

EMPIRICAL MODEL SIMULATING RAINWATER HARVESTING SYSTEM IN TROPICAL AREA

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ABSTRACT

Rainwater harvesting is the technique of capturing the rainfall to meet some water needs in both urban and rural areas. The volume of rainwater collected from rainwater harvesting system varies from place to place and depends mainly on the climatic condition. Typically, the rainwater harvesting system is composed of the catchment (roof), gutter, rainwater pipe, and storage tank. Reliability of a rainwater harvesting system mainly depends on the collected volume in rainwater storage tank and it is also used to check whether the collected volume of rainwater can meet a specific water demand (either for potable or non-potable uses). In the present study, a rainwater harvesting system is installed at the Faculty of Engineering, University Putra Malaysia. The system is tested using data from 24 different rain events. The collected data include rain depth and rainwater volume. It is found that the rainwater volume ranges from 0.027 m^3 to 4.03 m^3 . The actual data are used to produce an empirical model for predicting the collected rainwater volume. Calibration and validation processes are conducted to the proposed model and T-test shows that the model prediction is within 95% level of confidence. Furthermore, the water consumption for toilet flushing is monitored using water meter. Reliability of the installed rainwater harvesting system for toilet flushing is computed. It is found that the system reliability ranges from 26.61 % to 100 % depending on daily water demand and recorded rainwater depth.

Keywords: Rainwater harvesting, system modeling, assessment, reliability

1. INTRODUCTION

Rainwater harvesting is the technique of collection and storage of rainwater from roofs during rain events for future use. This technique is appropriate in many countries such as United Kingdom, Germany, China, Japan, Thailand, Sri Lanka, India, Australia, Brazil and United States of America. The technique is relevant in areas with sufficient rainfall for collection but experiencing water shortage due to either limited availability of conventional water resources or high water demand. It can also be used in arid regions to overcome water shortage.

Rainwater can be used to meet part of domestic water demand including both potable and non-potable. In urban areas, at a household level, rainwater can be used for flushing toilets, watering gardens and washing floor and these uses are known as non-potable. While in rural areas, it becomes the main source of water for potable uses which include drinking, bathing, and cooking. In rural areas it is recommended to treat the collected rainwater prior to use particularly if it is intended to be used for drinking.

A simplified rainwater harvesting system consists of a storage tank which is usually connected to a rooftop through a pipe. Rooftops are constructed from various types of materials such as concrete slab, plastic corrugated sheets, metal corrugated sheets, corrugated cement tiles and corrugated clay tiles. The collection areas of rainwater harvesting systems are buildings' roof. The size of the roof varies from one type of building to another. Small roof size or catchment usually is found in houses and large size is found in super markets and airports. The size of catchment has a direct influence on the collected rainwater volume from a catchment. The intensity of the rainfall is also another factor affecting the collected volume of rainwater. Many rainwater harvesting systems installed in many countries including Malaysia but the main concern is the reliability of these systems. The reliability depends solely on collected

