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Modelling of StormPav Green Pavement System Using Storm Water Management Model and SolidWorks Flow Simulation

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Abstract: Storm Water Management Model (SWMM) and SolidWorks Flow Simulation (SW-FS) models to represent StormPav Green Pavement System are tested through a case study of commercial premises. Modelling effort of simplifying the complex StormPav system to take in only the effective storage volume is attempted using the 1D SWMM. A 3D modelling of capturing the multi-compartmental and multi-unit StormPav system is attempted using SW-FS. The modelling outputs in terms of velocity distribution within the StormPav system of the two developed models are found to reasonably matched.

***Index Terms*: hydraulics, permeable road, road drainage, routing, stormwater**

I. INTRODUCTION

This paper is describing methods to model StormPav Green Pavement System. It is intended as a permeable road [1] with subsurface storage underneath its pavement layer [2]. Attempts have been made to model the StormPav system as permeable road [3] and on-site detention [4,5]. But the focus here is to represent the system as stormwater conveyance, rather than detention storage.

A single unit of StormPav consists of three precast concrete pieces, namely a hollow cylinder sandwiched between two hexagonal plates. Presented in Fig 1, it shows a small-scale pilot study of StormPav system [6], in which the top hexagonal plate functions as the pavement, the bottom hexagonal plate as the base and the hollow cylinder as the storage chamber.

Each hexagonal plate has a 40mm service inlet that when placed on top, it drains surface water up to 10,000mm/hour; while at the bottom, it allows infiltration to the soil. The surface area on a single plate is $0.1624 m^2$. Height of each plate is 0.075m. Each hollow cylinder has a 40mm side service inlet. The cylinder has an inner diameter of 0.28m and a thickness of wall of 0.06m. Height of each cylinder is 0.3m.

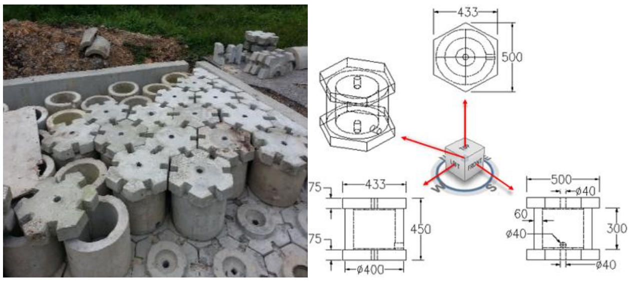

Fig. 1: StormPav Green Pavement System

II. THEORY

Arranging the StormPav units together to replace the conventional road, it forms a long rectangular container with multiple compartments within. By design, the hollow cylinders are not sealed to the plates; therefore, water is free to seep in and out of the cylinders and the spaces between them. The assumptions made are as described below.

Firstly, water naturally takes the form of its container [7]. As such, once stormwater is directed to the StormPav system, it fills up the compartment and fulfills the function of water detention. Secondly, water flows from a region of high pressure to a region of low pressure. By providing an outlet to the container [8], the velocity at the outlet increases, the pressure at the vicinity of the outlet decreases [9]. Thirdly, fluidity of water could flow through wide and tight spaces alike [10]. The multi-compartment nature of StormPav is not a hinder to water flow.

Based on the second and third assumptions, it is deduced that flow through the StormPav system is possible. Representing the system in a computerized environment is explored next. The authors are presenting two different models, namely SWMM and SW-FS.

SWMM is a freeware under the license of US Environmental Protection Agency that is practical to use. It is a one-dimensional (1D) model that utilizes Dynamic Wave technique to solve the St Venant equations to its flow modelling.

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