Development of Turbulence Model for Two-Dimensional River Analysis

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Frequently occurring flood and drought have increased the necessity of an effective water resources control and management of river flows. Therefore, the simulation of the flow distribution in natural rivers is great importance to the solution of a wide variety of practical flow problems in water resources engineering. Usually in many flow problems, two-dimensional approach can provide good estimates of complex flow features in the flow around islands and obstructions, flow at confluence and flow in braided channel. The challenging problem facing two-dimensional hydraulic model is the treatment of turbulence flow around irregular boundary. This situation is encountered in most practical river and coastal engineering problems, such as flood propagation, dam break analysis, tidal processes and so on.

The objective of this study is to develop an accurate and robust two-dimensional finite element method for turbulence simulation in open channels. The developed model is based on Streamline Upwind/Petrov-Galerkin finite element method and Boussinesq's eddy viscosity theory. The method developed in the study is depth-averaged mixing length model which assumes anisotropic and local equilibrium state of turbulence.

Several numerical simulations were carried out, which examined the performance of the turbulence model for the purpose of sensitivity analysis. Artificial channels that appear horizontal flow and vertical flow were carried out. Validation and verification were performed by comparing with analytical solution and observation data. The simulation on the Han river were performed for tests. The results were compared with the observation data. The suggested model displayed reasonable flow distribution compare to the observation data in natural river flow.

As a result of this study, the developed two-dimensional finite element model provides a reliable results for flow distribution of turbulence simulation in open channels, and determine the limits of eddy viscosity for a variety of open channel flow.

References

[1] Cea et al., *Journal of Hydraulic Engineering*, Vol. 133, pp1160-172.(2007)