UNIVERSITI TEKNIKAL MALAYSIA MELAKA

TO DESIGN A MODEL OF AN OPEN AND UNDERGROUND RAIN WATER HARVESTING SYSTEM USING RECYCLED MATERIAL AND TO STUDY ITS BENEFITS FOR DOMESTIC APPLICATIONS

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Mechanical Engineering Technology (Maintenance) with Honours.

by

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DECLARATION

I declare that this thesis entitled “To Design A Model Of An Open And Underground Rain Water Harvesting System Using Recycled Material And To Study Its Benefits For Domestic Applications” is the result of my own research except as cited in the references.

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APPROVAL

I hereby declare that I have read this report and in my opinion this report is sufficient in terms of scope and quality for the award of degree of Bachelor Of Mechanical And Manufacturing Engineeering Technology.

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DEDICATION

Dedicated to my beloved mother and father

My friends and family members

For their encouragement and support through the research

ABSTRACT

Rain Water Harvesting (RWH) is a technology where surface runoff is effectively collected during rainfall data. In order to support such technologies RWH systems should be based on design, material and equipment. Harvested rainwater can be used for rainfed agriculture or water supply for domestic use in households. This report focuses on the design of the RWH system at a single storey house in Malacca and its benefits to domestic use like gardening, washing vehicle, watering flowers, cleaning the drain and construction work. The material used on each component of this system is also a recycled material. Design selected based on rainfall data from Malaysia Meteorological and concept of design. The data analysis can get the size of the tank for this project application by calculating the average bill water demand for daily use. The bucket method was used to identify where the material use in this system can be used and function on every component. The result show the water flow for low rain from 0.105 to 0.106 liter/s and for medium and heavy rain was approaching each other from 0.216 to 0.229. This happened cause of the diameter the pipe necessary to give a required flow rate will depend upon the head of water available, the smoothness of the internal bore of the pipe and the effective length of the pipe.

ABSTRAK

Penuaian Air Hujan (RWH) adalah teknologi di mana aliran air permukaan dikumpulkan secara berkesan semasa data hujan. Untuk menyokong teknologi seperti sistem RWH harus berdasarkan reka bentuk, bahan dan peralatan. Air hujan yang dipanen boleh digunakan untuk pertanian hujan atau bekalan air untuk kegunaan domestik dalam isi rumah. Laporan ini memberi tumpuan kepada reka bentuk sistem RWH di sebuah rumah tunggal di Melaka dan faedahnya untuk kegunaan domestik seperti berkebun, membasuh kenderaan, menyiram bunga, membersihkan longkang dan kerja pembinaan. Bahan yang digunakan pada setiap komponen sistem ini juga merupakan bahan kitar semula. Reka bentuk dipilih berdasarkan data hujan dari Malaysia Meteorological dan konsep reka bentuk. Analisis data boleh mendapatkan saiz tangki untuk permohonan projek ini dengan menghitung permintaan air bil purata untuk penggunaan harian. Kaedah baldi telah digunakan untuk mengenalpasti di mana bahan yang digunakan dalam sistem ini boleh digunakan dan berfungsi pada setiap komponen. Hasilnya menunjukkan aliran air untuk hujan rendah dari 0.105 hingga 0.106 liter / s dan untuk hujan sederhana dan berat sedang menghampiri antara 0.216 hingga 0.229. Ini berlaku sebab diameter paip yang diperlukan untuk memberikan kadar aliran yang diperlukan akan bergantung kepada kepala air yang tersedia, kelancaran lubang dalaman paip dan panjang berkesan paip.

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LIST OF ABBREVIATIONS

RWH	-	Rain Water Harvesting
SAMB	-	Syarikat Air Melaka Berhad
NAHRIM	-	National Hydraulic Research Institute of Malaysia
PAM	-	Perbadanan Air Melaka
DAF	-	Dissolve Air Floatation
SPAN	-	Suruhanjaya Perkhidmatan Air Negara
PE	-	Polyethylene
PP	-	Polypropylene
UV	-	Ultraviolet
UFM	-	Ultra Filtration
BOM		Bill of Material

CHAPTER 1

INTRODUCTION

1.0 Project Briefing

Rain water harvesting or rain water collection system, is a technology that collects and stores rainwater for daily use. The recycling of rainwater involves the rainwater collected from the roof of a building. Then the rain water passes a filter, which eliminates waste and is placed either underground or on the side of building in a holding tank. It is very important to establish a new development source such as rain water to ensure that no shortage of water is present. As demand grows, there is a chance that Malaysia's major cities will face a water crisis. A rainwater collection system approach to the building is an effective way of minimizing water used in non-potable applications.

This system ranges from rain barrels to more elaborate structures with pumps, tank purification systems, pipe and catchment. The rainwater system components are relatively simple and a low maintenance level is needed once it is installed. It is made up of a collection system like a roof, a reservoir or a tank from recycled material that stores the water such as polyethylene tanks or metal tanks and drives to deliver where it has to go. This collected water can be used for landscaping, flush toilet, wash vehicle, wash drain, wash the house, wash the floor, and gardening.

The main objective of this project is to produce a model of "Rain Water Harvesting system" which will help to solve water supply problem and save the water usage. Rain water harvesting is a good solution. It will reduce the use of treated water from state government of Malacca or Syarikat Air Melaka Berhad (SAMB). Furthermore, this project will focus on the benefits and impacts of the rain water harvesting system in Malaysia's home.

1.1 Problem Statement

Rain water harvesting made to help problem like high cost of water use, this is because water is the main source in daily life. Water harvesting method previously advanced for more life are in recent times receiving renewed interest because they are able to make contributions to multiply water materials for agriculture and domestic use (Fink and Ehrler, 1978). With rain water harvesting, water use can reduce by used the rain water for outdoor activities such as wash vehicle, landscaping, gardening, toilet flush and others (Thamer 2007). After that, now many people are moving to the installation of devices which reduce. overall cost and use and recycle whenever possible If the savings can be added by putting in a rainwater harvesting tank, then significant cost reductions can be considered, in particular if water companies start to increase their prices.

Furthermore, water crisis in 1998 Malaysia, faced by severe water crises (El Nino Phenomena) as shown in Figure 1.0, is affected by climate change drought. Lembah Klang is therefore one of the top critical locations for the water crisis. All water supplies must be rated by the state water board to ensure that the entire user gets enough water. The government list some attempts to deal with scarcity; the rainwater harvesting system form part of it (Mohd.Shawahid et al., 2007). However, because users are unaware of the fact, the implementation of this system is not always further transferred (Mohd.Shawahid et al., 2007).

Next, Rain water collection is to supply the household with water. Rainwater is a renewable clean water source that can be used for household, garden watering and small productivity activities. According to National Hydraulic Research Institute of Malaysia NAHRIM's research, 34 percent of accumulated rainwater has be utilized by household of

six people (two adults and 4 school going children) for non-potable purpose according to month. It means that 34 percentage of dealt with water has been saving from non-potable use in step with month, at the identical time can decrease water bill. Furthermore, it also helps to reduce the risk of floods and loads on sewer systems. Low cost, accessibility and easy household maintenance make the rainwater harvesting system more attractive. Though the cost of capital is high, but no significant expenditures generally entail either operation or maintenance. Rainwater production in developing countries seems to be a useful way to minimize the water shortage.

Figure 1.0: News on water crisis in 1998 (Berita Harian, 1998)

(a).The plant is dry due to drought; b). Water problem is getting critical; c). Water problem is getting critical)

1.2 Objectives

The purpose of this study are:

1) To save the water usage for domestic application
2) To design a model of Rain Water Harvesting System

1.3 Scope Of Work

This project focuses on:

1) To design and produce a prototype of Rain Water Harvesting System for a single-storey terrace house in Malacca.
2) To ensure each part of the system functions correctly.

CHAPTER 2

LITERATURE REVIEW

2.0 Water Supply System

The water supply system is a water supply distribution structure of plant treatment of buildings or residences and subsequently used by users. This system involves various infrastructure structures of infrastructure facilities consisting of distribution system, reticulation system and water supply system at in the building. Usually, a system of water reticulation infrastructure from pipes main or public piping is used for the supplier to a desired area.

In addition to the design criteria to be considered, research also run on water authority regulations to ensure the system designed to meet predetermined standards. This includes materials suitable for pipes, valves, and main storage tanks in the building.

Water supply to the building is one of the types of services which is important as it is a basic necessity for the occupants to live in a house. The absence or failure of this service system will only cause the residents not to enjoy their daily lives well and can cause a building to fail.

More than half of water use is for indoor use building. Activities done at home greatly affect rates water use and this is closely related to the user's economic status. Schedule below shows the percentage of water use for residential homes and it is important to estimate the design of the water supply system needed for a day for every home.

Table 2.0: Domestic Water Usage (Azhar Kamaruddin, 2006)

NO	USABILITY	USE
1	Toilet flush	35%
2	Washing and bathe	25%
3	Drinking, cook and preparing food	15%
4	Wash plate	10%
5	Washing clothe	10%
6	Washing car and garden	5%

2.1 Water Treatment Systems

According to Wiedeman (2012), water treatment system has various concept and size that are different, whether by public at private ownership. Despite having system or process that different, main objective is supply clean water and can be trusted to community. Quantity and agent type additive or cleaner used through public system water different from type and source quality. Water supplies systems generally rely on floor water sources quality, whereas smaller structures tend to rely on flow water. However, water systems are discovered and the ecosystem is thus easy to contaminate. Type of water treatment system for clean water.

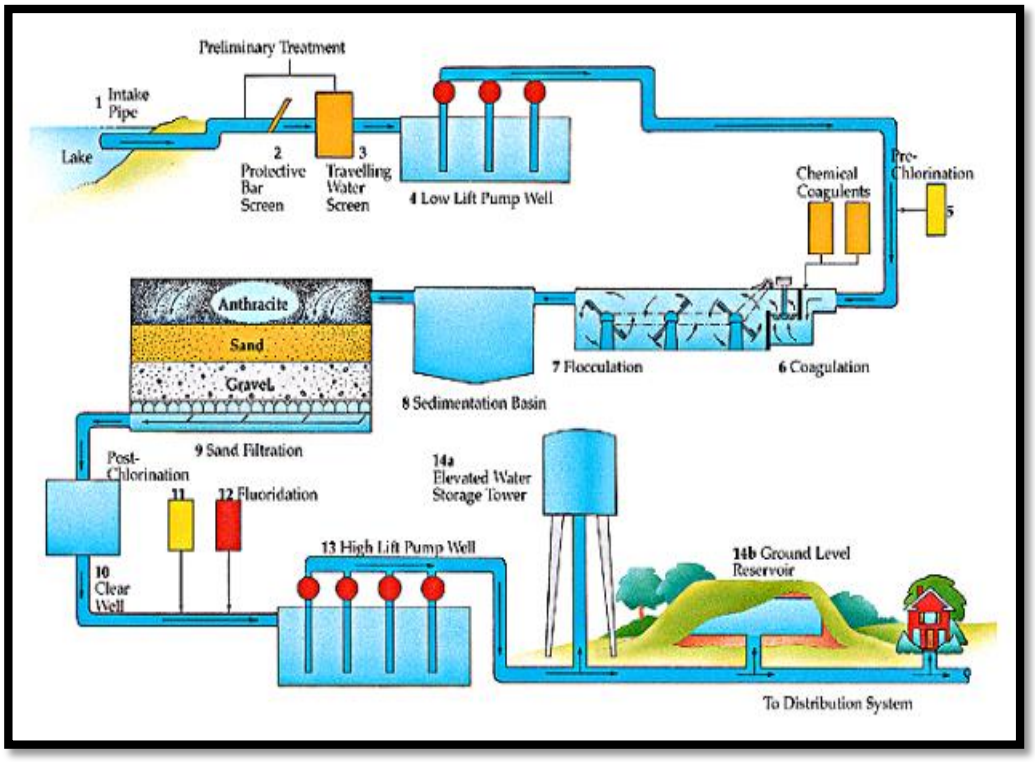

Figure 2.0: Water treatment plant surface water supply. (http://cof-cof.ca/surface-water-treatment-plant-flow-diagram/)

2.1.1 Flocculation/Sedimentation/Coagulation

Flocculation means water remedies that combine or coagulate small particles into larger particles, which become sedimentary out of the water. Used to promote coagulation is usually aluminum and iron salts or synthetic organic polymers. Settlement or sedimentation takes place naturally when flocculated debris are removed from the water. (Wiedeman, 2012).

2.1.2 Filtration

Many water treatment centers use filtration to remove all water particles. Such waste includes clays, silts, herbal, natural dependence, iron and manganese and microorganism, precipitating other treatment approaches in the facility. Filtration clarifies water and supplements disinfection efficiency. (Wiedeman, 2012).

2.1.3 Ion Exchange

Ion trade strategies are used to put off inorganic contaminants in the event that they cannot be eliminated safely by way of filtration or sedimentation. Arsenic, chromium, excess fluoride, nitrates, radium and uranium can be eliminated by using an ion alternate. (Wiedeman, 2012).

2.1.4 Absorption

Organic contaminants, undesirable colors and taste and odorous compounds may persist in the granular or powder active carbon floor, thereby eliminating them from potable water. Absorption allows more crystal-clear and odorless water production. (Wiedeman, 2012).

2.1.5 Disinfection

Water is disinfected earlier than getting into distribution device to make certain that doubtlessly dangerous microbes are killed. Chlorine, chloramines, or chlorine dioxide are by and big regularly used because they're very effective