



Faculty of Engineering

**POTENTIAL RAINWATER DIRECT STORAGE FOR FACULTY
OF ENGINEERING IN UNIMAS**

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**POTENTIAL RAINWATER DIRECT STORAGE FOR
FACULTY OF ENGINEERING IN UNIMAS**

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ABSTRAK

Sepanjang proses pembangunan, kita telah berhadapan dengan pelbagai masalah yang berkaitan dengan alam sekitar dan hari demi hari masalah ini menjadi semakin teruk. Banjir, kesan rumah hijau, pencemaran and pemanasan global adalah antara kesan-kesan yang terjadi akibat pembangunan yang kita alami hari ini. Untuk mengekalkan keseimbangan alam, menadah air hujan telah di kenal pasti sebagai salah satu daripada penyelesaian yang berinovasi. Ianya mempunyai potensi untuk di aplikasikan di Malaysia kerana negara kita mempunyai sumber kuantiti air hujan yang banyak. Pemasangan fasiliti ini dicadangkan untuk Fakulti Kejuruteraan di UNIMAS yang mana kriteria mengenai saiz tangki simpanan dan sistemnya dibincangkan dengan mengambil kira permintaan dan kuantiti air hujan itu sendiri. Tangki yang dicadangkan untuk fakulti sebaiknya mempunyai saiz 2.083m x 2.616m. Sistem ini menyediakan penyimpanan untuk penggunaan semula air hujan yang telah ditakung untuk kegunaan harian, seperti pam tandas, kerja pembersihan dan menyiram tumbuhan. Dengan melaksanakan sistem ini juga, kita akan dapat mengurangkan beban pada sistem kumbahan yang boleh menyebabkan banjir dan masalah kesihatan. Proses yang berkaitan merangkumi pemerhatian di kawasan kajian, data hujan dan pemungutan data dari fakulti untuk menentukan kapasiti tangki yang diperlukan. Kapasiti ini akan ditentukan dengan menggunakan tiga kaedah berlainan yang telah digunakan dengan meluas oleh beberapa projek di Malaysia seperti Demand Side approach, Supply Side approach dan Swinburne Method.

ABSTRACT

Over the years of development processes, we encounter a lot of environmental problems and it is actually getting worse day per day. Flooding, effect of green house, pollution, and global warming are some of the effects that happened due to the development we have today. To pursue the need for a more sustainable development, rainwater harvesting has been recognized as one of the innovative solution. It has the potential to be implemented in Malaysia since we have a very high quantity rainwater source. The installation of rainwater harvesting facilities is proposed for the Faculty of Engineering in UNIMAS in which the criteria of storage tank sizing and system discussed into details by considering the water demand and the rain quantity itself. The storage tank shall be of size 2.083m x 2.616m. This system provides storage to keep rainwater and re-used the water for everyday non-potable consumption, mainly for toilet flushing, general cleaning and for watering plant. By implementing this system also, we will be able to reduce the load we put on the sewerage system which might cause flooding and health problem. The process will include observation on study area, rainfall data, and collection of data from faculty to determine the storage capacity required. Storage capacity will be determined by viewing from three different methods available that has been used widely in other project in Malaysia such as Demand Side approach, Supply Side approach and Swinburne Method.

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NOTATIONS

Q	= peak flow	(l/s or m ³ /s)
I	= rainfall intensity	(mm/hr)
c	= runoff coefficient	
A	= catchment area	(m ²)
L	= liters	
m ³	= cubic meter	
m ³ /s	= meter per second	
l/s	= liters per second	
mm/hr	= milimeter per hour	
NAHRIM	= National Hydraulics Research Institute of Malaysia	

CHAPTER 1

INTRODUCTION

1.0 General

Over the centuries, the demand of water has increased, not only for our daily consumption, but also for agricultural and construction sector. In order to support the demand, there exists the stormwater management also known as Best Management Practices (BMPs), mainly to improve the quality of urban stormwater runoff due to its discharge.

This alternative management practices exists for the sake of human race. Our former Housing and Local Government Minister, Datuk Ong Ka Chuan, once mentioned that there are many ways to use this water. Other countries have introduced methods that can be adopted here in Malaysia. The ministry should not just appeal to housing developers to address this but instead, take the initiative to study suitable schemes and make them mandatory. (New Straits Times, 2008)

In brief, rainwater is described as the water that present during the precipitation events. Worrying what the potential impact of the runoff water could lead to, there exist many efforts to maintain the environment involving the direct storage or harvesting of rainwater, which involves the use of buildings elements such as roof, gutters and so on. This method may not be able to totally eliminate the havoc or disaster rains can brought us but in some ways, this method can simultaneously solve problems of water quality, floods, erosion and others.

In other countries, their people had been using rainwater for many purposes. They had this method practiced since years ago. They have good community awareness about the importance of environment and future needs of water. Our local people should also realize about the concept of ecological sustainability development, where the aim is to ensure development can occur without ruining the environment.

1.1 Project Background

This study focuses mainly about the rainwater or better known as the water from the rainfall. Usually, when the rain falls, part of it will either be absorbed into the ground or became surface runoff and drained into rivers.

The annual rainfall volume for Malaysia is 320 billion cubic meters (bcm) for Peninsular Malaysia, 194 bcm for Sabah and 476 bcm for Sarawak, and to let this large amount drained into rivers just like that is a waste since the whole nations now facing global warming, drought and the water tables actually are falling in some places. Grain producer's country like India, China and the United States face the problems where the ground water is running dry. This event can cause water shortages in the future because the population growth will increase drastically.

We use water not only for our daily consumption and in cooking, but also for many purposes including washing cars, gardening, laundry, mining, in construction activities and etc. Hence, this study will discuss more about storing water for current and future use. Since there is a lot of work can be done using this type of water instead of draining it to the river which can also lead to flash flood, we are also indirectly help to restore the environment by reducing the peak discharge.

There are many methods as mentioned in the Best Management Practices in order to manage the stormwater. One of the successful methods that have been adopted at several countries is by harvesting them before they became surface runoff. This method has a lot of advantages and thus this study will also discuss about the issues on implementing it. This project will also include some calculation about the storage basin and study its implementation at places with water stress.

In Universiti Malaysia Sarawak, UNIMAS new campus, the drain can reach up to almost a meter depth. This shows that there is a lot of excess rainfall that go through this system. If this water that flows in the drain is kept in a storage tank, then the water could be used for many purposes.

Since the new campus is greenless, planting trees is the only option. To do this, a lot of water will be needed. In Unimas campus area, worker cleans up the concrete path using the treated water and this is absolutely wastage. Cleaning the pavement does not need treated water to do the job since the purpose of cleaning the path was to remove the lichen. Rainwater can do the same job without any cost. Hence, we could save money on the water bills.

1.2 Objectives

The objective of this project is to estimate the potential amount of rainwater that could be stored for supplementary use such as toilet flushing, general cleaning and water for landscaping while discussing about the advantage of using the rainwater as our everyday use other than depending on the water from our taps.

The need of this study is because, before development occurred, most rainfall soaked into the ground and contributes to groundwater recharge or was recycled into the atmosphere by trees. However, the land use have affected the hydrologic cycle so much that we are now facing with drought at several places in Malaysia, and worst, even though Malaysia is rich with humidity, but still some of the remote places especially and sometimes in big cities, hard to get water supplied to their home, while some places facing flash flood in their residential areas and causing damages and losses of many lives.

The other objectives are:

- To identify the benefits of implementing this method at area of study
- To determine the best option to be applied at Faculty of Engineering in UNIMAS
- To study the design and sizing for rainwater storage based on project that has been done

CHAPTER 2

LITERATURE REVIEW

2.0 Water, Development and Flash Flood

Located between latitudes of 1° and 7° N with longitudes 110° and 119° E in South East Asia, Malaysia consisting of Peninsular Malaysia and separated with Sabah and Sarawak by the South China Sea, is well known with its high humidity.

Sarawak which is situated on the north-western coast of Borneo experiences two monsoons yearly where the South West Monsoon brings less rain while the North East Monsoon (Nov-Feb) brings heavy rainstorm. This rainstorm not only will cause problems such as flooding in low land area, but also contribute to erosion, reduced in groundwater recharge as well as affecting the water quality.

As in the big cities in the peninsular Malaysia, though they have a very good and well managed drainage system, but flash flood occurred almost every year now. We are familiar with flash flood at Kuala Lumpur, but what had happened the last two years has

shocked us. Most cities at Peninsular Malaysia were inundated. The flash flooding in several areas, Perlis, Pahang, Kelantan, others and the worst is at Johor, has affected Malaysia's economic activities.

Even in Borneo, Sabah and Sarawak also flooded at certain areas. At Kota Kinabalu, Sabah's busiest place, the water can go up to 1 meter high and causing very bad traffic congestion. In Sarawak, According to the data released from Drainage and Irrigation Department, during the year of 2007, flooding still occur at several places such as in Matang, Limbang, Lawas, Miri and Sibu town where the water rises from 0.3m to 1.5 m the highest and in January 2009, has been identified as the worst flood event ever in Sarawak history.

The rapid development of cities in Sarawak is the cause of the increased surface runoff volume in certain areas. This is because the hydrologic cycle has been affected in so many ways, especially during construction when the ground is compacted several times, it can no longer able to infiltrate the rainfall, and thus, the only way to dispose the water by converted it to runoff. When there is no proper drainage system, flooding always occurred. However, even there is a managed and proper system for urban drainage, sometimes, the rainwater runoff can be too much for the drain to handle and other impervious areas such as rooftops and roads are worsening it as they also contribute to flash flooding.

2.1 Water Demand

According to the International Year of Freshwater 2003 Fact Sheet, study by the WWF Malaysia, the water demand has increases during the last century, which is more than twice the rate of the intensive population growth. It is predicted that by the year 2025, the water withdrawal will increase by 50% in developing countries and 18% in developed countries, and about two thirds of world population (about 5.5 billion people) will face water scarcity.

While the overall demands for Sarawak by the year 2025 is still unpredicted, it is expected that water stress will occur in various regions throughout Sarawak in the years to come. This will happen from the concentration and development in certain areas. The spatial and temporal distribution of rains will further aggravate these shortages.

Living without water is something that will never crossed our minds. It is a fact that the water covers three quarters of the earth's surface. It seems a lot to us, however, the reality is, only one percent (1%) of all the water in the world is available for us to be consumed. We are facing the fact that we have a very limited amount of usable fresh water. That is the reason for now we have many methods to manage the rainwater. One of the ideas is that we reuse the rainfall for gardening and so on. Other is storage basin, a method for water detention or infiltration, in which the rain that falls can infiltrate into the ground at the made infiltration basin.

Environmental impacts due to the economic activities and development on the quality of the water resources has become a major issue and needs to be overcome. The extreme changes of global climate also play a role in determining the availability of water in years to come.

2.2 Stormwater Management by MSMA

There are many ways that can be implemented to manage the rainwater. Stormwater is the water that is present during precipitation events and or from snowmelt or runoff water from overwatering that enters the stormwater system. Currently, it is more preferable that the rainfall is drained to the receiving water. Apart from converting the rainfall to direct surface runoff, there are methods introduced by the DID which is known as Manual Saliran Mesra Alam Malaysia (MSMA) which is more environmental friendly.

MSMA has introduced a new concept in order to manage the rainfall. Generally, the stormwater quantity control facilities can be classified as either detention or retention facilities. The detention concept is to limit the peak flow by the temporary storage and gradual release of stormwater runoff by way of an outlet control structure or other release mechanism whereas the retention facilities are commonly sized to provide only reduction in the volume of stormwater, and possibly peak discharge, by the

temporary storage of stormwater runoff, which is released by evaporation and infiltration only. (MSMA Chapter 18, page 18-1)

2.2.1 Roof Top Harvesting

In direct storage system, the roof top plays the main role as it is the catchment areas. For collection of water, gutter is provided along the edge of the roof with a slope as the drain to help the rainwater flowing into the rain water down pipe (RWDP) and to the storage tank.

Most of the buildings today use galvanized iron sheets (G.I) for the roofing works. The gutters are provided as well and the rainwater is drained to the RWDP which is encased in the column for aesthetics value.

The above-ground and below-ground water storages are known as On-site Detention (OSD) facilities. The famous and most currently applied is the rainwater direct storage tanks. There are several types of storage water tanks that available in the market. All this are grouped into two types of storage tank which had the big potential to be implement are:

- i. Above-ground/surface Tanks
- ii. Underground Tanks

2.2.2 Implementation of Rainwater Direct Storage System in Malaysia

In his 2004 budget speech, our former prime minister, Tun Dato' Seri Dr. Mahathir Bin Mohamad mention on the budget to supply treated water to the rural areas especially in Sabah and Sarawak. Sabah and Sarawak have not enjoyed full coverage of rural water supply. As an interim measure, the Government has implemented rural water supply programmes, especially in schools, using rain harvesting and tube well system. To date, almost 700 schools in Sabah and Sarawak have been identified to benefit from these facilities, with a cost of RM242 million.

Storing rainwater has been practiced in Malaysia especially in the villages for a long time. A month after the drastic 1998 drought, the Minister of Housing and Local Government has expressed their concern to include the rainfall storage system for every housing estate. In accordance to the Government's interest in rainwater harvesting, the National Hydraulic Research Institute of Malaysia (NAHRIM) in collaboration with the Department of Irrigation and Drainage (DID) and few local universities has been doing research on rainwater harvesting for the system implementation.

At the moment, NAHRIM has carried out three pilot projects with the objective of collecting water from roof through surface and underground storage tank. The projects were applied at