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Technical paper

Integrating Infiltration Facility to Urban Road Drainage

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Abstract

It is proposed to merge an infiltration facility to the conventional road curb system. Towards this end, a Storm Water Management Model (SWMM) is developed to explore the effectiveness of the proposed component at Riveria housing estate, Kota Samarahan, Sarawak. The findings show that the integration is effective in reducing peak runoff. The results indicate that a scenario of hollow infiltration trench achieves zero runoff, and a scenario of filled infiltration trench has a 43.6% reduction in runoff compared with existing road drainage condition. Furthermore, the hollow infiltration trench is found to be the best among all the given scenarios. The SWMM modelling results provide a tool to quantitatively measure the probable use of the proposed measures to improve the existing road drainage system.

Keywords: *Impervious; MSMA; Road curb; Runoff; Stormwater; SWMM.*

1. Introduction

Conventional road drainage system with road curb is scrutinized in this paper. Road curbs are the standard element for road sections, and they also form part of the urban drainage system [1]. They are meant to eliminate ponding of stormwater along the curb line. This system allows stormwater to directly discharge into a drain as shown in Figure 1. Therefore, the key issue to be highlighted here is that this rapid disposal of surface runoff to urban drains makes it an ineffective measure to mitigate floods. The disposal method has increased runoff volume and runoff velocity, exacerbated pollutant inputs, hydrologic disturbance and flash flooding [2]. Hence, a new approach is required to achieve the goal of stormwater control measures.

Fig. 1: Example of current practice with road curb system

Stormwater source control has become an alternative solution for urban stormwater management [3-4]. An approach to upgrade the existing road drainage system is by merging the road curb with infiltration trench. The trench could be used to overcome the limitations of the road curb system while the benefits of road curb are maintained. The cumulative benefits of this practice would help to maintain the natural water balance against urbanization. The integration promotes groundwater recharge [5], enhances runoff quality naturally [6], and runoff reduction [7].

Infiltration trenches are generally installed near impermeable areas such as roofs and alongside roads to receive runoff [8-9]. Due to their simplicity, they usually perform well with other stormwater components [10]. Application of infiltration trenches does not require a wide land area [11], making them suitable to be merged with road curbs. The performance and efficiency of infiltration trenches in mitigating the impact of urbanization are evaluated using SWMM [12].

2. Study Site

Kota Samarahan, formerly known as Muara Tuang has a good road network connection to the adjacent Kuching City and other parts of Sarawak. This characteristic makes it suitable to be the central business district of Samarahan Division. Various educational, medical and research institutions are located within this region. Many projects such as the City Height, Uni Central, and Summer Mall have been rolling in, enabling Kota Samarahan to achieve the highest annual growth rate of 2.2 percent, the fastest in Sarawak (Chin, 2011). The Samarahan District Council covers a total area of 709.81 square kilometres. The population rose around 5 times from 46,966 in 2000 to 236,000 in 2010. Meanwhile, the growth of properties over ten years was observed to rise from 8,254 units in 2000 to 24,679 units in 2010.

The irreversible impacts of urbanisation cannot be underestimated. The increase in impervious ground surface could exacerbate flooding disasters. Control of stormwater flooding is supposed to be the responsibility of urban cities. Therefore, Riveria housing estate, Kota Samarahan is chosen as the study site. The aerial plan and study site of Riveria is illustrated in Figures 2 and 3. Riveria housing estate is situated beside Kuap River that borders the Kuching City and Kota Samarahan. Particularly, Lorong 2 is examined in this study. This lorong has a curb and walkway system on one side