Collaboration Initiative on Green Construction and Sustainability through Industrialized Buildings Systems (IBS) in the Malaysian Construction Industry

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Abstract

Malaysian Construction Industry has been urged to use innovative construction technique and to shift from traditional practice of brick and mortar to Industrialized Building System (IBS) construction. IBS is defined as a construction technique in which components are manufactured in a controlled environment (on or off site), transported, positioned and assembled into a structure with minimal additional site works. On the other hand, the issues of sustainability and green construction have been duly highlighted in the Construction Industry Master Plan (2005 – 2015) as being of significant importance for the Malaysian construction industry. The Malaysian government is also committed to addressing sustainability issues and meeting its target and obligations in this regard. This paper highlights several aspects of IBS that has the potential of contributing to green construction and sustainability. IBS promotes sustainability from controlled production environment, minimization of waste generation, extensive usage of energy efficient building material, effective logistics and long term economic stability which can contribute to better investment in environment technologies. The Construction Research Institute of Malaysia (CREAM), University of Salford and other research institutes in Malaysia will conduct a collaboration Research and Development (R&D) initiative on green construction and sustainability trough IBS implementation. From this paper, the authors hope to receive feedbacks, comments and recommendations to improve research aims, objectives, expected deliverables and research methodology.

Keywords: *Construction Industry, green construction, Industrialized Building System (IBS), Malaysia, and sustainability.*

1.0 THE MALAYSIAN CONSTRUCTION INDUSTRY SCENE

The Malaysian construction industry has played a major role on generating wealth trough a constant growth in GDP's contribution and influenced in the development of social and economic infrastructures and buildings. The industry provided job opportunities for almost 1.03 million people which represented 8% of total workforce [1]. The industry growth at the rate of 5.3% and contributed for almost 6% of the country's GDP in 2008 [2]. Estimation demand for construction under 9th Malaysia Plan (2006-2010) is projected at RM 280 billion in the average of RM 56 billion per year. The projection based on estimation of RM 180 billion of government funded projects, RM 140 billion of private funded and RM 20 billion Public Finance Initiatives (PFI) in this stipulated time frame [2]. However, the industry is under a constant pressure to deliver and to tackle issue on performance, safety, shortage of labour, environment and sustainability, dependency on foreign labour and demand in affordable housing. Malaysia attracted a huge number of foreign workers into the country to take up employment on site as unskilled labour doing manual jobs. According to Construction Industry Development Board (CIDB) Malaysia, 69% (552,000) out of total 800,000 of registered workers as at June 2007 is foreign workers [2]. Foreign workers are usually unskilled when they first arrived in Malaysia and this impacted the productivity and the quality of the construction industry. The social problems associated with foreign workers, further aggravates the situation. The local workforce and new graduates were reluctant to join the industry due to the *3D Syndrome* (dirty, difficult, and dangerous) which has been long associated with the industry. The productivity level of construction is worth RM 20,511, which an increase 1.52% from the previous years. Nonetheless, this growth is relatively low when compared to other industry [3]. The death occurred by occupational accident in construction is one of the highest in the country which showed 72 cases in 2008 and 95 cases in 2007. The rates is on-par with the number of cases in manufacturing industry, although the manufacturing produced larger volume of works and higher number of occupational accident [4].

Issues of sustainability have been duly highlighted in the Construction Industry Master Plan (2005 – 2015) as being of significant importance for the Malaysian construction industry [1]. The Malaysian Green Building Index (GBI) has been developed recently by Association of Consulting Engineers Malaysia (ACEM) and Pertubuhan Arkitek Malaysia (PAM) to promote sustainability in built environment. The introduction of the rating system provides new challenges for the industry players in building construction.

2.0 INDUSTRIALISED BUILDING SYSTEM (IBS) CONSTRUCTION

To cope with these challenges, Malaysian construction industry has been urged to use innovative construction technique and to shift from traditional practice to Industrialized Building System (IBS) construction. The importance of IBS is highlighted under the *Strategic Thrust 5: Innovate through R&D to adopt a new construction method* in the Construction Industry Master Plan 2006-2015 (CIMP 2006-2015) which has been published as means to chart the future direction of the Malaysian construction industry [1]. IBS is defined as a construction technique in which components are manufactured in a controlled environment (on or off site), transported, positioned and assembled into a structure with minimal additional site works [5]. The adoption of IBS was successful in Germany, Japan, Finland and Sweden to cope with construction challenges. It created a value added to the industry with greater emphasized on buildings quality and end

customer satisfaction. IBS has been applied in Malaysia since mid 60's by the use of pre-cast concrete beam-column element and panelized system [6]. IBS projects in Jalan Pekeliling, Kuala Lumpur and Rifle Range, Penang had used Danish System and French Estoit System respectively [6]. However, due to some criteria that were not suitable for local and cultural habits, the technology did not take off as planned. The recent influx of foreign workers has reignited the interest on IBS. Early IBS promotion and research was initiated then by the Housing Research Centre (HRC), Universiti Putra Malaysia (UPM). HRC had organized a series of national and international colloquiums and seminars on IBS. Not long after, the Construction Industry Development Board (CIDB) Malaysia had formed the IBS Steering Committee in the effort to bring to the fore all the IBS related issues in a systematic framework and IBS Strategic Plan 1999 were formed. CIDB, in 2003 had published the roadmap to guide the practitioners and decision makers in IBS implementation in Malaysia. The roadmap has been endorsed by the parliament of Malaysia in October 2003 involved government and inter-ministry actions towards greater adoption of IBS in Malaysia. The Industrialized Building Systems Roadmap 2003-2010 (IBS Roadmap) is based on the *5 M Strategy (Manpower, Materials-Components- Machines, Management Processes-Methods, Monetary and Marketing)* with the target of having an industrialized construction industry and introduce open building concept by the year 2010 [5].

Despite a well-documented benefits and strong support from the government, the take-up so far is not as high as first anticipated at this stage. Relatively, the low labour cost in Malaysia is the root cause of the problem. Although the members of the industry are open to the idea, a major portion of the industry stakeholders particularly in the private sector are indifferent, perhaps due to resistance towards change and insufficient information and fund to support the feasibility of change. Recent report (IBS Roadmap's mid-term review) projected that less than 35% of total construction projects (using at least one IBS products) in year 2006 as compared to forecasting IBS project of 50 % in 2006 and 70% in 2008 as projected in IBS Roadmap [7]. To create a *spilt-out* effect on IBS usage in the private sector, the government pledged to construct 100,000 units of affordable houses using IBS, announced back in 2005 and 2006 Budget. As an incentive to private sector's adopters, construction projects that utilized IBS components in 50% of the building works, will received an exemption of construction levy (CIDB levy - 0.125 % of total cost of the project according to Article 520) [7]. The new circular by the Ministry of Finance (MOF) emphasized on the full utilization of IBS for all government's projects. The circular emphasized that the use of IBS components in government projects should not be less than 70%. As in 2009, 320 government projects worth RM 9.43 billion have been identified to be carried out using the IBS [8]. Moreover, the government will establish new policy to reduce 50% of current 320,000 foreign workers registered with the sectors and CIDB has been allocated RM 100 million to train skilled workers in IBS [8].

3.0 THE ISSUE OF SUSTAINABILITY AND GREEN CONSTRUCTION

Issues of sustainability and green construction have been duly highlighted in the Construction Industry Master Plan (2005 – 2015) as being of significant importance for the Malaysian Construction Industry. The Malaysian government is also committed to addressing sustainability issues and meeting its target and obligations in this regard. Sustainable development and sustainable living have become buzzwords in the last 10 years. About 30- 40% of the total natural resources used in industrialized countries are exploited by the building industry. Almost 50% of this energy flow is used for weather conditioning (heating and cooling) in buildings. Almost 40% of the world's consumption of materials converts to the built environment, and about 30% of energy use is due to housing [9]. In construction, one of the areas that sustainable development researchers have concentrated on is energy efficiency of the building by reducing the energy consumption of buildings [10]. The other aspect of sustainability within construction is the idea of making buildings producers of energy using solar, wind and other non-conventional sources of energy, that can be produced on the building itself [11]. The need for sustainable development has been recognised and gain substantial popularity since the United Nation Conference on environment and Development, also known as Earth summit, held in Rio de Janeiro back in 1992. The Rio Declaration highlighted 27 guidance principals towards world's sustainable development and head of the nations pledge to take drastic action against pollution, global warming and ozone depletion. With the signing of the Kyoto agreement and the advent of *green consumer* there has been considerably more pressure on producers of the building to look for ways to make their product greener both by reducing the consumption of energy and producing some of the energy consumed on the building itself [12].

The United Kingdom, for example is on a path to cut its carbon dioxide emissions by some 60% on 2000 levels by 2050, with real progress by 2020 to address climate change and global warming [13]. This was further enhanced by the announcement in 2008, committing the UK to cut greenhouse gas emissions by 80% by the middle of the century [14]. UK government has highlighted that the house building industry is a key sector where carbon reductions can be made. The government set target of achieving zero carbon homes and the requirement of the higher levels of the Code for Sustainable Homes (CHS) by 2016 [15]. A building is considered to be zero carbon when the net carbon dioxide emission resulting from all energy used in building is zero [16]. UK government realised that innovative construction industry can holds the key to delivering the solutions that will address the challenge of climate change and the more efficient use of the resources. Close tolerance and highest quality control offers by IBS or offsite construction (as known in the UK) is used to achieve air tightest and will ensure optimal use of energy and less carbon emission could help to attain the required standard CHS and zero carbon target [17].

Malaysia's very own green building rating system has been launched on 21st May 2009 by the Work Minister, Datuk Shaziman Abu Mansor. The Green Building Index (GBI) developed to promote sustainability in the built environment and raise awareness among the industry players about environment issues. Building will be awarded GBI Malaysia rating score based on six key criteria including energy efficiency, indoor environment quality, sustainable site planning, material and resources, water efficiency and innovation. Both efforts in the UK and Malaysia provide fresh challenge for the

construction industry to practice sustainable development and at the same time providing highest quality of affordable building particularly in house building industry.

With the growth in construction activities, it has become imperative that design tools be provided which can give insights into the sustainability of a building at an early design stage itself, and helps the design team incorporate the sustainable solutions in a building very early in the design process. With the growing prominence of off-site construction we are starting to have the luxury of manufacturing buildings in a controlled environment, where issues of sustainability can be addressed faster, and more efficient. IBS can be a potential solution to achieve greatness in the area of green construction and sustainability.

4. 0 THE POTENTIAL ROLES IN GREEN CINSTRUCTION AND SUSTAINABILITY

There are several aspects of IBS that has the potential of contributing to different aspects of sustainability and green construction. Some of the major aspects are explained below:

4.1 Sustainability from Controlled Production Environment

IBS offers a controlled manufacturing environment with the ability to reach difficult nooks and corners, which are often inaccessible in regular in-situ construction. With the availability of production tools, and permanent jigs and fixtures, it is easier to control the workmanship of construction, ensuring a tighter construction resulting in lot lesser energy losses due to leakages (thermal leakage).

4.2 IBS and Waste

IBS traditionally has been known to minimize waste, with the ability to reuse material from one module or product into another, the sustainability agenda is supported through its use. However, several aspects of planning both in terms of materials management and production management have to be monitored in order to achieve the waste minimization benefits promised by IBS.

4.3 IBS and Building Materials

Several pre-fabricated technologies such as Structural Insulated Panels (SIPS) etc offer great potential in terms of fabrication of more energy efficient buildings [18]. However, if appropriate process control and planning are not implemented these potential benefits could be lost due to expensive on-site assembly processes. Therefore, it is important that the advent of new technologies should be accompanied by proper process design for on-site assembly.

4.4 IBS and Logistics

Some estimates recently have put the amount of environmental impact from material transportation activities to be one-third of total environmental impact on the entire construction process. IBS offers another benefit, and that is the ability to order in large quantities thus reducing the number of trips to be taken. Despite this potential benefit, it is important that a detailed material transportation and logistics plan be put in place.

4.5 IBS and Economic Sustainability

With Malaysian government's emphasis on reduction of reliance on foreign labour, and the ability of IBS to deliver to this goal is well documented. However, for this to succeed there is the need to develop a detailed training and dissemination strategy for promoting IBS and preparing the workforce for that.

With these potential benefits of IBS in mind, it is important that a detailed strategy for the implementation of sustainability through the use of IBS in Malaysia be formulated. The future research shall aims to provide useful insights that will result in the formulation of that strategy for the future.

5.0 THE FUTURE RESEARCH

It is proposed that a research group from University of Salford, Construction Research Institute of Malaysia (CREAM) and other research institutes in Malaysia team up to investigate the above discussed issues. It is also important that co-operation form industry is sought, as this is vital for information and data for the study and for the success of the proposed research. It is envisaged that the support of the Malaysian construction organizations would be obtained through the Construction Industry Development Board (CIDB) Malaysia and CREAM. The aims, objectives, output and research methodology for the future research depicted as the followings:

5.1 Aims

The aims of the research are as the followings:

- To examine and document the role and contributions of IBS to green construction and sustainability initiatives in Malaysia Construction Industry.

- To develop a framework for better understanding and measuring the different ways in which IBS contributes to Green Construction and Sustainability.

- Develop a targeted training material (or continuing professional development purposes) with the sole purpose of improving awareness, understanding, and disseminating lessons learned and a good practice in the area.

5.2 Objectives

The objectives of the research are as follows:

- To investigate the main issues in Green construction and Sustainability from an IBS perspective in the Malaysia Construction Industry.

- To ascertain and document the roles and contributions that IBS currently makes (and its potential) in green construction and sustainability in Malaysia Construction industry.

- To document the major drivers and challenges associated with implementing green construction and sustainability initiatives through IBS.

- To explore cases where green construction and sustainability issues are integral to IBS implementation with a view to documenting practices (including current and best practices).

- To determine and document the main factors (Critical Success Factors) that impact on the successful implementation of green construction and sustainability through IBS.

- To develop and validate a framework for better understanding and measuring the different ways in which IBS contributes to Green Construction and Sustainability.

- To develop a short training programme for professionals in the IBS sector on promoting and inculcating green construction and sustainability initiatives in IBS.

- To disseminate findings widely through industry and academic communication channels, including seminars, workshops, conferences and journals.

5.3 Outputs/Deliveries

The output and deliverable from this research are as follows:

- A complete report on the issue of green construction and sustainability in the Malaysian construction industry.

- A final study report with targeted recommendations and conclusions.

- A short training programme for professionals in the IBS sector on promoting and inculcating green construction and sustainability initiatives in IBS.

5.4 Research Methodology

It is proposed that a pluralist or multi-methodology [19 and 20] approach would be employed. This would allow depth and breadth and coverage of the issues involved to be investigated and documented. The methods proposed would entail interviews, questionnaires, cases studies and focus groups (used to validate proposed methodology).

6.0 THE WAY FORWARD

Malaysian construction industry has been urged to use innovative construction technique and to shift from traditional practice of brick and mortar to Industrialized Building System (IBS) construction. On the other hand, issues of sustainability and green construction have been duly highlighted in the Construction Industry Master Plan (2005 – 2015) as being of significant importance for the Malaysian construction industry. The Malaysian government is also committed to addressing sustainability issues and meeting its target and obligations in this regard. This paper highlighted future research between Construction Research Institute of Malaysia (CREAM), University of Salford and other research institutes in Malaysia to study the potential use of IBS for green construction and sustainability. IBS has a potential usage to promote sustainability from controlled production environment, minimize waste generation, usage of energy efficient building material, promote effective logistics and encourage economic stability and sustainability.

From this paper, the authors hope to receive feedbacks, comments and recommendations to improve research aims, objectives, deliverables and research methodology.

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