The Structure and Agency Role in Green Building Industry Adaptation: Malaysia's Green Building Index Development

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Abstract

In modern cities, construction are the principal users of energy, accounting for 70% of total electricity consumption plus 30% to 40% of total energy consumption. As a result, the building industry offers enormous prospects for reducing energy use using energy-saving technologies. In the green building industry, this research aims to investigate the process of creating building that is environmentally friendly. It explores the aspects and standards that must be put in place in Malaysia's green construction sector. It also outlines the barriers to the green construction industry's adoption. This research also highlights the government entities that are working to maintain the green construction sector. This research focuses on Malaysia's green building system, referred to as the Green Building Index (GBI). A method scoring instrument lets developers and building owners to plan and construct environmentally friendly structures. Meanwhile, sustainable buildings may bring energy and water savings, a conducive indoor atmosphere, greater access to transportation, and the use of recycled materials and plants in their projects, all of which help decrease our environmental footprint. The qualitative technique, which is document or content analysis employed for this investigation. The research was based on interview and observation with multiple participants of the associated personnel, as well as the utilization of case studies from reference literature.

Keywords: Green Building, Green Technology, Green Environment, Sustainable Building.

Introduction

Sustainable constructions, also referred to as green buildings, seem to be buildings that are friendly and energy efficient over the entire circle. A green building including an effective structure may save 30% until 60% energy used with a traditional structure which does not use and apply green building principles during the stages of operation, construction and design. Malaysia has made sustainable development one of its significant goals despite being a progressive state well with objective of joining the list of industrialized nations by 2020.

Global environmental objectives spurred the growth of green construction industry. Movement of Green Building has achieved remarkable success because it gives a measurable evaluation of individuals' efforts toward sustainable development. As a result, the terms of green building and sustainable development both closely interrelated. In Malaysia, the private enterprises and the government both beginning to be involved and take the required steps in decrease environmental concerns absent impeding development.

This article focuses on how to transition to sustainable building in Malaysia. The building industries must inexorably shift from its conventional manner of functioning by some consideration on environmental consequences to an unique addition in which environmental considerations take precedence. The goal of this study is to explore the topic of sustainability via the lens of IBS. (Industrialized Building System) applied, Green PASS program (Construction Industry Development Board, CIDB) and National Green Technology Strategy (KeTTHA, Kementerian Tenaga, Teknologi Hijau dan Air).

Sustainable building, sometimes known as 'green construction,' depicts the building projects industry's responsibility to modules can be integrated through a way that involves a specific amount of time. According [1] in the building sector, sustainability is a notion that must be implemented. It is essential to affect how a project is carried out to establish a blend among environmental protection and long-term development.

The primary objective of sustainable construction is decreasing the pollution, namely car emissions, waste materials, noise, and the discharge of pollutants into the environment, ground, and water. However, several challenges must be overcome while conducting a sustainable building project. The most significant impediment in construction is cost, which developers constantly use as an excuse to avoid implementing a green building sector. They need to adjust their mentality, stop seeking the cheapest option, and instead focus on the most outstanding long-term approach. Green buildings are often regarded as more valuable compared typical constructions and might be able to charge greater rents. It gives not only monetary advantages, but also non-monetary social and environmental benefits.

As a result, this research aims to evaluate the efforts made by the Government Agency. Specifically, to establish a green construction sector and investigate the aspects and characteristic that must be included in the industry of green construction implementation. The extent of this paper includes certain parts of what governments actions in creating green buildings in Malaysia that mostly on three buildings with certificates by GBI platinum. IBS applied for sustainability, the National Green Technology Strategy, and the Green PASS program to implement the green construction sector idea. More, it examines the aspects and requirements in development based on GBI and knowing what obstacles await developers—mainly supporting green practices in Malaysia's industrial growth.

Green Building

Green construction emphasizes efficient utilization of resources like as electricity, materials, water and also lessening the effects of buildings on environment and public health over the course of their lives via smart facility location, construction, maintenance,

operation and demolition [6]. Green buildings must be planned to reduce the environmental effect of construction. Malaysia's Green Building is still in its early stages, but it pushes for green technologies to ensure its future. Green building construction has been demonstrated to reduce solid waste generation. As a result, green building aims are to reduce carbon dioxide (CO2) emissions into the environment, which are anticipated to reach 40% globally (UNEP).

A green building can be defined as a high-performance building because it is built based on a complete concept that considers building forms interactions with the entire construction component, along with the service framework. According to Crossbie (2000), Green construction is a notion of integrated and comprehensive methods to decrease environmental effects in location, design, specifications, energy usage, and resources.

Green Buildings Taxonomy

The green building system of categorization is classified as sustainable building and assesses a building's sustainability. There are various standards for categorizing green building systems. Most nations have their systems based on climate, soil, geographical location, and environment. Nevertheless, the categorization method in different nations provide the same aim of green building, which to incorporate green technology on house and building.

Table 1

Classification of Green Building System

Green Building System	Country	Green Building System	Country
LEED (Leadership in Energy and Environmental)	USA	GBAS (China Green Building Assessment Method)	China
CEPHEUS (Cost EffiCost-EfficientHouses as Europe)	Germany	Protocollo Itaca / Green Building Counsil Italia	Italy
PromisE	Finland	Indian Green Building Counsil	India
GBI (Green Building Index)	Malaysia	BCA Green Mark Scheme	Singapore
BEAM (Building Environmental Assessment Method)	Hong Kong	BREEAM (Building Research Establishment Environmental Assessment Method)	UK
CASBEE (Comprehensive Assessment System for Build Environmental Efficiency)	Japan	Green Star SA	South Africa

Source: https://www.wbdg.org/resources/green-building-standards-and-certification-systems

Green Building Index (GBI)

PAM (Pertubuhan Arkitek Malaysia) designed the Green Building Rating for Housing Building Works.

The Green Building Index for Residential New Construction was created by ACEM (the Association of Consulting Engineers Malaysia) and PAM (Pertubuhan Arkitek Malaysia) as a building environmental scoring system (GBI-RNC). It created in evaluating residential houses for tropical climates such Malaysia. GBI is Malaysia's first complete methodology for assessing environmental quality design and implementation based on six major factors. The following are the six criteria:

- Indoor Environment Quality
- Energy Efficiency
- Materials and Resources
- Sustainable Site Planning and Management
- Innovation
- Water Efficiency

GBI has been created particularly for Malaysia's environmental, developmental setting and tropical weather, social and cultural demands. According to Green Building Index (2009), the approach seeks to support the construction sector as journey toward sustainable growth. Building owners and developers and have been able to construct green constructions thanks to GBI evaluations. Past research by [12, 13, 15,19] pictured green buildings may conserve energy and water by providing a superior enclosed atmosphere, improved public transit, and recycling works, lowering the effect of disastrous and environmental harm.

Green Building Design (GBD)

According to [14], "green design is a design approach that enhances the built atmosphere's quality while decreasing negative effects on the natural environment." McLennan's definition stresses that sustainable building isn't a fashion statement (aesthetic) attempt but a concept or method of dealing with structure.

Sustainable construction is defined by the Building Services Research and Information Association (BSRIA) as "the ability to design and manage the construction environment by the use of recycling resources in an efficient manner as well as applying ecological principles" [14]. The BSRIA has divided elements into three groups: removing the use of toxins, reducing the use of nonrenewable resources, and enriching the natural environment.

In addition, the United States Environmental Protection Agency (EPA) shows green buildings from an industrial standpoint as "the act of creating structures and using processes that are environmentally conscious and the efficient use of resources throughout a life cycle of the building is from siting to design, construction, operation, maintenance, renovation and demolition" [5].

National Green Technology Policy

The phrase "Green Technology" defines as goods, systems or equipment that have a low or no impact on the environment, are safe to use in promoting a healthy and enhanced environment in life. Henceforth, green-concept goods, equipment, or systems help preserve energy and natural resources while promoting renewable resources (KeTTHA, 2009).

The environmental, economic, and social dimensions of the National Green Technology Policy are defined in the following objectives: 1) to restrict the increase in energy use while promoting economic growth, 2) to promote the expansion of the green advanced technology sector and its contribution to the country income, 3) to improve Malaysia's competency in renewable technology on a worldwide scale by increasing state competency and green research and technology capability for innovation, 4) to offer sustainable growth and environmental protection for upcoming future, and 5) to increase public knowledge and education of green technology, and to promote its wider usage.

Methodology

As sources of information, this study relied on observation and interviews. First, the physical environment is observed, specifically a building research area that has received GBI platinum certificates. The buildings under consideration are The Energy Commission Building and the Malaysia Institutes of Architects (PAM). The physical environment in a green setting is defined by the components or building materials used in the structure's creation. Following that, interviews were held with personnel in the building space as well as the entity engaged in the building's development. The study's analysis was based on primary data gained by observation, interviews and secondary data obtained from reference sources example journals, papers, websites, books, relevant pamphlets, and prior researchers.

This paper uses exploration and observation as study designs. The observation was used after getting the data by identifying and taking suitable action. The data was collected constantly from the start of the investigation in order to suit the researcher's demands in completing the scope of this paper. As a result, the investigation could offer more thorough and specific information about the requirements for applying green ideas in building development.

GBI's certified building, which achieved a platinum accreditation in green building implementation, served as the study's sample. Furthermore, the researchers selected the Energy Commission Building, the Malaysia Institutes of Architects (PAM), and several government institutions engaged in the integration of green buildings in Malaysia as study examples.

For this study, an adequate research instrument is being developed that links the respondents' readiness in answering questions during the interviews. The respondents often reply to queries that are understood and easily heard. As a result, the questions provided were plain and brief, necessitating a minimal level of cognitive analysis that straightforward replies from them.

Content Analysis

Government Agency's Initiatives to Enhance the Sustainable Green Building Industry

The government places a high value on green industrial or non-industrial growth. As a result, numerous government entities, such as the Green Technology and Water (KeTTHA), Industrialized Building System (IBS), and Construction Industry Development Board (CIDB) and Ministry of Energy

Industrialized Building System (IBS)

IBS developed by the Malaysian government and construction industry. It used to signify construction industrialization and prefabricated materials in building projects. IBS is a building method wherein elements are manufactured in a factory (on/off-site), then

positioned, transported, and incorporated into a project with minimal onsite labor (Nawi et al., 2015; Hamid et al., 2008). Precast component systems, manufactured steel structures, innovative mold frameworks, prefabricated timber structures and modular block systems are among the products available.

The IBS not even a merging concept in the building construction business; it was originally utilized in 1624 when wood panel houses from England were introduced to North America. In addition, the Egyptian pyramids utilized the IBS concept, which included breaking down large blocks into smaller, better manageable parts for easier transportation. (Thomas & Sakarcan, 1994). In the United Kingdom, the usage of the IBS crossed a threshold with the installation of the Crystal Palace in 1851. As frame materials, wood, steel windows and glass were used. According to the SPI Survey, this structure was built in about four months.

The IBS was utilized in a wide range of major projects, including the Bukit Jalil Sports Complex, Petronas Twin Towers, and the Malaysian Light Rail Transit. Due to the fact that Malaysia has had this system in place for more than four decades, its utilization is still restricted. However, advances in the state's infrastructure allow the framework to expanding. Steel framework structure (lit-up beam system, tunnel form, permanent steel mold, molding form columns), Prefabricated timber framing system (prefabricated timber truss beams and columns), Steel framing system (beams, a column portal frame system and steel trusses) and Blockwork mechanisms are the five main types of IBS (lightweight concrete blocks and interlocking concrete masonry units).

IBS potentially to contribute to green development and sustainable. A controlled manufacturing environment, better use of energy-efficient materials, less construction waste, a safer that more stable working environment, and maybe more major investment on lengthy development economics can all help achieve this (Nawi et al., 2014b). As a result, the construction sector should take the advantage to leverage IBS as a strategic edge in the adoption of sustainable building.

Ministry of Energy, Green Technology and Water (KeTTHA)

Green Technology will be a main driver in boosting the national economy and fostering sustainable development, according to KeTTHA's policy statement. Green technology is the design of items, devices, and methods with the goal of preserving the natural environment and energy while minimizing and minimizing the negative effects of diverse endeavors.

KeTTHA implements two kinds of policies: national green policy on technology and national energy policy. The Policy on National Energy of 1979 has three main energy aims: 1) The Supply Objective; to guarantee a sufficient, safe, and price energy supply by creating and implementing alternative energy sources (both non-renewable and renewable), and to confirm the accomplishment of the goal, the attention of policy, especially in relation to gas and crude oil, 2) The Utilization Objective; to encourage sustainable power use and prevent wasteful and non-productive consumption of energy patterns, and 3) Environmental Energy; to reduce the negative effects on the environment of the energy supply chain, including energy generation, preservation, transit, and consumption.

National Green Technology's program and projects include: 1) the formation of the Green Technology and Climate Change Council (MTHPI), 2) eco-labelling, which motivates businesses to create environmentally sustainable goods while also assisting consumers in identifying environmentally sustainable goods. 3) Green Township, 4) Green Technology Studies (which include a Green Technology Master Plan and an Electric Vehicle Development Blueprint), and 5) Smart Partnership (that also includes green jobs,

green concepts in the curriculum guide throughout all stages of schools and universities, green ICT, and green technology cooperation between Malaysia and South Korea).

Malaysian Green Construction Initiatives: Construction Industry Development Board (CIDB)

In 2010, CIDB established the Best Practices in the area of Green Technology and the Building Sector technical committee. The group's primary goal was to help CIDB define and develop, industry standards, manuals, training modules and technical reports relating to green technology. Moreover, CIDB operates program that an eco-label to support businesses, particularly manufacturers, to develop sustainable construction parts. Green labelling has the potential to enhance the green construction evaluation framework. The government will implement green supply chain management in the near future as well.

Construction Industry Standards (CIS) are being developed by CIDB to measure the environmental effect of construction works. The Green Performance Evaluation System in Construction (Green PASS) is the standard title. To combat climate change, CIDB emphasize the need for achievement green building standards in order to develop a system that ties sustainability to effectiveness (CIDB, 2012). This guideline specifies how low-carbon building should perform while attempting to retain the desired degree of satisfaction.

Green PASS is designed achieve the requirements by encouraging interconnected construction with other CISs via regulatory requirements. The guideline of independent building that examines the effect of buildings on the environment. In fact, the Green PASS was established on the belief that design standards should tackle the performance of exterior buildings as measured by evaluation methods or other scoring systems. Consequently, it may be implemented, and followed for making it a useful approach in the construction industry.

Through prerequisites and achievement rules, the applicable standards will offer a minimum requirement for structures and systems. Furthermore, they will add to existing criteria to provide a coherent model, a green construction standard [2]. The goals of Green PASS are to: 1) establish a foundation of CIDB to create a secure and consistent database on building carbon output, 2) cater the use of an achievement standard in tackling sustainable buildings, 3) provide a framework linking sustainable development and achievement, and 4) push towards sustainable building.

Green PASS aims the carbon pollution from building projects over the life of a structure. This standard specifies the pre - intervention, during-, and post-construction phases of a building's life cycle, involving carbon emissions categorized as embodied carbon and operating carbon. Both new and current buildings must meet these standards. CO2 released prior to and during construction is embodied carbon [3,18]. CO2 produced from the time a building is built until it is decommissioned is called to as operational carbon. Diamond Rating will be the designation for the certification level.

The Green Building Industry's Aspects and Criteria for Acquisition

The Energy Commission Building

The Diamond Building, which houses the Energy Commission's headquarters, is in Precinct 2 of Putrajaya, near to Taman Pancarona, a community landscape park. The Diamond Building was planned and constructed with a long-term sustainability in mind. Lower utilization carbon fuels, water management, ecological construction material, minimizing waste and prevention, environmental considerations, road and transport supervision, and a demolition waste management plan are all aspects they are considering. Consequently, instead of the standard index of 135 kWh/m2/year, this

construction is predicted to have an energy value of 85 kWh/m2/year (MS1525).

The ASEAN Centre for Energy has awarded the Diamond Building, the eight-story headquarters of Malaysia's Energy Commission (Suruhanjaya Tenaga) in Putrajaya, the highest honor in the ASEAN Energy Award (AEA). The energy-efficient, passive-design structure is meant to use largely natural daylight and utilize around one-third the energy of a comparable-sized standard version. The building achieved Platinum certifications from Malaysia's GBI and Singapore's Green Mark program after it was completed in 2009.

Photovoltaic (PV) solar panels cover the roof of the Diamond Building, supplying approximately 10% of the building's power. Rainwater collecting devices may also preserve close to 80% of the desalinated water. The Diamond Building's inverted pyramid shape for more roof area to accommodate solar panels and much more floor area for greenery. The building's highlight, as per the Energy Commission, is a wide middle area designed to allow and control natural daylight by "an automatic roller-blind mechanism to controlled the intensity." It also pertains to the incident sunlight's angle. Designed by NR Architect from Kuala Lumpur, Malaysia, and the project's principal was Dr Soontorn Boonyatikam from Thailand. Kuala Lumpur-based IEN Consultants provided compared with the traditional advising and engineering support.

When designing a major office building, diamond form chosen for its practical advantages. By expressing value, transparency, and durability, the diamond embodies the Energy Commission's stanch. Furthermore, the one-of-a-kind design represents the most energy-efficient design approach.

Throughout the design process, comprehensive computational modeling of the diamond shape were run to ensure that the intended sunlight and energy efficiency were met. Furthermore, different sunlight expected to assume were conducted to ensure that enough and very well sunlight was available to maintain the residents' comfort levels. These simulations also provided valuable insight into the working procedures that could be taken to minimize energy usage while maintaining user comfort and safety.

The Building Energy Index (BEI) is a calculation that divides a property's total yearly energy consumption in kilowatt-hours (kWh) by its floor space per square meters (m2). In Malaysia, a standard office building has a BEI of 210 kWh/m2/year. At 2,800 hours of usage, the Diamond Building is expected to get a BEI of 85 kWh/m2/year, a % reduction in energy demand. The baseline BEI for the building is presently 65 kWh/m2/year. The Diamond Building's architecture idea is divided into four major categories: water efficiency, energy efficiency, indoor and outdoor environmental quality.

Malaysian Institute of Architects (PAM)

On a very narrow and severely constrained site, HMA & Associates (Ar Mohd Heikal bin Hasan) created the PAM Centre with an appealing and effective approach. Its east-facing front wall has a strong yet necessary pattern that may be used to mount a variety of screening platform. The diagonally piled street façade and planted outdoor atriums provide a distinctive tropical impression. The atriums surrounding the mono stairs expanding the area, creates a striking central linking section that connects the whole structure.

The goal of employing passive energy-saving features is to improve natural day lighting, air circulation, and heat gain [4]. Tree planting serves to retain frigid air at the cement wall, which is later exonerated to chill the building in the morning. Another example of active energy-efficient architecture is the use of ground glass and gaps throughout the structure to limit views. The plants across all levels of the tower are designed to absorb CO2 and create oxygen.

Other effective energy-saving aspects provide an air-conditioning structure by high

VRF method providing cool air and lower consumption of energy, an illumination area with energy-efficient LED and T5 lighting, sustainable sources of a 25k Wp photovoltaic (PV) system, and a Building Automation System with Energy Management Program to enhance consumption of energy and consumer. Rainwater collection to reduce the need for water supply for cleaning and irrigation, totally water-efficient WELS 3-tick certified fittings, and hybrid car charging points and bicycle docks to encourage greener forms of transportation It also relates to Building Energy Intensity (BEI), which reduces overall building energy use by combining EE methods.

Ministry of Work Malaysia

The Ministry of Work is managing the public projects, highways, the building sector, engineers, planners, and quantity surveyors. The one-of-a-kind design of this structure includes a part in the panel's center point with one angular position slanted inside and one corner angled outside. Using slanted glass panels to emphasize distinct reflect lights, this design was intended to display diamonds.

Semi-unitized facades with 30.38 millimeters thick Illuminated Glazed Silver Grey reflecting and blue sight glass, PVDF, and ultra-robust powder painted extrusion aluminum make up the facade structure office building types A and B. Fenestration type C, on the other hand, features an open connection covering system that makes of aluminum advanced composites (Champagne Metallic & White shadow gap at the bottom). There are two unique parts to the construction project. Initially, a metal frame shaped like a leaf support supports the roof, which is supported by a steel and concrete column structure from level 32 to the top floor. From cellar 1 to the top floor, there are 20 pillars of constructions with varying floor size at each level. The second aspect is the Building Energy Index Requirements. The annual Energy Consumption Index should not be more than 100 kWh/m2. Within two years of passing the facilities over to the client, a sustainable building index of 200 kWh/m2/year must be shown with one full year of real measurements gathered from the property.

Sunlight efficiency and day absorption into indoor environment are also part of energy saving. It also has a light management system that switches off lights automatically when natural sunlight meets the light need during the day. The demand is for energy-efficient lighting in the range of 300-400 lux, which converts the initial T8-light reduced design into T5-light tube energy-efficient office supplies. Renewable power, such as PV cells, is used as an extra energy source to help the building earn GBI points. If the lux is suitably lit, an automated sensor that can save energy usage is installed on the light along the facade to switch it off.

In terms of water efficiency, recycled water may assist the Ministry of Work Malaysia to minimize its consumption of clean water by using the 'Rainwater Harvesting' and 'Gray Water Recycle' technologies.

Conclusion

Sustainability is becoming a key concern for construction operators, politicians, and industry as the world pushes toward nil energy construction. The effect of energy and gases of greenhouse becomes efficient when a building reaches net-zero energy use. Through its development, administration, use, alteration, and removal, the built environment has the potential to inflict enormous environmental damage. Urbanization consumes space and degrades landscapes and natural resources. Parameters are extracted from the environment and then restored when they are no longer needed, generally in a deteriorated condition, in the built environment. Fortunately, people are starting to recognize the dangers of unsustainable development and are working toward

better, more responsible development. Extensive research and case studies conducted throughout the world have revealed the benefits of building sustainably. In Malaysia, the government, non-governmental groups, and educational institutions have actively promoted sustainable development during the last five years, demonstrating positive progress in this sector. However, based on the findings of the poll, it appears that the benefits of sustainable methods have yet to be completely achieved despite the slow adoption of this method among building professionals. In actuality, some construction builders believed that the concept's realization was on the low end of the scale. A lack of information, inadequate law enforcement, education vs experience, and a passive culture are all issues that impede active implementation. At the current rate, this state is only anticipated to improve. More methods and strategy should be implemented vigorously in order to hasten the transition to a more sustainable building sector, which is essential for constructing a viable future

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