2D NUMERICAL SIMULATION OF FOUR BRANCHES EXPERIMENTAL SUPERCRITICAL JUNCTION FLOWS

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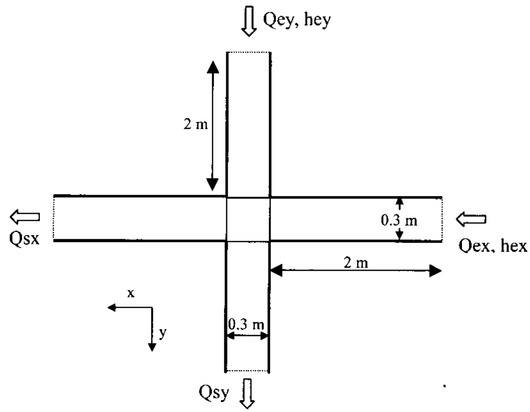
Four supercritical typical flows are studied experimentally in a four-branch channel junction (Fig. 1) with steep inlet and outlet slopes and an horizontal intersection. The water depth field of each flow configuration is measured on the physical model (Fig. 2) and then compared to the water depths computed with a 2-dimensional shallow water equation model using four different mesh densities. This comparison shows that, for all the meshes, the model is able to capture the main observed flow structures : oblique and normal hydraulic jumps, eddying on the downstream corner and deflection planes. Nevertheless, some discrepancies occur concerning the exact locations, shapes and intensities of these structures.

Besides, a statistical analysis is performed in order to compare precisely the measured water depths and the computed water depths interpolated on the measurement grid. It appears that the water depth prediction quality depends mainly on the capacities of the code to simulate the width and angle of the observed oblique jump. Indeed, for the configuration with a wide oblique jump (*C2* on Fig. 2), the local water depth gradient is not fairly predicted as the numerical model always predicts thin oblique jumps. This discrepancy is the main limit of the numerical code used here to simulate the supercritical flow junctions. On the other hand, for the configurations with a thin observed oblique jump, the discrepancies are mainly due to slight oblique jump angle prediction errors. Furthermore, it is shown that the use of a coarse mesh does not permit to capture the local high water depth zones and that the interpolation of the numerical results using this mesh density on the measurement grid tends to smooth the predicted flow. This tends to artificially increase the oblique jump width and may improve the statistical analysis. However, it can be concluded that the use of a rather low mesh density as done by most urban flood modelers should be enough to represent the supercritical flows at the junction

Finally, it appears that experimentally, the measured water depths are not fixed in time and are oscillating around the average value even for fixed upstream conditions. We observed that the average standard deviation of the measured water depths is of the same order of magnitude as the root mean square error between computed and observed water depth fields for all the configurations even if it remains lower.



Qe = inflow discharges
he = normal upstream water depth
S = channel slopes

Fig. 1 Plan sketch of the experimental set-up

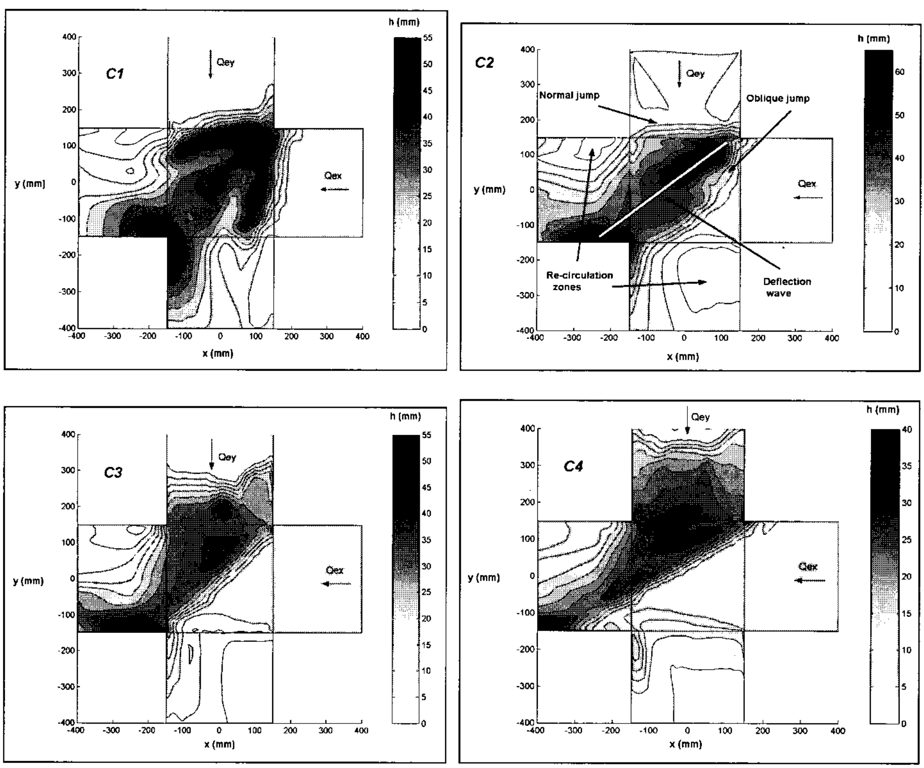


Fig. 2 Measured water field interpolated on a fine grid for the four configurations.