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Water Practice & Technology Vol 12 No 3
doi: 10.2166/wpt.2017.077

Modelling rainwater harvesting for commercial buildings

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Abstract

Commercial areas are generally fully paved and with more impervious land cover than residential areas. This paper demonstrates a wall-mounted rainwater harvesting system designed to deal with limited land space. An arrangement of three tanks in series was used on a commercial shop lot where flat roofs generate large amounts of runoff. The system is compact, and can be installed and fitted close to any wall, promoting the efficient use of space. Analytical procedures and computational fluid dynamic modelling were used to explore the system's potential. This rainwater harvesting system, with its three water storage tanks, works well, and is suitable for implementation and can be integrated into urban stormwater management.

Key words: flat roof, flow, roof runoff, shop lot, wall-mounted tank

INTRODUCTION

Rainwater harvesting is the interception of rainwater from roof systems so that it can be collected, stored, and possibly treated for reuse (Natibu & Mahoo 2000; Petrucci *et al.* 2012). The rainwater tank type and size are the major considerations for such a system (Worm & van Hattum 2006). Conventional rainwater tanks have substantial capacity, whether above or below ground (Morey *et al.* 2016), and occupy a lot of space that could be used for other purposes.

Wall-mounted tanks like those introduced here have smaller capacity than conventional ones and are installed on building walls (Tang & Mah 2015). Figure 1 presents examples of wall-mounted rainwater tanks on houses. Generally, sloping roofs are favored and house roofs have several sloping planes fragmented to varying surface areas. The tank shown transfers parts of the rainwater from the drainage downpipe. Too large a storage volume may result in a tank that it might not be feasible to suspend from a wall.

However, this paper deals with commercial buildings, which often have flat or gently-sloping roofs. They may use less water per capita than residential buildings, but harvesting rainwater could contribute to reducing rainwater volumes in urban drains, thus helping to mitigate flash flooding. Figure 2 shows typical shop lots in Malaysia, where rainwater is drained to both the front and back. The roof is a single plane with a large surface area. Placing rainwater tanks on the tightly-spaced lots requires a new approach and a series of wall-mounted tanks was thought suitable to cater for the greater amount of roof runoff. This paper outlines an investigation into the parameters for the wall-mounted tanks using analytical and computational fluid dynamics (CFD) methods.