IJREAT International Journal of Research in Engineering & Advanced Technology, Volume 6, Issue 5, Oct - Nov, 2018
ISSN: 2320 – 8791 (Impact Factor: 2.317)
www.ijreat.org

Modelling Of Stormwater Detention Under Urban Road For Conveyance And Storage

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Abstract
With appropriate inlet and outlet designs, big stormwater storage structure could be reduced by allowing a function of conveyance to be added to the storage. In this paper, stormwater detention under urban road in a typical commercial area is studied for simultaneous conveyance and storage. This is done by incorporating StormPav Green Pavement as a form of permeable road along the front street of typical commercial buildings. Storm Water Management Model (SWMM) is used to simulate the processes of capturing stormwater runoff generated from the buildings and road surfaces. Results show that StormPav Green Pavement is able to demonstrate the capability of conveying and storing stormwater runoff for different storm durations under the intensity of 10-year Average Recurrent Interval (ARI).

Keywords: *On-Site Detention, Permeable Road, StormPav Green Pavement, SWMM, Urban Drainage.*

1. Introduction

Models of permeable road are available since 1960s in hopes of reducing floods, raising water tables and replenishing aquifers. To date, permeable roads are generally designating a subsurface storage to capture portion of stormwater runoffs [1-2]. In normal practice, drainage engineers tend to pay more attention to the storage capacity for safety purposes. They tend to design the volume of storage space equals to potential amount of stormwater runoff plus additional minimum spaces reserved for adverse climates [3]. As a result, storage structure could end up as a big structure depending on the size of the contributing upstream catchments.

Big storage structure incurs higher cost in terms of construction and the associated safety precaution devices that should come along with the structure. Yet, it is possible to reduce the storage structure without compromising the reduction of stormwater impacts a storage structure could provide. In the case of a permeable road, the subsurface storage could be modified to have a function of stormwater conveyance. The empty space of the storage structure provides the ponding effect that attenuates a hydrograph peak [4-5]. Theoretically, the mentioned system could be represented in Figure 1.

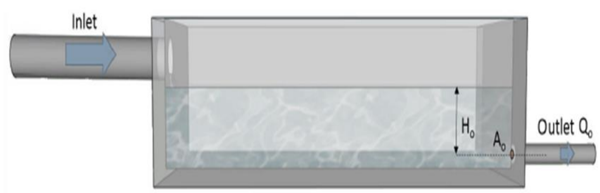

Fig. 1 Schematic diagram of detention storage and conveyance [6]

Manipulating the outlet could allow the captured stormwater to flow. The size of orifice outlet can be calculated based on Equation (1). An orifice discharge system serves as the flow regulator for the detention storage. Note that the equation applies to free flow orifice discharge conditions; thus, the downstream sump or pipe would need to satisfy this condition to use this equation below.

$$Q_o = C_o A_o \sqrt{2gHo} \quad (1)$$

where
Qo = Orifice discharge rate (m^3/s);
Co = Discharge coefficient (m^2);
Ao = Area of orifice (m^2);
g = Acceleration due to gravity ($9.81 m/s^2$);
Ho = Maximum head to the centre of the orifice (m).

Meaning, detention of stormwater provided by the storage volume can be released by the orifice outlet. This filling and draining effect could reduce the size of the storage structure. Hence, the permeable road not only captures