GREEN BUILDING INDEX MALAYSIA: DRIVERS AND BARRIERS OF IMPLEMENTING IT IN THE MALAYSIAN CONSTRUCTION INDUSTRY

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CIVIL ENGINEERING

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by

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CERTIFICATION OF APPROVAL

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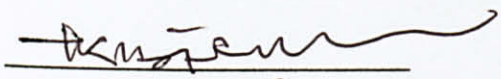

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TRONOH, PERAK

June 2010

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

Muhammad Yazid Bin Salehuddin

ABSTRACT

Green building or sustainable building is defined in different ways but they share common view that it should be design and operated to reduce negative impact on environment and human health. These design include how efficient the energy, water and other resources been consumed. Another factor it consider is how the management of the waste and pollution is been conducted throughout the construction process. In recognition of these problems, a number of tools have been developed to evaluate the performance of the building in terms of the impact on environment. Malaysia also has developed their green rating tools called Green Building Index (GBI). It was launched on April 2009 and developed by Pertubuhan Arkitek Malaysia (PAM) and the Association of Consulting Engineers Malaysia (ACEM). This research will go deeply on the characteristic of GBI compared to other green rating tools worldwide specifically in residential properties. The research will follow by a survey distributed to professional who involved the building construction industry to obtain their opinion on GBI. The survey will help gather some information on the respondent's (professional) opinion, knowledge and perception of the implication of GBI in Malaysia. After the survey is finished, the researcher will list out the drivers and barriers in implementing the GBI in Malaysia and discuss the solution for it.

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I would like to express the deepest appreciation to my Supervisor, Dr. Mohd. Faris Khamidi, who has the attitude and the substance of a genius; he continually and convincingly conveyed a spirit of adventure and an excitement in regard to research. Without his guidance and persistent help this dissertation would not have been possible.

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I would like to acknowledge and extend my heartfelt gratitude to my parent, especially my father Salehuddin Bin Mohd Isa who has been helped me a lot during the survey process. Not forgetting my colleagues and everyone who has been there during my worst and best time throughout this research. The companionship and teamwork help me a lot to understand how it feels to be one of the helping hands in getting the job done successfully.

Last but not least, I wish everyone a happy day and a successful life. As in conducting this Final Year Project, it does change my perception on how to motivate myself to be a better person in the near future and also the meaning of hard work to achieve my goal. Thank You!

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LIST OF ABBREVIATIONS

BREEAM	–	British Research Establishment Environmental Assessment Methodology
LEED	-	Leadership in Energy and Environmental Design
GBI	-	Green Building Index
PAM	-	Persatuan Arkitek Malaysia
ACEM	-	Association of Consulting Engineers Malaysia
IEQ	-	Indoor Environment Quality

Chapter 1: INTRODUCTION

1.1 Background of Study

The environmental impact of the building design, construction and operation industry is significant. Buildings annually consume a significant amount of energy, electricity, water and produce waste. Green Buildings, sometimes referred to as "Sustainable Buildings" or "Environmental Buildings" are designed to enhanced energy efficiency, promote renewal energy, and improve indoor environment quality. As an added benefit, Green Building also reduces operating cost, enhance building market value and increase worker productivity (commercial buildings). In other words Green Building has environmental, economic and social elements that benefit all building stakeholders, including owners, occupants and the general public.

Since 1990's, the Green Building rating system began to developed starting with the BREEAM (UK,1990) and later LEED (USA,1996). Most of the Green rating tools available in the world today concentrated within the temperate climate zones. Malaysia's Green Building Index or GBI is designed specifically for the tropical climate (hot and humid) and Malaysia's current social, infrastructure and economic development.

GBI is developed by Pertubuhan Arkitek Malaysia (PAM) and the Association of Consulting Engineers Malaysia (ACEM). It is a profession driven initiative to lead Malaysia towards a more responsible built environment. Two different sets of Green Building Indices have been developed for commercial and residential properties. The assessment criteria of the Green Building Index for commercial and residential buildings include energy efficiency, indoor environmental quality, sustainable site planning and management, materials and resources, water efficiency and innovation.

1.2 Problem Statement

Building construction industry is one of the greatest contributors to global warming and other form of environment pollution. Even though the energy and transport sector were the main sources for this problem, the role of construction industry should not be underestimated. Statistic shown that worldwide buildings contribute 33-38% on carbon emission, 30-40% on world's energy consumption, 40-50% on raw materials, 68% on electricity consumption and 12% on water consumption (The World Green Building Council & Environment Protection Agency, EPA 2004). Study also shown that Malaysia is the highest country that uses energy per capita (Fig. 1)

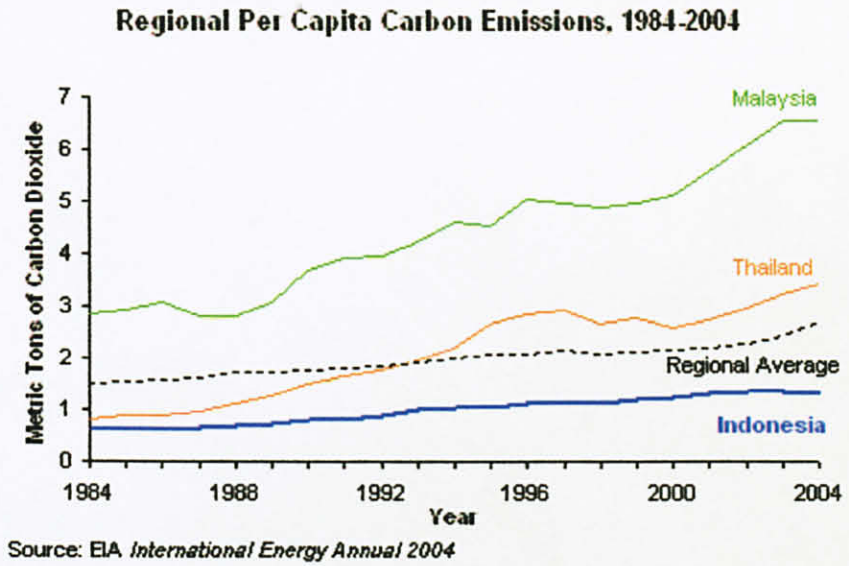


Figure 1: Regional Per Capita Carbon Emissions, 1984-2004

Malaysia's population alone has been growing at a rate of 2.8% from 23 million in 2000 to 27 million today. Currently 24% of urban home energy consumption comes from the use of cars to and from work, while 31% is from the use of cars after work. By 2015, Malaysia is expected to become a net importer of energy.

In response to this concern regarding the impact of design and operations of buildings to our environment, many experts and researchers have developed several green building rating systems. The main objective is to measure environmental

performance of the buildings based on several criteria. In Malaysia, we have our own green rating system called Green Building Index (GBI).

The main concern here is to know whether our country is ready to adopt this new concept and applied it. What are the barriers throughout the process? And what other alternatives can be done to promote this application of GBI? This research will provide an overview of GBI application and identifies various drivers and barriers in implementing the concept in our country. Ideally, after all the factor had been identified, the suitable solution can be implied to tackle the problem.

1.3 Objective

Three (3) main objectives are as stated below:

1. To gain expert opinion on the Green Building Index Malaysia application through a survey and interview based on their experience.
2. Identify various drivers and barriers in implementing the GBI in our country
3. Propose a solution to promote the application of GBI in Malaysia

1.4 Scope of Study

This project will cover on the characteristics of the Green Building Index Malaysia specifically for the Residential properties in terms of what they are, why they are used, who should use it, where they are used, how they are used and when they are used. Survey and interview will be conducted in order to gather all the data needed for analysis. The target for this survey are professional bodies involving in building industry such as architect, engineer, developer, quantity surveyor and many more. This will be very helpful in gathering information on the respondent's opinion, knowledge and perception of implication of GBI in Malaysia. Demographic data will be provided based on the survey result. Comparison between the green rating systems all over the world and GBI will be studied in terms of assessment criteria, buildings types, climate, and certification process. Research from the Internet, Journals and Books needed to collect information about other green rating tools.

Chapter 2: LITERATURE REVIEW

Many experts and researchers have developed several green building rating systems. The main objective is to measure environmental performance of the buildings based on several criteria that will be discussed later. The British Research Establishment Environmental Assessment Methodology (BREEAM) is the earliest rating system developed in 1990. Now there is lot of different system developed by different countries depending on their climate and current social. Australia and Singapore had their own green rating systems. Singapore has its GREENMARK system while Australia has its GREENSTAR system. Both systems based in part on the US Leadership in Energy and Environmental Design (LEED) rating system, one of the world's most widely adopted green assessment tools (Venus Hew, 2008). Being one of the country that full of construction industry, Malaysia also developed their own green rating system for commercial and residential properties specifically for tropical climate (hot and humid) and Malaysia's current social. Even though Singapore climate same as our country, GREENMARK is designed specifically the priorities and needs of Singapore. As stated in the research objectives, this study will provide an overview of Green Building Index Malaysia (GBI) specifically for residential properties, in terms of what they are, why they are used, who should use it, where they are used, how they are used and when they are used. In addition to that, comparison between the green rating systems all over the world and GBI will be studied in terms of assessment criteria, buildings types, climate, and certification process.

2.1 Introduction of Green Building Index

The professional bodies that responsible for the development of GBI are Pertubuhan Arkitek Malaysia (PAM) and the Association of Consulting Engineers Malaysia (ACEM). Research was conducted based on the existing green rating system, such as BREEAM (Britain), LEED (USA), GREENMARK (Singapore) and GREENSTAR

(Australia) to establish our own version of green rating system. Headed by PAM Past President Ar Dr Tan Loke Mun (Building Construction Authority, BCA of Singapore) GBI was introduced on 21st May 2009 (Green Design Forum,2009). The GBI objectives is to reduce carbon footprint in Malaysia and raise awareness among Developers, Architects, Engineers, Planners, Designers, Contractor and the Public regarding the environmental issues. Using this system, developers can design and construct sustainable buildings and it can be assessed and guided to reduce or minimize the impact on environment. The GBI comprised of two different tools, namely the GBI Residential and GBI Non-Residential respectively. Both of it will be using the same criteria for assessment but different emphasis (percentage) for each category.

GBI is unique compared to other rating tools because it was designed for both Residential and Non-residential properties. The reason it was designed separately because of different time peak energy use for both properties. Residential building function differently compared to Non-residential buildings (e.g. Industrial, Institutional). Usually Non-residential building operate at maximum capacity during the day while Residential building during the evening and night. Headed by Ar. Chan Seong Aun, GBI Residential assessment emphasizes more on sustainable site planning and management, followed by energy efficiency. The amount of energy used at Residential building usually much less than Non-residential building. This drive the GBI panel to develop the rating systems that consider environmental quality of homes through better site selection, accessibility of public transport, as well as improved infrastructure. Those factors not only will reduce the negative impact to environment but also benefit to residents and community by creating a better and safer place. "Residential properties with green rating compliance will be more desirable to potential house buyers and those seeking to rent, given the lower utility bills and healthier lifestyle" (Datuk Chan Sau Lai, National Council, 2008). Depending on the score evaluated by certified GBI facilitator, buildings will be rated accordingly and given the award of Platinum, Gold, Silver or Certified ratings. Final award is given one year after the building is first occupied. The awarded GBI rating is only valid for three years and buildings will have to be reassessed to maintain their GBI rating.

The sample of GBI assessment tools (Residential) can be found in **Appendix B.**

Key Components of the GBI (Residential)

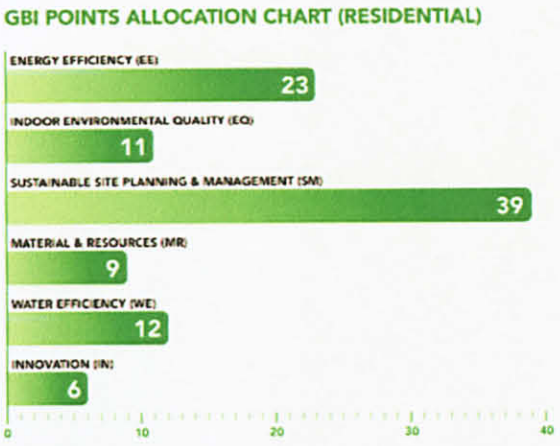


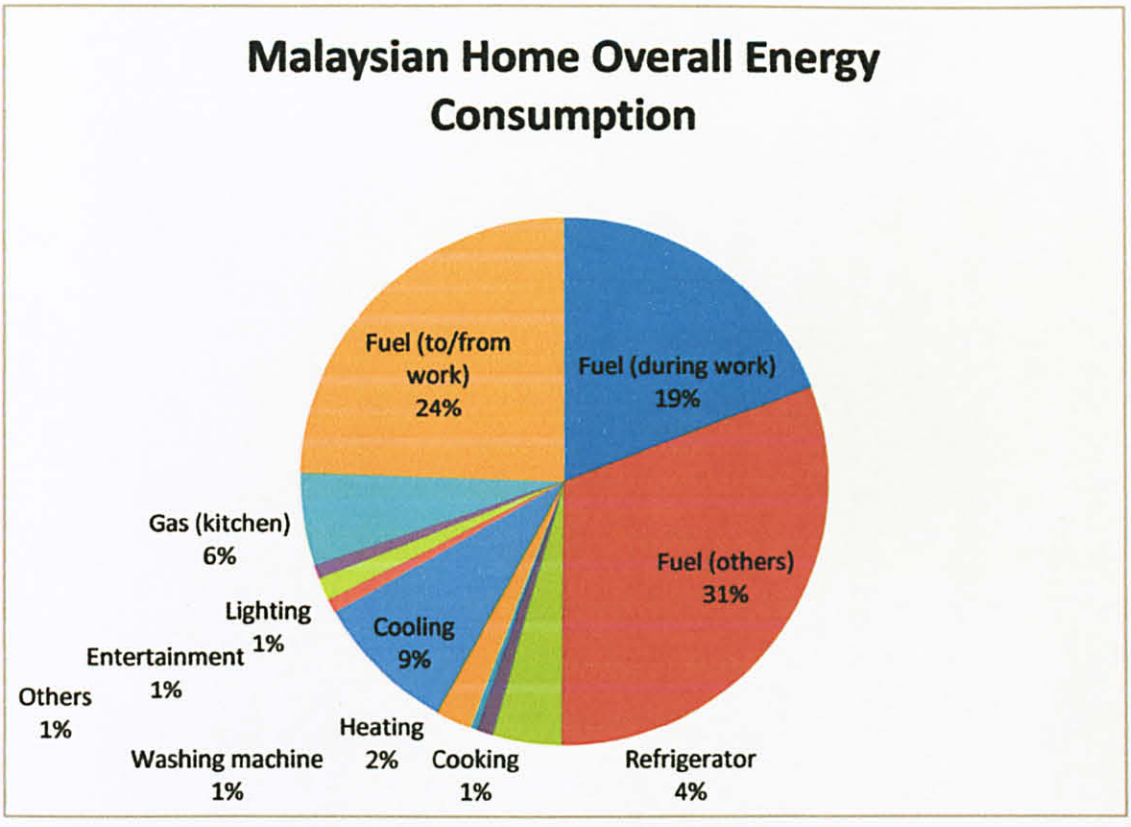
Figure 2: GBI Points Allocation Chart (Residential)

Source: http://www.greenbuildingindex.org/rating_system.htm

2.1.1 Sustainable Site Planning and Management

For a new housing project, selection of the site that will support a healthy community while minimizing the environmental impact is very crucial. Developers should not only build houses without proper investigation of the proposed site. Some of the criteria need to be considered by developers such as availability of public transport and basic amenities such as schools, places of worship, shops and park. This will reduce the fuel consumption by the residents in that area. As shown in figure 3 fuel is the most used energy by Malaysian. Providing Green Open Spaces to counter the Urban Heat Sink[1] effect and manage stormwater by using natural drainage, planning to avoid concentrated flows, and reducing impermeable surfaces. Developers also should consider doing re-development of Brownfield[2] sites rather than opening a new site.

[1] Metropolitan area which is significantly warmer than its surrounding rural areas.
[2] Land that is or was occupied by a permanent structure, which has become vacant, underused or derelict and has the potential for redevelopment.



Source: Ir Grumit Singh/ CETDEM

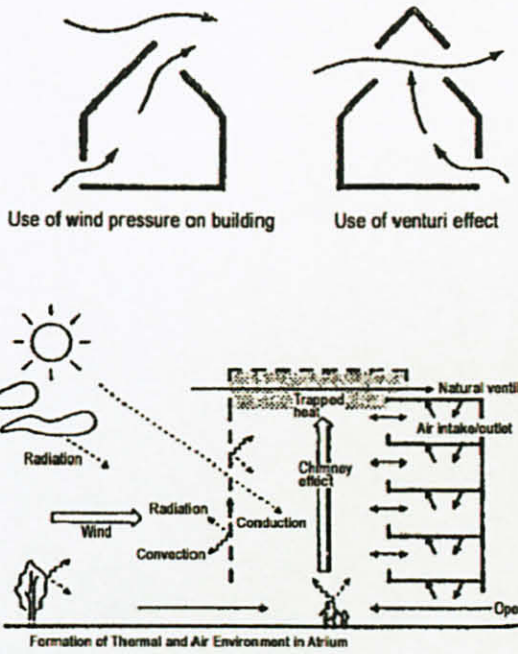
Figure 3: Malaysian Home Overall Energy Consumption

2.1.2 *Energy Efficiency*

Energy saving are the greatest way to return back the investment on green building. Energy efficiency is an integral part of green building and required a good design by architect. The sun, heat and high humidity are the key elements architect has to utilize in designing a sustainable building. Start by orientating the building to take advantage of sun angles so that energy requirement for day lighting will be reduced. One of the most important designs for energy efficiency buildings is roof. The roof plane receives the most sunlight and for the longest period through the day. Architects should use this as an advantage to utilize the renewable energy sources provided by using the solar system installed on the roof.

2.1.3 *Indoor Environment Quality (IEQ)*

By making use of good level of daylight, the energy requirement for the building will be reduced. Natural ventilation or passive cooling (figure 4) also a smart way to utilize the nature to cool down the temperature in the building. A good design should provide cross ventilation for all public and circulation phase. This will reduce the cost of electricity equipment in the house during the day. The other factor that contributes point in IEQ is sound insulation. Building should be designed with adequate insulation between dwelling units. Also, by providing the optimal level of thermal comfort for the building occupants, energy is not wasted over heating or over cooling the building.



Source: "Passive System House Design" by the Institute for Building Environment and Energy Conservation, published by Maruzen Co., Ltd.

Figure 4: Principle of natural ventilation

2.1.4 *Water Efficiency*

For these criteria, the assessment will rate by how efficient water been used in or outside the buildings like water recycling. One good example of water recycling practice is rainwater harvesting. Rain barrels are installed to make use of rain water for later use and reduce main water usage. Stored water may be used for watering plants or flushing toilets. Proper landscape design also increased outdoor water used efficiency. For example, vegetation and soils to improve water retention so it will reduce water consumption for landscape irrigation. For indoor water use efficiency, installing water efficient appliances can be the solution to this problem.

2.1.5 *Materials and Resources*

Choosing the right materials is crucial in construction since it consumes 50% of all resources globally (Edwards, 2002 in van Wyk and Chege). Proper supervision of waste generated by construction is needed and recycling the material is very effective way to reduce environmental pollution. Waste construction that can't be recycled should be disposed to proper landfill. Proper area and storage should be provided for collection of waste materials. For GBI assessment total tonnage of waste or truck load of waste disposal will be calculated in their rating calculation. Use durable products and materials that can be reused or recycled at the end of their lives. For example, since most of the building in Malaysia using reinforced concrete, contractor should go for the concrete made with fly ash and recycle aggregate base which is cheaper. Source of the product also can contribute in 'greening' the building. Locally produced materials have lower transport cost and it will benefit the developer. Developer should also avoid purchasing toxin materials like pressure-treated lumber that contains arsenic and chromium, two highly toxic elements that seeps into soils. Toxic substances are often used as preservatives, fire retardants, finishes, and sealants for building materials. These toxins are released throughout a product's life and pose a risk to construction crews working with recently treated materials, residents who come into contact with the substances daily, and the surrounding environment (Ross Spiegel and Dru Meadows, 2005).

2.1.6 *Innovation*

This criteria is included to encourage and reward the developer that using innovative technologies, design and process of construction that give a positive impact on environmental. In this modern day, new sustainable technologies, process and techniques are constantly being developed that can improve energy efficiency in buildings. For example, the inclusions of 'Solar Tube Skylight' (figure 5) in the building design. Solar Tube Skylights are great invention, as they bring in more natural light which will cutting down the cost on artificial light electricity as well as promoting good health for a home's occupants (Evelyn Lee,2006). It uses technology by refracting, reflecting and concentrating solar light into a small tube using mirrors and lenses. This invention is suitable for our country which is hot and humid.

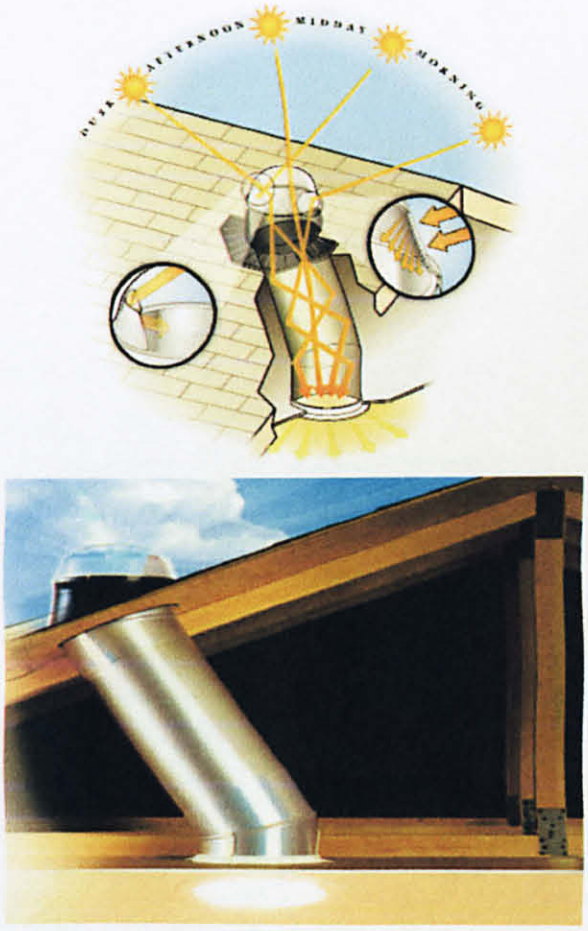


Figure 5: Solar Tube Skylight

Source: http://www.inhabitat.com/2006/12/28/solar-tube/

2.2 Other Green Building Tools

There are many other green building rating systems all over the world. Those tools were developed by their country suitable for their climate and social life. Even though these tools easily can be accessed online, trained facilitator is required to conduct an assessment for certification. The certification and scope of inspection in assessment different for each tool. Some of the tool developed by other country had been adopted by other country for their used. Majority of the green building tools are voluntary in their application but there are some country that made it mandatory like Singapore. Here are some of the green building rating systems available all around the world.

2.2.1 Building Research Establishment Environmental Assessment Method (BREEAM, Britain)

BREEAM is the earliest green rating tool assessment. It was developed by the British Research Establishment in 1990. It is the leading and most widely used environmental assessment method for buildings. It sets the standard for best practice in sustainable design and has become the de facto measure used to describe a building's environmental performance. Canada, Australia and several European countries have developed variations of BREEAM and use it for their country (AHSRAE Journal, 2004). BREEAM Canada and BREEAM GreenLeaf are examples of such efforts. After the assessment, the building will be awarded 'Pass', 'Good', 'Very Good' or 'Excellent' rating. BREEAM major categories for assessment include the following:

1) **Management**
2) **Health and Well-Being**
3) **Energy**
4) **Transport**
5) **Water**
6) **Materials**
7) **Land Use**
8) **Ecology**
9) **Pollution**

2.2.2 Leadership in Energy and Environmental Design (LEED, U.S.A)

LEED was developed by U.S Green Building Council (USGBC) in 1998. LEED has grown to encompass more than 14,000 projects in the United States and 30 countries covering 1.062 billion square feet (99 km²) of development area (Green Building by the Numbers, USGBC, 2008). LEED was originally developed as a rating system for new commercial buildings but has become a rating system for other building sectors. The success of LEED has created demands for adapting the rating system for existing buildings, commercial interiors and residential buildings. LEED major categories for assessment include the following:

1) **Sustainable Sites**
2) **Water Efficiency**
3) **Energy and Atmosphere**
4) **Materials and Resources**
5) **Indoor Environment Quality**
6) **Innovation and Design Process**

2.2.3 Green Star (Australia)

Green Star is a voluntary environmental rating system for buildings in Australia. It was launched in 2003 by the Green Building Council of Australia (GBCA). GBCA is a national, not-for-profit organization that is committed to developing a sustainable property industry for Australia by encouraging the adoption of green building practices. It is uniquely supported by both industry and governments across the country. Green Star has built on existing systems and tools in overseas markets including the British BREEAM (Building Research Establishment Environmental Assessment Method) system and the North American LEED (Leadership in Energy and Environmental Design) system. Green Star major categories for assessment include the following:

1) **Management**
2) **Indoor Environment Quality**
3) **Energy**

4) **Transport**
5) **Water**
6) **Materials**
7) **Land use and Ecology**
8) **Emissions**
9) **Innovation**

2.2.4 Green Mark (Singapore)

Green Mark was launched by the Building and Construction Authority (BCA) in January 2005 as a green rating system to evaluate buildings in Singapore. In April 2008, Singapore made it mandatory for all new or existing buildings exceeding 2,000m² in floor area to have their Green Mark minimum rating (Certified). There are some of the projects in Malaysia that got the Green Mark certifications from Singapore. It is high rise development called Sunway Pallazio in Sri Hartamas who won the Green Mark Gold Award, while Sunway Challis in Damansara received the Green Mark Certified Award (Business Times, July 2nd 2009). Green Star major categories for assessment include the following:

1) **Energy Efficiency**
2) **Indoor Environment Quality**
3) **Water Efficiency**
4) **Environmental Protection**
5) **Innovation**

2.3 Business Case for Green Building

One of the favourite questions usually asked by developers before they wanted to adopt this 'Green Building' in their project is "Does green pay off?" Research has conducted by both US Green Building Council [22] and the GBCA[8] proved that initial cost of green building is between zero to 10 percent more. But, the business and other benefits of green building will cover back the initial cost that had been invested.

The payback method involves calculating the number of years it'd take to recover the initial additional cost for green building. For this formula, additional cost (numerator) will be divided with annual savings (denominator) to obtain the payback for investment. Life Cycle Cost (LCC) is used to measure total cost of a green project through project's entire useful life. It measures the opportunity cost of one investment versus an alternative and provides data as which might provide a better ROI.

2.4 Overview of Green Building Index

In order to conduct more thorough study regarding GBI, research had been done through various resources like internet, journals, books, articles, etc. This information will be helpful to gain better understanding about GBI and it will be very helpful in the process of drafting the questions for surveys and interview. After the research had been done to identify all the criteria in GBI and other green rating tools, comparison table (Table 1) had been constructed to see clearly the difference between GBI and other green rating tools in term of its criteria.

2.4.1 Comparison between GBI and Other Green Rating Tools

Table 1: Comparison between GBI and other Green Rating Tools

	GBI	BREEAM	LEED	Green Star	Green Mark
Energy Efficiency	✓	✓	✓	✓	✓
Indoor Environmental Quality	✓		✓	✓	✓
Water Efficiency	✓	✓	✓	✓	✓
Sustainable Site	✓		✓		
Environmental Protection					✓
Management	✓	✓		✓	
Materials	✓	✓	✓	✓	
Innovation	✓		✓	✓	✓
Transport		✓		✓	
Emissions				✓	
Ecology		✓		✓	
Land use		✓			
Pollution		✓			
Health and Well Being		✓			

Note: For GBI "Sustainable Site" and "Management" criteria is put under one category, but for other tools they were separated.

From the table, it can be seen that GBI is lacking some of the criteria adopted by other tools such as:

1) Environmental Protection
2) Health and Well Being
3) Transport
4) Land use &Ecology
5) Pollution
6) Emissions

The criterion's that lack in our GBI will be explained as below:

A. Environmental Protection (Green Mark)

According to Green Mark under the Environmental Protection categories consists of four (4) sub criteria which are:

a) Sustainable construction

Encourage the adoption of building designs, construction practices and materials that are environmental friendly and sustainable.

b) Greenery

Encourage the use of greenery, restoration of trees to reduce heat island effect

c) Environmental Management Practice

Encourage the adoption of environmental friendly practice during construction and building operation.

d) Public Transport Accessibility

Promote the use of public transport to reduce pollution from individual cars

B. Health and Well-being (BREEAM)

This criterion is aiming at reducing indoor pollutants and improving the thermal comfort. Plus it also considered the adequacy of ventilation and lighting quality.

C. Transport (BREEAM and Green Star)

Generally this criteria emphasis on:

a) Encouragement of using public transport
b) Distance between residential development to public transport or public amenities

D. Land use & Ecology (BREEAM and Green Star)

This category is to encourage the use of existing building and sites, minimize the use of new land in order to reduce the environmental impact. Site selection also provides an extra mark for assessment depending on the site location and their surroundings.

E. Pollution (BREEAM)

This criteria measure the pollution emits or occurred during the construction period or after the building is completed. It also considered how they manage the waste materials produced during construction that can lead to pollution. This criteria is similar to 'Emissions' used in Green Star except that Green Star has developed their own formula on how to estimate the greenhouse emission. Credit also been given for building that use local or renewable energy.

F. Emissions (Green Star)

These criteria consider the amount of waste discharge by various appliances used in residential properties that will give an impact on environment. Green Star has come up with Greenhouse Gas (GHG) Emissions Calculator to estimates the greenhouse emissions from the building and compares these to the emissions from a benchmark building.

2.5 What's Next on Green Building Index Malaysia

Researchers and experts had strived to develop our own rating tools but the question is "Is our construction industry ready to use these new rating tools and adopt it in their future project?" The next chapter will discuss the opinion from the expert from various professions in building construction to gain overall understanding about drivers and barriers of GBI in Malaysia.

CHAPTER 3: METHODOLOGY

3.1 Data Collection

3.1.1 Literature Reviews

By doing literature reviews, the outline and overview of the research topic can be identified. Besides, the author can get more understanding about Green Building Index and other green rating tools worldwide. The sources for the literature review are such as books, articles, journals, internet and etc. For this study, literature review will help the author to construct the survey questionnaire that will be distributed. Literature review also mainly used for the first and second objectives of this study which are to provide an overview of Green Building Index Malaysia and to compare between Green Building Index Malaysia and other green rating tools.

3.1.2 Survey

In order to achieve the objectives of this project, survey is the efficient way to gain an experts opinion regarding GBI application in Malaysia specifically for Residential properties. The targeting respondent for this survey is minimum 30 people from various sectors in building construction industry. The result from the survey will be presented in the form of graph or chart so it will give clear view of the results. Analysis will also be done based on the graph or chart. The questionnaire was design to determine:

a) Benefits of Green Building
b) Green Building contribution in reducing the environmental impacts
c) Barriers in constructing 'Green Building'
d) Initiatives to increase 'Green Building' application
e) Bodies responsible in the initiative to promote GBI application

3.2 Sources

The target for this survey are professional bodies involve in construction industry. For example architects, engineer, quantity surveyor, developer, etc. Both government and non-government workers will be the target to obtain the different opinion from both sectors. The survey will target those who in relevant industries for more than 5 years. General audience like students, lecturers, or anyone else will also be considered to gain opinion from the public regarding the GBI. The respondents will be invited to do the survey by mail or online for convenience and ease of processing.

3.3 Instrumentation

Questionnaires were used as the primary data-gathering instrument for this study. The information in the literature review was used to meet the objectives of this study. The questionnaire (Appendix A) has four sections that include:

1. Section A: The respondent profile (Checklist)
2. Section B (Understanding Green Building)
   - Experience and knowledge about Green Building application in Malaysia (5 points on the Likert Scale)
3. Section C (Green Building Application)
   - Benefits of Green Building (5 points on the Likert Scale)
   - Barriers in implementing Green Building concept (5 points on the Likert Scale)

3.4 Data Analysis

Likert Scalling using Mean Index Formula

The returned questionnaires were analyzed using Statistic Program for Social Science (SPSS) software. Frequency, mean, standard deviation and total mean were calculated. The outputs from every question analyzed were presented in the form of table or chart. For section A and B frequency analysis were used to present the data in the form of percentage. For section C, mean, standard deviation and total mean were calculated. The formula for mean is as shown below:

$$Mean\ Index = \frac{\sum a_i x_i}{N}$$

Where:

$a_i = constant\ expressing\ the\ weight\ to\ each\ response\ (1\ to\ 5)$

$x_{i=frequency\ of\ the\ response}$

N = total number of response

(Source: Montgomery,Monger&Hubele,2007)

Mean Factor Analysis

In order to rank the result from the questionnaire returned, the author has decided to use Mean Factor Analysis method. The data gathered is tabulated and mean for each criterion was calculated using Mean Index formula shown before. After that, the author will show the result by specific line graph drawn to show the trend of the mean. After that, another line is introduced and labeled as 'Total Mean' which is the average of total mean. Any items / variables with its' mean value is less than the 'Total Mean' the items / variables are considered as 'Low Level', if the mean value is same as the 'Total Mean', then it is 'Moderate' and if the mean value is higher than the 'Total Mean' so, it is considered as 'High Level'

CHAPTER 4: RESULTS AND ANALYSIS

4.1 Introduction

This study focused on the significance of Green Building Index implications in Malaysia. As mentioned in chapter 3 on methodology, survey questionnaire were used as the data collection instrument. Questionnaires were distributed to professional bodies involved in construction industry like architects, engineers, quantity surveyors, developers, etc. The questionnaires were used to address the objective of this research.

In this chapter the objectives will be addressed and compared with the outcome of the survey. The objectives include identifying the following:

1) To specify the importance and significance of GBI in Malaysia
2) To identify the drivers and barriers of implicating the GBI in Malaysia
3) To determine the benefits of GBI

As noted in methodology, questionnaires were sent to professional from various sectors in building construction industry. The total number of 32 questionnaires was returned to the researcher. Surveys received were entered into a data file and analyzed through the Statistical Program for Social Science (SPSS) software. The frequencies of respondents and percent (%) were tabulated based on the returned questionnaires. The determination of mean and standard deviation were calculated and analyzed in questions with a five-point scale or Likert Scale.

The results from the survey were determined in the following order:

1) Section A: Demographic characteristic of respondents
2) Section B: Understanding "Green Building"
    a) Respondents understanding about Green Building
    b) Respondents understanding about GBI and other Green Rating tools worldwide
3) Section C: Green Building Application
    a) Benefits of implying green building concept
    b) How Green Building can contribute in reducing environmental impacts
    c) Barriers in implementing Green Building concept
    d) Initiatives to increase Green Building application
    e) Parties responsible in the initiatives of GBI application

4.2 Data Analysis

4.2.1 Section A: Demographic characteristic of respondents

This section is covered about respondents profile like gender, age, profession, experiences and education level. The data from this section will be used as reference for the data gathered in Section B and C. The following are the information from the questionnaire.

Table 2: Respondents' Profile for the survey conducted

RESPONDENTS' PROFILES						
Age	**20-30**	**31-40**	**> 40**			
	9.4%	34.4%	56.2%			
Gender	**MALE**		**FEMALE**			
	87.5%		12.5%			
Experience	**< 3 YEARS**	**4-5 YEARS**	**6-10 YEARS**	**> 10 YEARS**		
	0%	9.4%	9.4%	81.2%		
Profession	**C&S**	**Mechanical**	**Architect**	**Electric**	**Academician**	**OTHER**
	21.9%	21.9%	37.5%	12.5%	3.1%	3.1%
Education	**DOCTORAL**	**MASTER**	**BACHELOR**	**DIPLOMA**	**CERTIFICATE**	
	0%	15.6%	84.4%	0%	0%	

4.2.2 Section B: Understanding Green Building

This section concerned about respondents knowledge about Green Building Index Malaysia and other green rating tools worldwide. It also asks whether they have an experience on working on any Green Project. Open ended question were asked for their opinion regarding 'Green Building' application for residential properties.

Question 1: How well do you know about Green Building?

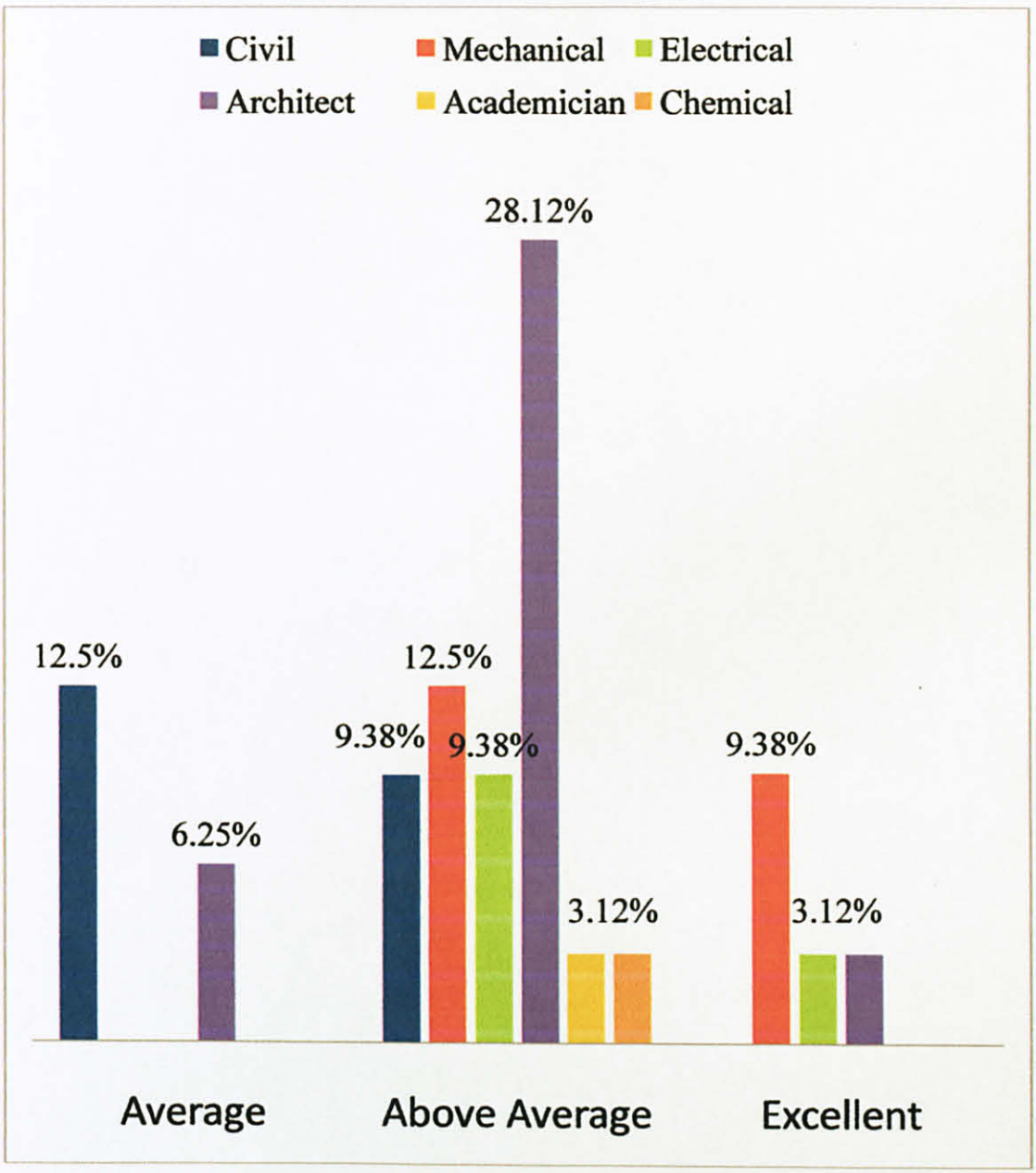


Figure 6: How well the respondents know about Green Building

Question 2: Have you completed (or still working) on any Green Project?

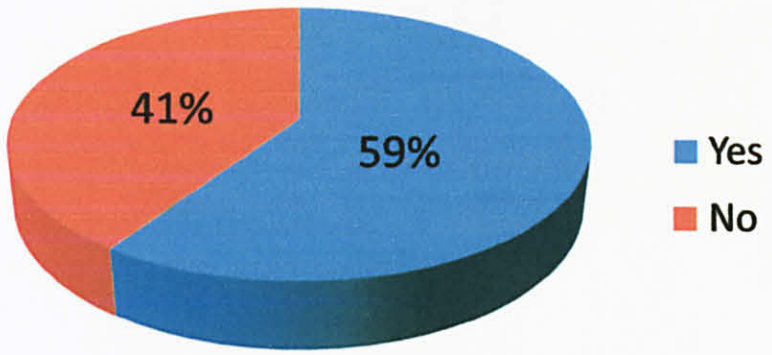


Figure 7: Have the respondents completed (or still working) on any Green Project

As shown in the figure 6, all respondents are well known about Green Building. Only 22.22% have an average knowledge about Green Building while 62.95% is above average and 14.81% is excellent. These prove that generally, none of the professional bodies in our country that doesn't know at all about the concept of Green Building. In the pie chart of question 2, it shows that 55.56% of the respondent have completed (or still working) on any Green Project while 44.44% haven't been involved in any of the Green Project.

Question 3: Green Building is more costly than conventional building?

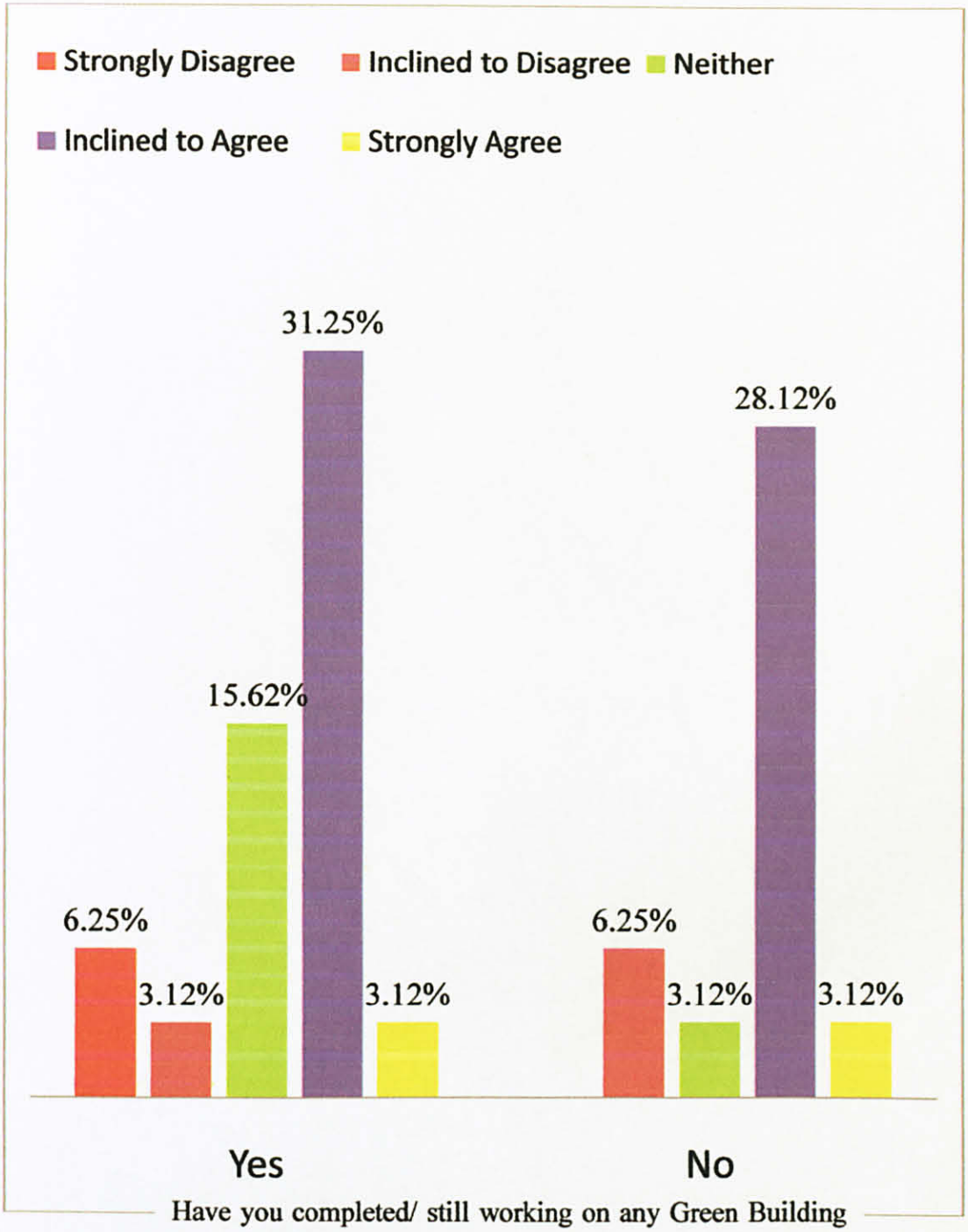


Figure 8: Green Building is more costly than conventional building?

Question 5: Will you consider for Green Building criteria for your next project?

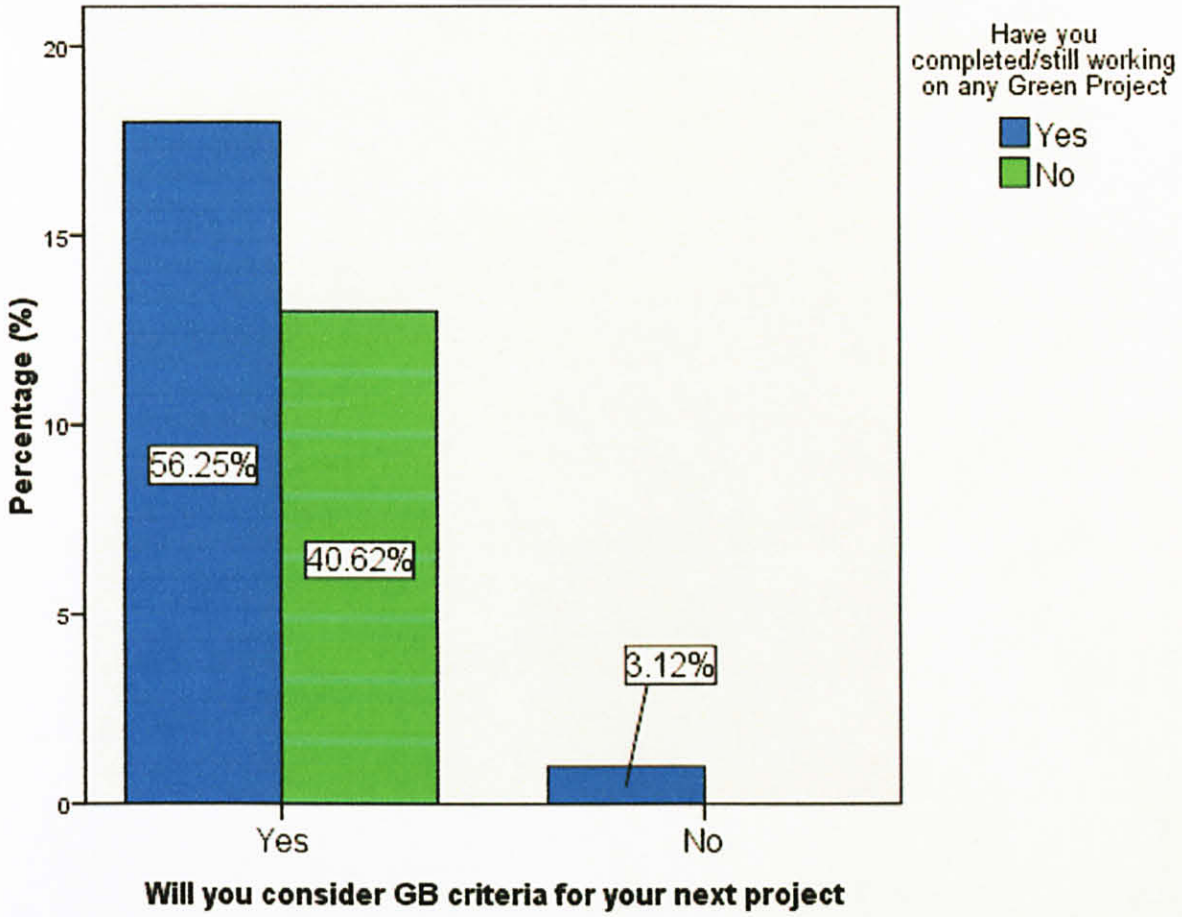


Figure 9: Will you consider for Green Building for next project?

Question 6: How well do you know about Green Building Index (GBI) Malaysia?

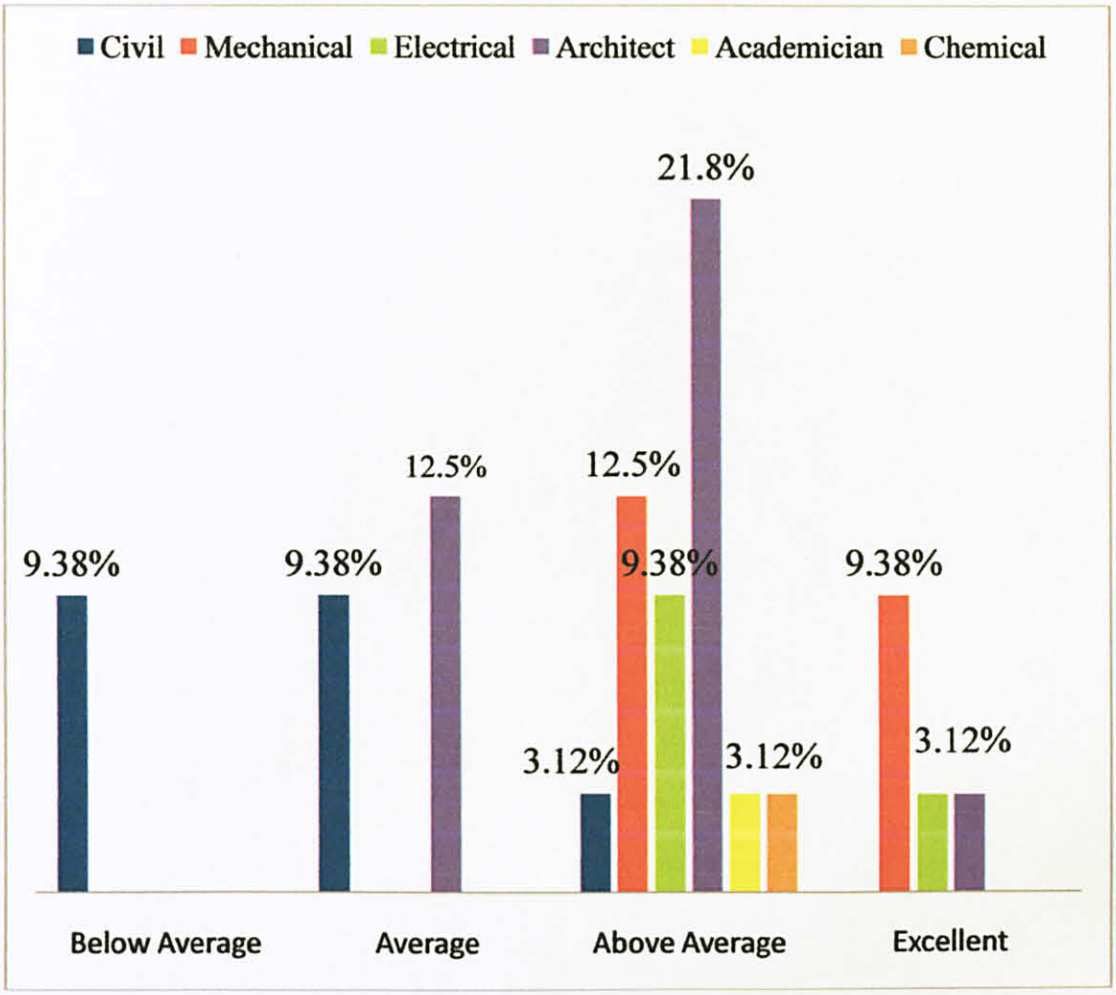


Figure 10: Respondent knowledge about GBI

From the figure 8, it can be concluded that majority of the respondents (66.66%) agree that Green Building is more costly than conventional building (Inclined to agree and Strongly Agree). While 18.52% doesn't agree with that statement (Strongly Disagree and Inclined to Disagree) and 14.81% is neither. The figure also segregate respondents based on their experience whether they have completed (or still working) in Green Project which make the data more reliable since they have an experienced. In question 5, it has been shown in figure 9 that 96.29% of respondents will consider for Green Building for their next project, regardless whether they have an experience with Green Project or not. Only 3.7% of respondent who had experience with Green Project doesn't consider going for Green Project for him/her next project. In question 6, the author asked the respondents specifically about their knowledge about GBI. It is shown in figure 10 that 70.35% (Above average and Excellent) of respondents have a good knowledge about GBI, while 11.11% is below average and 18.52% is average.

Question 7: Do you think that implication of Green Building in our country is important?

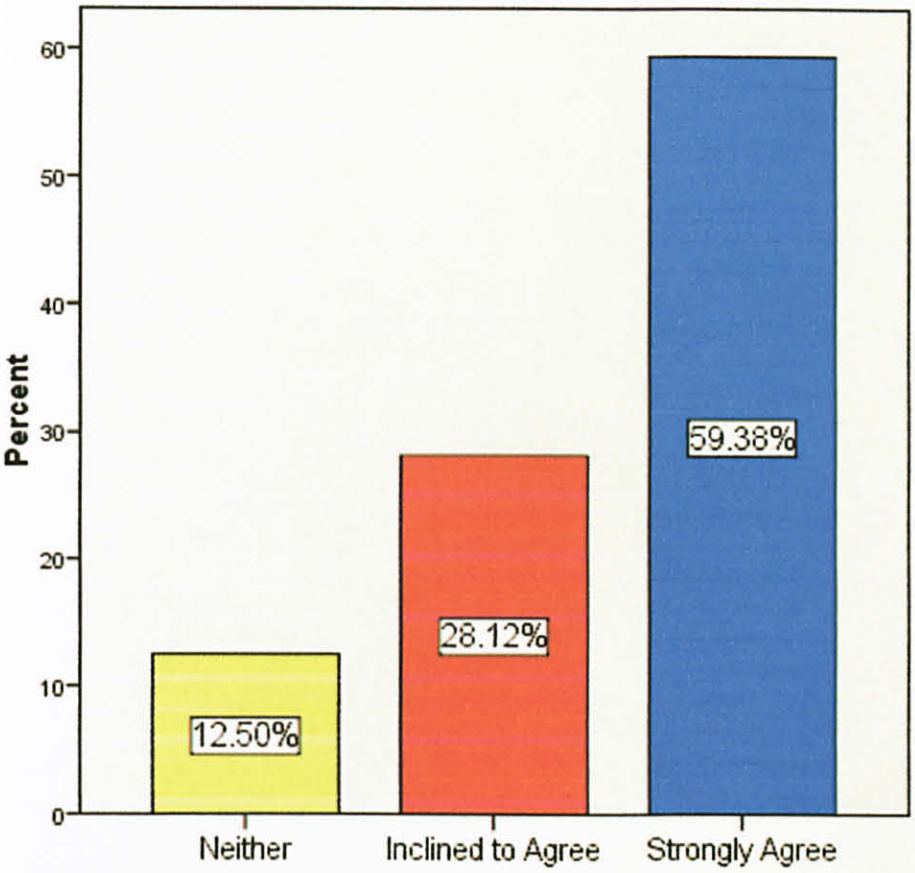
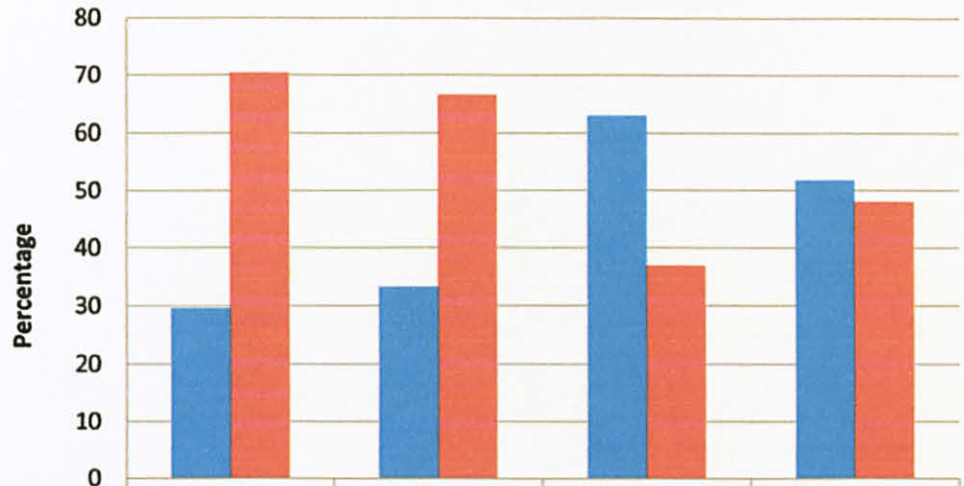


Figure 11: Respondent opinion about importance of GBI application

Question 8: There were other green building rating tools that had been established before GBI. Do you familiar with these tools?



	BREEAM	Green Star	LEED	Green Mark
Familiar	29.6	33.3	63	51.9
Not Familiar	70.4	66.7	37	48.1

Figure 12: Respondents knowledge about other Green Rating tools

In question 7, it is a quite straight forward question where the author asked whether the implication of Green Building in our country is important. It is shown that 51.85% of respondents are strongly agreed with it. 33.33% of them were agreed and only 7.41% choose neither. It indicates that all of the respondents agree that implication of Green Building in our country is important. In question 8, the figure 12 gives information on how familiar the respondents on green building rating systems which is an assessment tools to green building certification. Unfortunately, the respondents have relatively very low knowledge or familiarity towards the green building rating system like BREEAM and Green Star. The data shows that 70.4% of them do not familiar with BREEAM and 66.7% with Green Star. In contrast to LEED, it shows that 63% of them familiar with these tools and for Green Mark, it is balanced between those who familiar and those who doesn't. Hence, it can be concluded that even some the professional in our country didn't familiar with this green rating tool worldwide even though it had been long established like BREEAM. There should be strategic implementation strategy in term of knowledge transfer of the Green Building concept and its rating system, especially regarding the Green Building Index Malaysia.

4.2.3 Section C: Green Building Application

This section concerned about these respondents opinion about Green Building application in our country. Question (9) discussed about benefits for these professional bodies if they were applying the Green Building concept for their project. Basically for them benefits that they were expecting more is in term of money and value of their project. Question (10) discussed about environmental impacts of Green Building application to the environment. Question (11) discussed about barriers in implementing the Green Building concept which lead to question (12) where it discussed about initiatives that should be given in order to promote this Green Building concept. Question (13), the author asked for their opinion who should play major role in the initiative of GBI in Malaysia. In order to asses this data, a Likert Scale or five point scale was used. Each of the question data will be calculated for their mean and standard deviation using SPSS software. The author decided to present the result from SPSS calculation in the form of table. In addition to that, the author also show the line graph indicating that total mean factor and mean for each question to show how the mean for each criteria is distributed either they fall under the "High Level" or "Low Level" category.

Question 9: The implication came with several benefits. Tick on each benefits that you agree/disagree.

Question 9 asked the respondents their opinion on benefits of implementation of "Green Building" concept. The author provides the answers in the questionnaire based on the several articles and journals published regarding the benefits of Green Building and the author concluded it into four (4) items. The data were analyzed and tabulated as shown in Table 3.

Table 3: Benefits of Green Building

	Percentage (%)						
	1	**2**	**3**	**4**	**5**	**Mean**	**SD**
High return on investment (ROI)	6.2	15.6	21.9	43.8	12.5	3.41	1.103
Reduce environmental impacts	3.1	0.0	0.0	43.8	53.1	4.44	0.801
Increased market values	6.2	6.2	18.8	53.1	15.6	3.66	1.035
Low maintenance	3.1	12.5	40.6	34.4	9.4	3.34	0.937
	Total Mean factor					**3.71**	

1= Strongly Disagree, 2= Disagree, 3= Neither, 4= Inclined to Agree, 5 = Strongly Agree

SD= Standard deviation

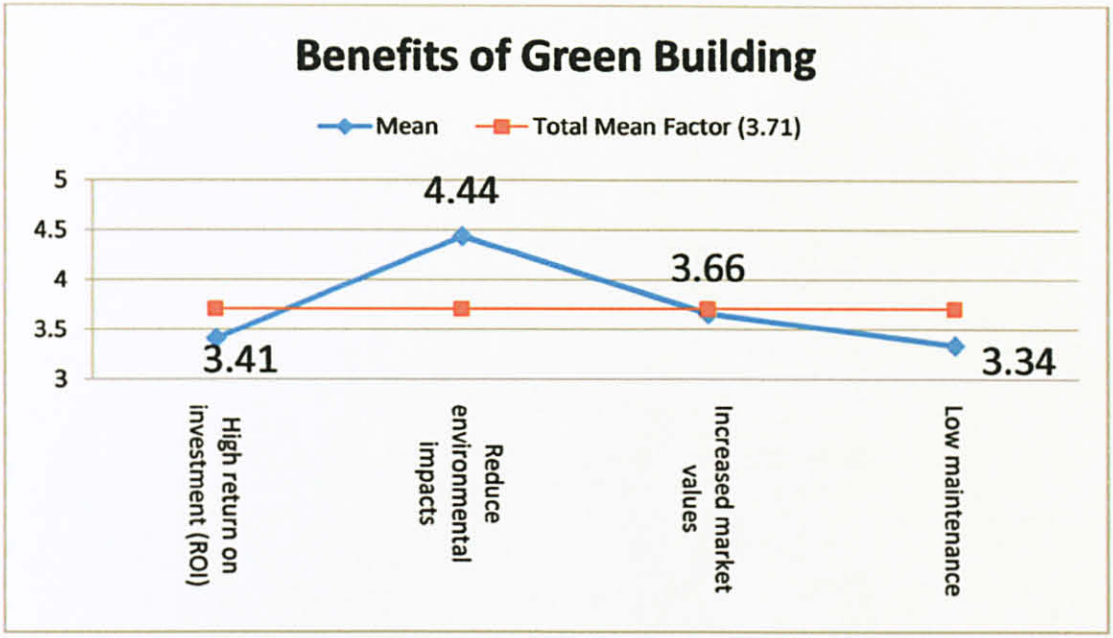


Figure 13: Mean Factor for the Benefits of Green Building

Most of the respondents agree that reduce environmental impacts is the main benefits of the Green Building application (Mean score = 4.44). From the figure 13, we can see that only Reduce Environmental Impacts fall under the 'High Level' category, whereas the other three benefits fall under the 'Low Level" category since it is below the value of Mean Factor which is 3.71.

So it is prove that from the objective of Green Building which is to preserve the environment is connected to the main benefits from the figure 13 which is reduce environmental impacts. Somehow when we look at the cost benefits, most of them still doubt about it. From figure 13, High Return on Investment (ROI), Increased Market Value and Low Maintenance fall below the Total Mean Factor which all three of them involve money. Hence, we can conclude that there are still some of them having doubts to go for the 'Green Building' concept because of the risk of losing money. They were still doubt that by going for the Green Building they will get high return on investment (ROI) or they will reduce the cost of their maintenance.

For high return on investment (ROI) and increased market value criteria, their standard error for the mean is large and it is expected a large variation in the sampling distribution of the mean (Assoc. Prof Dr Bahaman, Measures of dispersion). If the standard deviation is less than one, that means most respondents agree with each other, therefore it can be assumed that mean of the sample to be the mean of the

population. In contrast, if the standard deviation is more than one, most of the respondents do not agree with each other. In this question high return on investment and increased market value have a standard deviation value of 1.103 and 1.035 respectively. It means the respondents rated to the different response for this question.

Question 10: How Green Building can contribute in reducing the environmental impacts. Tick on each criteria that important on this role.

Question 10 concern more on how Green Building can contribute in reducing the environmental impacts. The author provides the answers in the questionnaire based on the Green Building Index Malaysia rating tools for new construction (residential properties). The respondents were asked to select their agreement with 12 characteristics. The data were analyzed and tabulated as shown in Table 4.

Table 4: How Green Building can contribute in reducing the environmental impacts

	Percentage (%)						
	1	**2**	**3**	**4**	**5**	**Mean**	**SD**
Usage of renewable energy	0.0	3.1	18.8	31.2	46.9	4.22	0.870
Reduce energy consumption in building	0.0	0.0	0.0	21.9	78.1	4.78	0.420
Selection of sites near to public transport service	3.1	3.1	25.0	37.5	31.2	3.91	0.995
Selection of sites near to public amenities	0.0	3.1	18.8	56.2	21.9	3.97	0.740
Re-development of existing sites	0.0	0.0	25.0	56.2	18.8	3.94	0.669
Reduce material wastage and construction wastage	0.0	0.0	6.2	25.0	68.8	4.62	0.609
Proper management of construction waste	0.0	0.0	9.4	31.2	59.4	4.50	0.672
Material re-use or recycle	0.0	3.1	12.0	37.5	46.9	4.28	0.813
Water harvesting & recycling	0.0	3.1	9.4	46.9	40.9	4.25	0.762
Efficient devices/system that reduce water consumption	0.0	3.1	12.5	50.0	34.4	4.16	0.767
New innovation or design	0.0	0.0	28.1	37.5	34.4	4.06	0.801
	Total Mean Factor					**4.24**	

1= Very Unimportant, 2= Unimportant, 3= Neutral, 4= Important, 5 = Very Unimportant, SD= Standard deviation

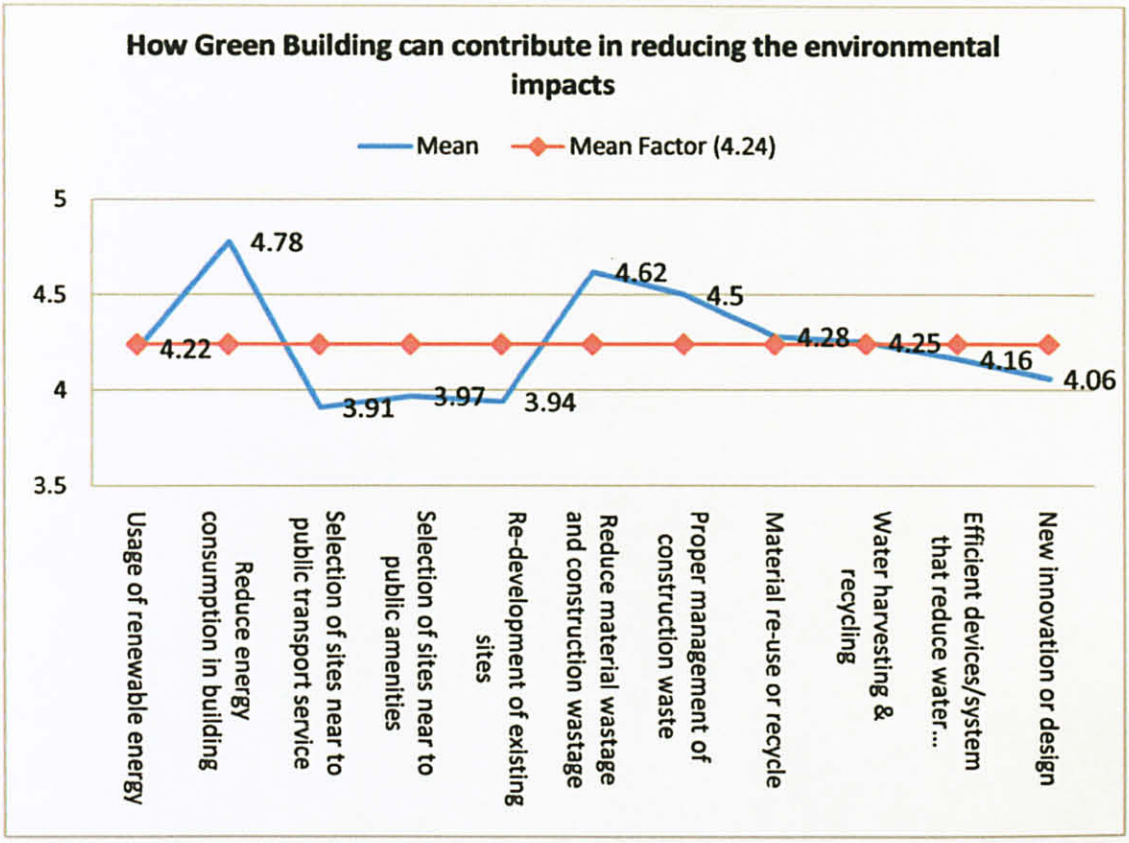


Figure 14: Mean Factor for the contribution of Green Building towards the reducing environmental impact

Most of the respondents agree that Green Building can contribute in reducing the environmental impacts by reducing energy consumption in building (Mean score = 4.78), by reducing material wastage and construction wastage (Mean score = 4.62), by proper management of construction waste (Mean score = 4.50), by recycle or reuse the material (Mean score = 4.28), and by water harvesting or recycle (Mean score = 4.25). It also showed that Total Mean Factor for this question is 4.24 (Inclined to agree), proving that respondents agree that criteria that was provided in the Green Building Index Malaysia sufficient enough to reduce the environmental impacts.

We can see that from the definition of Green Building earlier, stated that Green Building was developed to optimize the usage of resources like energy, materials and water. In the figure 14, it proves that respondents agree that in term of reducing environmental impacts, the optimize usage of these resources is the highest contribution. Respondents also agree that selection of sites near public amenities or transport and redevelopment of new sites is not gave a major contribution towards reducing the environmental impacts. This may be influenced by the location of the project itself. If the project located at the urban area where the public transport or

public amenities is developed this criteria maybe can be considered. But in the rural area this criteria is hard to judge since there is no development of this public amenities or transport in that area.

In this table, it can be seen that none of the characteristics that have standard deviation more than one. It proves that most respondents agree with each other, therefore it can be assumed that mean of the sample to be the mean of the population. In contrast, if the standard deviation is more than one, most of the respondents do not agree with each other.

Question 11: There are some barriers in constructing 'Green Building'. Tick on each barrier, you think is significant in this role.

Question 11 asked the respondents their opinion about factors that contribute to the reluctant of developer/client to adopt the 'Green Building' concept for their project. The answers were provided by the author based on the articles by Sudhakar Reddy and J.P. Painuly, 2003 (Diffusion of renewable energy technologies—barriers and stakeholders' perspectives). The respondents were asked to select their agreement with 10 characteristics. The data were analyzed and tabulated as shown in Table 5.

Table 5: Barriers in constructing 'Green Building'

	Percentage (%)						
	1	**2**	**3**	**4**	**5**	**Mean**	**SD**
High upfront cost	3.1	3.1	9.4	53.1	31.2	4.06	0.914
Long payback	0.0	3.1	25.0	56.2	15.6	3.84	0.723
Risk of trying something new	12.5	9.4	25.0	34.4	18.8	3.38	1.264
Lack of knowledge	6.2	18.8	15.6	46.9	12.5	3.41	1.132
Lack of expertise	12.5	21.9	9.4	50.0	6.2	3.16	1.221
Additional fees	0.0	21.9	34.4	34.4	9.4	3.31	0.931
No incentives	12.5	9.4	18.8	43.8	15.6	3.41	1.241
Lack of technology	21.9	31.2	21.9	21.9	3.1	2.53	1.164
Lack of public awareness	3.1	18.8	6.2	46.9	25.0	3.72	1.143
Client request	0.0	12.5	37.5	34.4	15.6	3.53	0.915
	Total Mean Factor					**3.44**	

1= Strongly Disagree, 2= Disagree, 3= Neithe r, 4= Inclined to Agree, 5 = Strongly Agree, SD= Standard deviation

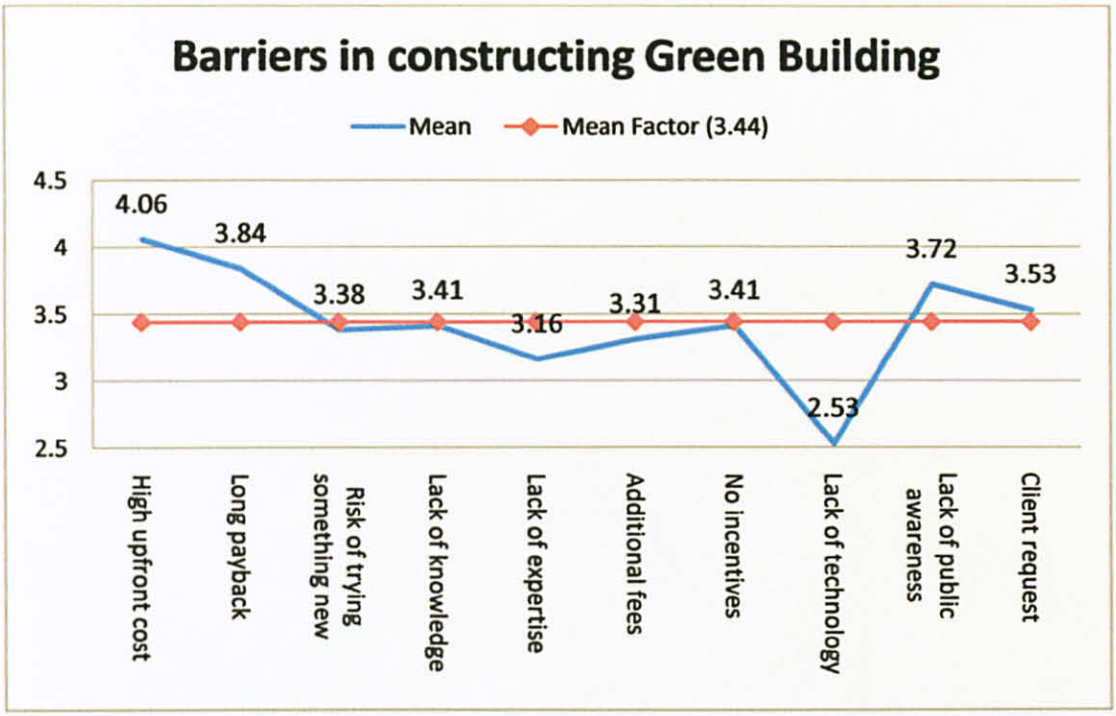


Figure 15: Mean Factor for the Barriers in constructing Green Building

From the table 5, we can see that high upfront cost is the main barrier for them to go for 'Green Building' (Mean score = 4.06). It then followed by Long Payback (Mean score = 3.84), Lack of Public Awareness (Mean score = 3.72), and Client Request (Mean score = 3.53). These four (4) barriers fall under 'High Level' category which their mean is higher than Mean Factor which is 3.44 in value.

Hence, it proved that money is still a main consideration for any change they want to imply since this change will cost them lot of money and long period to cover it back. It also prove that still in our country there is lack of promotion of this new concept that make some of them doesn't know about this or it benefits. Awareness of this issue also can be very crucial since it will influence clients decision of they want to adopt this concept or not. The least factor for the barriers of constructing 'green building' is the lack of knowledge and technology. Hence, it is prove that our country is sufficient with the expertise and technology to go for Green concept. It's just a matter of us if we want to adopt it or not.

In this also we can see there are 6 criteria that have standard deviation value that is more than 1 (refer the highlighted one). It proves that most respondents didn't agree on each other for these 6 criteria.

Question 12: What are the initiatives to increase 'Green Building' application.

Following the question 11 regarding the factor that might influence people to not go for 'Green Building' concept, the author asked the initiatives to promote this concept in our country. The respondents were asked to select their agreement with 6 characteristics. The results from this question were analyzed and summarize in Table 6.

Table 6: Initiative to increase 'Green Building' application

	Percentage (%)						
	1	**2**	**3**	**4**	**5**	**Mean**	**SD**
Tax rebates	0.0	0.0	15.6	43.8	40.6	4.25	0.718
New regulations / standards	0.0	0.0	9.4	46.9	43.8	4.34	0.653
Implementation in early education	3.1	0.0	15.6	40.6	40.6	4.16	0.920
Endorsement by media (TV. Internet, books. Etc)	0.0	0.0	15.6	59.4	25.0	4.09	0.641
Trained local professional in this field	0.0	6.2	6.2	46.9	40.6	4.22	0.832
Documentation of cost and benefits	0.0	3.1	12.5	50.0	34.4	4.16	0.767
	Total Mean Factor					**4.20**	

1= Strongly Disagree, 2= Disagree, 3= Neither, 4= Inclined to Agree, 5 = Strongly Agree, SD= Standard deviation

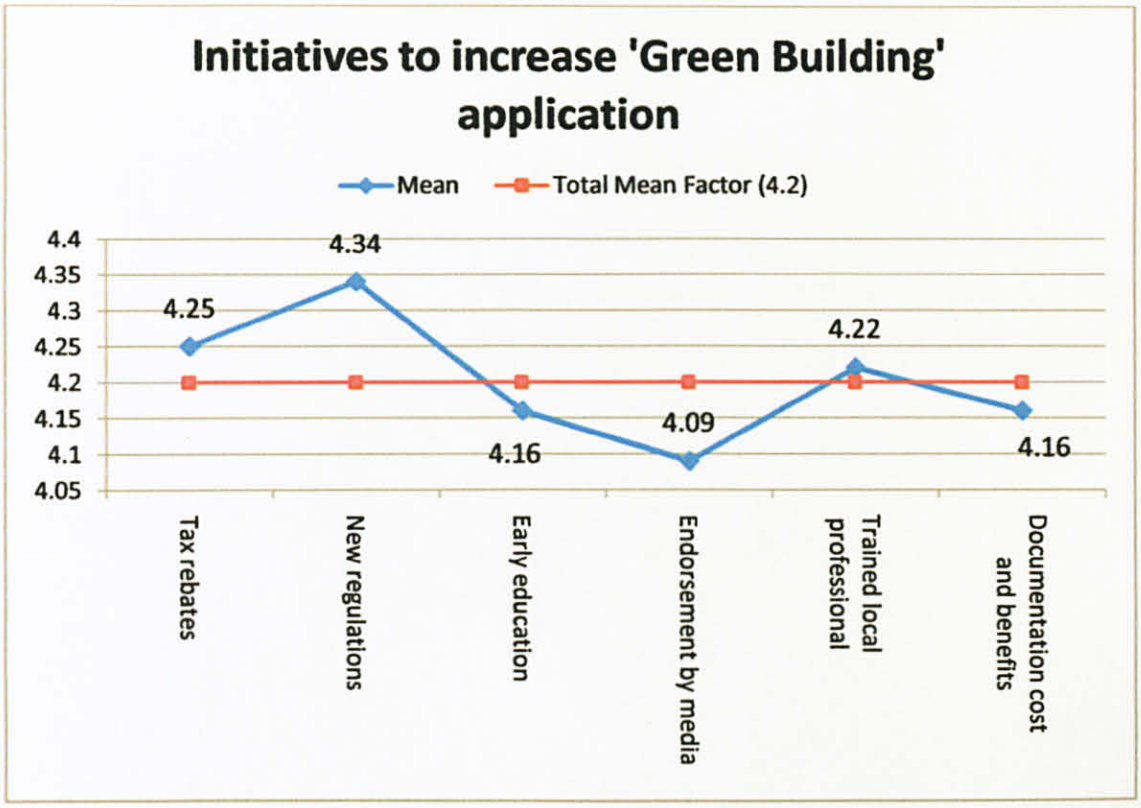


Figure 16: Mean Factor Initiative to increase 'Green Building' application

Most of the respondent agree that New Regulation is the most efficient initiatives in order to increase this 'Green Building' application (Mean score = 4.34). It followed by Tax Rebates (Mean score = 4.25) and Trained Local Professional (Mean score = 4.22). These three (3) fall under the category of 'High Level' and the rest of it under the category of 'Low Level'.

Hence, we can conclude that, government which has the power to change the regulation in our country play a major role in order to increase the 'green Building' concept. We can see also, Endorsement by Media is the lowest factor that can contribute to initiative to increase this 'Green Building' application because the respondents think that it is not really important for public to know this concept instead of the bodies in construction industry. In this table, it can be seen that none of the characteristics that have standard deviation more than one. It proves that most respondents agree with each other, therefore it can be assumed that mean of the sample to be the mean of the population.

Question 13: Who do you think is responsible for the initiative of GBI application in Malaysia

Question 13 asked the respondents their opinion about the bodies responsible for the initiative of GBI application. This question was designed as a follow up from question 12. There were 5 bodies listed and respondents were asked to rate their importance for the initiative of GBI in Malaysia. The data were analyzed and tabulated as shown in Table 7.

Table 7: Bodies responsible for the initiative of GBI application

	Percentage (%)						
	1	**2**	**3**	**4**	**5**	**Mean**	**SD**
Developers	0.0	3.1	0.0	34.4	62.5	4.56	0.669
Construction company	6.2	9.4	9.4	43.8	31.2	3.84	1.167
Government	0.0	3.1	3.1	15.6	78.1	4.69	0.693
Technical professionals (Architects, Engineers, Quantity Surveyor, etc)	0.0	3.1	3.1	25.0	68.8	4.59	0.712
Clients	3.1	0.0	9.4	28.1	59.4	4.41	0.911
	Total Mean Factor					**4.42**	

1= Very Unimportant, 2= Unimportant, 3= Neutral, 4= Important, 5 = Very Important, SD= Standard deviation

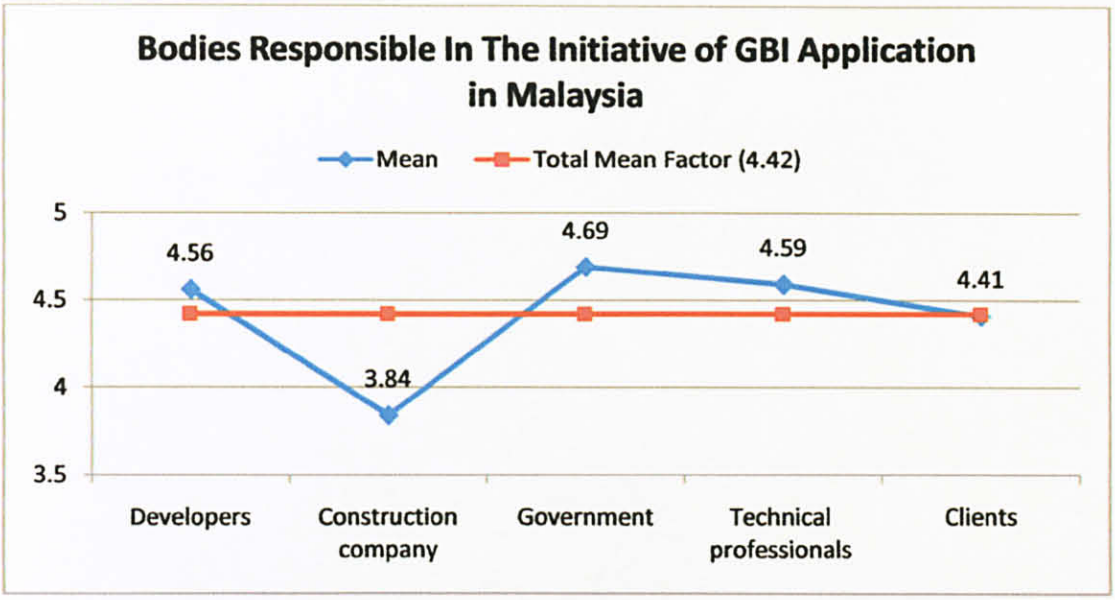


Figure 17: Mean Factor Bodies responsible for the initiative of GBI application

Most of the respondents agree that Government play a big role for the initiatives to increase the GBI application (Mean score = 4.69). It was then followed by Technical Professional (Mean score = 4.59) and Developers (Mean score = 4.56). The rest of it fall under the category 'Low Level' which are Clients (Mean score = 4.41) and Construction Company (Mean score = 3.84).

We can see the relationship of this answer with the answer from question 12 where the respondents agree to choose New Regulation as the most effective method as the initiative to increase this 'Green Building' concept. Only the government has the authority to change the rule in our construction industry to push them to apply the 'Green' concept on each of their project. In contrast with Construction Company, respondents think that they cannot contribute much in the effort to promote this concept since all decision is not made by them but instead it is from the client.

In this question Government has a standard deviation value of 1.167. It means the respondents rated to the different response for this question.

CHAPTER 5: CONCLUSIONS

5.1 Conclusion

Green Building is not a new concept that had been introduced but instead it's already established long before in other country like Britain, America and Japan. To make sure buildings in their country were properly rated based on the building performance to reduce environmental impacts, they have come out with rating tools to evaluate the building. Since the issue of environmental protection is becoming more important, most of the country nowadays had decided to go for sustainable development in their construction industry. Some of them had their own Green rating Tools and some of them adopted it from existing tools that already established.

Malaysia also didn't exempt from applying this concept of sustainable development. On 21st May 2009, Malaysia had launched our own Green Rating Tool called Green Building Index Malaysia (GBI). GBI was designed specifically for the tropical climate (hot and humid) and Malaysia's current social, infrastructure and economic development. Up until now, GBI is voluntary and not a statutory requirement and so it is not compulsory.

5.2 Main Barriers and Drivers in the Implementation of GBI in Malaysia

From the survey answered by respondents, the author had come out with the top three (3) factors for the Barriers and Drivers in implementing the GBI concept in Malaysia. Those factors were:

Barriers

1) High upfront cost

Since the implementation of GBI need a change in design and method of construction, most of the developers resist adopting this concept. They are not willing to take a risk losing profit in their profit if they go for this concept.

2) Long payback

Same as the first factor, this also concern about the money invest from the developer. They still doubt that going for a 'green building' concept will cost them a long period to gain back their profit. Since the recent critical economic condition around the world, most of them concern more on the profit rather than preserving the environment for the future.

3) Lack of public awareness

This factor may be related back to the first and second one. Developers resist to go for 'green building' since they still doesn't fully understand what is the purpose and benefits of Green Building itself. They need some prove that going for 'green' project doesn't cost them to lost their money but instead they will contribute in preserving the environment for future generation.

Drivers

1) New regulations

Changing in rules and regulations in our construction industry is the effective way to increase the 'green building' application in Malaysia. In this research, the author had found out that most respondents from the survey agree that new regulation should be introduced to encourage the usage of GBI in our construction industry. This way they will have an obligation to follow the rules introduced by government.

2) Tax rebates

By giving a tax rebates to those project who applied the GBI in their project, it could encourage developers to go for a 'green building' concept for their project. Since the barriers for implementing this concept is influenced by cost or money, this method could influence the developer's decision whether to go for this concept or not.

3) Trained local professional in this field

Have our own expertise in this 'green building' concept could save a lot of money since we don't need to hire professional from outside to manage and consult the project. As prove in the survey conducted, high upfront cost is the main barrier for implementing this concept and this way is one of the alternatives to reduce the upfront cost of the project.

5.3 Recommendations

As a conclusion from this research, the author managed to rank the top three of drivers and barriers in implementing the GBI in Malaysia. Below are recommendations in order to encourage the usage of GBI. The recommendations were suggested by the author from the result of the survey. The recommendation can be explained as below:

I. Government plays a big role in the initiative to promote this concept in our country. For example, the new regulation in construction should be introduced to force our construction industry to adopt this new concept in their project. Government also can give incentives for those implied this concept like tax rebates or awards.

II. In order to make sure the public aware about this 'Green Building' concept, effective promotion using mass media need to be considered. As we know Malaysian always watching Television, surf the Internet, listening to Radio, and reading Newspaper. This can be an alternative to deliver them about this 'Green Building' knowledge so that they will aware about the importance of it.

III. Implementation in early education also can be one of the ways to promote 'Green Building'. This should be implemented especially in higher education like university or college that has offered courses related in construction industry. Currently, not many institutions had applied this knowledge into their education syllabus. Education and training of Green Building and its rating system also can be applied to those who already work in this construction industry regardless of their age or experience. This can be done through seminar, forum, conference or training session.

5.3.1 Recommendation for Further Studies

Due to the limited time and resources for this study, the author strongly recommends more extensive research for this topic. Some of the recommendations for future study are as follows:

I. Get more respondents to answer the survey. This might helped to get a larger sample size and support findings that can be adapted to rest of population in Malaysia.

II. Future research might get the respondents from all over Malaysia to see whether there is difference in opinion related to location of their work. This will make the data more reliable since for this research, the author only able to get respondents from the urban area only.

III. Future research may refer back to this research data to see if there is any improvement in term of application of Green Building Index in our country. This will show of there is any improvement of awareness of this issue in the future.

CHAPTER 6: ECONOMIC BENEFITS

6.1 Economic Benefits

From the figure 15, the research proves that the main barriers in constructing Green Building is the high upfront cost that need to be prepared by developer if they decided to adopt the 'green' concept in their project. While it is true that green building will cost more money at the starting phase of the project, but in the long term it will save a lot of money through a low operating during the lifetime of the building. The economic benefits of constructing a green building can be huge. Some of the main benefits are explained as below:

1) Water and Energy Savings

After a long use of water and energy in the green building, the occupants will see the reduction in their bill costs that will cover back the money they invested for the property. This will continue the huge saving in the long term. This will benefit the buyers or tenants for this 'green' residential building. They can use that money for other things besides utility bills.

2) Increased Property Values

Since energy costs are at an all time high, the low cost of operating and the easy maintenance of the green building will make for much lower vacancy rates along with much higher property values. This will benefit the developers of the Green Building project as they will attract buyers to buy the house with the characteristic of not only environmental friendly but also save their money.

3) Improved Employee Attendance and Productivity

The green buildings have control of temperature and ventilation along with increased natural lighting. This attributes to a much improved employee attendance and health. It has been found that the improvements to your indoor environment lowers your health care costs along with your work losses (Green Building Cost And Financial Benefits, 2003). Employee productivity will be much greater because of the positive indoor environmental conditions. They will be sick much less often and will have a better over sense of well-being.

APPENDIX A

Survey Questionnaire

UNIVERSITI
TEKNOLOGI
PETRONAS

28th January 2010

The General Manager / Project Manager / Technical Professional
(To whom it may concern)

Dear Sir / Madam,

The Green Building Index Malaysia: Quantitative Survey on Expert Opinion

My name is Muhammad Yazid Bin Salehuddin. For my Final Year Project (FYP), my research is about Green Building. Specifically my research title is **Green Building Index Malaysia: Quantitative Survey on Expert Opinion.**

The purpose of this research is to study the concept of Green Building Index Malaysia by gaining an expert opinion through a survey among the professional bodies who are involved in Building Construction Industry.

We have devised a questionnaire which we would like you to complete and return. With your cooperation, we should be able to collect as much data as possible for the research regarding the Green Building Rating System in Malaysia. Your name will not be used in any reporting of this research.

Please complete and return the questionnaire attached by **1st March 2010**. You can return the questionnaire by:

1) Self-addressed envelope with stamp attached with this letter **or**
2) Fax at 05-3656716 (attention: Dr Mohd Faris Khamidi)

Should you require any further information regarding this questionnaire, please do not hesitate to contact Muhammad Yazid Bin Salehuddin at 017-6975101

We are thanking you in advance for your kind support.

Yours sincerely,

.....

(Dr. Mohd Faris Khamidi)
Department of Civil Engineering,
Universiti Teknologi PETRONAS,

DR. MOHD FARIS KHAMIDI
Civil Engineering Department
Universiti Teknologi PETRONAS
Bandar Seri Iskandar
31750 Tronoh, Perak Darul Ridzuan, MALAYSIA

cc: Muhammad Yazid Bin Salehuddin

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INSTITUTE OF TECHNOLOGY PETRONAS SDN. BHD.
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Bandar Seri Iskandar, 31750 Tronoh, Perak Darul Ridzuan, Malaysia

Tel: 605-3688000 Fax: 605-3654075 D. Lines: HRM 605-3688291 Finance 605-3688283 IRC 605-3688486
Corporate Services 605-3688237 Student Support Services 605-3688410 Registrar 605-3688345 Security 605-3688313
Fax: HRM 605-3656568 Finance 605-3654087 IRC 605-3667672 Student Support Services 605-3667746 Registrar 605-3654082 Website http://www.utp.edu.my

UNIVERSITI TEKNOLOGI PETRONAS

UNIVERSITI TEKNOLOGI PETRONAS
CIVIL ENGINEERING
Questionnaire Regarding Green Building Index Malaysia

INTRODUCTION

Dear Sir / Madam,

This research is a Final Year Project (FYP) report. As a part of the research; I am distributing questionnaires to the person who are involved in Building Construction Industry. Your professional views and opinion are important for the research. Your response will help us to better understand the application of Green Building Index in Malaysia.

The questionnaire consists of a variety of closed and open ended questions. Your participation is voluntarily. Your name will not be used in any reporting of the research and your rights will be protected. Your answers will be reported and aggregated with other respondents.

If you have any enquiries regarding this survey procedure or wish to make suggestions, please contact the researcher. Also, you can contact us if you would like to request a copy of the survey result.

Thank you.

Muhammad Yazid Bin Salehuddin
Civil Engineering Student
HP: 017 - 6975101
Email: yazid.salehuddin@gmail.com

THE OBJECTIVES OF QUESTIONNAIRE

1. To specify the importance and significance of GBI in Malaysia
2. To identify the drivers and barriers of implicating the GBI in Malaysia
3. To determine the benefits of GBI

Researcher:
Muhammad Yazid Bin Salehuddin
Civil Engineering Student

Supervisor:

Dr. Mohd Faris Khamidi
Lecturer
Civil Engineering
University Technology Petronas

Queostionnaire for Respondent

SECTION A: RESPONDENT PROFILE

Name (optional) :_____

Gender

Male	
Female	

Age:

20-30	
31-40	
>40	

Profession :

Civil and Structural Engineer	
Mechanical Engineer	
Electrical Engineer	
Architect	
Quantity Surveyor	
Planner	
Academician	

Other: _____

Education :

Doctoral Degree	
Master Degree	
Bachelor Degree	
Diploma	
Certificate	

Personal Experience:

<3 years	
4-5 years	
6-10 years	
>10 years	

Company/Institution/Organization:

_____

Company Base: _____

How long have you been working for this company?

_____

Section B: Understanding "Green Building"

1. How well do you know about Sustainable Building / Green Building?

1 – Very Poor	2 – Below Average	3 - Average	4 – Above Average	5 - Excellent

2. Have you completed (or still working) on any Green Project?

   Yes ( )

   No ( )

3. Green Building is more costly than conventional building?

1 – Strongly Disagree	2 – Inclined to Disagree	3 - Neither	4 – Inclined to Agree	5 – Strongly Agree

4. What is your opinion regarding 'Green Building' (Residential Properties)?

   _____

5. Will you consider for Green Building criteria for your next project?

   Yes ( )

   No ( )

6. How well do you know about Green Building Index (GBI) Malaysia?

1 – Very Poor	2 – Below Average	3 - Average	4 – Above Average	5 - Excellent

7. Do you think that implication of Green Building in our country is important?

1 – Strongly Disagree	2 – Inclined to Disagree	3 - Neither	4 – Inclined to Agree	5 – Strongly Agree

8. There were other green building rating tools that had been established before GBI. Do you familiar with these tools?

Rating Tools	Familiar	Not Familiar
United Kingdom, BREEAM (Building Research Establishment Environmental Assessment Method)		
Australia, Green Star		
United States, LEED (Leadership in Energy and Environmental Design)		
Singapore, Green Mark		
Other (please indicate):		

Section C: Green Building Application

9. The implication came with several benefits. Tick on each benefits that you agree/disagree.

Benefits	1 - Strongly Disagree	2 - Inclined to Disagree	3 - Neither	4 - Inclined to Agree	5 - Strongly Agree
High *return on investment* (ROI)					
Reduce environmental impacts					
Increased market value					
Low maintenance					
Other (please indicate):					

10. How Green Building can contribute in reducing the environmental impacts. Tick on each criteria that important on this role.

	1 - Very unimportant	2 - Unimportant	3 - Neutral	4 - Important	5 - Very Important
Usage of renewable energy					
Reduce energy consumption in building					
Selection of sites near to public transport service					
Selection of sites near to public amenities					
Re-development of existing sites					
Reduce material wastage and construction wastage					
Proper management of construction waste					
Material re-use or recycle					
Water harvesting & recycling					
Efficient devices/ system that reduce water consumption					
New innovation or design					
Other (please indicate):					

11. There are some barriers in constructing 'green building'. Tick on each barrier, you think is significant in this role

Barriers	1 - Strongly Disagree	2 - Inclined to Disagree	3 - Neither	4 - Inclined to Agree	5 - Strongly Agree
High upfront cost					
Long payback					
Risk of trying something new					
Lack of knowledge					
Lack of expertise					
Additional fees					
No incentives					
Lack of technology					

Lack of public awareness					
Client request					
Other (please indicate):					

12. What are the initiatives to increase the 'Green Building' application? Tick on each line

	1 - Strongly Disagree	2 - Inclined to Disagree	3 - Neither	4 - Inclined to Agree	5 - Strongly Agree
Tax rebates					
New regulations/ standard					
Implementation in early education					
Endorsement by media (TV, Internet, Books)					
Trained local professional in this field					
Documentation of cost and benefits					
Other (please indicate) :					

13. Who do you think is responsible in the initiative of GBI application in Malaysia?

	1 - Very unimportant	2 - Unimportant	3 - Neutral	4 - Important	5 - Very Important
Developers					
Construction company					
Government					
Technical professional (Architects, Engineer, Quantity surveyor, etc.)					
Clients					
Other (please indicate):					

APPENDIX B

GBI ASSESSMENT CRITERIA

FOR
RESIDENTIAL NEW CONSTRUCTION

(Source: www.greenbuildingindex.org)

GBI ASSESSMENT CRITERIA
FOR
RESIDENTIAL NEW CONSTRUCTION (RNC)

FIRST EDITION | JUNE 2009 | VERSION 1.0

www.greenbuildingindex.org | info@greenbuildingindex.org

CONTENTS

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INTRODUCTION

WHAT IS THE GREEN BUILDING INDEX (GBI)?

The Green Building Index is an environmental rating system for buildings developed by PAM (Pertubuhan Arkitek Malaysia / Malaysian Institute of Architects) and ACEM (the Association of Consulting Engineers Malaysia). The Green Building Index is Malaysia's first comprehensive rating system for evaluating the environmental design and performance of Malaysian buildings based on the six (6) main criterias of Energy Efficiency, Indoor Environment Quality, Sustainable Site Planning & Management, Materials & Resources, Water Efficiency, and Innovation.

The Green Building Index is developed specifically for the Malaysian tropical weather, environmental and developmental context, cultural and social needs.

The GBI initiative aims to assist the building industry in its march towards sustainable development. The GBI environmental rating system is created to:

- **Define green buildings by establishing a common language and standard of measurement;**
- **Promote integrated, whole-building design;**
- **Recognise and reward environmental leadership;**
- **Transform the built environment to reduce it's environmental impact; and**
- **Ensure new buildings remain relevant in the future and existing buildings are refurbished and upgraded properly to remain relevant.**

WHO CAN USE THE GREEN BUILDING INDEX?

GSB encourages all members of Project Teams, Building owners, Developers and other interested parties (including Contractors, Government and Design & Build Contractors) to use the Green Building Index to validate environmental initiatives at the design phase of new construction or base building refurbishment; or construction and procurement phase of buildings. Use of the Green Building Index is encouraged on all such projects to assess and improve their environmental attributes.

Use of the Green Building Index tool without formal certification by an independent accredited GBI Certifier does not entitle the user or any other party to promote the Green Building Index rating achieved. No fee is payable to GSB for such use, however formal recognition of the Green Building Index rating - and the right to promote same - requires undertaking the formal certification process offered by Greenbuildingindex Sdn Bhd.

All Green Building Index rating tools are reviewed annually; please forward any feedback to info@greenbuildingindex.org

PROJECT INFORMATION

PROJECT NAME	
PROJECT ADDRESS	
POSTCODE	
STATE	

APPLICANT	
CONTACT PERSON	

ARCHITECT	
CIVIL ENGINEER	
STRUCTURAL ENGINEER	
MECHANICAL ENGINEER	
ELECTRICAL ENGINEER	
QUANTITY SURVEYOR	
LAND SURVEYOR	
LANDSCAPE CONSULTANT	
OTHER SPECIALIST CONSULTANT(S)	
MAIN CONTRACTOR	
LOCAL AUTHORITY	
TOTAL GROSS FLOOR AREA	
LAND AREA FOR LANDED PROPERTY	

BUILDING DESCRIPTION	

ASSESSMENT CRITERIA
OVERALL POINTS SCORE

PART	ITEM	MAXIMUM POINTS	SCORE
1	Energy Efficiency	23	
2	Indoor Environmental Quality	11	
3	Sustainable Site Planning & Management	39	
4	Material & Resources	9	
5	Water Efficiency	12	
6	Innovation	6	
	TOTAL SCORE	100	

GREEN BUILDING INDEX CLASSIFICATION

POINTS	GBI RATING
86+ points	Platinum
76 to 85 points	Gold
66 to 75 points	Silver
50 to 65 points	Certified

ASSESSMENT CRITERIA SCORE SUMMARY

PART	CRITERIA	ITEM	POINTS	TOTAL
1	**EE**	**ENERGY EFFICIENCY**		
	EE1	Minimum EE Performance	3	23
	EE2	Renewable Energy	5	
	EE3	Advanced EE Performance based on OTTV & RTTV	10	
	EE4	Home Office & Connectivity	2	
	EE5	Sustainable Maintenance	3	
2	**EQ**	**INDOOR ENVIRONMENTAL QUALITY**		
	Air Quality, Lighting, Visual & Acoustic Comfort			11
	EQ1	Minimum IAQ Performance	2	
	EQ2	Daylighting	2	
	EQ3	Sound Insulation	2	
	EQ4	Good Quality Construction	1	
	EQ5	Volatile Organic Compounds	1	
	EQ6	Formaldehyde Minimisation	1	
	Verification			
	EQ7	Post Occupancy Evaluation: Verification	2	
3	**SM**	**SUSTAINABLE SITE PLANNING & MANAGEMENT**		
	Site Planning & Transport			39
	SM1	Site Selection	1	
	SM2	Public Transportation Access	12	
	SM3	Community Services & Connectivity	8	
	SM4	Open Spaces, Landscaping & Heat Island Effect	4	
	Site & Construction Management			
	SM5	Construction System & Site Management	3	
	SM6	Stormwater Management	3	
	SM7	Re-development of Existing Sites & Brownfield Re-development	4	
	SM8	Avoiding Enviromentally Sensitive Areas	2	
	SM9	Building User Manual	2	
4	**MR**	**MATERIALS & RESOURCES**		
	Reused & Recycled Materials			9
	MR1	Storage & Collection of recyclables	2	
	MR2	Materials Reuse and Selection	2	
	MR3	Construction Waste Management	2	
	Sustainable Resources			
	MR4	Recycled Content Materials	1	
	MR5	Regional Materials	1	
	MR6	Sustainable Timber	1	
5	**WE**	**WATER EFFICIENCY**		
	Water Harvesting & Recycling			12
	WE1	Rainwater Harvesting	4	
	WE2	Water Recycling	2	
	Increased Efficiency			
	WE3	Water Efficient Landscaping	2	
	WE4	Water Efficient Fittings	4	
6	**IN**	**INNOVATION**		
	IN1	Innovation in Design & Environmental Design Initiatives	5	6
	IN2	Green Building Index Facilitator (GBIF)	1	
			TOTAL POINTS	**100**

1 ENERGY EFFICIENCY (EE)

MINIMUM EE PERFORMANCE | RENEWABLE ENERGY | ADVANCED EE PERFORMANCE | HOME OFFICE & CONECTIVITY

23 POINTS

ITEM	AREA OF ASSESSMENT	DETAIL POINTS	MAX POINTS	SCORE
EE1	**MINIMUM EE PERFORMANCE**			
	Establish minimum Energy Efficiency (EE) performance to reduce energy consumption in buildings, thus reducing CO_2 emission to the atmosphere. Apply OTTV and RTTV formulas of MS 1525 for residential buildings. OTTV ≤ 50 W/m², RTTV ≤ 25 W/m² Roof U ≤ 0.4 W/m²K (Lightweight) Roof U ≤ 0.6 W/m²K (Heavyweight)	3	**3**	
EE2	**RENEWABLE ENERGY**			
	Encourage use of renewable energy.		**5**	
	A) Low-rise (3-Storeys and below):			
	Where 1 kWp is generated by renewable energy, ***OR***	1		
	Where 40% of building energy consumption or 2 kWp (whichever is the lower) is generated by renewable energy, ***OR***	2		
	Where 60% of building energy consumption or 3 kWp (whichever is the lower), ***OR***	3		
	Where 80% of building energy consumption or 4 kWp (whichever is the lower), ***OR***	4		
	100% of building energy consumption or 5 kWp (whichever is the lower)	5		
	B) Hi-rise (Above 3-Storeys):			
	Where 0.5% of building energy consumption or 5 kWp (whichever is the higher) is generated by renewable energy, ***OR***	1		
	Where 1.0% of building energy consumption or 10 kWp (whichever is the higher), ***OR***	2		
	Where 1.5% of building energy consumption or 20 kWp (whichever is the higher), ***OR***	3		
	Where 2.0% of building energy consumption or 30 kWp (whichever is the higher), ***OR***	4		
	Where 2.5% of building energy consumption or 40 kWp (whichever is the higher)	5		
EE3	**ADVANCED EE PERFORMANCE BASED ON OTTV & RTTV**			
	Establish EE Performance to reduce dependence on Energy to keep indoor environment at satisfactory comfort level. Computed OTTV and RTTV to show lower dependence on Energy to maintain indoor thermal comfort.		**10**	
	OTTV ≤ 46 W/m² Lightweight Roof U-value ≤ 0.35 W/m²K Heavyweight Roof U-value ≤ 0.5 W/m²K	2		
	OTTV ≤ 44 W/m² Lightweight Roof U-value ≤ 0.30 W/m²K Heavyweight Roof U-value ≤ 0.4 W/m²K	4		
	OTTV ≤ 42 W/m² Lightweight Roof U-value ≤ 0.25 W/m²K Heavyweight Roof U-value ≤ 0.3 W/m²K	6		
	OTTV ≤ 40 W/m² Lightweight Roof U-value ≤ 0.2 W/m²K Heavyweight Roof U-value ≤ 0.2 W/m²K	8		
	OTTV ≤ 38 W/m² Lightweight Roof U-value ≤ 0.15 W/m²K Heavyweight Roof U-value ≤ 0.15 W/m²K	10		
EE4	**HOME OFFICE & CONNECTIVITY**			
	Encourage dual use spaces and working from Home thereby discourage avoidable commuting.		**2**	
	Multiple-use type developments, ***OR*** High speed internet access available at homes > 1MB/s	2		
EE5	**SUSTAINABLE MAINTENANCE**			
	Ensure that the building's energy related systems will continue to perform as intended beyond the 12 months Defects & Liability Period. Document Green Building Design features and strategies for user information and guide to sustain performance during occupancy.		**3**	
	Buildings With Common Management: 1. Provide a designated building maintenance office equipped with facilities (including tools and instrumentation) and inventory storage; 2. Provide evidence of documented plan for at least 3-year facility maintenance and preventive maintenance budget; ***OR***	3		
	Buildings Without Common Management: 1. Provide a evidence of documented plan for at least 3-year preventive maintenance budget.	3		
	ENERGY EFFICIENCY (EE) TOTAL		**23**	

2 INDOOR ENVIRONMENTAL QUALITY (EQ)

AIR QUALITY, LIGHTING, VISUAL & ACOUSTIC COMFORT | VERIFICATION

11 POINTS

ITEM	AREA OF ASSESSMENT	DETAIL POINTS	MAX POINTS	SCORE
AIR QUALITY, LIGHTING, VISUAL & ACOUSTIC COMFORT				
EQ1	**MINIMUM IAQ PERFORMANCE**			
	Establish minimum indoor air quality (IAQ) performance to enhance indoor air quality in building, thus contributing to the comfort and well-being of the occupants.		2	
	Meet the minimum requirements of ventilation rate in the local building code	1		
	Provide cross ventilation for all public and circulation spaces	2		
EQ2	**DAYLIGHTING**			
	Encourage and recognise designs that provide good levels of daylighting for building occupants. Demonstrate that a nominated percentage of the Habitable Rooms as defined under UBBL has a daylight factor in the range 1.0 – 3.5% as measured at floor level;		2	
	if > 50% of Habitable spaces, ***OR***	1		
	if > 75% of Habitable spaces	2		
EQ3	**SOUND INSULATION**			
	Encourage and recognise building that is designed with adequate insulation between dwelling units. Ensure that the air bourne sound penetration between spaces are controlled within the following criteria;		2	
	Inter dwelling sound penetration between dewelling units < 45 dBAeq.	1		
	Intra dwelling air bourne sound penetration between walls in the same dwelling unit should not exceed the following values: Bedroom < 40 dBAeq Other areas < 30 dBAeq	1		
EQ4	**GOOD QUALITY CONSTRUCTION**			
	Encourage and recognise good quality construction – first time right – that does not require re-work that wastes materials and labour.		1	
	Subscribe to independent method to assess and evaluate quality of workmanship of building project based on CIDB's CIS 7: Quality Assessment System for Building Construction Work (QLASSIC). Must achieve a minimum score of 70%	1		
EQ5	**VOLATILE ORGANIC COMPOUNDS**			
	Encourage and recognise projects that reduce the detrimental impact on occupant health from finishes emitting internal air pollutants. Reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants. Volatile Organic Compound (VOC) content to comply with requirements specified in international labelling schemes recognised by GBI. ***0.5 point is awarded for each of the following up to a maximum of 1 point:*** 1. Low VOC paint and coating 2. Low VOC carpet or flooring 3. Low VOC adhesive and sealant ***OR*** no adhesive and sealant used.	1	1	
EQ6	**FORMALDEHYDE MINIMISATION**			
	Reduce the exposure of occupants to formaldehyde and promote good indoor air quality in the living space. Products with no added urea formaldehyde are to be used. ***0.5 point is awarded for each of the following up to a maximum of 1 point:*** 1. Composite wood and agrifiber products defined as: particleboard, medium density fiberboard (MDF), plywood, wheatboard, strawboard, panel substrates and door cores; 2. Laminating adhesives used to fabricate on-site and shop-applied composite wood and agrifiber assemblies; 3. Insulation foam; 4. Draperies	1	1	
VERIFICATION				
EQ7	**POST OCCUPANCY EVALUATION: VERIFICATION**			
	Provide for the assessment of comfort of the building occupants over time.		2	
	Commit to implement a post-occupancy comfort survey of building occupants within a period of 12 months after occupancy. This survey should collect anonymous responses about thermal comfort, visual comfort and acoustic comfort in a building. This should include an assessment of overall satisfaction with thermal, visual and acoustic performance and identification of thermal-related, visual-related and acoustic-related problems.	1		
	Develop a plan for corrective action if the survey results indicate that more than 20% of occupants are dissatisfied with the overall comfort in the building. This plan should include measurement of relevant environmental variables in problem areas.	1		
	INDOOR ENVIRONMENTAL QUALITY (EQ) TOTAL		**11**	

3 SUSTAINABLE SITE PLANNING & MANAGEMENT (SM)

SITE PLANNING & TRANSPORT | SITE & CONSTRUCTION MANAGEMENT

39 POINTS

ITEM	AREA OF ASSESSMENT	DETAIL POINTS	MAX POINTS	SCORE
SITE PLANNING & TRANSPORT				
SM1	**SITE SELECTION & PLANNING**			
	Proposed development is appropriate for the site and complies with the Local Plan or Structure Plan for the area. **The proposed building must comply with the following requirements:** 1. The Structure Plan for the area ***AND/OR*** The Local Plan where available 2. Infrastructure requirement is available for the area.	1	**1**	
SM2	**PUBLIC TRANSPORTATION ACCESS**			
	Encourage the selection of sites close to transport hubs and the planning of new housing areas to encourage the use of public transport. This is to reduce the current and future heavy dependence on private transport, which is the greatest contributor to Green House Gas (GHG) emission. Points are awarded according to proximity of the development to public transport hubs and quality of the access to the transport hub. For new housing areas, the provision of transport hubs for the housing concerned with proper shelter, amenities, shuttle facilities and parking facilities are encouraged. Points are awarded according to the subsection categories. **NOTE: SELECT EITHER SM2A & SM2B *OR* SM2C & SM2D**		**12**	
SM2A	**Distance from Mass Transport Station/Hub to building within 1km (50% of points if from Shuttle Bus Stop)**			
	0 - 250m	8	**8**	
	251 - 500m	6		
	501 - 750m	4		
	751m - 1km	2		
SM2B	**Walkway from building to Mass Transport Station if less than 750m from Mass Transport Station**			
	Dedicated footpath	2	**4**	
	Covered walkway	3		
	Covered walkway that incorporates provision for the handicapped	4		
	OR			
	Sheltered and secured waiting area for shuttle van or bus in the residential building if more than 750m from Mass Transport Station	4		
SM2C	**Transport Terminal within the Residential Area with covered seating and waiting area for a minimum of 10% of the total number of residential units**			
	Score is average of points of all residential units in the residential area as for **SM2A**	8	**8**	
SM2D	**Walkway from building to Transport Terminal if less than 750m from Transport Terminal:**			
	Dedicated footpath	2	**4**	
	Covered walkway	3		
	Covered walkway that incorporates provision for the handicapped	4		
	OR			
	Car park provision next to Transport Terminal:			
	Car park provision for at least 20% of total number of residential units not more than 250m from the Terminal	4		
	OR			
	Designated bicycle lane provision in at least 90% of the Residential area and a Secured bicycle parking area in the Transport Terminal for 10% of the total number of residential units:			
	Provision of Bicycle Lanes	2		
	AND Provision of Bicycle Parking Area	2		

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ITEM	AREA OF ASSESSMENT	DETAIL POINTS	MAX POINTS	SCORE
SM3	**COMMUNITY SERVICES & CONNECTIVITY**			
	Encourage the selection of sites close to basic community amenities and the planning of new residential areas to encourage the provision of local amenities. This is to reduce the current and future heavy use of private transport after working hours, which is the greatest contributor to GHG emission. Points are awarded according to proximity of the development to community amenities. Points are awarded according to the subsection categories.		**8**	
	SM3A Basic Amenities as listed below are provided or are available within 750m of the residential units ***(Less 1 point if more than 750m away)***: 1. Grocery Store or Mini-market 2. Restaurant or Coffee Shop 3. Surau or Mosque 4. Playground or Public Park	4		
	SM3B Other Amenities as listed below are provided or are available within 750m of the residential units ***(0.5 point per item or equivalent up to maxiumm of 2 points. Less 0.5 point if more than 750m away)***: 1. Clinic or Medical Center 2. Police Station or Police Pondok 3. School or Creche 4. Bank, Post Office or ATM	2		
	SM3C Additional Amenities as listed below are provided or are available within 750m of the residential units ***(0.5 point per item or equivalent up to maxiumm of 2 points. Less 0.5 point if more than 750m away)***: 1. Library 2. Community Center or Hall 3. Wet Market or Supermarket 4. Barber Shop 5. Laundry	2		
SM4	**OPEN SPACES, LANDSCAPING AND HEAT ISLAND EFFECT**			
	Development should have smaller footprints and more landscaping, thereby reducing the well known effects of heat islands around hard scaped areas.		**4**	
	Provision of landscaping with indigenous plants to 10% of total development area	1		
	Provision of additional similar landscaping of every extra 5%: ***1 point up to a maximum of 3 points***	3		
SITE & CONSTRUCTION MANAGEMENT				
SM5	**CONSTRUCTION SYSTEM & SITE MANAGEMENT**			
	Encourage IBS and reduce on-site construction. Reduce material wastage and construction wastage to landfill sites. Reduce the polluting effects of construction and from workers during construction.		**3**	
	Reduce pollution from construction activities by controlling pollution from waste and rubbish from workers. Create and implement a Site Amenities Plan for all construction workers associated with the project. **The plan shall describe the measures implemented to accomplish the following objectives:** 1. Proper accommodation for construction workers at the site or at temporary rented accommodation nearby. 2. Prevent pollution of storm sewer or receiving stream by having proper septic tank. 3. Prevent polluting the surrounding area from open burning and proper disposal of domestic waste. 4. Provide adequate health and hygiene facilities for workers on site.	1		
	CIDB IBS score ≥ 50%, ***OR***	1		
	CIDB IBS score ≥ 70%	2		
SM6	**STORM WATER MANAGEMENT**			
	Manage surface water run off from developments. Reduce the pollution and storm water loading of the river systems from the development. Reduce flood risk. Retain rainwater for recycling and appropriate use.		**3**	
	Complies with MASMA minimum requirements	1		
	Exceeds MASMA requirements by 30%: ***entitled to 2 additional points pro rated for lower values***	2		
SM7	**RE-DEVELOPMENT OF EXISTING SITES & BROWNFIELD SITES**			
	Discourage development in environmentally sensitive areas. Encourage re-development of existing sites. Reward rehabilitation of Brownfield site and development in the rehabilitated sites.		**4**	
	Re-development of exisitng sites or refurbishment of existing building	2		
	Rehabilitation of brownfield sites	2		
SM8	**AVOIDING ENVIROMENTALLY SENSITIVE AREAS**			
	Avoid development of inappropriate sites and reduce the environmental impact from the location of a building on a site.		**2**	
	Do not develop buildings, hardscape, roads or parking areas on portions of sites that meet any one of the following criteria: • Prime agriculture land as defined by the Town and Country Planning Act • Land that is specifically identified as habitat for any species threatened or endangered lists • Within 30 meters of any wetlands as defined by the Structure Plan of the area. ***OR*** within setback distances from wetlands prescribed in state or local regulations, as defined by local or state rule or law, whichever is more stringent: • Previously undeveloped land that is within 15 meters of a water body, defined as seas, lakes, rivers, streams and tributaries which support or could support fish, recreation or industrial use. • Land which prior to acquisition for the project was public parkland, unless land of equal or greater value as parkland is accepted in trade by the public landowner. • Land which is classified as Class IV (steeper than 30 degrees)	2		
SM9	**BUILDING USER MANUAL**			
	Document Green Building Design features & strategies for user information and guide to sustain performance during occupancy. Provide a Building User Manual which documents passive and active features that should not be downgraded.	2	**2**	
	SUSTAINABLE SITE PLANNING & MANAGEMENT (SM) TOTAL		**39**	

4 MATERIALS & RESOURCES (MR)

REUSED AND RECYCLED MATERIALS | SUSTAINABLE RESOURCES

9 POINTS

ITEM	AREA OF ASSESSMENT	DETAIL POINTS	MAX POINTS	SCORE
REUSED AND RECYCLED MATERIALS				
MR1	**STORAGE & COLLECTION OF RECYCLABLES**			
	Facilitate the reduction of waste generated by construction that is hauled and disposed off in landfills and recycling after occupancy.		2	
	During Construction, provide dedicated area(s) and storage for collection of non-hazardous materials for recycling.	1		
	During Building Occupancy, provide permanent recycle bins.	1		
MR2	**MATERIALS REUSE AND SELECTION**			
	Reuse building materials and products in order to reduce demand for virgin materials and to reduce waste, thereby reducing impacts associated with the extraction and processing of virgin resources. Integrate building design and its buildability, with careful selection of building materials in relation with embodied energy and durability of the materials to lower carbon content and better building life cycle.		2	
	Use salvaged, refurbished or used materials such that the sum of these materials constitutes at least 1% (based on cost) of the total materials for the project. The used, refurbished and new building materials concerned are to be assessed for eco preferred content, durability, the product manufacturer's environmental management system and whether the product is modular and/ or designed for disassembly. To include reusability and the number of cycles on the usage (minimum 15 cycles) of temporary materials; such as temporary formwork system, temporary framing or support system, etc. ***0.5 point for 1.0% and additional 0.25 point for every additional 0.5% up to a maximum of 2 points.***	2		
MR3	**CONSTRUCTION WASTE MANAGEMENT**			
	Divert construction debris from disposal in landfill and incinerator. Redirect recyclable recovered resources back to manufacturing process. Redirect reusable materials to appropriate sites.		2	
	Recycle and/or salvage at least 50% of non-hazardous construction debris. Develop and implement a construction waste management plan that, at a minimum identifies the materials to be diverted from disposal and whether the materials will be sorted on site or co-mingled. Quantify by measuring total tonnage of waste or truck loads of waste disposal. ***1 point for 50% and additional 0.25 point for every additional 5% up to a maximum of 2 points.*** ***If project uses high level of prefabrication with IBS score > 70, 1 point for every 10% increase in prefabrication up to a maximum of 2 points.***	2		
SUSTAINABLE RESOURCES				
MR4	**RECYCLED CONTENT MATERIALS**			
	Increase demand for building products that incorporate recycled content materials, thereby reducing impacts resulting from extraction and processing of virgin materials.		1	
	Use materials with recycled content such that the sum of post-consumer recycled plus one-half of the pre-consumer content constitutes at least 10% (based on cost) of the total value of the materials in the project. Recycled content shall be defined in accordance with the International Organization of Standards Document. ***0.5 point for 10% and 0.25 point for every additional 5% up to a maximum of 1 point.***	1		
MR5	**REGIONAL MATERIALS**			
	Increase demand for building materials and products that are extracted and manufactured within the region, thereby supporting the use of indigenous resources and reducing the environmental impacts resulting from transportation		1	
	Use building materials or products that have been extracted, harvested or recovered, as well as manufactured, within 500km of the project site for a minimum of 20% (based on cost) of the total material value. Mechanical, electrical and plumbing components shall not be included. Only include materials permanently installed in the project. ***0.5 point for 20% and 0.25 point for every additional 5% up to a maximum of 1 point.***	1		
MR6	**SUSTAINABLE TIMBER**			
	Encourage environmentally responsible forest management: Where ≥ 50% of wood-based materials and products used are certified. *These components include, but are not limited to, structural framing and general dimensional framing, flooring, sub-flooring, wood doors and finishes. To include wood materials permanently installed and also temporarily purchased for the project. Compliance with Forest Stewardship Council and Malaysian Timber Certification Council requirements.* ***Where the project has no timber content, this credit may be transferred to MR5***	1	1	
	MATERIALS & RESOURCES (MR) TOTAL		9	

5 WATER EFFICIENCY (WE)

WATER HARVESTING & RECYCLING | INCREASED EFFICIENCY

12 POINTS

ITEM	AREA OF ASSESSMENT	DETAIL POINTS	MAX POINTS	SCORE
WATER HARVESTING & RECYCLING				
WE1	**RAINWATER HARVESTING**			
	Encourage rainwater harvesting that will lead to reduction in potable water consumption:		**4**	
	Rainwater harvesting that leads to ≥ 10% reduction in potable water consumption, ***OR***	1		
	Rainwater harvesting that leads to > 30% reduction in potable water consumption, ***OR***	2		
	Rainwater harvesting that leads to > 40% reduction in potable water consumption, ***OR***	3		
	Rainwater harvesting that leads to > 50% reduction in potable water consumption	4		
WE2	**WATER RECYCLING**			
	Encourage water recycling that will lead to reduction in potable water consumption:		**2**	
	Treat and recycle ≥ 5% wastewater leading to reduction in potable water consumption, ***OR***	0.5		
	Treat and recycle ≥ 10% wastewater leading to reduction in potable water consumption, ***OR***	1		
	Treat and recycle ≥ 20% wastewater leading to reduction in potable water consumption, ***OR***	1.5		
	Treat and recycle ≥ 30% wastewater leading to reduction in potable water consumption	2		
INCREASED EFFICIENCY				
WE3	**WATER EFFICIENT LANDSCAPING**			
	Encourage the design of system that does not require the use of potable water supply from the local water authority:		**2**	
	Reduce potable water consumption for landscape irrigation by ≥ 50% (e.g. through use of native or adaptive plants to reduce or eliminate irrigation requirement, ***OR***	1		
	Do not use potable water at all for landscape irrigation	2		
WE4	**WATER EFFICIENT FITTINGS**			
	Encourage reduction in potable water consumption through use of efficient devices:		**4**	
	Reduce annual potable water consumption by > 10%, ***OR***	1		
	Reduce annual potable water consumption by > 30%, ***OR***	2		
	Reduce annual potable water consumption by > 40%, ***OR***	3		
	Reduce annual potable water consumption by > 50%	4		
		WATER EFFICIENCY (WE) TOTAL	**12**	

6 INNOVATION (IN)

INNOVATION INITIATIVES | MAINTENANCE PROGRAM & GREEN BUILDING INDEX FACILITATOR

6 POINTS

ITEM	AREA OF ASSESSMENT	DETAIL POINTS	MAX POINTS	SCORE
IN1	**INNOVATION IN DESIGN & ENVIRONMENTAL DESIGN INITIATIVES**			
	Provide design team and project the opportunity to be awarded points for exceptional performance above the requirements set by GBI rating system: ***1 point for each approved innovation and environmental design initiative up to a maximum of 5 points, such as:*** • Innovative planning that displays "less is more" and "small is beautiful"; • Rehabilitation of existing buildings for re-use in innovative ways; • Innovative use of building features to passively cool the building • Heat recovery system (contributing to at least 10% of total required capacity); • Mixed mode / low energy ventilation system; • Waterless urinals (fitted to all male toilets); • Central waste conveyance system; • Central vacuum system	5	**5**	
IN2	**GREEN BUILDING INDEX FACILITATOR (GBIF)**			
	Green Building Index Facilitator to support and encourage the design integration required for Green Building Index rated buildings and to streamline the application and certification process.		**1**	
	At least one principle participant of the project team shall be a Green Building Index Facilitator.	1		
			INNOVATION (IN) TOTAL	**6**	