

Rainwater Harvesting System in a Congested Residential Estate

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Abstract

Occurrences of flash floods in urban areas have increased significantly and become an issue of concern to the public. However, physical development continues unabated due to urbanisation and high demands for residential houses. Towards this end, a Water Sensitive Urban Design (WSUD) approach such as rainwater harvesting system is proposed for residential development to mitigate flash floods without discouraging economic development of a city. Conventional rainwater tank is not suitable anymore as most of the residential housing developments are providing smaller land space. Thus, a design to cater for limited empty spaces is emerging. This has been the intension of this paper to introduce a wall-mount rainwater harvesting system in congested residential estates. In this research, super slim rainwater tank and air conditioner-sized tank have been designed to fit into a standard housing compound. The rainwater tanks act as a tool to store certain amount of stormwater runoff from roof area before it is discharged into drainage system. It is found that the peak runoff discharge is reduced from 0.003100 m³/s to 0.002703 m³/s and 0.002152 m³/s for the two types of aforementioned tanks. Reductions of 13% and 31% on peak runoff discharge are registered respectively by testing different configuration of water tanks. Due to the reduction of peak runoff discharge, the stormwater runoff could be controlled and subsequently mitigate the occurrence of flash flood. Sustainability could be achieved by managing stormwater runoff in an effective way with the aids of rainwater harvesting system.

Keywords: Rainwater Harvesting, Detention, Flash flood, Stormwater runoff, Urban drainage, Water Sensitive Urban Design.

1. Introduction

Due to the rapid economic growth and fast urban development of Kota Samarahan area, the local population has risen substantially. Consequently, natural hydrological cycle and catchment's hydraulic characteristics have suffered significant changes. Construction of infrastructures has caused changes in land use patterns in many places [1]. As such, the peak runoff discharge increases as runoff is hindered from infiltrating into the soil; instead, the water flows into drains [2]. The conventional drainage system is no longer effective in managing the increased runoff. Hence, flash floods occur frequently and the problem might worsen particularly in the downstream areas [3].

This research focuses on the implementation of a Water Sensitive Urban Design (WSUD) approach [4]-[7] which is a rainwater harvesting system [8]-[13] in a congested residential area of Kota Samarahan. Due to the high demand for housing, most of the residential developments have higher density of built-up units. Houses are designed with limited empty spaces [14]. Figure 1 shows an aerial map depicting the development of residential estates surrounding Universiti Malaysia

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