Improved Understanding of Performance of Local Controls Linking the above and below Ground Components of Urban Flood Flows

Submitted by

Istvan Galambos

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...dedicated to my family, with love and gratitude...

Abstract

This work is devoted to investigation of the flow interaction between above and below ground drainage systems through gullies. Nowadays frequent flood events reinforce the need for using accurate models to simulate flooding and help urban drainage engineers. A source of uncertainty in these models is the lack of understanding of the complex interactions between the above and below ground drainage systems.

The work is divided into two distinct parts. The first one focuses on the development of the solution method. The method is based on the unstructured, two- and three-dimensional finite volume method using the Volume of Fluid (VOF) surface capturing technique. A novel method used to link the 3D and 2D domains is developed in order to reduce the simulation time.

The second part concentrates on the validation and implementation of the Computational Fluid Dynamics (CFD) model. The simulation results have been compared against 1:1 scale experimental tests. The agreement between the predictions and the experimental data is found to be satisfactory. The CFD simulation of the different flow configurations for a gully provides a detailed insight into the dynamics of the flow. The computational results provide all the flow details which are inaccessible by present experimental techniques and they are used to prove theoretical assumptions which are important for flood modelling and gully design.

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