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Research Article

Accommodating stormwater storage structure in the veranda of shop building

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Abstract
This paper describes the investigation to place water storage structure under the veranda of a shop building. A veranda is a commercial building feature in Southeast Asia with a narrow walkway about 3 m wide. Given the small space's limited capability to hold rainwater from the building roof, a draining tank is, therefore, a more viable choice. Rainwaters flow in and out the tank simultaneously with an outlet control that enables water storage within. A modular-based stormwater storage system that could be assembled under the veranda was selected. Storm Water Management Model version 5.0 was used to model the system. The modular-based system's availability of field test data allowed calibration and verification exercises using the mentioned software and yielded R Square values between 0.97-0.99. As such, the parameters of the system as a storage unit were applied in the modelling of the same system in the veranda. Two cases were presented. The water storage structure was modelled in a single shop lot and a partial commercial area with six units of shop lots and surrounding streets. Modelling the single shop lot with 60% of its roof directing waters to the water storage structure was predicted to reduce 25-30% of its peak values comparing the post-development hydrographs with and without the intervention. The partial commercial area modelling yielded only 0.4-10% prediction in its reduction, suggesting additional intervention was required.

Keywords
Flood adaptive, Sponge city, Stormwater detention, Sustainable development, SWMM, Urban runoff.

1.Introduction
In line with the concept of sponge city, manmade structures are constructed to absorb stormwater across a city [1]. By having these small structures distributed along the flow path of stormwater runoff, parts of the waters are stored in the structure. As such, less water quantity is discharged to the urban drains during a storm event. The stored waters are then released after the drains are relieved, and the carrying capacities are increased [2]. Built-up surfaces in the city would cause the stormwater runoff to spike quickly. As depicted in *Figure 1*, such a condition is represented in the post-development hydrograph shape, which is narrow and with steep limbs. On the other hand, the pre-development hydrograph is represented with a lower peak, broader base and gentle limbs. The latter hydrograph shape is influenced by the filtration of stormwater to the soil layers and attenuation of flow due to natural vegetative covers.

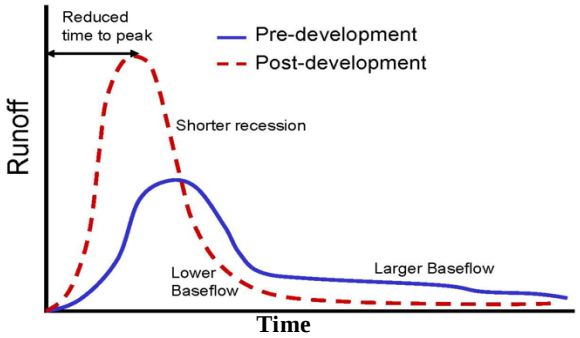

Figure 1 Stormwater runoff for pre- and post-development conditions

In the perspective of engineering hydrology, manmade structures could be designed to mimic the natural processes to lower the peak of post-development hydrograph to a near pre-development condition [3].

Availability of urban spaces to install stormwater storage structures pose as a challenge nowadays. Green strips with trees and plants are always suggested

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