Research Article

Dual-system concept for stormwater control in commercial centre

Darrien Y.S. Mah[1*], Janice Lynn Ayog[2] and Afdal Haziq Mohamad Salehe[3]

Faculty of Engineering, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia[1]
Faculty of Engineering, Universiti Malaysia Sabah, 88400 Kota Kinabalu, Sabah, Malaysia[2]
Syarikat Haziq Jaya Pvt Ltd, Desa Ilmu, 94300 Kota Samarahan, Sarawak, Malaysia[3]

Abstract
This paper describes the stormwater characterization due to a dual stormwater detention system that is tailored for a commercial area. A commercial centre is known to have the area covered with two distinct land uses, namely the shop buildings and tarred road surfaces. Manipulating these land uses for more environmental-friendly urban stormwater management; a novel dual stormwater detention system is introduced within the buildings and roads. Using a case study of a simple one-row shop building, a detention system is proposed under the walkway in front of the shop lots and under the parking spaces in front of the same shops. Storm water management model (SWMM) version 5.0 is used to simulate three scenarios of drainage flow in the study site. Simulations of a single detention system of either under the walkway (Scenario 1) or parking spaces (Scenario 2) are carried out. Scenario 3 is a simulation of a dual system combining the previous two scenarios. Scenario 2 has a catchment of about 10% of the total commercial centre; Scenario 2 has about 20% and Scenario 3 has about 30%. It is found that Scenario 3, namely the dual system with the highest connected water contributing catchment produces the best stormwater control by lowering the post-development peak hydrographs by 1.5 times, thus achieving the nearest to the pre-development condition. The simulations also show that the two separate single detention systems are less effective than the dual system in this case study.

Keywords
Impervious surfaces, Land use, Permeable pavement, Stormwater detention, Underground storage, Urban runoff.

1.Introduction
In a congested urban area like a city, its land surface area is covered with buildings and other infrastructures. Little bare or green spaces are available that could absorb stormwater into the ground. Disposal of excess stormwater from the urban area relies on the urban drains, and the urban drainage system is increasingly challenged by the greater amount of rainfall due to climate change in the recent years [1].

Scientists and engineers alike, are working to improve the well-being of urban dwellers. For example, sponge city as a new stormwater management strategy, has been introduced in more and more cities [2]. Pockets of land spaces or manmade structures are constructed to absorb stormwater, like sponges would soak up water [3, 4].

A dual stormwater system is one of the ways to optimize limited spaces, in which in normal practices, are constructed separately.

A single system may yield little impact on stormwater control at a catchment scale [5]. Combining stormwater control systems in an urban environment, for example, trenches alongside urban trees are reported in favour of unmitigated impervious surfaces [6]. The types of stormwater control combination vary from catchment to catchment [7]. A structure for commercial area may be different than a residential area. Availability of spaces or catchment area is another factor that determines the selection of appropriate measures [8].

This paper explores on a commercial centre, in which its land uses are distinctively made up of shop buildings and tarred roads. Therefore, to be specific, the dual system here is meant for a stormwater system fitted as a part of the building structure, and then coupled with another system as part of the low

*Author for correspondence

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