NUMERICAL MODELLING OF COMPOUND CHANNEL FLOW

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Introduction. Most natural rivers have compound cross-section. Compound channel flow is characterized by complicated three-dimensional flow structures. These structures are called secondary flows and have been classified into two categories by Prandtl (1952). He distinguished the secondary flows of the first kind and of the second kind. The secondary flows of the the second type are typically about 2-3% of the maximum streamwise velocity (Nezu and Rodi, 1985), however, they have a major impact on the mean flow and turbulence structures.

Numerical Methods. To investigate numerically the influence of secondary flows in compound channel flows, the isotropic k-s and Shear Stress Transport (SST) models, and anisotropic explicit algebraic Reynolds stress model (EARSM) and Reynolds stress models were used in the analyses.

Results and discussion. Firstly, the comparison of predicted results produced by k-s, SST and EARSM with measured data was performed. It revealed that both isotropic models failed in reproducing secondary flows, while EARSM was able to reproduce successfully the secondary flow pattern.

Secondly, numerical prediction of the secondary flows using more elaborated anisotropic models, such as BSL EARSM and higher-order Reynolds stress models, BSL RSM and SSG RSM was assessed. Secondary flows were captured by all these turbulence models and a good agreement with experimental data by Tominaga and Nezu (1991) was obtained.

Conclusions. An anisotropic turbulence model is required if three-dimensional turbulence structures are to be accurately predicted. The verification and validation analysis has revealed that refined mesh had satisfactorily converged for most variables. The simulations have reproduced the complex flow pattern of primary velocity field, secondary currents, Reynolds stresses, anisotropy of turbulence and production term of secondary currents.

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