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Modelling the Outlet of Multi-Chamber Stormwater Detention System

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ABSTRACT

Outlet size influences the detention volume that is crucial in a stormwater system. This paper describes an application of improving the outlet size of such a system. A field test is built in a terraced house that consists of a 4.40m × 4.70m × 0.45m multi-chamber stormwater detention tank connected to 0.1m diameter inlet and 0.05m diameter outlet. During field monitoring, an overtopping event is observed that puts a quest to re-look into its design. The field test has enabled the data collection of ten storm events with peak rainfall ranging from 20-48mm. A stormwater detention model is developed using the US Environmental Protection Agency's Storm Water Management Model (SWMM). Calibration of the model with the observed storm events has returned with good matches with R Square values more than 0.9. With the calibrated model, investigations into the outlet sizes of 0.050m, 0.055m and 0.063m are carried out. The existing field test setup with the outlet size of 0.050m has water levels in the detention tank higher than the expected design values; and therefore, overtopping is observed for rainfall depth over 40mm. By simulating a scenario of enlarging the outlet size to 0.055m, the system is improved to accommodate rainfall depth up to 45mm, but overtopping is expected for rainfall depth over 45mm. By simulating another scenario of enlarging the outlet size further to 0.063m, the possibility of overtopping is eliminated but at a cost of achieving only in average 10% of attenuation between peak inflow and peak outflow. It is the least attenuation rate compared to average 30% for 0.050m and 20% for 0.055m. In short, the modelling efforts are demonstrated as a practical solution to the improvement of the intended stormwater detention system.

Keywords: Field test; On-site detention; Outflow; StormPav; SWMM; Water level

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