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Investigating 1D and 1D/1D Modeling Using SWMM

K. T. Lee, M. C. Hung
Dept. of River & Harbor Engrg., National Taiwan Ocean Univ.

ABSTRACT

In this study, Storm Water Management Model (SWMM) was used to develop an urban sewer system model (1D model) for runoff simulation. In the meantime, a compound drainage system, which integrates the street network with the underground sewer system (1D/1D model), was built. Detail analysis was conducted to investigate the differences of the runoff simulations by applying the 1D and the 1D/1D models. The results showed that the flooding water was temporary stored in the entire predetermined ponded area in applying the 1D model. Whereas the flooding water in the 1D/1D model can only be stored in narrow streets in the early flooding stage, and then the flooding water spread over the subcatchment when the flooding water depth was higher than the height of the road curb. Consequently, the simulated runoff peak generated from the 1D/1D model was found always larger than the peak obtained from the 1D model. Moreover, in the flow recession simulations, the flooding water stored in the ponded areas can only be drained back to the sewer system in the 1D model when the downstream sewer flow was subsided. However, the flooding water in the 1D/1D model simulation can be transmitted through the roadway flowing adjacent non-surcharge manholes. Hence, the flooding water in the 1D/1D mode showed a quick recession than that simulated by applying the 1D model.

Moreover, a series of numerical experiments was conducted to investigate the adequateness of the nonlinear runoff module in SWMM model for rainfall-runoff simulation in suburban mountain areas. The results showed that the runoff module can well imitate the rainfall-runoff relationship in a simple terrain feature. Nevertheless, as the catchment area increased, runoff would follow gully/stream networks; hence the simplified detention tank in the SWMM model is unable to simulate the complex runoff collection system. It is recommended that when the suburban mountain area is larger than 5 km2, the nonlinear runoff module of the SWMM model may not be adequate. Further consideration is required to include the stream network structure of catchments for runoff simulation.