EVALUATING THE EFFICIENCY OF HOUSEHOLD STORMWATER DETENTION SYSTEM

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Abstract

This paper describes the evaluation of water storing capacity of a household stormwater detention system based on field data. Collection of field data is often sidelined due to the cost and human capital incurred. However, the true value of field data is demonstrated here by comparing the observed and design data. A field test is completed in a real-life terrace house, utilizing the house's 95m^2 side canopy as roof catchment and 4.40m x 4.70m car porch area to station a detention tank. Precast concrete modular units with 3.9m^3 effective storage volume are assembled within the tank. Downpipe with 0.1m diameter is installed to connect the roof gutter to the detention tank; while pipeline with 0.05m diameter is installed as the outlet from tank to the house perimeter drain. The mentioned setup is subjected to actual rainfalls from December 2019 till February 2020 that corresponded with the peak of Northeast Monsoon season. Ten observed storm events with peak hourly total rainfall readings ranging from 22 to 48mm are selected for analysis. Rainfall and water level readings from the field test allow the derivation of roof runoff volume and detained water volume in the tank. It is found that the household stormwater detention system is able to capture about 50% of the roof runoff. However, the current setup is found to cause flooding for rainfall over 40mm. The flooding issue, however, is undetected by the design data that underestimated the water storing capacity. This is due to the use of uncommon precast concrete modular units that may not have its flow characteristics represented by existing formula and model. No matter how uncommon the modular units be, various types and forms of stormwater detention system are becoming the new normal in the industry and field test is the best tool to validate their performances.

Keywords: Field test, On-site detention, Runoff, Stormpav, Urban drainage, Water level

Introduction

Stormwater detention systems are manmade facilities to stop and store urban surface water in an identified spot from running in the towns or cities [1],[2]. In the context of this paper, it is a detention system specifically designed for household application (Figure 1). The concept is to have each household to capture parts of running water within their car porch, so that a large accummulated water from a human settlement could be delayed into the urban environment [3],[4]. This could mitigate the happening of flash flood and soil erosion [5]. As such, the main performance for such a system is its water storage capability [6], in which this paper is evaluating the detention volume of a household stormwater detention system using field data.