UNIVERSITI TEKNOLOGI MARA

ECONOMIC EVALUATION OF RAINWATER HARVESTING SYSTEM FOR EDUCATIONAL INSTITUTION

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Dissertation submitted in partial fulfillment
of the requirements for the degree of
Master of Science
(Green Architecture)

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AUTHOR'S DECLARATION

I declare that the work in this dissertation was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This dissertation has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Implementing the Rainwater Harvesting System (RWHS) is a step towards conserving the water where the demand continues to grow worldwide, including in Malaysia. In recent years, RWHS projects have been implemented in Malaysia involving many types of buildings such as housing, commercials, government buildings and educational institutions. Although many research has been carried out on RWHS, there is a lack of studies on the potential of RWHS at educational institutions in Malaysia. Educational institutions have been considered as 'small cities' which consist of various types of building with different functions. The study on the economic aspect of RWHS for different categories of building is also absent. Thus, a comprehensive study on the RWHS potential and economic benefits for the whole educational institution buildings category is needed to determine the potential of RWHS for each category of building. Hence, the objective of this study is to analyse the potential and economic benefits of RWHS for all different categories of buildings at the educational institution, which are academic, administration and hostel. The first step is to identify the Design Parameters (DPs) of RWHS, second is to analyse the RWHS Reliability (R), third is to evaluate the Payback Period (PBP) of the system and fourth is to determine the most economic RWHS for each building category at the educational institution. An educational institution which is Politeknik Sultan Azlan Shah (PSAS) was selected as the case study. Systematic Literature Review (SLR) and semi-structured interviews with RWHS experts were conducted in identifying design parameters of the RWHS. Then, a daily water mass simulation created in Microsoft Excel was adopted in analysing the RWHS reliability. A cash flow spreadsheet which also created in Microsoft Excel was used in evaluating the RWHS PBP for each building category, and finally the most economic RWHS for each building category were determined based on the results of Reliability (R) and Payback Period (PBP) obtained. It was found that the most potential for RWHS implementation is the Academic building category since it has the highest reliability (91.98% to 97.30%) and shorter PBP (18 to 26 years), due to the balance between rainwater supply and water demand compared to other building categories. The Hostel building category is relatively economical to implement the RWHS with lower reliability (63.14% to 74.52%) and longer PBP (23 to 26 years). Meanwhile, the Administration building category is the least economic to implement the RWHS where Payback Period (PBP) has exceeded the estimated system's lifespan due to low water demand. As a conclusion, this study contributes to new knowledge and guidance on reliability and economic benefit of RWHS implementation for different building categories at educational institutions in Malaysia. This knowledge is a significant input to the Ministry of Higher Education, educational institutions, and consultants in the industry.

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