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The Implementation of Extensive Green Roof Technology in High Rise Residential Building

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Abstract: Extensive green roof designs have been widely implemented in developed countries, but not in Malaysia. Several factors contributed to the lack of implementation of the green roof in Malaysia, such as the lack of awareness among stakeholders of green roof technology, technical factors, economic factors, lack of skilled knowledge creation and limited local expertise and unexperienced green roof practitioners. The objectives of the research were to study the level of awareness among the stakeholders, to identify challenges and to identify the method encourage the implementation of extensive green roof in the high rise residential building. In this study, quantitative approach was used through the distribution of questionnaires to 45 stakeholders that have experience with extensive green roof in a high-rise residential building in Kuala Lumpur. Subsequently 40 respondents answered and returned the questionnaires and were analyzed using Statistical Package for Social Sciences (SPSS) software. In addition, the findings showed that the respondents had moderate levels of awareness; the most important challenges were knowledge of green roof systems; it is important to provide the right information for a large green roof; and the most successful approach was collaboration between the government and academics to conduct research. In conclusion, this research will help to increase the level of awareness among stakeholders in the implementation of a large green roof in high-rise residential buildings, the barrier of a large green roof can be tackled and the extensive green roof widely adopted in the construction sector can be promoted.

Keywords: Green roof, High rise, Residential, Malaysia

1. Introduction

In the 21st century, many countries are facing the problem of lack greenery space and the environmental issues that include global warming, climate change, urban heat island (UHI) and sea level rise (Ismail, Aziz, Nasir, & Taib, 2012; Wong & Chen, 2008). These countries find out different methods to solve these issues. One of the methods is promoting green building by each country. In Malaysia, the government is active in promoting green technology in the construction sector to develop

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a healthy and green environment. Green building or sustainability building is part of green technology in the construction sector. The green buildings refer to structure and the application of processes that are environmentally and energy efficient in the building. Meanwhile, it can reduce the environmental problem by a set of design, construction and maintenance techniques of the building (Shiva, 2016). Green buildings have developed in residential and commercial buildings (Baharin, 2012).

Green roof is a green technology and ideas to develop green cities (Fauzi, Malek & Othman, 2013). Green roof refers to the green structures in a green building (Preisler, 2006). The green roof is a system that used special plants in growing medium, vegetation and covers a membrane on the top of the building roof also known as living roofs or vegetated roofs (Hassell & Coombes, 2007). The extensive green roof is a thin layer of a special growing medium for planting short rooted plants, such as sedum. The extensive roof normally located over a drainage mat. The roofs require little or no additional structural support from the building (Worden *et al.*, 2004). The roof system requirement is to install the root-resistant roof layer onto the roof membrane. There are many benefits of green roofs and divided into three categories. There are environmental benefits, economic benefits and aesthetics benefit (Oberndorfer *et al.,* 2007). Among the environmental benefits are improve the water management on the roof which reduces the storm water runoff, reduces the city temperature and reducing the carbon dioxide around the building. In the economic benefits is energy efficient in the building and increasing the life span of the roof. In order to achieve green cities, awareness of the extensive green roof system in the building among the society must be successful. The purpose of this research is to improve the implementation of the extensive green roof technology in the residential building.

1.1 Research Background

Nowadays, the environmental issue always occurred, not only in Malaysia but also in foreign countries. So, the green building acts an important role in protecting the environment. The green building also provides us with a lot of benefits such as improve quality of life and improve occupant health and comfort. The implementations of green roof have been widely used in the developed countries such as North American and European countries to protect the environment but there is limited adopt in Malaysia. The implementation of the green roof system in Malaysia mostly found in the commercial building and the residential building (Rahman, Ahmad, & Rosley, 2013).

The green roof categorized into two types which are intensive green roof and extensive green roof (Osmundson, 1999). The extensive green roof is the roof that plant with simple plants such as sedum or seed naturally. However, the intensive roof plants the trees or shrub on the roof and it need more structural support. Both types of green roof are adopted in Malaysia. The implementation of green roof is very important for next generation to ensure they have a good quality of living environment. Previous researchers have listed out many benefits from research on green roof technologies in term of environmental, economics and aesthetics (Ismail *et al*., 2009). Although the green roof technology provides many advantages to humankind, but it also has some constraint when adopting it.

1.2 Problem Statements

The concept of green roof is a new phenomenon in Malaysia. There are not many projects implementing extensive green roof system in Malaysia (Rahman *et al.,* 2013). Green roofs are becoming more and more popular in the world but Malaysia has not yet been accepted compared with developed countries such as Germany, Canada, South Korea and Japan (Rahman *et al*., 2015). The awareness among the stakeholders of green roof technology was one of the constraints to implement of the extensive green roof (Zuniga & Eugenia, 2013). The challenges in implementation of extensive green roof in the high rise residential building that include knowledge factors, economic factors and lack development of professional knowledge (Ismail *et al*., 2012). The structure of the green roof is more complicated compare with traditional building's roof. It consists a lot of layers to provide the plants

growing. The limited of local expertise and inexperienced green roof professionals cause the implementation of green roofs in Malaysia is still at a poor level (Ismail *et al.*, 2012). Besides, inexperienced of green roofing contractor will cause the green roof installed incorrectly, it will delay the construction process and caused the project overruns. The lack of skill of the installer of the green roof will cause the poor performance of roof and it gives the negative impact to the client to use green roof and directly caused the limited adopt of green roof in Malaysia (Berardi, Amir, & Ali, 2014).

High rise residential building's roof usually exposed to the ultraviolet light from sun and heat, it will cause the small splits and become large leaks on roof (Co, 2015). By using the green roof system, it help to increase the life span of the roofing membrane. The growing media and plant material of green roof protect roofing membranes from solar exposure and ultraviolet radiation (Getter & Rowe, 2006). During rainy day, the rainfall is excessive on asphalt paving flat roof of high rise residential building, it will give the runoff strain to the storm water system of the roof and cause flooding (Laforsch *et al*., 2009). The rain also flushes contaminants such as chemical substances, heavy metals and other substances on the flat roof and these contaminants will pollute waterways, beaches and river. The implementation of the extensive green roof which including plants materials, filter layer and the drainage layer on the high rise residential building help to absorb large quantities of rainfall, reduce the storm water runoff, reduce flood and reduce the pollutant from the roof to minimal level . Moreover, the dark-coloured pavement roof on high rise residential building tends to heat absorbs during the days and it releases slowly at night. The heat absorbing of the roof will increase the indoor and outdoor temperature of the building and then give the impact to the urban heat island. By application of the green roof is one of the most effective ways of combating the urban heat island effect (Getter & Rowe, 2006).

1.3 Research Questions

i. What is the level of awareness among the stakeholders regarding the implementation of extensive green roof system in the high rise residential building?
ii. What are the challenges of the extensive green roof system of the high rise residential building?
iii. What are the methods to encourage the implementation the extensive green roof to the high rise residential building?

1.4 Research Objectives

i. To investigate the level awareness among the stakeholder in implementation the extensive green roof system in high rise residential building.
ii. To identify the challenges of the extensive green roof system of the high rise residential building.
iii. To identify the methods to encourage the implementation extensive green roof to the high rise residential building.

1.5 Significance of the Study

The implementation of the extensive green roof in the high rise residential building can protect the roof of residential building and it can reduce the negative impact on the environment. This research is important to improve the implementation extensive green roof to the high rise residential building. Otherwise, it also has benefited and can contribute to academic and stakeholder of the construction company. This research can be the reference to assist academic carry the future research in the future and as a learning reference. Moreover, the level awareness of the extensive green roof among the stakeholder of the construction company will be increased and it helps the stakeholders to improve the implementation extensive green roof to the residential building

1.6 Scope of the Study

The geographical scope of this study focuses on the high rise residential building with the extensive green roof at Kuala Lumpur. However, the respondent of this study is selected the professional respondent which is the stakeholder of the green roof building.

2. Literature Review

2.1 Green Roof

The green roof is a technology that integrating plants in the building to build a green environment. Green roof or planted roof also can be referring to roof garden in other places or country. The roof garden is an open space that designed to provide an open place for human pleasure and activities (Osmundson, 1999). The green roof is a green space that design with adding growing medium layers and plants layers on the top of building traditional roofing system in a building (Nigel & Noel, 2004). The green roof is to install living vegetation on the roof of the building. In addition, the green roof is a stable living ecosystem that can help the urban environment more suitable for life, efficient and sustainable development (Hitesh *et al*., 2005) According to the Oak Ridge National Laboratory (2010), green roof can be identified as a roofing system that is designed, constructed, maintained, rehabilitated, and demolished with an emphasis throughout its life-cycle on using natural resources efficiently and preserving the global environment.

2.2 Extensive Green Roof

The principle of the extensive green roof involves providing a very thin layer of soil over the roof structure that supports low growing vegetation (refer Figure 1 in Appendix A). Extensive green roof is lightweight, modern versions of the sod roofs that are a centuries-old tradition in Scandinavia. The extensive roofs can be installing on a flat roofs and on roofs with slopes of up to thirty degrees (Werthmann, 2007). Extensive green roof also defined as shallow green roof systems and it is usually inaccessible installation in which the growing medium is a thin layer with a maximum depth of about 150mm which including vegetables or plants (Asmat, Muna Hanim & Abdul Malek). The plants that suitable for planting on the extensive green roof are mosses, grasses, succulents and some flowering plants. The weight of the extensive green roofs is less than the intensive green roof and its appropriate implementation for largely sized rooftops and on the sloped roofs. Meanwhile, the technically construction processes of the extensive green roofs is simple than the intensive green roof (Berardi & Ghaffarian, 2014)

2.3 System and Component of Extensive Green Roof

Green roofs are made of a system of manufactured layers deliberately placed over roofing structures which support growing medium and vegetation (Chow & Abu Bakar, 2016). An extensive green roof system contains a high quality waterproofing membrane, root barrier layer, drainage layer; filter layer a lightweight growing medium, and vegetation. These components can be installed separately on the roofs (Tolderlund, 2010). Figure 2 in Appendix A shows the components of the green roof.

(a) Vegetation Layer

Plants build up the uppermost layer, which adds life to the green roof system (Vijayaraghavan, 2016). The different vegetation options will require different depths of the substrate (growing medium) in order to support the plants and their root structures. The type of plants used for the extensive green roof is usually having high dough tolerance, great ability to absorb rainwater after a dry period. The

plants that suitable for the extensive green roof are the plant with the short and soft root to avoid penetration of the root barrier (Vijayaraghavan, 2016).

(b) Growth Substrate

The substrate is the soil or growing medium on a green roof. This is soil replacement that suitable for green roofs. It provides the necessary nutrients and good anchorage for the plants, together with aeration of the roots even in wet conditions. Substrate is important for any green roof plant growth and performance of the green roof. Generally, the depth of substrate is dependent on the type of vegetation being planted. The characteristics of the substrate for extensive green roof are low bulk density, high stability, high water holding capacity, hydraulic conductivity and so on (Vijayaraghavan, 2016). Low growing vegetation or plants will require very low levels of the low nutrient, free draining substrate. Meanwhile, the high growing vegetation such as wildflower will require deeper substrate which is 100mm-150mm.

(c) Filter Layer

A filter layer is located between growth substrate layer and drainage layer, which separate the growth substrate from the drainage layer. The filter layer has small pores to filter out the small media particles and soil fines while the water flows into the drainage layer below. These filter fabrics must have high tensile strength in order to withstand the load above. In addition, the filter fabric also acts as a root-barrier membrane for plants or vegetation which have soft and short roots (Vijayaraghavan, 2016).

(d) Drainage Layer

The drainage layer acts as an important role in the success of any green roof. It maintains an optimal balance between air and level of water in the green roof system. Most green roof vegetation requires an aerated and non-water-logged substrate for good growth. The drainage layer helps in removing of excess water from the substrate to ensure that the substrate layer doesn't become waterlogged. Drainage layer also protects waterproof membrane and improve thermal properties of green roof (Townshend, 2007).

(e) Root Barrier

Root barriers are located between drainage layer of the green roof and the roofing membrane for waterproofing systems. It is a layer which puncture-resistant material to avoid roots of the vegetation on the green roof's upper layers penetrating the roofing membrane and prevents leaks (Bianchini & Hewage, 2012).

(f) Waterproof Layer

The waterproof layer is a principal of the green roof. It protects the roof layer from water to break through and penetrates into the building. The purpose of waterproof layer is to avoid the roof of the building leaks (Snodgrass, 2006).

(g) Roof Deck

Roof deck comes in many forms of material. Green roof is commonly installed on the concrete slab, steel or steel-concrete composite.

2.4 Awareness of the stakeholder of the Extensive Green Roof in High Rise Residential Building

The adoption of the green roof system in Malaysia is still far behind compared to developed countries. This situation may be due to factors such as technical awareness, cost, technology, skills, structural integrity, maintenance and so on that affect the use of green roofs. This study focuses on the awareness of the stakeholders involved in the construction industry. Awareness of the green roof by the

stakeholder involved in construction industry is crucial in determining the direction of this green technology. This is because they play an important role in the evacuation and application of green technology, especially green roof system in Malaysia.

According to MASTIC (2010), awareness is defined as the degree of a person knows about an issue either through his or her reading, hearing, observation or feeling. Awareness is the condition or ability to see, feel, or become aware of events, objects, or senses. The simple sense of awareness is the ability to identify, process, and understand the critical elements of information about what is happening around. Awareness is also interpreted as a dynamic conscious reflection on the situation that individuals face. It provides a dynamic orientation to the situation, an opportunity to reflect the past, present and future and the potential of the situation. Dynamic reflection contains logical concepts, imaginations and unconscious and unconscious components that allow individuals to developmental events event instructions (Bedny & Meister, 1999).

2.4.1 Elements of Awareness

Awareness is related to general responses or feelings about something that happens. Awareness can arise from various aspects such as aspects of knowledge, attitudes, and actions (Barnes, 2005). Many authors agreed about the special awareness of environmental protection and conservation requires knowledge, understanding, change of attitudes and actions by every individual, society or parties involved.

(a) Knowledge

Knowledge development requires more data acquisition or new information. It requires regular understanding, application, analyse, synthesize and evaluate materials on a regular basis as well as a knowledge framework that can place and manipulate new information (Klein, Moon, & Hoffman, 2006).

(b) Understanding

Understanding is a process that involves identifying patterns, interpretations and evaluating the situation. Understanding also requires the process of integration information to understand how a situation will affect the goals and objectives. This is in developing a comprehensive picture or a partial description for the parties involved (Barnes, 2005).

(c) Attitude

Developing an attitude of appreciation and concern for the environment is a delicate and difficult process. Many educators believe that attitude change comes from the experience of life. The experience can take place outside and in the classroom. The experience gained from two main sources which are interaction with the outside environment and the education in class (Chaiklin, 2011).

(d) Action

The primary goal of the awareness is the ability to establish action and participation in an issue or matter. This is a complicated process because it requires the adaptation of new behaviour. This is a complex process because it requires elements such as self-motivation and life experience to change the behaviour of individuals or encourage individual actions (Carruthers, 2009).

2.5 Challenges of the Implementation Extensive Green Roof

The challenges of the implementation of the extensive green roof can be discussed in the limitation of the knowledge and awareness, lack of incentive, increasing of maintenance cost of the extensive green roof, cost of design and construction. Besides, the technical difficulty during the design and

construction process in the extensive green roof. The weak affordability of extensive roof to withstand wind load and weak structural loading for applying extensive green roof system also is the barrier to promoting the roof.

(a) Lack of knowledge and awareness

Lack of knowledge means that an inadequate information sharing to the stakeholders (Zuniga & Eugenia, 2013). This is because lack of government use of extensive green roofs in their green roof projects and causes the public and the private sectors are not familiar with the extensive green roof systems. Meanwhile, the government and social communities lack in promoting the implementation of the extensive green roof on the rooftop among the public and private sectors (Townshend & Duggie, 2007). Moreover, lack of scientific research focused on the management and maintenance of the high rise building cause the lack to adopt of the green roof in the high rise residential building (Ismail *et al*, 2016).

(b) Lack of incentive

Lacking knowledge and awareness of the extensive green roof in the government sector causes the incentives that provided by the government to developers for installing extensive green roofs are inadequate. Besides, lack of incentive from the government towards the owners of the existing buildings also as challenges of implementation of extensive green roof (Getter & Rowe, 2006).

(c) Higher Cost

The extensive green roof is required to properly design a suitable roof base. So that, the design cost and the construction cost are higher than a traditional roof (Townshend & Duggie, 2007). Moreover, the extensive green roofs require regular of maintenance throughout their life span. So that, implementation of the extensive green roof will increasing the maintenance cost (Ngan, 2004). The maintenance cost of the extensive green roof in high rise building is more higher (Zuniga & Eugenia, 2013).

(d) Structural loading

Roof structural loading is the main factor determining the viability and cost of green roof installation, especially for extensive green roofs. The extensive green roof required some structural load to support compare with the traditional rooftop. Retrofitting an existing roof to the extensive green roof may not be feasible if the structural capacity of the roof is inadequate (Hui & Chan, 2008).

(e) Technical issues and risks associated with uncertainty

In the construction of the extensive green roofs that required some technical guideline. During installation of the extensive green roof system, there has some technical issue should be considered that include design issue, installation issue with the layer between waterproofing layer and plant layer, wind load and structural load (Urbis Limited, 2007).

2.6 Method to Encourage the Implementation Extensive Green Roof

The methods to encourage the implementation of extensive green roofs are discussed below:

(a) Incentives

The government provides incentive to developers and owner of existing buildings. The government offers extra floor area bonus to developers who construct certain green roof areas (Cutlip, 2006.). Long-term financial incentives affect green roofs over a long period even covering the whole life-cycle of a green roof. A long-term financial incentive is beneficial for a green roof's owner to maintain the roof

and conserve the plants. It also provides the potential for building confidence in implementing a green roof (He, 2011).

(b) Subsidies

The government aims to promote the use of extensive green roof systems it may need to provide subsidies for the construction of extensive green roof systems for existing and new buildings and buildings (Tam *et al.*, 2011). The lump-sum subsidy is the funding which government or non-governmental organization offers by one time to cover total or part of the cost of a green roof. It includes grant programs, governmental direct subsidies, and awarding of competitions. Besides, the non-government organization (NGO) also can help to provide the subsidies in the promoting of the green roof system. The government selects a number of projects by competition and offers money award. For example, Chongqing Government conducted a competition for Outstanding Roof Gardens, offering awarding instead of subsidy in 2005. As a competition, this policy promotes not only the quantity but also the quality of roof gardens (He, 2011). In addition, cooperating with media coverage, this competition could arouse both the dwellings and the developer's awareness of roof gardens.

(c) Education

To promote extensive green roof systems the government could act as a leader in using extensive green roof systems for governmental buildings. The government also should be cooperating with the mass media to educate the public to be aware of the importance of the green roof. Site visits, seminars and mass media could also be organized to disseminate knowledge to industry and public (Tam *et al*., 2011).

(d) Regulation Policy

The regulation policy also gives the role to encourage the implementation of extensive green roofs. For example, amount of green area compulsory in open space under property development regulations, the percentage of prescribed green space compulsory on roofs for development projects. Besides, green roof construction sets as a statutory requirement under certain conditions such as roof area and building size.

(e) Setup Guideline

To promote the green roof system, the stakeholder of the green roof must have clearly understanding definitions of different green roof systems and basic components of green roof systems should be included in the guidelines as well as information on the structures of green roof systems and functions of each component. The guidelines should also include specifications for design, construction and maintenance (Zhang, Shen, Tam, & Lee, 2012). The green roof contractor must have clearly setup guideline in constructing the extensive green roof. The contractor must provide a knowledgeable and qualified proposal. The contractor also must understand the performance characteristics of individual green roof components.

3. Research Methodology

In this research, the quantitative method is using data collection instrument. The questionnaire was designed by setting several relevant questions. The questionnaire distributed to the stakeholder of high rise residential building around Kuala Lumpur. Primary data was very important to the study because it gave the highest priority and result come from respondents are affect the study.

3.1 Research Design

Research processes act as a guideline in doing this study. It was a well-organized process made up of different stages and each stage is interrelated. The important stages of methodology step process to

carry out to achieve the objective of the project. Therefore, there were few procedures have been arranged in phases to ensure research can be completed and achieve the objective (refer Figure 3 in Appendix B).

(a) Phase I

In this phase, researcher identified the current issues and problem and select the title that is suitable based on the identified the problem. After that, the researcher will identify the research question, objective, research scope and significance of this research. The objectives of this study were set based on the research questions. The research objectives select are to investigate the level awareness among the stakeholder in implementation the extensive green roof system in high rise residential building, to identify the challenges of the extensive green roof technology of the high rise residential building and to improve the implementation extensive green roof to the high rise residential building. Moreover, a literature review that related to the extensive green roof was explained and discussed through reading from journal, book, government report, and reputable website.

(b) Phase II

In order to achieve the objectives, a quantitative approach was implementing for data collection. A set of questionnaires distributed to the respondent. The target respondents in this survey are the stakeholder in implementation the extensive green roof system in high rise building at Kuala Lumpur.

(c) Phase III

The data was analysed using descriptive statistic. The responses in the questionnaires were tabulated, percentages were calculated, and the results were presented in the form of tables, graph, charts as well as textual discussions. The researcher concludes the results and make the recommendation based on the collected data in the conclusion and recommendation sections.

3.2 Data Collection

The relevant information of the research topic is collected from primary data (Chua, 2006). In this research, primary data was collected by distributing questionnaires to respondents. A questionnaire survey is the main instrument to obtain information and data from the respondent. This method is selecting because questionnaire can use for a large sample, geographically dispersal and collection of data in short time. In this research, the questionnaire will be divided into four sections. The first section of question was a respondent demographic, the second section about the level awareness in implementation the extensive green roof system in high rise residential building, the third section is on the challenges of the extensive green roof technology of the high rise residential building, and the fourth suction was the method to encourage the implementation extensive green roof to the high rise residential building. The questionnaire of this research used the Likert scale questions in the close-ended questions (Fellows & Liu, 2009). Likert scale questions are very simple and often use in the questionnaire. The respondents will ask to answer each statement based on their degree of the agreement and disagreement (Gliem, 2003). Table 1 in Appendix A shows the Likert Scale that was used on the level agreement for questions asked in the questionnaire.

3.3 Data Analysis

The collected data was analysed using Statistical Packages for Social Sciences (SPSS) software as an analysis tool for the purpose of getting results of the research. The SPSS is using to identify the frequency and percentage of each element in the questionnaire based on research objectives Next, the data was explained using descriptive analysis. Descriptive analysis is to describe the characteristics of the data by obtaining the frequency, percentage and mean obtained from the questionnaire. Descriptive statistics help researchers simplify the abundance of data in a reasonable way (Trochim, 2006). Each descriptive statistic reduces a lot of data into a simpler summary. Collected data can be made in the

form of pie charts or bar charts. Descriptive Statistics are used to present quantitative descriptions in a manageable form. If researcher simply renders the raw data, it will be difficult to visualize what the data shows, especially if the data are many. Thus, descriptive statistics are very important to allow a researcher to present data in a more meaningful way, which allows for a simpler interpretation of the data.

Table 2 in Appendix A shows the classification of mean index which is the descriptive statistic method researcher used to analyze the data. Different range of mean index that score by data collected will fall into different level of agreement that suitable to the scale. Five level of agreements which are very low level of awareness, low level of awareness, moderate level of awareness, high level of awareness and very high level of awareness have different range of mean index. In addition, this research also used relative index to present the findings. By comparing the relative indexes, these values were arranged in order from the smallest to the largest. From this order can be determined which was more effective to determine the importance. The relative value is divided into five phases with each stage having a fraction of the respective value as illustrates in Table 3 in Appendix A.

4. Data Analysis and Results

4.1 Rate of Response

Table 4 in Appendix D showed that the structured questionnaires were distributed to 45 construction organizations in Kuala Lumpur who are involved in implementation of the green roof system. Subsequently, the number of the respondents who were answered and returned the questionnaire were 40 respondents. All the returned questionnaires were complete and valid, thus respond rate was at 88.89 %. The 88.89% of a response rate was good, as a response rate of more than 40% is acceptable (Akoa, 2011).

4.2 Respondents Demographic

Table 5 in Appendix D illustrated respondents' demographics such as designation and year of experience of the respondents. Most of respondents were contractors which was 30% (12 respondents). The respondents who were developers had 22.5% (9 respondents). There were 15% (6 respondents) who work as architects and 12.5% (5 respondents) were landscape architects. There is an equal number of respondents were engineers that consist of 4 respondents (10% of respondents), and 4 respondents (10% of respondents) who were project managers. Table 4.2 also showed the work experience of respondents in the construction industry. Most respondents that had working experience for 5 years to 7 years were 35% (14 respondents). There were 22.5% (9 respondents) that had working experience for 2 years to 4 years, 17.5% (7 respondents) that had working experience for 8 years to 10 years and 15% (6 respondents) that had working experience for 11 years and above. There are 10% (4 respondents) that had work experience for less than 1 year.

4.3 Level Awareness of Green Roof Implementation

This section explains the level of awareness of extensive green roof implementation among respondents based on elements of awareness such as knowledge, understanding, attitude, and action. Table 6 showed the level awareness of knowledge of the extensive green roof among the respondents of implementation of extensive green roof. The highest mean value was 4.125 for the respondents were agreed with them knew the advantages of the extensive green roof system. The knowledge of respondents had the high level awareness with the mean value of 4.075, which were the respondents knew the disadvantages of the extensive green roof system. Besides, the respondents who had the general knowledge about the extensive green roof with a mean value of 3.900. However, the

respondents who had the knowledge in details about the extensive green roof were in the moderate level of awareness which was 3.125 of mean value.

Table 6: Knowledge of the Extensive Green Roof among Respondents

	Element	Mean	Standard Deviation	Level Awareness
No	Knowledge			
1	I have the general knowledge about the extensive green roofs.	3.900	0.591	High level
2	I know the advantages of the extensive green roofs system.	4.125	0.463	High level
3	I know the disadvantages or the extensive green roofs system	4.075	0.474	High level
4	I have the knowledge in details about the extensive green roof.	3.125	0.790	Moderate level
	Average	3.806	0.580	High level

The level of knowledge of the respondents was at a high level awareness with an average mean value of 3.806. The high level awareness of knowledge about implementation of the green roof is caused by the consultants susceptible to the development of new technologies and systems in the construction industry. The consultants focused of the latest new technology in the construction industry (Rahman *et al.*, 2015)

Table 7 showed the understanding of the extensive green roof among the respondent of implementation of extensive green roof. The highest mean value was 4.175 for the respondents understood that extensive green roof system can protect the environment. The respondents who understood the basics of the extensive green roof system were in the high level awareness with the mean value of 3.725. The respondents who understood the requirements to ensure the completion of the extensive green roof were in the moderate level awareness with the mean value of 3.075. The respondents had high level awareness level of understanding with an average mean value of 3.650.

Table 7: Understanding of the Extensive Green Roof among Respondents

	Element	Mean	Standard Deviation	Level Awareness
No	Understanding			
1	I understand the basics of the extensive green roof system.	3.725	0.599	High level
2	I understand that the extensive green roofing system can protect the environment.	4.175	0.385	High level
3	I understand the requirements to ensure the completion of the extensive green roof system.	3.075	0.797	Moderate level
	Average	3.650	0.594	High level

The high level awareness of the understanding about implementation of the green roof is caused by the consultants have a high level understanding of the basics of the green roof system. The reason due to the consultants were exposed to green roof since they studied in educational institution and also through books and articles reading (Rahman *et al.*, 2015).

Table 8 showed the attitude of the extensive green roof among the respondent of implementation of extensive green roof. From Table 4.4, the respondents had the level of attitude at a moderate level awareness with an average mean value of 2.6. The attitude of the respondents try to improve their understanding of the extensive green roof system to their working organization was at the moderate level of level awareness, which was 2.950 of the mean value. The respondents who were focused on the latest news and information about the green roof system were at moderate level with the

mean value of 2.650. The respondents who attended seminars and course that related to the extensive green roof system were at the low level of awareness, which were 2.250 of mean value.

Table 8: Attitude of the Extensive Green Roof among Respondents

	Element	Mean	Standard Deviation	Level Awareness
No	Attitude			
1	I focused on the latest news and information about the green roof system	2.650	0.949	Moderate level
2	I am attending seminars and course that related to the extensive green roof system.	2.250	0.832	Low level
3	I try to improve my understanding of the extensive green roof system to my working organization.	2.950	0.904	Moderate level
	Average	2.617	0.895	Moderate level

The moderate level awareness of the attitude in implementation of the green roof is due to the aesthetic value of a building will increase. A study by Rahman *et al*., (2012) and Jeremy *et al*., (2013) addressed the positive attitudes and aesthetic reactions toward green roof implementation.

Table 9 showed the action of the extensive green roof among the respondent of implementation of extensive green roof. The highest value of mean was 2.675 for the respondents had promoting the implementation of green roof system for construction projects. The respondents who were planned to implement an extensive green roof system for construction project at the moderate level awareness of action with the mean value of 2.625. The respondents who were implementing the extensive green roof for the existing green roof was at the low level of awareness, which was 1.825 of mean value. The respondents' level of action was at a low level awareness with an average mean value of 2.375.

Table 9: Action of the Extensive Green Roof among Respondents

	Element	Mean	Standard Deviation	Level Awareness
No	Action			
1	I am promoting the implementation of green roofing systems for construction projects.	2.675	0.730	Moderate level
2	I plan to implement an extensive green roof system for construction projects.	2.625	0.868	Moderate level
3	I am implementing the extensive green roof system for the existing building	1.825	0.675	Low level
	Average	2.375	0.758	Low level

The low level awareness of the action in implementation of the green roof is caused by the contractor and project manager were limited influencing green roof system when them involved in the green roof project. The contractors' involvement is limited in the influence of green building practices (Buys & Hurbissoon, 2011).

4.4 Challenges of the Implementation of Extensive Green Roof

Table 10 showed the challenges of the implementation of extensive green roof according to their relative index value. The order rank is used to indicate challenges that very high influence as the number 1 and the very low influence as thirteen (13) numbers.

Table 10: Relative Index for the Challenges of the Implementation of Extensive Green Roof

No	Challenges	Relative index	Rank
1	Knowledge of green roof systems is important to provide the right information for an extensive green roof.	0.875	1
2	Lack knowledge of developers.	0.740	6
3	Lack knowledge of contractors.	0.705	8
4	Lack knowledge of architects.	0.710	7
5	Lack scientific research on the management.	0.675	11
6	Lack of scientific research on the maintenance.	0.655	12
7	Lack of information provided by the government to the developers.	0.830	3
8	Less promotion by government to the developers.	0.840	2
9	Inadequate incentives that provided by the government to the developers.	0.690	9
10	The construction cost is higher.	0.775	4
11	Increasing the design cost.	0.760	5
12	Increase the load on the roof structure.	0.675	11
13	Limited standard design.	0.675	11
14	Limited guidelines.	0.710	7
15	Limited experience of the green roof professional.	0.760	5
16	Difficulty during the design process	0.690	9
17	Difficulty during construction process	0.680	10
18	Difficulty in laying the waterproofing layer.	0.670	12
19	Difficulty in laying plant layer.	0.690	9
20	Lack maintenance of extensive green roof.	0.605	13

Based on Table 10, showed that the knowledge of green roof system was the important challenges of implementation the extensive green roofs in high rise residential building which 0.875 of relative indexes. The lack of the scientific research about the method of installation and benefits of the extensive green roof affect the implementation of the extensive green roof system (Ismail *et al.*, 2016)**.** Zuniga and Eugenia (2013), mentioned that lack of knowledge caused the respondents lack of information and the knowledge about the green roof system. The government less promoting the extensive green roof to the developers was the second challenges which its relative index is 0.84. According to Townshend & Duggie (2007), mentioned that the less promotion by the government will affected the implementation of the extensive green roof. In the previous research by Zhang, Shen, Tam, & Lee (2012), indicated that the support by the government has been an early stage of development very important in promoting the use of green roofs. If the government don't take any action in promoting the green roof system, it will cause the construction industry will not active in the competitive and will not considered the adoption of the green roof system.

This is followed by third challenges which is lack information provided by the government to the developer with relative index is 0.83. Most of the respondents agree that government acts as important role in give the information in detailed to the developers. If the developers have inadequate information about the extensive green roof system, it will cause the limitation of the green roof in the construction industry (Zhang et al., 2012). The forth challenges was the construction cost of the extensive green roof is higher which the 0.775 of relative index. In the study by Ngan (2004), indicated that the construction and design cost of green roof system is higher than conventional roof. This is because the architects or landscape architects will increase the design cost in implementation of the extensive green roof.

With a relative index of 0.76, the design cost of the extensive green roof is higher and the limited experience of the green roof professional became the fifth challenges of the implementation of the extensive green roof in the high rise residential building. According to the Apul (2008), the implementation of the extensive green roof will increase construction cost due to the increasing the

material cost and the extra roof load capacity. The high cost of installation and materials for green roof due to the limitation of green roofs suppliers in Malaysia (Ismail *et al.*, 2012). The previous research by Ismail (2012), mentioned that the limitation of local expertise and inexperienced green roof professionals created a challenge to implement green roofs in Malaysia. According to Zuriea (2010), indicated that the lack of experience among green roof professional that ultimately lead some problem to the building.

The others important challenges that influencing the implementation of the extensive green roof system in the high rise residential building were lack knowledge of the developers which was 0.74 of relative index, lack knowledge of architects and limited guidelines were obtained the relative index for 0.71, and lack knowledge of contractors (relative index 0.705) . The moderate important challenges that affecting the implementation of the extensive green roof were inadequate incentives that provided by the government to the developers, difficulty during the design process and difficulty in laying plant layer. The relative indices of them were 0.69. Besides, the other challenges are difficulty installation during construction process with the relative index of 0.68, lack scientific research on the management, increase the load on the roof structure and limited standard design (relative index 0.675). The others challenges that included lack of scientific research on the maintenance and difficulty in laying the waterproofing layer. Both of them had the 0.655 of the relative index. The last challenge is lack maintenance of extensive green roof which was 0.605 of the relative index.

4.5 Methods to Encourage the Implementation Extensive Green roof to the High Rise Residential Building

Table 11 showed the analysis result for 40 respondent's agreement toward the method to encourage the implementation of the extensive green roof in the high rise residential building. From the survey, 22 respondents strongly agreed with the government gave details explanation to the developers. Also, 28 respondents strongly agreed with the cooperation between the government and mass media to educate the public to be aware of the benefits of the implementation extensive green roof. Based on the data obtained from the questionnaires, 26 respondents strongly agreed with cooperation between the academicians to conduct research. Then, 27 respondents agreed with the government provide an incentive to developers was the method to encourage the implementation of extensive green roof. Besides, there were 25 respondents agreed with the government provides incentives to owners of existing high rise residential buildings is the method to encourage the adoption of the extensive green roof.

Table 11: Method to Encourage the Implementation Extensive Green roof to the High Rise Residential Building

No	Methods	Mean
1	The government gives details explanation to the developers.	4.45
2	Cooperation between the government and mass media to educate the public to be aware of the benefits of the implementation extensive green roof.	4.575
3	Cooperation between the government and academician to conduct research.	4.625
4	The government provides incentives to developers.	3.975
5	The government provides incentives to owners of existing high rise residential buildings.	3.775
6	The government provides the subsidies in the promoting of the extensive green roof system in the high rise residential building.	4.075
7	The government provides subsidies for the maintenance of the extensive green roof.	4.075
8	The government provides details operation guideline to the contractor.	4.550
9	Increasing the amount of green area compulsory in an open space for property development projects.	4.500

Data obtained from the survey shows 21 respondents agreed and 11 respondents strongly agreed with the government provides the subsidies in the promoting of the extensive green roof is one of the methods in implementation of the extensive green roof in high rise residential building. Then, 20 respondents agreed with the government provide subsidies for the maintenance of the extensive green roof is the method to encourage the implementation of the extensive green roof in high rise residential building. Moreover, 24 respondents strongly agreed with the government provide detail operation guideline to the contactor is the method to encourage the implementation of the extensive green roof. Next, 24 respondent agreed with the increasing the amount of the green area compulsory in an open space for property development project. Based on Table 4.10, there were majorities of the respondents strongly agreed that the cooperation between the government and academician to conduct the research was the effective method to encourage the implementation extensive green roof to the high rise residential building with the mean value of 4.625. The cooperation between the government and academician created the own green roof research group and association. The government and academician from the local and international universities can collaborate to conduct research in identifying the factor that cans successful implementation of the green roof system (Ismail *et al.*, 2012).

Table 11 showed that the cooperation of the government and the mass media to educate the public to be aware of the benefits of the implementation extensive green roof was another method to encourage the implementation of green roof system with the mean value of 4.575. Due to the cooperation between government and mass media, it will increase the awareness of the public to adopting the extensive green roof. According to the Zuniga & Eugenia (2013), stated that the mass media was acts as the important role to educate the public for expand the influencing of the green roof system. The educations to the public for enhance the awareness of the importance of green roofs was one of the method to encourage the implementation of extensive green roof (Tam *et al.*, 2011). Besides, the government provides the subsidies and incentives also were the method to encourage of implementation of the extensive green roof. This is due to the subsidy is the funding which the government offers to cover total or part of the cost of a green roof, it will decrease the cost of the implementation of the extensive green roof in high rise residential building. The long-term financial incentives affect green roofs over a long period even covering the whole life-cycle of a green roof. A previous research by Ismail (2012), stated that providing incentive is a successful method to promote green roofs to the construction industry.

5. Conclusion

The overall results of the respondents involved with this questionnaire were identified through this study. The implementation of the extensive green roofs in high rise residential building among stakeholders in the construction industry was at moderate level of awareness. It also showed the need for mechanisms in increasing awareness and their knowledge of environmental sustainability green roofs. Furthermore, the main challenges of green roof implementation are knowledge of green roof systems is important to provide the right information for an extensive green roof, less promotion by government to the developers and lack of information provided by the government to the developers. Therefore, the stakeholders in the constructions industry were agreed that the cooperation between the government and academician to conduct research was the most effective method to encourage the implementation of the extensive green roof. The cooperation between the government and mass media to educate the public to be aware of the benefits of the implementation of the extensive green roof also was the important method to encourage the implementation extensive green roof to the high rise residential building. Moreover, the government provides details operation guideline to the contractor also was one of the methods. Without the comprehensive operation guideline, it caused the failure of implementation of the extensive green roof in the high rise residential building and difficulty during construction process. Finally, this study was conducted only in Kuala Lumpur. The result that obtained by researcher may not same as other location in Malaysia. Therefore, it is recommended that future study can be conducted in other district or state to investigate the level awareness among the

stakeholders of the green roof system and factors that cause the limitation of the implementation of the green roof system in Malaysia.

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References

Akoa, B.B. (2011). Cost overruns and time delays in highway and bridge projects in developing countries - experiences from Cameroon. Maters diss., Michigan State University.

Apul, D. (2008). University of Toledo North Engineering Building: Installation of a Green Roof. Retrieved 10 30, 2011, from Sustainable Engineering and Science:http://www.eng.utoledo.edu/civil/newweb/sustainability/Courses_Offerd/Installation %20of%20a%20Green%20Roof.doc

Asmat, I, Muna Hanim, A. S & Abdul Malek A. R.(2008), "Using Green Roof As a

passive Design Technology To Minimise the Impact of Global Warming," 2nd Int. Conf. Built Environ. Dev. Ctries. (ICBEDC 2008), no. Icbedc, pp. 588-598

Baharin, N. H (2012). Self Assessment Green Building Index for Residential Estates, 1–11. Retrieved from https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&ved=0ahUKEwjSx7-Q9r7TAhUFqI8KHZgHCc4QFgguMAI&url=http%3A%2F%2Feprints.utm.my%2F31509%2F1%2FNoor HamizahBaharinMFKA2012ABS.pdf&usg=AFQjCNErgZQb9N6Fe8WL0drfiSavmLfFhA&sig2=BXNcya _VJSltQ8aiMwSh8Q

Berardi, U., Amir, H., & Ali, Ig. (2014). State-of-the-art analysis of the environmental benefits of green roofs. *Applied Energy*. Elsevier. https://doi.org/10.1016/j.apenergy.2013.10.047

Bianchini, F., & Hewage, K. (2012). How "green" are the green roofs? Lifecycle analysis of green roof materials. *Building and Environment*, *48*, 57–65. https://doi.org/10.1016/J.BUILDENV.2011.08.019

Chow, M. F., & Abu Bakar, M. F. (2016). A Review on the Development and Challenges of Green Roof Systems in Malaysia. *International Journal of Civil, Environmental, Structural, Construction and Architectural Engineering*, *10*(1), 16–20.

Co, D. C. T. (2015). 10 Most Common Roofing Problems. Retrieved from http://www.nfmt.com/orlando/pdf/CommonRoofingProblemswhitepaper.pdf

Cutlip, J. (2006). Green Roofs : A Sustainable Technology, (October), 1–6. Retrieved from http://smsf-mastergardeners.ucanr.org/files/168313.pdf

Fauzi, M. A., Malek, N. A., & Othman, J. (2013). Evaluation of Green Roof System for Green Building Projects in Malaysia. *International Journal of Environmental, Ecological, Geological and Mining Engineering*, *7*(2), 53–59. Retrieved from https://waset.org/publications/1385/evaluation-of-green-roof-system-for-green-building-projects-in-malaysia

Fellows, R. & Liu, A. (2009). *Research Methods for Construction*. Blackwell Science.

Getter, K. L., & Rowe, D. B. (2006). The role of extensive green roofs in sustainable development. *HortScience*, *41*(5), 1276–1285. https://doi.org/10.17776/csj.30292

Gliem, J., & Gliem, R. (2003). Calculating, interpreting, and reporting Cronbach's Alpha Reliability Coefficient for Likert-type scales. *Midwest Research-to-Practice Conference in Adult, Continuing, and Community Education*.

Green Roof. (2018). Retrieved May 30, 2018, from http://www.restorationgardens.ca/green-roof-layers-and-systems/

He, M. M. (2011). *Prmoting Green Roofs in China: A Comparison of Green Roof Policies in the United States (U.S) and China*.

Hitesh, D., Doug, B., James, L., Paul, M., Angela, A., Beth, A., & Michael, V. (2005). *Report on the Environmental Bebnefits and Costs of Grenn Roof Technology for the City of Toronto*. Toronto.

Hui, S. C. M. (2010). Development of technical guidelines for green roof systems in Hong Kong. *Buildings*, (November), 1–8.

Ismail, W. Z. W., Ismail, F., Hashim, A. E., Irfan, A. & Ramli, R. R. (2009). Potentiality of Ecological Friendly Effect on Human Behaviour of Green Building Design. *InCEBS: Proceedings of the 1st National Conference on Environment-Behaviour Studies.*

Ismail, Z., Aziz, H. A., Nasir, N. M., & Taib, M. Z. M. (2012). Obstacles to adopt green roof in Malaysia. *CHUSER*

2012 - 2012 IEEE Colloquium on Humanities, Science and Engineering Research, (December), 357–361. https://doi.org/10.1109/CHUSER.2012.6504339

Klein, G., Moon, B., & Hoffman, R. R. (2006). Making Sense of Sensemaking 1: Alternative Perspectives. *IEEE Intelligent Systems*, *21*(4), 70–73. https://doi.org/10.1109/MIS.2006.75

Laforsch, C., Tollrian, R., Granholm, G. J. M., Olszewski, J., Administrative, C., Jean, O., … Ndèye, S. (2009). This article was originally published in the. *Neuroscience*, *3*(October), 1159–1166. https://doi.org/10.1016/B978-008043152-9.02245-4.Author

Ngan, G. (2004). *Green Roof Policies: Tools for Encouraging Sustainable Design*. Retrieved from http://www.gnla.ca/assets/Policy report.pdf

Nigel, D., & Noel, K. (2004). *Planting Green Roof and Living Wall*. Timber Press.

Oberndorfer, E., Lundholm, J., Bass, B., Connelly, M., Coffman, R., Doshi, H., et. al. (2007). Green roofs as urban ecosystems: Ecological structures, functions and services. *BioScience*, *57 (10)*, 823–833.

Osmundson, T. (1999). *Roof Gardens, History, Design, Construction*. New York: Norton & Co.

Preisler, S. (2006). *Green Structure*. *New York*. Retrieved from http://depts.washington.edu/open2100/pdf/2_OpenSpaceTypes/Open_Space_Types/green_structures.pdf

Rahman, S. R. A., Ahmad, H., Mohammad, S., & Rosley, M. S. F. (2015). Perception of Green Roof as a Tool for Urban Regeneration in a Commercial Environment: The Secret Garden, Malaysia. *Procedia - Social and Behavioral Sciences*, *170*, 128–136. https://doi.org/10.1016/j.sbspro.2015.01.022

Rahman, S. R. A., Ahmad, H., & Rosley, M. S. F. (2013). Green Roof: Its Awareness Among Professionals and Potential in Malaysian Market. *Procedia - Social and Behavioral Sciences*, *85*, 443–453. https://doi.org/10.1016/j.sbspro.2013.08.373

Shiva，Ji. (2016). Green Building Materials and their Common Use in Everyday Life, (January), 0–30. https://doi.org/10.13140/RG.2.1.1635.4323

Snodgrass, E., & Snodgrass, L. (2006). *Green Roof Plants: a resource and planting guide*. Portland: Timber Press.

Tam, V. W. Y., Zhang, X., Lee, W. W. Y., & Shen, L. Y. (2011). Applications of extensive green-roof systems in contributing to sustainable development in densely populated cities: A Hong Kong study. *Australasian Journal of Construction Economics and Building*, *11*(1), 15–25.

Tolderlund, L. (2010). Design Guidelines and Maintenance Manual for Green Roofs In the Semi-Arid and Arid West © Design Guidelines and Maintenance Manual for Green Roofs in the Semi-Arid and Arid West In collaboration with Green Roofs for Healthy Cities City and County of Denver Environmental Protection Agency Region 8 Urban Drainage and Flood Control District Design Guidelines and Maintenance Manual for Green Roofs In the Semi-Arid and Arid West ©. Retrieved from https://www.epa.gov/sites/production/files/documents/GreenRoofsSemiAridAridWest.pdf

Townshend, D., & Duggie, A. (2007). *ARCHITECTURAL SERVICES DEPARTMENT STUDY ON GREEN ROOF APPLICATION IN HONG KONG FINAL REPORT URBIS LIMITED Prepared by : Checked by : Approved for Issue by : Design*. Retrieved from https://www.archsd.gov.hk/media/11687/1353-green-roofs-es-2007-02-16.pdf

Trochim, W. M. K. (2006). *Research Methods Knowledge Base Qualitative Measures*. Retrieved from https://pdfs.semanticscholar.org/ca82/06e94c0beb7d63e10d04131966233f3d2a70.pdf

Vijayaraghavan, K. (2016). *Green roofs: A critical review on the role of components, benefits, limitations and trends*. *Renewable and Sustainable Energy Reviews*. https://doi.org/10.1016/j.rser.2015.12.119

Werthmann, C. (2007). *Green roof*. Retrieved from www.waitakere.govt.nz

Wong, N., & Chen, Y. (2008). *Tropical urban heat islands: climate, buildings and greenery*. Retrieved from https://content.taylorfrancis.com/books/download?dac=C2010-0-41008-8&isbn=9781134221103&format=googlePreviewPdf

Zhang, X., Shen, L., Tam, V. W. Y., & Lee, W. W. Y. (2012). Barriers to implement extensive green roof systems: A Hong Kong study. *Renewable and Sustainable Energy Reviews*, *16*(1), 314–319. https://doi.org/10.1016/j.rser.2011.07.157

Zuniga, M., & Eugenia, M. (2013). *Geen Roof Technology Adoption: What Stakeholders need ti Know about it*.

Appendix A

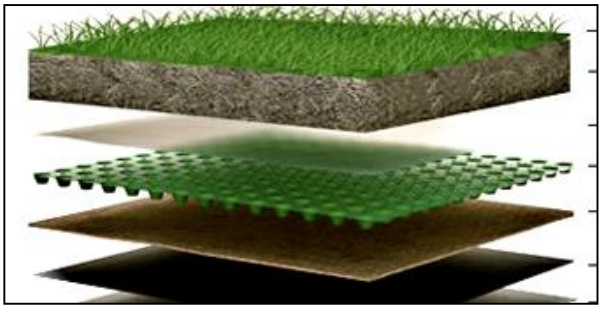

Figure 1: Extensive Green Roof (Green Roof, 2018)

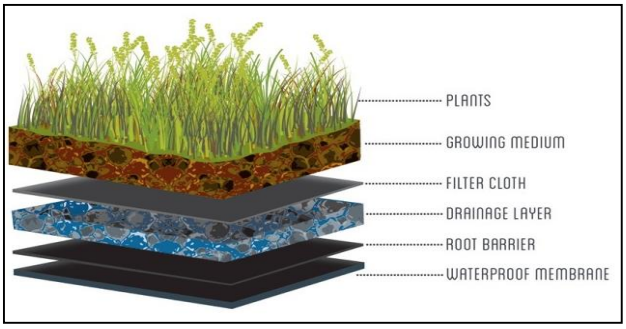

Figure Error! No text of specified style in document.**: Components of the green roof (Green Roof, 2018)**

Appendix B

Table 1: Level Agreement

Scale	Definition
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

Table 2: Classification of mean index (Uebersax, 2006)

Mean index	Awareness Level
0.00≤ Mean index＜1.50	Very low level
1.50≤ Mean index＜2.50	Low level
2.50 ≤ Mean index＜3.50	Moderate level
3.50≤ Mean index＜4.50	High level
4.50≤ Mean index＜5.00	Very high level

Table 3: Classification of Relative index

Relative Index	Meaning
0.2< Relative Index < 0.3	Not important
0.3< Relative Index < 0.5	Less important
0.5< Relative Index < 0.7	Moderate important
0.7< Relative Index <0.9	Important
0.9< Relative Index < 1.0	Very important

Appendix C

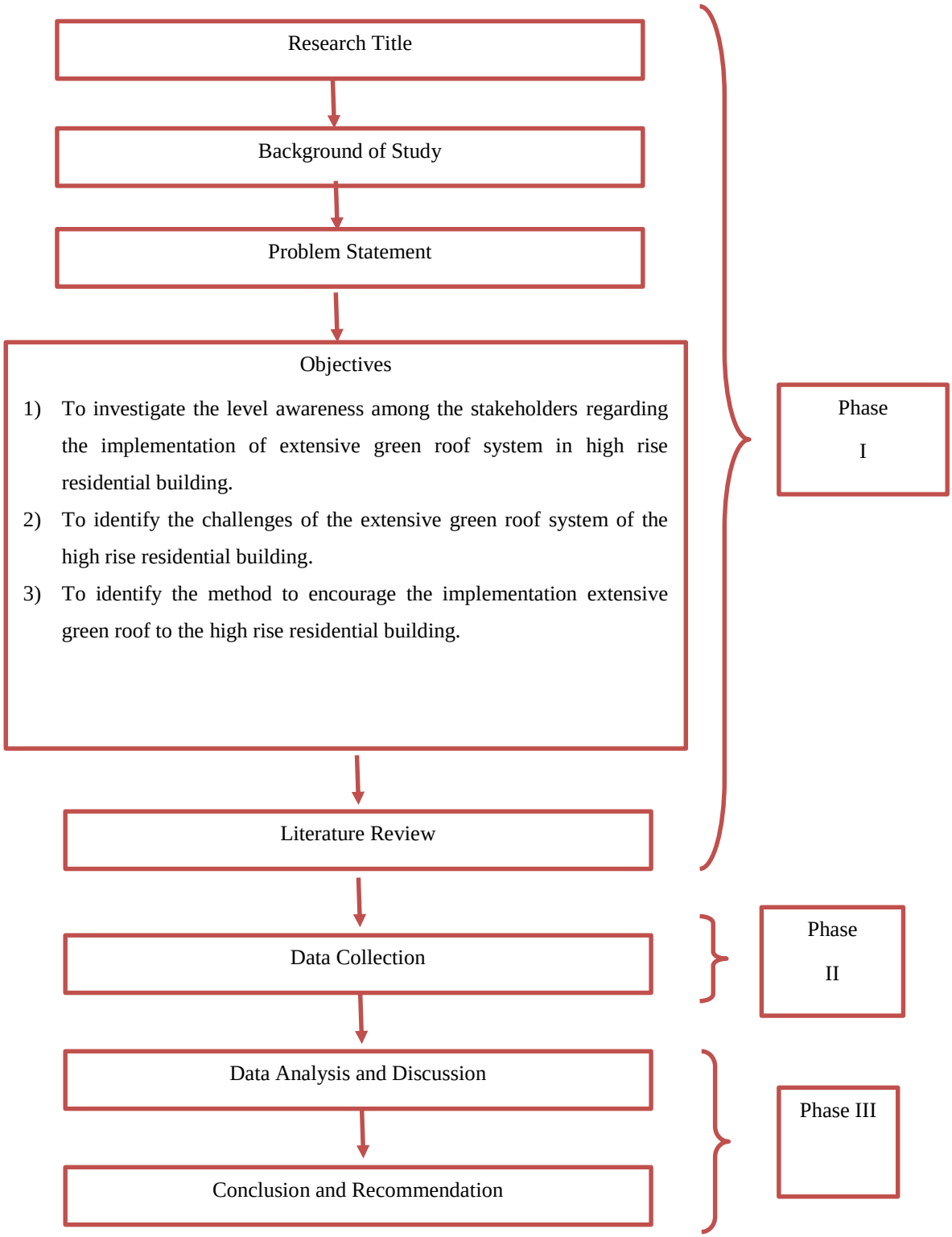

Figure Error! No text of specified style in document. **: Research Methodology Flowcharts**

Appendix D

Table Error! No text of specified style in document.**: Response Rate**

Questionnaires	Numbers	Percentage (%)
Distributed	45	100
Returned	40	88.89
Valid	40	88.89

Table 5: Respondents Demographic

Category	Frequency	Percentage (%)
Designation		
Contractor	12	30
Developer	9	22.50
Architect	5	15
Landscape Architect	5	12.50
Engineer	4	10.0
Project Manager	4	10
Total	40	100.0
Working_Experience		
Less than 1 year	4	10
2 - 4 years	9	22.5
5 - 7 years	14	35
8 - 10 years	7	17.5
11 years and above	6	15
Total	40	100