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Green Roof: Its awareness among professionals and potential in Malaysian market

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Abstract

This paper discusses the awareness of green roof technology among Malaysian professionals in built environment industry and its potential in the country's market. A total of 30 projects of local green roofs has also been identified and used in this study. Online survey is used as the tool to get feedback from the professionals who are the professional, in the construction discipline, the landscape architect, architect, developer, government officer, urban planner, project executive and also academicians.

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1. Introduction

Green Revolution is the main theme of the era in 21st Century. Many scholars around the world are investigating and promoting the importance of green revolution by the use of green technology to reduce the impact of global warming. Urban heat island, high energy demands, air pollution and lack of green spaces are among Malaysia's most crucial environmental issues in its urban areas like Kuala Lumpur, Pulau Pinang and Johor Bahru. In 2009, at the United Nations Climate Change Conference in Copenhagen, Denmark, Prime Minister of Malaysia, announced Malaysia's target to decrease 40% of released carbon dioxide until 2020 (Anandaraj, 2011). Therefore, numerous steps have been taken by the government to realize their green mission. Among the strategies are the establishment of Malaysia Green

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Technology Corporation (GreenTech Malaysia), enactment of legal mechanisms to regulate and enforce green technology, and to define the role of every government agency involved in the implementation of green technology in the country. An example of the initiative is the region's largest green technology exhibition and conference, International Greentech and Eco Products Exhibition and Conference Malaysia (IGEM), organized by Ministry of Energy, Green Technology and Water (KeTTHA) every year since 2010 (3rd IGEM, 2012). On 15th January 2013, as announced by Minister of KeTTHA, the theme for IGEM 2013 is "Advancing Green Growth". The aim is to enhance and strengthen the adoption of green technology in the country (4th IGEM, 2013). Green building is part of green technology whereby green roof is one of the approaches to create sustainable green cities development. In order to achieve a sustainable development, awareness about green roof among all classes of society is vital to make it successful. Moreover, the involvement of professionals in built environment to adopt the technology in the future development is necessary. Even though, green roof is not a new phenomenon, its application in the country is still rather limited.

This paper discusses the awareness of green roof technology among professionals in Malaysian built environment industry through a survey. The aim of the survey is to investigate green roof awareness among the respondents and its potential in the Malaysian market. The findings are based on the results of the survey from professionals comprising of landscape architect, architect, developer, government officer, urban planner, project executive and also academicians within the construction discipline. The total number of 120 respondents participated in this survey.

Green roof is a vegetated system where plants are planted on the roof using an engineered growing medium laid on certain layers of the system (Tan, 2008; Dunnett et. al, 2011). From the world's perspectives, green roof industry started in the early 1970s in Germany, and in the mid-1980s in Central and Western Europe. Singapore, Eastern Europe and USA started in the early 2000s while Hong Kong, Manila and China only started adopting the green roof system in the mid 2000s (Ho, 2011). Green roofs in Malaysia are becoming increasingly popular recently not just because its aesthetical value but also due to its positive impact on environmental issue. The two major types of green roof are intensive and extensive (Osmundson, 1999). Intensive green roof is also known as roof garden of which the plants comprise of trees and shrubs and needs regular maintenance. Therefore, the system requires specific support from the building as it is generally heavy. However, this type of green roof is accessible. Extensive green roof is lighter compared to intensive green roof in terms of loading. It is less expensive and requires low maintenance, but the selection of plants is rather limited than intensive green roof. It offers limited accessibility as most of the time, it is only accessible for maintenance purposes. Each type of green roof has its own advantages and disadvantages. Therefore, the purpose of having a green roof should be determined and understood before selecting the best type of green roof to meet the goal of a project.

Green roof is one of the methods to sustain the environment (Köhler, 2001). Previous research done on green roof proved that green roof had many economic, environmental, and social benefits (Getter & Rowe, 2006; Oberndorfer et. al, 2007). Economic benefits include increasing the marketability of the building land properties in branding it as a green building (Oberndorfer et al., 2007; Rahman and Ahmad 2012; Rahman et. al., 2012). Green roof is also one of the approaches in designing an energy efficient building as it helps to reduce the amount of electricity for air-conditioning units in the building. Zainordin et. al (2012) stated that air conditioner is a high energy consumption electrical facility in Malaysian offices (57%) due to the increase in demand to provide thermal comfort for building occupants. Green roof is beneficial to the environment through storm water mitigation (Mentens, 2006; Stovin et. al, 2012), carbon sequestration (Ismail et. al, 2012), flash flood reduction and also replenishing back greenery in the city (Brenneisen, 2003 and Miller, 2005). Malaysia has very dense greenery in rural areas but not in the city whereby the CBD areas mostly concrete jungle (New Straits Time, 2011). Use of green roof could

help Malaysia alleviate flash floods that always occur nearly every year during the monsoon season. On 24th December 2012, the country was shocked by the worst flash flood in Kuantan as a result of 10 hours of non-stop heavy rain. It was reported as the worst flood in the capital city of Pahang compared to the previous one in 1971 (Harakah daily, 2012). On the other hand, social benefits of green roof include providing open spaces for gathering and recreational for building occupants and citizens.

Green roofs can provide benefits towards country in many aspects. However, without the support from the society especially professionals in built environment industry, it may not be possible to gain the benefits of the technology. Therefore, this study is important as it is aimed at investigating green roof awareness among professionals and its potential market in Malaysia. In addition, this study has managed to compile a total of 30 green roof projects throughout the country. The reason for the compilation is to indicate and assess to what extent the green technology is implemented in the country. Thus, the result is a notable finding to be discussed and analysed to determine the direction of future green roof use in Malaysia.

2. Method

The findings are based on the survey from a total of 120 professionals in the construction discipline comprising of landscape architect, architect, developer, government officer, urban planner, project executive and also academicians. The survey was posted online.

2.1. Survey questionnaire

Online survey is selected as it is a fast and easily reachable method to get feedback from the professionals. The survey was posted online for 44 days, from 21st June 2012 until 2nd August 2012. The professionals in built environment industry were chosen as they were the parties involved in the use of green roof in the country. Therefore, their views may affect the direction of green roof development in future. The professionals were categorized based on their field to understand the different views among them. The population of respondent groups is shown in Table 1.

Table 1. Percentage of respondent population size

Category	Population size	Response Rate (%)
Landscape Architect	37	30.8
Architect	20	16.7
Academician	14	11.7
Developer	13	10.8
Urban Planner	13	10.8
Government Officer	12	10.0
Project Executive	11	9.2

The number of professionals who answered survey questions in accordance to their respective fields is unequal. Based on the findings, the higher populations of respondents group are the 37 professionals in the Landscape Architecture discipline forming 30.8% of the responses. The lowest population is the Project Executive (11) forming 9.2% of the responses.

2.2. Survey form

The survey form has a total of 11 questions; 4 are open-ended questions while the rest are close-ended. The questionnaire was divided into three sections. The first section of the survey questionnaire was designed to identify and categorized respondents' field in the built environment industry. This section aims to determine whether the respondents are familiar with green roof and whether they have already implemented the technology in their previous project in Malaysia. Section two of the survey questionnaire consists of three questions which are aimed at identifying whether our local professionals are aware of the benefits of having green roof in their project. This section also depicts which type of green roof is easily found in Malaysia. Respondents were also asked to indicate any local green roof projects in Malaysia that they know of for the purpose of compiling a green roof projects list. The final section of the survey questionnaire consists of four questions depicting respondent opinion on the potential market for green roof technology to be implemented in the country. Moreover, the cost for a one square meter green roof in Malaysia is also being asked to get clear information regarding the availability of the system in Malaysia.

3. Result and discussion

3.1.1. Professional knowledge about green roof

From the survey, all respondents (100%) have heard about green roof and 57.5% has used the technology in their previous projects. Table 2 indicates the response rate for each group of professionals and the number of respondents who have implemented green roof system in their projects.

Table 2. Percentage of professionals who implemented green roof projects

Category	Population size	Number Responded	Response Rate (%)
Landscape Architect	37	34	81.1
Architect	20	16	80.0
Academician	14	0	0
Developer	13	12	92.3
Urban Planner	13	0	0
Government Officer	12	0	0
Project Executive	11	7	63.6
Total	120	69	57.5

There are 69 professionals who have implemented green roof system in their projects. However, only 28 professionals give the name of the undertaken green roof projects. This may due to the professionals wanting to keep the information confidential. Therefore, only 30 green roof projects were noted from the survey and sorted according to its building category. Table 3 indicates the category of building undertaken with green roofs projects by the 28 professional and the types of building under each category.

Table 3. Category of buildings and types of building undertaken with green roof projects

Category of building	Types of building	Number of project	Percentage (%)	Total number of project	Overall percentage (%)
Residential	Condominium	11	78.6	14	46.7
	Apartment	2	14.3		
	Bungalow	1	7.1		
Commercial	Office	5	38.5	13	43.3
	Hotel	2	15.4		
	Shopping Mall	2	15.4		
	Retail Shop	1	7.7		
	Rooftop Bar	1	7.7		
	Mixed development	1	7.7		
	Integrated Parking	1	7.7		
Institution	Museum	2	66.7	3	10.0
	College	1	33.3		

Based on the findings, there are three categories of buildings undertaken with green roofs projects in the country. The most popular building category is residential buildings (46.7%) while there are few green roof projects under the category of institutional buildings (10%). Many professionals implemented green roof on residential building because, in their opinion, today's societies lack awareness and sense of appreciation for public greenery. Thus, it may cause green roof to be abandoned and vandalized if it is designed for open public access. Therefore, implementing green roof system and integrating it with the design of a residential building may be more reasonable as the green roof will be for private use. The professionals also believe that private designed green roofs are easier to monitor and maintain as the expenses can be outsourced by the residents of the condominium. Another assumption is due to the higher demands of urban dwellers to have their own garden in their homes instead of going to a nearby park. The residents may demand to have a sense of ownership by having a garden that could be accessed within a few minute walk from their homes. This concept of living may be one of the factors derived by most of the professionals in implementing green roof systems in the design layout of a residential building. There are three types of residential building. They are condominium, apartment and bungalow. The most common type of residential building with green roof projects are condominium (78.6%) while the least is bungalow (7.1%). There are five types of commercial buildings whereby professionals implemented green roof projects. The details of the types of buildings are shown in Table 4. For commercial building, office (38.5%) is the most common building with green roof projects while fewer (7.7%) retail shop, rooftop bar, mixed-development and integrated parking use green roof. The use of green roofs on office building may be due to the high demand from corporate building owners as they acknowledge the positive impacts of the systems in increasing the building property value. This may also be due to the current trend in central business district (CBD) area when most of office building owners would like to participate and show their commitment in supporting the green agenda in Malaysia. Apart from that, besides aesthetical values, green roofs can also be a long term investment which can benefit the owner in the long run. Museum (66.7%) is the common institutional building having green roof projects among the category of institutions. This is because the designed green roof area within the museum can attract more visitors as it enhances the building uniqueness. Moreover, the return income benefits through the entrance

fees of the museum can be used as funds to maintain the green roof. Thirty green roofs projects are recorded successfully from the survey and the details are shown in Table 4.

Table 4. Compilation of thirty green roofs project in Malaysia

Green roof Project	Location	Type of green roof	Type of building	Level	Accessibility	Completion Year
Islamic Art Museum	Tasik Perdana, Kuala Lumpur.	Extensive	Museum	One	Public access	1998
Secret Garden	Bandar Utama, Kuala Lumpur.	Intensive	Shopping mall	Seventh	Public access (but on weekend only)	2007
Menara Mesiniaga	Subang Jaya, Selangor.	Extensive	Office	First level of the extended roof area.	Non-accessible	1992
Oasis Ara Aquare	Damansara, Selangor.	Extensive	Retail shop	Second	Accessible	2009
Kiara 9	Mont Kiara, Kuala Lumpur.	Intensive	Condominium	Three and a half (consist of 16 gardens)	Private access	2011
Casa Desa Condominium	Taman Desa, Kuala Lumpur.	Intensive	Condominium	Third	Private access	2008
The Saffron	Sentul East, Kuala Lumpur.	Intensive	Condominium	Fourth	Private access	2008
Riana Green East	Wangsa Maju, Kuala Lumpur.	Intensive	Condominium	Fourth	Private access	2009
The Tamarind	Sentul East, Kuala Lumpur	Intensive	Condominium	Fourth	Private access	2006
Menara Binjai	Ampang, Kuala Lumpur.	Intensive	Office	Every third floor has access to garden terraces, Sky garden at thirty two floors.	Private access	2011
Rice Museum (Laman Padi)	Langkawi, Kedah.	Extensive	Museum	First	Public access	2009
Setia Eco Villa	Shah Alam, Kuala Lumpur.	Intensive	Bungalow	First	Private access	2007
Idaman Residence	Jalan P. Ramlee, Kuala Lumpur	Extensive	Condominium	Thirty four	Private access	2008
Balin Roof Garden Nak Hotel	Sandakan, Sabah.	Intensive	Hotel	Eight	Private access	..
Zouk Club	Kuala Lumpur	Intensive	Rooftop Bar	..	Private access	..
Lot 10	Kuala Lumpur	Intensive	Shopping mall	Eight	Public access	..
Monte Bayu	Cheras, Kuala Lumpur.	Intensive	Apartment	Seventh	Public access	..

Park Seven Condo	Persiaran KLCC, Kuala Lumpur	Extensive	Condominium	..	Private access	2008
Dataran Shamelin	Cheras, Kuala Lumpur	Intensive	Office	First	Public access	..
KLIA covered integrated parking	Sepang, Kuala Lumpur.	Intensive	Integrated parking	Fifth	Public access	1998
Cimb Bank Menara Bumiputera Commerce	Jalan Raja Laut, Kuala Lumpur.	Extensive	Office	First	Non-accessible	..
Malaysian Design Innovation Centre	Cyberjaya, Selangor.	Extensive	College	On top of low-rise building	Private access	2004
Mewah Oil Headquarters	Port Klang, Selangor.	Intensive	Office	Fourth	Private access	2003
Swiss Garden Residences	Jalan Pudu, Kuala Lumpur.	Intensive	Apartment	Sixth	Private access	2011
Hilton & Le Meridien	Jalan Stesen Sentral, Kuala Lumpur.	Intensive	Hotel	..	Private access	2003
Suasana Sentral Condominium	Sentral, Kuala Lumpur.	Intensive	Condominium	Sixth	Private access	2002
Ritze Perdana 2	Petaling Jaya, Selangor.	Intensive	Mixed-development (shops and condominium)	Sixth	Private access	2010
Perdana Exclusive	Petaling Jaya, Selangor.	Intensive	Condominium	Fourth	Private access	..
Flora Damansara	Petaling Jaya, Selangor.	Intensive	Condominium	Sixth	Private access	..
The Maple	Sentul West, Kuala Lumpur.	Intensive	Condominium	Fifth	Private access	2006

3.2. Benefits of having green roofs

The survey questionnaire also indicates professionals' views on the advantages of having green roof. Based on the findings, only 15.8% of the professionals did not respond to the questions. Table 5 shows response rate among the professionals.

Table 5. Professionals' view on the advantages of green roof

Designation	Population size	Number Responded	Response Rate (%)
Landscape Architect	37	34	91.9
Architect	20	16	80.0
Academician	14	12	85.7
Developer	13	11	84.6
Urban Planner	13	10	76.9
Government Officer	12	10	83.3

Project Executive	11	8	72.7
Total	120	101	84.2

Among the seven professional designations within the built environment industry, Landscape Architect has the highest response rate (91.9%). This may be due to the interest of professionals from landscape architecture field in green technology. Moreover, their involvement in green roof implementation is crucial in terms of design and also for planting selections. The lowest response rate is from the Project Executive (72.7%). This may be due to some Project Executive being unfamiliar with the benefits of green roofs as the information is not disseminated widely throughout the industry. From the survey, professionals have given 16 advantages of having a green roof.

Based on the findings, Landscape Architect (32), Architect (12), Academician (10) and Government Officer (7) agree that green roof is beneficial for heat mitigation. This may due to most of the professionals in landscape architecture, architecture, academia and government sector have observed the ability of green roof in lowering the temperature based on the performance of their previous green roof projects and study. Seven of the Government Officers also agree that green roof could save the environment from global warming effects. Eight Developers and six Project Executives believe that green roof has a high aesthetic value. This may due to most of the developers believing that the green roof aesthetic value is the main key point for its implementation as it can increase the marketability value of new building development especially in central business district (CBD) area. The Project Executive found aesthetic aspect as the main benefit of green roof due to their unfamiliarity with the technical aspects of the system and its ability to sustain the environment it occupies. The Urban Planners (8) stated that green roof is beneficial as an alternative green area in the city where most of the lands are being explored for new building construction. They believe that green roof could function as a recreational place for urban dwellers. All the findings are summarized in Table 6.

Table 6. Summary of green roof advantages

Advantages	Number Responded	Response Rate (%)
Urban Heat Island (UHI) mitigation	72	71.3
Aesthetic value	39	38.6
Alternative green area	29	28.7
Save environment	28	27.7
Storm water management	20	19.8
Thermal comfort	19	18.8
Increase Green Mark point	17	16.8
Soften building façade	17	16.8
Educational opportunities	15	14.9
Natural habitat creation	14	13.9
Energy efficiency	12	11.9
Improve air quality	11	10.9
Increase roof life span	9	8.9
Psychology health	5	5.0
Reduce noise	3	3.0

Based on the summary of green roof advantages, the majority of the professionals in the built environment industry agree that green roofs could help to mitigate urban heat island (UHI) in the city (71.3%) compared to other advantages. Only a minority believe that green roof could reduce the noise of the city's hustle bustle (3%). This may be because the benefit has not been practically study and proven yet in the Malaysian context. The disparity of views among the professionals is mainly because of the differences of their background knowledge and technical expertise in the industry.

3.3. Types of green roof in Malaysia

Green roofs in the Malaysia can be classified into two types, which are intensive and extensive. From the findings, the common type of green roof in Malaysia is intensive green roof (93 responses forming 77.5%) while extensive green roof (27 responses forming 22.5%) is less found in the country. This may be due to the sentiments of many professionals, that extensive green roof has lower aesthetic value than intensive green roof as the plant selection is limited. Thus, this may lead them to believe that an extensive green roof has less advantage if compared to intensive green roof.

3.4. Green roof market in Malaysia

Respondents were asked whether green roof has potential in the Malaysian market for the final question of the survey. From the findings, 94% of the respondents agree that green roofs have potential marketability in the country. The professionals also stated that the general cost uptake for one square meter intensive green roof is RM400 and above while for extensive is around RM300 to RM400. The expensive construction cost for green roof design becomes one of the barriers for the systems implementation in Malaysia. This may due to the lack of green roof expertise and supplier or manufacturer within the country. In other Asian countries which started implementing green roof in mid 2000s, the cost uptake for one square meter of extensive green roof is approximately between RM100 to RM350. In China, the cost for one square meter extensive green roof is RM111, in Manila, RM148, and in Hong Kong, the cost is RM320. Singapore started green roof implementation in the early 2000s. However, the cost for one square meter of extensive green roof is similar with Hong Kong, RM320. The cost for one square meter of extensive green roof is much lower in China and Manila compared to Singapore and Malaysia. This may due to the production and manufacturing of most of the materials for green roof are within the country.

The Singapore government initiated an incentive schemes to accelerate the growth of green roofs in their country. Therefore, it is possible for Singaporean professionals in the built environment industry to implement the system even though it is expensive. On the other hand, the Malaysian government has started to encourage Malaysian professionals to embrace green technology application in 2009. This effort can be seen through the launching of the National Green Technology Policy with the establishment of the National Green Technology Council in July 2009. Budget 2010 indicated that the Government had allocated RM1.5 billion for companies that supply and utilize green technology through Green Technology Finance Scheme (GTFS). The government also introduces a series of tax incentives which one of them is for Green Building Index (GBI) certified buildings. The incentive scheme provides income tax exemption for the owner of the building and stamp duty exemption for the property buyers according to the specified rules and conditions (Green Tax Incentives for a Sustainable Malaysia, 2010).

4. Conclusion

The compilation of 30 green roof projects from the survey shows that intensive green roof is the most common green roof being constructed in the country. While the common type of building where most intensive green roof are used is residential. The survey findings suggest that most of Malaysian professionals in built environment industry are aware of green roof technology. However, due to certain barriers including lack of knowledge and technical expert, expensive cost of green roof and green roof application techniques are not widely disseminated or spread among professionals led to less interest to use the system. Malaysian professionals involved in the construction of green roof need to import construction materials from abroad, in particular, the western countries. However, the cost of green roof construction could be decrease if we have our own green roof supplier and manufacturer in the country. Research must be done to find potential local resources to be tested and further utilize usage for green roof construction in Malaysia. The product may be more durable to the harsh tropical climate condition and also be more compatible with the nature of our native plants. Therefore, all parties in the industry and government body have the responsibility to promote green roof system as one of the approaches for green technology application in the country. Thus in return, it could help to accelerate the marketability and progress of green roof in the country.

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