THE ECO-LABELING ON SUSTAINABLE ROOF MATERIALS

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ABSTRACT

Construction industry is a major sector that needed the consideration of sustainable development agenda through sustainable construction. The sustainable construction therefore has several approaches on eco-friendly building, which focuses on harmony environment. These can be applied through the choices of material and construction methods that resulted in low level of environmental impacts worksites. The sustainable construction agenda involves optimal management of energy, water, waste management, maintenance and comfort improvements such as thermal and acoustic performance, visual and odour aspects through having good quality living. This research therefore is aim to classify sustainable characteristics or eco-friendly elements that can be utilised onto eco-labeling of roof materials through develop the assessment checklist guideline. This research therefore is focusing on roof materials of steep slope roof system that suitable with the tropical Malaysian climate. The data was gathered using the matrix checklist of sustainable characteristics for roof materials. The data then after was analysed using content analysis method and statistical analysis. This study found Clay Tiles, Fiberglass Insulation, Steel Roof Truss, Fiberglass Roofing Tissues and Aluminium drainage materials were the most sustainable roof materials that suited for a steep slope roof system. The simplified matrix checklist of sustainable roof materials then after is produced as the final result of this study that may benefit for construction industry references.

ABSTRAK

Industri pembinaan adalah sektor utama yang perlu menitikberatkan agenda kelestarian pembangunan menerusi kelestarian pembinaan. Kelestarian pembinaan mempunyai beberapa pendekatan ke atas bangunan yang eko-mesra dimana ia fokus terhadap persekitaran yang harmoni. Ini dapat diaplikasikan melalui pemilihan bahan-bahan dan kaedah pembinaan yang memberi impak paras terendah terhadap persekitaran tapak-tapak kerja. Agenda kelestarian pembinaan melibatkan pengurusan tenaga, air, pengurusan sisa, penyelenggaraan yang optimum dan meningkatkan keselesaan seperti tenaga haba dan bunyi, visual dan aspek bauan melalui penyediaan tempat tinggal yang berkualiti. Penyelidikan ini bermatlamat untuk mengklasifikasikan ciri-ciri kelestarian yang boleh digunakan untuk tujuan eko-label bahan bina. Ini membangunkan suatu panduan penilaian di mana senarai semak untuk menentukan bahan-bahan binaan bumbung yang lestari dapat disediakan. Skop penyelidikan ini memfokuskan kepada bahan-bahan binaan bumbung bagi sistem bumbung curam yang sesuai digunakan dalam cuaca tropika di Malaysia. Data-data yang diperolehi menggunakan senarai semak matriks yang mengandungi ciri-ciri lestari untuk bahan-bahan bumbung. Data–data ini kemudiaanya dianalisa menggunakan kaedah analisis kandungan dan analisis statistik. Penemuan dalam penyelidikan ini mendapati *Clay Tiles, Fiberglass Insulation, Steel Roof Truss, Fiberglass Roofing Tissues* dan *Aluminium drainage* adalah bahan binaan bumbung yang paling lestari. Matrik senarai semak yang telah dikemas kini yang akan digunakan untuk mengenalpasti bahan-bahan binaan bumbung yang lestari adalah hasil dari penyelidikan ini. Semoga ianya akan menjadi rujukan serta memberi faedah kepada industri pembinaan.

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CHAPTER 1

INTRODUCTION

1.1 General Background

Construction sector has an important role to play in delivering sustainable development. The sustainable development is the initiative to meets the needs of the present without compromising the ability of future generations to meet their own needs (Brudtland, 1987). This response to sustainable development helps to minimise the negative environmental impact of buildings performance. The construction building is achievable by enhancing efficiency and moderation in the use of sustainable materials (Kohler, 1999). The environmental impact of construction, green buildings, designing for recycling and eco-labeling of building materials have captured the attention of building professionals across the world in responding to sustainable development (Rees et. al, 1999). Thus far, from these initiatives of sustainable development the Environmental Building Assessment (EBA) has emerged as one of the major issues in order to build up the sustainable construction (Hudson et. al, 2000).

The emergence and evolution of EBA responds to a tension between the desire for objective, scientifically rigorous and stringent performance criteria with the desire for practical, transparent, simple to understand criteria that ask the industry to respond to manageable step changes in practice. EBA methods were conceived as being voluntary and motivational in their application and their current success can be either taken as a measure of how proactive the building industry is in creating positive change or its responsiveness to market demand. However, public authorities are increasingly using market-based tools as a basis for specifying a minimum environmental performance level for their building (Raymond et. al, 1990).

An initiative of EBA has been put into the ideas of green building development. The green building brings together a vast array of practices and techniques to reduce and ultimately eliminate the impacts of buildings on the environment and human health. But effective green buildings are more than just a random collection of environmental friendly technologies. They require careful, systematic attention to the full life cycle impacts of the resources embodied in the building and to the resource consumption and pollution emissions over the buildings complete life cycle.

Responses to sustainable development can be applied through sustainable building. By using selected sustainable materials whenever possible, the sustainable building will make a significant contribution to its overall impact on the environment. As the results it will provide the healthy living of the occupants of the building.

The characteristics of sustainable materials must be non-toxic, recycled and recyclable, renewable, local, standard sizes, modular, pre-cut (reduces waste), certified wood, durable and long lasting and etc. BREEAM, NABERS, Green Star, LEED, HK-BEAM and Eco-specifier are assessment tool that identified the classification of sustainable materials applied to the building.

The shift from 'green building' to 'sustainable building' entails a number of great challenges and opportunities for the developers and users of planning and building assessment tools. The current assumption is that a new generation of building assessment tools is required to meet the current and forthcoming requirements associated with the description and assessment of each building's contribution to sustainable development. Based on the available building assessment tools it can classify and give some ideas of sustainable characteristics for construction roof materials in this study in order to create an eco-labeling for sustainable roof materials.

1.2 Problem Statement

Building in Malaysia, currently had no permanent identification of sustainable building. Malaysian building development currently using Uniform Building by Law (UBBL) as a guideline, whilst as compared to European Union, they have their Green Building Program and Energy Efficiency Program. Lack of sustainable building identification in Malaysia led to poor building design that resulted inefficiency of energy and material usage. Material used and resources selection are importance in sustainable building, thus it will reduce habitat destruction and control depletion of

natural resources. By building labeling, the way to construct the building will response to sustainable site development, water efficiency, energy efficiency, indoor environmental quality and directly helps to reduce global warming. The materials with specific characteristics such as durable, comfortable and environmental friendly are the key variables of high performance of sustainable building efforts.

Malaysia need to develop its own building assessment, aiming essentially at accelerating the adoption of green building practices by the building sector concerned (Yeoh, 2005). Building materials in Malaysia are various types. This research, therefore, will conduct an eco-labeling for roof materials. It is led to identify the sustainable characteristics/ properties/ eco-friendly of roof are suitable used for a building. This labeling identification then will helps in future development of sustainable building assessment for Malaysia. This research will encourage the building stakeholders involve in building development seriously and take part using sustainable label which it additionally also enhance awareness and knowledge of Malaysian citizen on sustainable building.

This research focused on roof due to it is an important part of the building and plays a major role in providing a shelter and at the same time concern about the building envelope and energy. The building envelope is the separation between the interior and the exterior environments of a building. It serves as the outer shell to protect the indoor environment as well as to facilitate its climate control. The design of the supporting structure will be governed by the shape and geometry and the layout of the structural system for the building, the climatic conditions and the site environment and so on. The roof, insulation, and ventilation must all work together to keep the building free of moisture and provide protection from the heat. The roof design of a building can impact the buildings thermal insulation which is an important factor to achieving thermal comfort for its occupants. Insulation reduces unwanted heat loss or gain and can

decrease the energy demands of heating and cooling systems. It related to the issues of adequate ventilation and the level of sound insulation (Wikipedia, 2008).

There are a few numbers of roofing choices available for high-performance buildings such as new roof shingles on the market today, which have produced electricity using solar technology. The building performances are more refer to the breathable qualities which endow with vapour permeability, hygroscopicity and capillarity in order to avoid interfaces. It allowed moisture or thermal conflict emerges, and to spread moisture load away from vulnerable area (Padfield, 1999). Roof technology also has reflective roofing materials or coatings that can help send the heat back into the sky rather than into the building. In the design of the building, roofing materials should be integrated into the whole-building design where sustainable identification has been put into consideration. So, the building construction's materials has an important role to play in delivering sustainable living which reflects to social, economic and environmental reasons (Brudtland, 1987).

1.3 Aim of the Research

The aim of this research is to classify sustainable characteristics/ eco-friendly elements of roof materials which can be used to develop the matrix checklist of sustainable roof materials.

1.4 Objective of the Research

The goal of the research is to achieve objectives listed below:

1. To identify the importance of the Sustainable Building (SB).
2. To identify the application of sustainable building assessment.
3. To develop the sustainable characteristics/eco-friendly elements of roof materials and produce the matrix checklists in order to identify sustainable roof materials.

1.5 Scope of the Study

The limitation of this research is focusing on roof materials included insulation materials that are suitable for the Malaysian climate. Type of roof system that will be analysed is focusing on steep slope roof system. This type of roof are common roof structures used in Malaysia, which is including five main parts which are; the (i) roof covering, (ii) roof insulation, (iii) roof underlays, (iv) roof trusses and (v) roof drainage. The identification of sustainable elements of roof materials identified using content analysis from journals and observation through the roof material catalogue's specification. The sustainable matrix checklist is developed and then distributed to various parties participate in Malaysian construction industry.

1.6 Importance of Study

The results from this study can be a guidance and reference sources to all parties involved in the construction industry such as architect, contractors and clients which need to consider the sustainable characteristics/ eco-friendly elements to construct the building. Sustainable characteristics/ eco-friendly roof also can give comfort to the occupants and protect the environment from the pollution, shelter from the rain and rainwater collection for domestic use, shade from the sun and UV protection, skylights for daylighting deep within buildings, surface for energy collection, solar hot water and photovoltaic. Roof form can be designed to minimise wind turbulence, wind driven stack ventilation, thermal and environmental barrier. Roof provides space for the most important insulation (Green Building Press, 2007).

1.7 Overview of Research Methodology

The research methodology are created to draft the necessary planning which should be done systematically to complete this research until achieve the determined objectives. The planning is very importance to make sure the smooth work while collecting and analyse the data for this research. Besides that, it is also can save a lot of time and cost. This methodology consists of four stages:

1.7.1 Initial Stage

a) Initial discussion

The initial discussion carried out the overview on issues related to this study. This discussion done using a brainstorming meeting and exchanging ideas within supervisors and others professional related parties.

b) Literature review

In this literature review, discussion covered the definition of the Sustainable Development (SD), Sustainable Building (SB), Sustainable Materials, Eco-labeling materials and the roof part structures. It is also discussed about the available Sustainable Building Assessment as the tools to assess the implemention of eco-labeling scheme for construction materials. The literature review will be captured through books, journals and previous thesis from Perpustakaan Sultanah Zanariah (PSZ) and various online sources.

1.7.2 Second Stage- identifying and collecting data.

In this stage the study will involves the process of collecting information. The important data that helps to achieve the objectives of this research are divided into two categories which are primer data and secondary data.

i. Primer data

The sources of primary data are from construction roof material suppliers, manufacturers and also the developers. The primary data will be gained by distributing the proposed sustainable matrix checklist. It is very important to know the ideas and opinion about the roof properties and also observation from the catalogue of construction material products of roof materials and structure.

ii. Secondary data

The secondary data will be collected by browsing websites and database to get understanding and information about the sustainability concept, foreign environmental building assessment, roof system and materials.

1.7.3 Third Stage – Analyse, commentary and summarise the data

In this stage, the data or information collected from stage one and two will be compiled and summarised to develop the research findings. The data collected are analysed using the qualitative method (content analysis technique) and also quantitative method (calculated by SPSS 11.5 software and Microsoft Excel XP 2003).An analysis for every type of construction roof's materials will be produced in final sustainable matrix checklist. This final sustainable matrix checklist will present precisely the characteristics/ eco-friendly elements of sustainable roof materials.

1.7.4 Final Stage – Research's findings writing

The findings will be compiled in the final research writing to explain and summarise the collected data which is needed to achieve an overall determined objectives.

1.8 Expected Findings

The first expected findings is to list out the importance of sustainable building. By identifying what is the importance of sustainable building, this will helps the researcher to identify the elements of sustainable roof materials. The element identification can be done by referring to other advanced countries which have their own labeling scheme such as LEED and BREEAM. These elements should cover economy of resource, durability, comfort and environmental design.

Then the second expected finding is to identify the application of sustainable building assessment. This data collection can be collect based on the observation and understanding of the available foreign sustainable building assessment such as LEED, NABERS, BREEAM, ECO-SPECIFIERS and GREENSTAR assessment method.

The final expected finding is to form of matrix checklist that can explain the choice of the best sustainable roof materials. Through content analysis technique the sustainable roof materials matrix checklist can be give options of solution for builders to response to sustainable construction agenda. This positive response will take account to the needs of Malaysian construction industries, availability of sustainable materials, level of knowledge about sustainable building and its implication to economic society and environmental.

1.9 Summary of Chapters

This report is divided into seven (7) chapters. **Chapter 1** describes the overall intention of the study. It also explains the objectives, the scope and limitation and the brief methodology adopted for the study.

Chapter 2 is literature reviewed that gathered ideas and represent from the reading material such as books, journals and magazine. This chapter focused on the sustainable development and also its relationship between sustainable design, sustainable construction, sustainable materials, building assessment method and also eco-labeling on materials. The understanding on this chapter is important because the researcher can extract the main aspects of sustainable development that direct the idea to the construction of the matrix checklist for sustainable roof materials.

Chapter 3 explains about the roof parts, roof systems, roof materials and also requirements to construct the quality roof. This chapter is extracting the sustainable characteristics/ eco-friendly elements that can be used to identify the quality and sustainable roof.

Chapter 4 describes in detail the methodology used for this study to achieve the objectives. This includes methodology for the data collection and data analysis.

Chapter 5 analysed the data from the questionnaire survey using statistical analysis and mean index value analysis. Each part of the questionnaire was analysed in details and the bar chart diagrams are used to visualize the results.

Chapter 6 discussed in details the findings in the previous chapter. The discussion is concerning about the agreement and disagreement of each sustainable characteristics/ eco-friendly elements for roof materials by the professionals. The comparison also has been made between data analysis results and roof's catalogues observation to identify the most sustainable materials used for roof construction.

Chapter 7 concludes the overall study on the subject and evaluate whether the objectives of the study are met. Recommendations for further studies are also suggested.

1.10 Conclusion

The global demand of sustainable development required respond from sustainable construction where constructing and operating buildings requires enormous amounts of energy, water, and materials and creates large amounts of waste which gives effects to the ecosystems around people in countless ways. The buildings themselves create new indoor environments that present new environmental problems and challenges as the environmental impact of buildings becomes more apparent, a growing field called sustainable construction is leading the way to reduce that impact at the source and it is the practice of creating healthier and more resource efficient models of construction, renovation, operation, maintenance, and demolition. Sustainable construction should not be seen as something that is exclusive to expensive projects, as it has the potential to be applied to any development even small aspects of a development are switched to more sustainable materials used in order to construct the sustainable building which is an essential aspect of widening efforts to conceive an ecologically responsible world. The sustainable materials is includes not only how materials are produced, but also the impacts across their whole lifecycle. This encompasses reducing the inefficient use of resources and minimising the environmental and social impacts of their production and use. So, in order to easy identifying the sustainable materials, the eco-labeling need be produced on the construction materials, thus at first sustainable characteristics/ eco-friendly elements has to be identified and need the development of sustainable materials matrix checklists. This step needed to be done to each part of buildings and roof materials is one of the focused in this study.

1.11 Definition

1. Eco-labeling

A label which identifies overall environmental preference of a product or service within a specific product/service category based on life cycle considerations.

2. Sustainable

Capable of being maintained at a steady level without exhausting natural resources or causing ecological damage

3. Sustainable materials

Non toxic, durable, resist to weather, long lasting, low maintenance, friendly materials, can give the comfort

4. Roof systems (steep slope roof system)

Steep-slope roof systems typically are composed of individual pieces or components installed in shingle fashion and its consist of three primary parts; roof deck, underlayment (provides temporary protection until a roof covering is installed and provides a secondary weather proofing barrier) and roof covering.

6. Environmental Building Assessment

An environmental building assessment method reflects the significance of the concept of sustainability in the context of building design and subsequent construction work on site. The role of an environmental building assessment method is to provide a comprehensive assessment of the environmental characteristics of a building using a common and verifiable set of criteria and targets for building owners and designers to

achieve higher environmental standards. It also enhances the environmental awareness of building practices and lays down the fundamental direction for the building industry to move towards environmental protection and achieving the goal of sustainability.

7. The Eco-labeling on sustainable roof materials

An assessment system to rate the metrics of each roof materials characteristics which is focusing in environmental performance and performance of building. (Yeoh, 2005).

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