Implementation Framework of Green Building Design For Malaysian Government Building

Shiela Sharif, Assoc. Prof. Dr. Sr Syahrul Nizam Kamaruzzaman and Prof. Michael Pitt

Abstract—The purpose of this study is to develop the Implementation Framework of Green Building Design for Government Project. Implementation of Green Building Design is very important in Malaysia to conduct and execution of the green government project. Based on the literature, there is no guideline has been developed to conduct and execution of green government projects in Malaysia. The research intended to answer the questions about the factors involve in the development of the framework, what is the significant relationships exists between the factors involve and the Implementation Framework and whether there is significant relationship exists between the factors in implementation framework. A total 1500 respondent selected between multilevel of project team including engineers, assistants engineers, technical assistant and stake holders. In conclusion the research answered all pertaining questions regarding development of Implementation Framework of Green Building Design through quantitative research and hypothesis testing.

Keywords— Green Building, Green Building Design, Implementation Framework, Government Building.

I. INTRODUCTION

The building which we live, work and play interact with our environment, affecting stormwater run off, energy and water consumption, transportation patterns, and indoor air quality. Recognition of the role that buildings have in our environment has led to significant efforts to design, build and maintain more sustainable structures (Parris, 2010). Green building practices practices includes environmentally responsible and resource efficient, promote building practices that conserve energy and water resources, preserve open spaces, minimise the emission of toxic substances, harmonise with the local climate, traditions, culture and the surrounding environment, sustain and improve the quality of human life, maintaining the capacity of the ecosystem at local and global levels. Benefit of green building to the environment is save energy use at 24% up to 50%, CO₂ emissions 33% up to 39%, water use save 40% and solid waste reduction of 70% for each energy use at 24% up to 50%, CO₂ emissions 33% up to 39%. Benefit of green building to the environment is save energy use at 24% up to 50%, CO₂ emissions 33% up to 39%, water use save 40% and solid waste reduction of 70% for each energy use at 24% up to 50%, CO₂ emissions 33% up to 39%

II. PROBLEM IDENTIFICATION

Prime Minister of Malaysia, Dato’ Sri Haji Mohamad Najib bin Tun Haji Abdul Razak has announce Malaysia commitment in United Nations Climate Change Congress 2009 (COP 15) in Copenhagen on 17 December 2009 that during 2020 Malaysia will reduce carbon emission rate up to 40 % from the current rate on 2005. There is also major issues for Malaysia that we will become a net importer of energy by 2015. The way Malaysian building has been designed will affect the energy consumption required. There is difficulty to justify Implementation Green Building in Government projects. Existing guidelines and Code of Practise on Energy Efficiency and Renewable energy to achieve low carbon building in the market such as MS1525, Dasar Teknologi Hijau and Development and publication of EE in Buildings Guidelines does not cover the strategies or method to implement green building for government project. Besides that, in Malaysia, there is only Green Building Index which is the rating tool for Green Building and a private initiatives.

Public Works Department of Malaysia is the largest implementor of Government Buildings and projects in Malaysia. Despite the excellent and best practise of project management procedures and guidelines that has implement in Public Works Department ,however the method and procedure in conducting or implement the green building project has not been emphasized clearly and systematically. The total no of green project initiated to Public Works Department for 10th Malaysian Plan for Public Building Branch, Public Works Department as shown on table I.

In addition to Public Works Department initiatives and commitment to deliver outstanding Green Building Projects as mention in the Public Works Department Key Performance Indicator in the Strategic Framework 2012-2015 to produce...
outstanding project delivery. This Implementation Framework is a starting point and beginning role of Public Works Department as the Implementor of Green Building Projects for Government of Malaysia.

### Table I

**GREEN BUILDING PROJECT IN BUILDING WORKS BRANCH FOR 10TH MALAYSIA PLAN**

**SOURCE: HEAD PROJECT OFFICE, BUILDING WORKS BRANCH, PUBLIC WORKS DEPARTMENT.**

<table>
<thead>
<tr>
<th>BIL</th>
<th>NAMA MP</th>
<th>HOPT</th>
<th>NAMA PROJEK</th>
<th>HOPT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jabatan Perdana Menteri</td>
<td>CKBA</td>
<td>PEMBANGUNAN INSTITUT HALAL MALAYSIA DI ENSTEK, NILAI N.SEMBILAN</td>
<td>UPP 3</td>
</tr>
<tr>
<td>2</td>
<td>Jabatan Perdana Menteri</td>
<td>CKBA</td>
<td>KOMPLEKS MAHKAMAH BARU KOTA KINABALU</td>
<td>UPP 4</td>
</tr>
<tr>
<td>3</td>
<td>Kementerian Pertanian &amp; Industri Asas Tani</td>
<td>CKBA</td>
<td>PEMBINAAN PUSAT PEMPROSESAN GETAH TERMAJU BERSEPADU DI KOTA TINGGI, JOHOR</td>
<td>UPP 6</td>
</tr>
<tr>
<td>4</td>
<td>Kementerian Sumber Manusia</td>
<td>CKBA</td>
<td>PEMBINAAN PUSAT LATIHAN PENGAIJAR DAN KEMAHIRAN LANJUTAN DI TANJUNG MALIM, PERAK</td>
<td>UPP 6</td>
</tr>
<tr>
<td>5</td>
<td>Perbendaharaan</td>
<td>CKBA</td>
<td>PEMBINAAN BANGUNAN PEJABAT LEMBAGA HASIL DALAM NEGERI MALAYSIA CAWANGAN TELUK INTAN</td>
<td>UPP 1</td>
</tr>
<tr>
<td>6</td>
<td>Kementerian Kemajuan Luar Bandar &amp; Wilayah</td>
<td>CKBA</td>
<td>PEMBINAAN KAMPUS UNIKL - MALAYSIAN INSTITUTE OF AVIATION TECHNOLOGY (UNIKL MIAT), SUBANG</td>
<td>UPP 4</td>
</tr>
<tr>
<td>7</td>
<td>Jabatan Perdana Menteri</td>
<td>CKBA</td>
<td>KOMPLEKS IBU PEJABAT MAHKAMAH SYARIAH NEGERI PULAU PINANG</td>
<td>UPP 5</td>
</tr>
<tr>
<td>8</td>
<td>Kementerian Sumber Manusia</td>
<td>CKBA</td>
<td>PEMBINAAN PUSAT LATIHAN DAN PEROLEHAN PERALATAN LATIHAN BAGI INSTITUT LATIHAN PELADANGAN (ILPG) SEGAMAT, JOHOR</td>
<td>UPP 6</td>
</tr>
</tbody>
</table>

### III. RESEARCH OBJECTIVES

The Introduction and the problem statement above led to the formulation of the research aim and objectives. The broad aim of this research is to introduce/establish implementation framework of green building government building. In accordance with the research aim, the pertaining objectives of this study are: a) To determine the control factor/critical areas to focus on the green building design. B) To assess current project team/staff perception in implementation of green building project. C) To intergrate green building factors as rating tools in existing design and project management procedure. D) To build implementation framework of green building design for government building.

### IV. LITERATURE REVIEW

Green building (also known as green construction or sustainable building) refers to a structure and using process that is environmentally responsible and resource-efficient throughout a building's life-cycle: from siting to design, construction, operation, maintenance, renovation, and demolition. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort.

Although new technologies are constantly being developed to complement current practices in creating greener structures, the common objective is that green buildings are designed to reduce the overall impact of the built environment on human health and the natural environment by:

- Efficiently using energy, water, and other resources
- Protecting occupant health and improving employee productivity
- Reducing waste, pollution and environmental degradation

A similar concept is natural building, which is usually on a smaller scale and tends to focus on the use of natural materials that are available locally. Other related topics include sustainable design and green architecture. Green building does not specifically address the issue of the retrofitting existing homes.

#### A. Reducing environmental impact

Green building practices aim to reduce the environmental impact of new buildings. Buildings account for a large amount of land.
B. Goals of green building

The concept of sustainable development can be traced to the energy (especially fossil oil) crisis and the environment pollution concern in the 1970s. The green building movement in the U.S. originated from the need and desire for more energy efficient and environmentally friendly construction practices. There are a number of motives to building green, including environmental, economic, and social benefits. However, modern sustainability initiatives call for an integrated and synergistic design to both new construction and in the retrofitting of an existing structure. Also known as sustainable design, this approach integrates the building life-cycle with each green practice employed with a design-purpose to create a synergy amongst the practices used. Green building brings together a vast array of practices and techniques to reduce and ultimately eliminate the impacts of new buildings on the environment and human health. It often emphasizes taking advantage of renewable resources, e.g., using sunlight through passive solar, active solar, and photovoltaic techniques and using plants and trees through green roofs, rain gardens, and for reduction of rainwater run-off. Many other techniques, such as using packed gravel or permeable concrete instead of conventional concrete or asphalt to enhance replenishment of ground water, are used as well.

While the practices, or technologies, employed in green building are constantly evolving and may differ from region to region, there are fundamental principles that persist from which the method is derived: Siting and Structure Design Efficiency, Energy Efficiency, Water Efficiency, Materials Efficiency, Indoor Environmental Quality Enhancement, Operations and Maintenance Optimization, and Waste and Toxics Reduction. The essence of green building is an optimization of one or more of these principles. Also, with the proper synergistic design, individual green building technologies may work together to produce a greater cumulative effect.

On the aesthetic side of green architecture or sustainable design is the philosophy of designing a building that is in harmony with the natural features and resources surrounding the site. There are several key steps in designing sustainable buildings: specify 'green' building materials from local sources, reduce loads, optimize systems, and generate on-site renewable energy.

C. Siting and structure design efficiency

The foundation of any construction project is rooted in the concept and design stages. The concept stage, in fact, is one of the major steps in a project life cycle, as it has the largest impact on cost and performance. In designing environmentally optimal buildings, the objective is to minimize the total environmental impact associated with all life-cycle stages of the building project. However, building as a process is not as streamlined as an industrial process, and varies from one building to the other, never repeating itself identically. In addition, buildings are much more complex products, composed of a multitude of materials and components each constituting various design variables to be decided at the design stage. A variation of every design variable may affect the environment during all the building's relevant life-cycle stages.

D. Energy efficiency

Green buildings often include measures to reduce energy use. To increase the efficiency of the building envelope, (the barrier between conditioned and unconditioned space), they may use high-efficiency windows and insulation in walls, ceilings, and floors. Another strategy, passive solar building design, is often implemented in low-energy homes. Designers orient windows and walls and place awnings, porches, and trees to shade windows and roofs during the summer while maximizing solar gain in the winter. In addition, effective window placement (daylighting) can provide more natural light and lessen the need for electric lighting during the day. Solar water heating further reduces energy costs. Onsite generation of renewable energy through solar power, wind power, hydro power, or biomass can significantly reduce the environmental impact of the building. Power generation is generally the most expensive feature to add to a building.

E. Water efficiency

Reducing water consumption and protecting water quality are key objectives in sustainable building. One critical issue of water consumption is that in many areas, the demands on the supplying aquifer exceed its ability to replenish itself. To the maximum extent feasible, facilities should increase their dependence on water that is collected, used, purified, and reused on-site. The protection and conservation of water throughout the life of a building may be accomplished by designing for dual plumbing that recycles water in toilet flushing. Waste-water may be minimized by utilizing water conserving fixtures such as ultra-low flush toilets and low-flow shower heads. Bidets help eliminate the use of toilet paper, reducing sewer traffic and increasing possibilities of reusing water on-site. Point of use water treatment and heating improves both water quality and energy efficiency while reducing the amount of water in circulation. The use of non-sewage and greywater for on-site use such as site-irrigation will minimize demands on the local aquifer.

F. Materials efficiency

Building materials typically considered to be 'green' include rapidly renewable plant materials like bamboo (because bamboo grows quickly) and straw, lumber from forests certified to be sustainably managed, insulated concrete forms, dimension stone, recycled stone, recycled metal, and other products that are non-toxic, reusable, renewable, and/or recyclable (e.g. Trass, Linoleum, sheep wool, panels made from paper flakes, compressed earth block, adobe, baked earth, rammed earth, clay, vermiculite, flax linen, sisal, seagrass, cork, expanded clay grains, coconut, wood fibre plates, calcium sand stone, concrete (high and ultra high performance, roman self-healing concrete), etc. The EPA
commercial buildings. During the construction phase, one goal should be to reduce the amount of material going to landfills. Well-designed buildings also help reduce the amount of waste generated by the occupants as well, by providing on-site solutions such as compost bins to reduce matter going to landfills.

To reduce the impact on wells or water treatment plants, several options exist. "Greywater", wastewater from sources such as dishwashing or washing machines, can be used for subsurface irrigation, or if treated, for non-potable purposes, e.g., to flush toilets and wash cars. Rainwater collectors are used for similar purposes.

Centralized wastewater treatment systems can be costly and use a lot of energy. An alternative to this process is converting waste and wastewater into fertilizer, which avoids these costs and shows other benefits. By collecting human waste at the source and running it to a semi-centralized biogas plant with other biological waste, liquid fertilizer can be produced. This concept was demonstrated by a settlement in Lubeck Germany in the late 1990s.

Practices like these provide soil with organic nutrients and create carbon sinks that remove carbon dioxide from the atmosphere, offsetting greenhouse gas emission. Producing artificial fertilizer is also more costly in energy than this process.

V. PROPOSE CONCEPTUAL FRAMEWORK FOR IMPLEMENTATION

FRAMEWORK OF GREEN BUILDING DESIGN FOR MALAYSIA

GOVERNMENT BUILDING

The suggested framework (Figure 1) is derived from the analytical literature review of the study which consists of concept process phases and also in depth review of previous study conducted from previous research. This framework consist of 5 factors involving project management procedure/guideline/government policies, type of project execution (design and build/convensional) and project staffs perceptions.

I. Waste reduction

Green architecture also seeks to reduce waste of energy, water and materials used during construction. For example, in California nearly 60% of the state's waste comes from recycled industrial goods, such as coal combustion products, foundry sand, and demolition debris in construction projects.

Building materials should be extracted and manufactured locally to the building site to minimize the energy embedded in their transportation. Where possible, building elements should be manufactured off-site and delivered to site, to maximise benefits of off-site manufacture including minimising waste, maximising recycling (because manufacture is in one location), high quality elements, better OHS management, less noise and dust.

G. Indoor Environmental Quality enhancement

The Indoor Environmental Quality (IEQ) category in LEED standards, one of the five environmental categories, was created to provide comfort, well-being, and productivity of occupants. The LEED IEQ category addresses design and construction guidelines especially: indoor air quality (IAQ), thermal quality, and lighting quality. Indoor Air Quality seeks to reduce volatile organic compounds, or VOC's, and other air impurities such as microbial contaminants. Buildings rely on a properly designed HVAC system to provide adequate ventilation and air filtration as well as isolate operations (kitchens, dry cleaners, etc.) from other occupancies. During the design and construction process choosing construction materials and interior finish products with zero or low emissions will improve IAQ. Many building materials and cleaning/maintenance products emit toxic gases, such as VOC's and formaldehyde. These gases can have a detrimental impact on occupants’ health and productivity as well. Avoiding these products will increase a building's IEQ.

Personal temperature and airflow control over the HVAC system coupled with a properly designed building envelope will also aid in increasing a building's thermal quality. Creating a high performance luminous environment through the careful integration of natural and artificial light sources will improve on the lighting quality of a structure.

H. Operations and maintenance optimization

No matter how sustainable a building may have been in its design and construction, it can only remain so if it is operated responsibly and maintained properly. Ensuring operations and maintenance (O&M) personnel are part of the project's planning and development process will help retain the green criteria designed at the onset of the project. Every aspect of green building is integrated into the O&M phase of a building's life. The addition of new green technologies also falls on the O&M staff. Although the goal of waste reduction may be applied during the design, construction and demolition phases of a building's life-cycle, it is in the O&M phase that green practices such as recycling and air quality enhancement take place.

I. Waste reduction

Green architecture also seeks to reduce waste of energy, water and materials used during construction. For example, in California nearly 60% of the state's waste comes from recycled industrial goods, such as coal combustion products, foundry sand, and demolition debris in construction projects.
VI. METHODOLOGY
The research will be focused on:-
Integration of green building element in existing Public Works Department Design Procedures and PWD existing project management system such as Quality Management System. The Green Building element here are:

a) Efficient use of natural resources
b) Waste minimization
c) Eco-friendly construction materials
d) Incorporation of local climate conditions
e) Less energy required to transport building materials.
f) Limited impact on surroundings
g) Consideration of life cycle costs
h) Health
i) Easy accessibility
j) Efficient Building management and commissioning.
k) Social capacity and building users comfort.
l) Convenient indoor environment.

Implementing active design procedure inside Public Works Department Green Building projects which involves active design process which includes energy efficiency, waste management, water efficiency and renewable energy systems.

Integration of current government policy, code of practice and guidelines- MS 1525, Dasar Teknologi Hijau Negara into the implementation framework. Besides that integration of the framework with PM BOK- Project management 9 knowledge of areas.(cost, quality, procurement).

Investigate what is the project staff perception and awareness in implementation of green building design projects and finally compare to Code of Sustainable Home UK.

VII. SIGNIFICANT OF RESEARCH
7.1.1 Output:

b) To produce/publish guideline for implementation of Green Building Design for Government Building/Government Projects.

7.1.2 Outcome:

a) Preliminary (Cawangan)

- There is guideline on how to implement Green Building Design in PWD projects.
- There is guideline about participation various disciplines in PWD such as mechanical engineer, civil engineer, electrical engineer, architect and quantity surveyor in implementation of Green Building Design.
- There is guideline about role and responsibility of PWD and various government agencies (stake holders) such as EPU in implementation of Green Building Design.
- PWD become the reference for implementation of Green building design in government projects in Malaysia.
- The execution and implementation of green building design in PWD is more systematic and efficient.
- Gives more understanding and awareness to all project management staff in the implementation of green building design in the projects.

Benefits to the customer:

- Deliver a more energy efficient building to the customer.
- Deliver a safer energy consumption building to the customer.
- Help customer to save cost on energy.

Tertiary (Country)

Benefits to the country:

- Green or sustainable building design will save energy resources in Malaysia.
- Green building design will resolve the issues of Malaysian energy consumption and usage.

7.1.3 Impact

- Smooth implementation/management of Green Building Design Projects for PWD/Government.
- Standard rules/responsibility of various levels of project team in implementation/management/execution of Green Building Design Projects For PWD/Government.
- Standard contract administration of Green Building Design Projects in PWD/Governments.

VIII. CONCLUSION

Implementation framework of green building design for Malaysian Government Building is important in addition to ensure the success of Public Works Department as implementer of Green building for Malaysian Government Projects. This framework also important for Malaysia to have a clear and systematic execution/implementation of green government project in Malaysia.

REFERENCES


