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# A FEASIBILITY STUDY ON RAINWATER HARVESTING SYSTEM FOR MOSQUE IN PERAK TENGAH

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***Abstract:***
This feasibility study on Rainwater Harvesting System for the mosque in Perak Tengah is provided to make sure this system can give many benefits to the building users. From the feasibility study obtained on Rainwater Harvesting System (RWHS) for the selected mosque, it is found that RWHS has huge potential to reduce the building water bill every month. Since rainwater can be collected easily, it can be used directly for non-potable work such as landscape work, cleaning work and toilet flushing system. It can reduce the use of water from the main water supply. This research is obtained to support the development of green technology sector to align with the Government initiative towards the national green development. In this study, questionnaires have been distributed to the guest in the mosque. Besides that, interviews have been conducted with the management parties of the mosque organization. In addition, record of the water bill has been measured as a reference to this study. These approaches are important in order to investigate whether the RWHS is feasible to be installed in the mosque. The findings showed that Rainwater Harvesting System is suitable to be installed in the mosque in Perak Tengah. The system manage to save water, increase the usage efficiency and recycled the grey water for other water usage in the mosque.

**Keywords:** Feasibility; Rainwater Harvesting System; Green Technology; Religion Building; Water Saving

## 1.0 INTRODUCTION

RWH system was introduced in the early 1998 in order to harvest rainwater to be used for agriculture sector (Shahwahid et al., 2007). However, in 1999, the application of RWH system was expanded to other function. For example, the conservation of water in order to avoid issue of decreasing treatment water due to drought season (Shahwahid et al., 2007).

For local contact that is in Malaysia the hot and humid climate is suitable for the installation of RWH system. It is because Malaysia has enough rain to make sure that RWH system is fully functioned. One example of the RWH system project carried out by National Hydraulic Research Institute of Malaysia (NAHRIM) was on double storey terrace house at Taman Wangsa Melawati in Kuala Lumpur. The finding showed that RWH system is able to save 34% of the household water supply (Khai et al., 2016). From the example given it shows that it is feasible to install the RWH System in Malaysia. With the use of RWH system it will reduce the amount of daily water usage. As a developed country like Malaysia, RWH System can play an important role in the development of sustainable urban water system (Raimondi & Becciu, 2014).

Consequently, design for RWH system needs to be given detail attention, especially in term of its technique of installation to ensure that this system is cost effective. In addition, the designer of this system needs to consider the suitability of the usage and the type of RWH system that is affordable and compliance with the building condition (Zelenakova et al., 2014). The main issue for Malaysia is the population growth that will definitely increase the water demand. Thus, Malaysian need to be aware of their daily water consumption especially during drought season, where the water stock is crucial

Malaysia government has given attention to introduce rainwater harvesting system as a solution to avoid water crisis in the future. Malaysia has a few cities with high density of population such as Lembah Klang, Pulau Pinang and Johor Bahru. These cities require more demands on water supply than other cities in Malaysia (Che-Ani et al., 2009).

Rainwater harvesting system is a practice of collecting, storing and supplying direct to the user. Guideline of rainwater harvesting must be referred to as to ensure that installation is compliance with water supply system. Rainwater harvesting is a collection process of rainwater from the roof to a storage tank. However, it needs to be designed in detail so that the capacity of storage tank is suitable and is able to achieve the proper installation procedures. Design of rainwater harvesting must follow the condition water demands from the user of the building. In a residential sector, the typical RWH systems involves the end-uses of stored rainfall water that includes non-potable water for flushing toilet and for irrigating garden (Martin et al., 2015).

## 2.0 LITERATURE REVIEW

A global population report on environmental and water issues has estimated that more than 2.8 billion people in 48 countries will be facing the problem of lacking of water supply by 2025 (Manan et al., 2006). Therefore, it is significant to have alternative techniques to gather water supply. With this rainwater harvesting system it is a solution to prevent the problem in the future time. A systematic technique to implement strategies to maximise water reuse and recycling through integration of water using activities or processes is needed through RWH system. By maximising water reuse and recycling it, it can minimise freshwater consumption and wastewater generation (Manan et al., 2006).

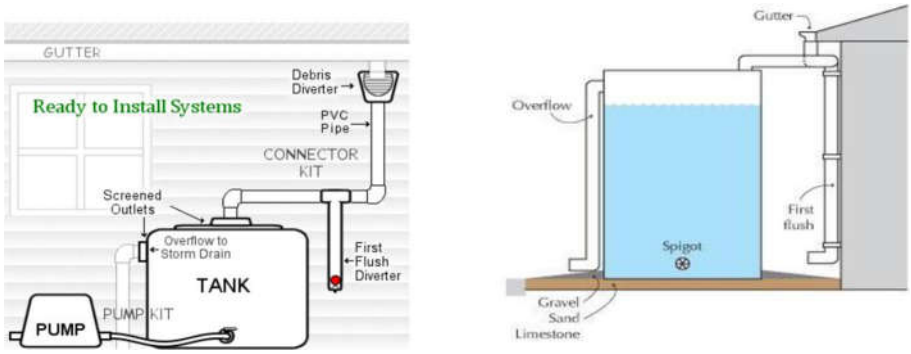
In Malaysia, the design of RWH system is unfriendly and not attractive to the users. Therefore, system designers need to have good cooperation with architects in order to come out with a good design to install RWH system. This is also important for them to examine the present policies on rainwater harvesting, to identify possible predicament and to provide suggestion for a successful implementation of rainwater harvesting policy in Malaysia (Shahwahid et al., 2007).

Malaysia climate is appropriate and suitable with rainwater harvesting system. It is because Malaysia country is located in a dynamic climate and it has a potential to achieve the aim and objective of installation. In order to promote rainwater harvesting system in Malaysia, a cooperation must be provided between Malaysian people and the government sector in order to disseminate this technology. In addition, rainwater harvesting is proposed by the government as part of the solution to mitigate water scarcity problem (Khai et al., 2016).

### *2.1 Application of rainwater harvesting system for Mosque*

Rainwater harvesting has various constructive benefits for mosque. İt is inexpensive and highly decentralized, empowering individuals and communities to manage their water (Shadeed & Lange, 2010). The collecting and storing rainwater are the major purpose of this system for a long time. With a systematic installation of RWH system, it can be used to aid water storage for mosque and still maintain the water to be in a good condition to be used for various purposes such as in landscaping and toilets. However, rainwater must be treated and filtered to get high quality of water.

Nevertheless, the continuous population's growth and the increasingly stringent environmental regulations pose important challenges in the design of modern water infrastructures (Raimondi & Becciu, 2014). The system can be designed according to type. The type can be classified in four categories which are (i) simplified method based on user defined relationship, (ii) continuous mass balance simulation, (iii) non-parametric approaches based on probability matrix method and (iv) statistical method (Raimondi & Becciu, 2014). However, for mosque, the suitable type is simplified method based on user as shown in Figure 1. The selection of suitable tank in the mosque area is necessary in order to gain the best water flow and whether it is integrated with pump or gravity-based system.




(a) Pump-type system (b) Gravity-type system

Figure 1: Types of RWH system that is suitable for Mosque
Source: http://bluegoldaustin.com/residential/rainwater/(2018)

Other than that, tropical region such as Malaysia receives heavy rainfall throughout the year and this make the idea of utilizing rainwater as a main water resource an attractive option (Shaheed et al., 2017). Malaysia receives rainfall averaging around 2400mm for Peninsular Malaysia, 2360mm for Sabah and 3830mm for Sarawak (Che-Ani et al., 2009). Thus, RWH is suitable to be used because RWH is a system classified as an easy method of installation and has many benefits.

This system is designed to fit suitably to the climate change. It can be installed at any place without any problem. The function of RWH is still in a good condition even when there is a climate change. The main role of RWH system in a mosque is to increase the amount of available water by capturing rainwater in one area for local use or to transfer to another area (Adham et al., 2016). By transferring the water collected it can be reduced the usage of clean water supply, especially if the water is used for landscaping and toilet flushing system only. The water can be used in many application and for different type of users. In addition, the advantage of using rainwater harvesting system for a mosque are listed as follows:

a) Rainwater harvesting system is a solution to avoid water crisis in the future. Even though, Malaysia has enough amount of rainfall to achieve the rainwater harvesting installation; however, during dry and drought season, the water level may drop. This is where the RWH system is important. It will help mosque users, especially when they are using the toilet during the dry and drought season. It can help to secure fresh water to be used for ablution purposes only.

b) Design aspect and building function affect the reason on choosing the RWH system for mosque. It will give benefit to the public when using the mosque. Design aspect and building function affect the reason on choosing the RWH system for mosque. It will give benefit to the public when using the mosque. Design by the architect in Malaysia nowadays, to take more comprehensive, sustainable, and progressive approach. With the design characteristic by architect, it can give benefit to the building and the user in a long term period. İt has come to a point where there is an urgent need to redefine this approach of designing the mosque by taking into account past values, the surrounding environment and future expectation (Aziz, 2016) with the addition of green technology application, like RWH system.

c) Water security is part of the reason for the installation of rainwater harvesting. It is because increasing of the population growth make the amount of water supply to be increased. Quality of water is very important to the health, livelihood, development etc, especially for a community that used mosque frequently. The Malaysian water-related authorities aim at securing water resources in order to

ensure that a sufficient amount of water is available to meet the demands of both human society and ecosystem (Shaheed et al., 2017) and this should start from public building like a mosque.
In order to support such technologies like RWH systems, there is a need to base the installation on local skills, materials and special equipment (Helmreich & Horn, 2009). The type of installation will be related to the building function, cost of installation, quality of water, security of the water storage etc. For cases like mosque, it is significant to study on the daily number of mosque's users and the capacity of water needed in a mosque.

## 3.0 METHODOLOGY

This study employed two methods which is a mixed method approach that combined both the quantitative and qualitative method as a process of data collection for the feasibility study on rainwater harvesting system for mosques in Perak Tengah. In this feasibility study, two case studies have been selected in Perak Tengah district. The chosen case study is Masjid Al-Sideq and Iskandar Bestari in Perak Tengah. This feasibility study was to ensure that the mosque gained benefit after the rainwater harvesting system installation. There are four stages provided in the feasibility study on rainwater harvesting system as described below.

In Stage 1, the desktop study on the introduction, background study, problem statement, aim of research, research objective, research question, scope and limitation of research, and research outline, methodology are provided as an early stage for the guideline. For stage 2, exploration on the definition of rainwater harvesting, literature review, concept of rainwater harvesting, characteristic of rainwater harvesting, basic component of rainwater harvesting, and agency of rainwater harvesting system in Malaysia are provided to make sure data collection process can be collected effectively. The data collection comes from the journal, book, interview, case studies, questionnaires, water bill collection, and field survey at the case study.

In stage 3, the data analysis for the questionnaire used a software of SPSS, while the water consumption formula from NAHRIM used numerical data. In stage 4, discussion on the finding of the research was produced. The findings were related to the data collection and achieve all of the aim and objectives of this study.

## 4.0 ANALYSIS AND FINDINGS

From the survey research, there are two types of respondents who took part in the study the management of the mosque and the users of the mosque. It was found that the responses from the study agree with the installation of Rainwater Harvesting System. During the data collection process, it was observed the two mosques would install a different type of RWH system. For instance, in Case Study 1, Masjid As-Sideq could be installed with the RWH System where a pump for making a water pressure to the user could be used for this purpose. Furthermore, in Case Study 1, the main issue for Masjid As-sideq is the problem of increasing water bill. For Case Study 2, the Mosque of Iskandar Bestari would likely be suitable to use the gravity system (from the water tank direct to the user) for RWH System. It is because the topography of Case Study 2 is suitable to use a gravity system. Furthermore, Case Study 2 does not have problem of increasing water bill. Figure 2 and 3 shows the result of the research.

Figure 2 shows that majority of respondents agreed with the idea of installing RWH system in the mosques. More than 60% of the respondents agreed that the RWH system is only suitable for toilet flushing systems, and 30% agreed with the usage of RWH system for landscaping purposes, while 10% of respondents agreed with other function, for instance cleaning purposes. For feasibility study in term of cost, it is found that the pump system is much more expensive that the gravity system.

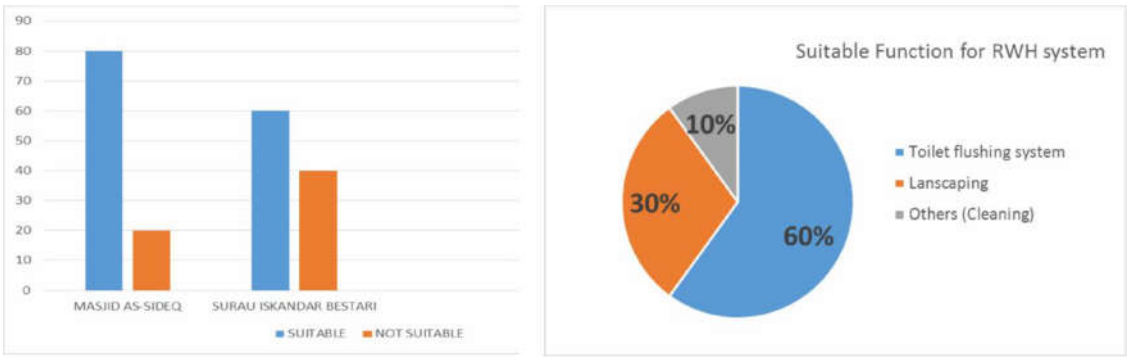



Figure 2: Percentage of Respondent's Opinion in Rainwater Harvesting Installation For Case Study 1 And Case Study 2

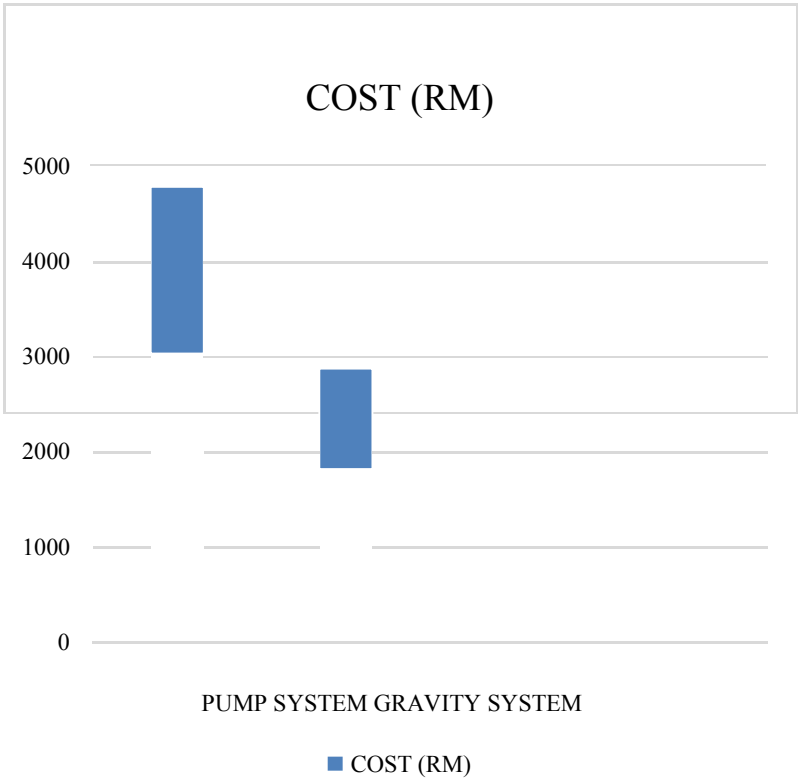



Figure 3: Estimating Cost (RM) For Different Type Of Rainwater Harvesting İnstallation

Figure 3 shows that the pump system needs a total cost of RM4500.00 to install the system, whilst for gravity system it is only RM 2700.00

## 5.0 CONCLUSION

From the research, it is found that suitability of RWH system installation depends on the condition of the building. Besides that, the cost of installation must be considered during the feasibility study. It is to make sure that the design selected is suitable for the RWH System installation for a mosque. In

addition, it is to make sure a suitable cost for installation is chosen with the current building condition. Before the installation of RWH System in mosque is obtained, it is important to consider the method of installation, the design of RWH system, the cost of installation and the maintenance lifetime aspect. This is to make sure the owner and users' of mosques are satisfied with the benefit from the RWH Installation.

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