on the weir. Give the direction of the force exerted by the flow onto the sill.

Solution (Broad-crested weir)

d_2 = 0.173 m. $F_{sliding}$ = 178 kN. The force exerted by the fluid onto the weir sill acts in the downstream direction.

2. A rectangular (5.5 m width) concrete channel carries a steady discharge of 6 m^3/s. The longitudinal bed slope is 1.2 m per km. (a) What is the normal depth at uniform equilibrium ? (b) At uniform equilibrium what is the average boundary shear stress ? (c) At normal flow conditions, is the flow supercritical, super-critical or critical ? Would you characterise the channel as mild, critical or steep ?

For man-made channels, perform flow resistance calculations based upon the Darcy-Weisbach friction factor.

Solution (Uniform equilibrium flow)

(a) d = 0.64 m (c) Fr = 0.68 : near-critical flow, although sub-critical (hence mild slope) (See discussion in textbook page 95-96)

More exercises in textbook pp. 19-20, 46-49, 87-93, 108-110, 111-118.

"The Hydraulics of Open Channel Flow: An Introduction", *Butterworth-Heinemann Publ.*, 2nd edition, Oxford, UK, 2004.