

Application of Optimization Model for Urban Drainage Layout Design under Street Flow and Operation of Pumping Station

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Considering the uncertainty of urban rainfall-runoff, this study establishes the urban flood control optimization model which embed a street flow simulation model under the pump operation and detention facilities for flows into the street and sewer system. The optimization model is developed by defining and formulating the objective function, constraints and decision variables, in which the flood reduction Benefit/Cost ratio is set to be the objective function. The reasonable range of the height of curbs and the elevation to operate pumps are considered as constraints. The decision variables are specially designed as the height of curbs and the elevation to operate the pumps. Hereafter, the flooding situation before and after the construction of the flood control facilities during each return period is simulated by Storm Water Management Model (SWMM) and solved by the Simulated Annealing (SA) algorithm. Subsequently, the Annual Benefit/Cost Ratio is calculated to optimize the layout design of drainage facilities and pumping operation. This study selected the Min-Sheng community in Taipei city as the test site to evaluate the flooding reduction benefit. Results show that the street flow space has a better effect on the flood control during low return period while the detention facilities have a better reduction on the flood during the high return period. The simulation-optimization outcomes illustrated that the side curbs in street flow space can better flood control in the low-lying area and less effective in the narrow street area. Moreover, the detention facilities improve the flow control in the highland, while with no significant effect in the surrounding area of the end of the sewer. Furthermore, the detention facilities in the highland and large catchment retain high-flow flood; those at the end of the sewer, hold middle-flow flood; and those in the small catchment, impound low-flow flood.

Keywords: Street Flow, Pump Operation, Detention Facilities, Urban Flood Control, SWMM, Simulated Annealing