ADAPTABLE EFFECTIVENESS OF INDUSTRIALISED BUILDING SYSTEM (IBS) IN CONSTRUCTION PROJECT

ZULKARNAIN BIN MUHAMAD

A report submitted in partial fulfillment of the requirements for the award of the degree of Bachelor of Civil Engineering

Faculty of Civil Engineering And Earth Resources
Universiti Malaysia Pahang

JUNE 2013

ABSTRACT

Generally, implementation of Industrialized Building System (IBS) as a new technology has been proposed to be used in construction project. Used of IBS can reduce labor usage, increase productivity and better the quality of building construction. Unfortunately, construction using Industrialized Building System (IBS) are still lacking in Malaysia. This study is mainly focused on the effectiveness of IBS from perspective of respondents involved in construction projects who have had experienced using IBS and problems faced by people involved in construction projects who have experienced using conventional method. The data were collected through literature review and questionnaire through contractor within the Selangor district. From the findings, the level of IBS usage in construction projects is still low which is far from the government's target to fully implement the use of IBS in construction projects This study also found that the most effective IBS system in construction projects is reduce construction waste and produce a good and clean of construction site. The main problem faced by conventional method that can encourage IBS implementation in construction projects is dependence on foreign workers and poor quality of construction materials.

ABSTRAK

Perlaksanaan Sistem Bangunan Perindustrian (IBS) sebagai satu teknologi baru telah dicadangkan untuk digunakan dalam projek pembinaan. Perlaksanaan IBS boleh mengurangkan penggunaan tenaga kerja, meningkatkan produktiviti dan mendapatkan kualiti pembinaan yang lebih baik. Malangnya, pembinaan menggunakan Sistem Bangunan Perindustrian (IBS) masih kurang di Malaysia. Kajian ini tertumpu kepada keberkesanan IBS dari perspektif responden yang terlibat dalam projek pembinaan yang menggunakan IBS dan masalah yang dihadapi oleh responden yang terlibat dalam projek pembinaan yang menggunakan kaedah konvensional. Data yang dikumpul melalui kajian literatur dan soal selidik kepada kontraktor di dalam daerah Selangor. Dari penemuan, Tahap penggunaan IBS dalam projek pembinaan masih rendah berbeza dengan sasaran kerajaan untuk melaksanakan sepenuhnya penggunaan IBS di dalam projek pembinaan Kajian ini juga mendapati bahawa sistem IBS yang paling berkesan dalam projek pembinaan adalah mengurangkan sisa pembinaan dan menghasilkan tapak bina yang bersih. Masalah utama yang dihadapi melalui kaedah konvensional yang boleh menggalakkan pelaksanaan IBS dalam projek pembinaan adalah pergantungan kepada pekerja asing dan kualiti bahan binaan yang rendah.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1

INTRODUCTION

1.1 Title: Adaptable Effectiveness of Industrialized Building System (IBS) In Construction Projects

1.2 Introduction

Nowadays, Malaysia has been involved in usage the new technology of construction that is consistent with other countries development. Malaysia has gone a step forward by developing Industrialized Building System (IBS) to compete in the development of infrastructure. Used sophisticated technology will improve the quality and productivity construction projects to enable infrastructure development in Malaysia would be comparable with developed countries.

Technological developments allow the construction of a building to be more effectively and systematically with the use of this industry. Use of structure pre-cast was first introduced in Malaysia in the early years of the 1970s but until the beginning of the 90's, it has to be addressed. Most of the methods specific to the industry pre-cast structure are focused on civil construction such as bridges, railway transit, tunnels and fly-over.

Now, the government is encouraging the use of concrete systems pre-cast in construction of the building where it is capable of reducing labor foreign as well as cost savings.

However, this method still has yet to be fully application construction industry in Malaysia despite four decades of its introduction. This is clearly prove that the major players in the construction industry is not yet ready to experience a paradigm shift that requires the use of new technologies and systems but still attached to the method conventional bring many disadvantages. If seen the positive impact of IBS, it promises advantages such as reduction of workers on site, reducing waste building materials, reduction of construction materials on site, environmental conservation and better quality control, construction sites are better organized and safe and shorter construction period. In other words, IBS shows that it is an alternative to the method depends to the work of the construction site, wet dirty, difficult, unsafe and still attached to the use of foreign labor. This condition on site is enough to make excuses, why Industries sector have suffered changes in a country that is moving to the level of developed nations and industrial.

IBS has been practiced in other countries such as Singapore, Australia, Japan, Denmark, Finland and the United Kingdom on the advantages of the new method. Use of IBS in construction promises many advantages such as reduction workers at the construction site, reducing waste materials, reduction of materials on-site construction, environmental conservation, cleaned site construction, better quality control, more orderly construction site safe and the short time of construction (Elias Ismail 2005).

IBS commonly used in our country can be categorized into five types of include the main frame and panel pre-cast concrete box, the system steel frame, the system pre-finished wood frame, steel framing systems and system block pre-cast (CIDB, 2003). Although IBS has been introduced since the early 1960s but the method still fails to fully apply in the construction industry as expected.

The Government will ensure that by 2015, all construction projects in the country will use the Industrialized Building System (IBS) as applicable in the country developed. IBS construction projects are more economical over time using panel frame structures of steel panels are stronger than the based conventional concrete is still practiced today. Thus, the knowledge expertise and technology in the building owned by the participants as developers, consultants, contractors, and suppliers will catalyze the process of achieving it in construction industry (Warszawski, A., 1999).

Hopefully with the full use of IBS in the future can stimulate the construction industry in Malaysia and it is able to create an image country in country's construction industry. It can also reduce entry foreign labor into the country and can avoid high social problems among foreign workers. By using fully IBS it also reduces construction period for each project and also reduces the labor.

1.3 Problem Statement

IBS appears as the most suitable system to overcome several problems in construction industry especially overused of foreign labor and low productivity rate. Unfortunately, the level of IBS usage in local construction industry is only 15% in2003 (CIDB, 2003a). In 2006, only 10% which is less than one third of total completed construction project using at least one IBS product (CIDB, 2007).Moreover, Tan Sri Dato' Ir. Jamilus Hussein has stressed in his speech in Malaysian IBS International Exhibition 2009 that construction industry are still far from achieving the ideal objective as articulated in IBS Roadmap even though almost all activities identified in the roadmap has been implemented. Based on the Roadmap mid-term review, it is clearly stated that one of the most barriers is negative perception by the consumer and the practitioner. Even contractors whom experiences in IBS construction project before, reluctant to use IBS in their next project. Why is this so?

1.4 Objective of study

The study is done to achieve the goals which satisfy the title of the study which is Adaptable Effectiveness of Industrialized Building System (IBS) in construction project.

The objectives of the study are:

i. To identify used of IBS in implementing of IBS in construction projects.

ii. To determine the level of IBS usage in construction project.

iii. To determine the effectiveness of the implementation IBS in construction projects

1.5 Scope of study

The study will be done based on the scope limit to ensure the objectives of the study can be achieved. The study will be focused on four (4) parts. There are the area of study, the method of study, the respondents involved and the area of topic of the study. This study will be conducted at Selangor which is consists of several districts. The reason of choosing Selangor is the state has high number of contractors that using IBS on their projects compare to other state. This study will be conducted in two (2) methods. The first method will be done by interviewing the respondent involved with the questionnaires provided. The second method is by sending the questionnaires through postage delivery to the contractors. The targeted respondents involved in this study are the contractors, the engineer, the architect and the quantity surveyor. The topic of the study will be focused on Industrialized Building System (IBS).

1.6 Importance of study

This study will be done to identify the effectiveness of Industrialized Building System (IBS) in the construction projects for contractor company in Selangor which using the Industrialized Building System (IBS) in the project. Besides, the study will be done to overcome the problems occurred in construction site and to help the government in managing the expenditure of local country based on 2010 budget by reducing foreign workers in construction site. In addition, the study is to determine the best solution and recommendation to solve the current problem by using the Industrialized Building System (IBS).

CHAPTER 2

LITERITURE REVIEW

2.1 Introduction

History of IBS in Malaysia construction methods began almost forty years ago with the construction of the Public Housing Tunku Abdul Rahman; or commonly known as the Flat Circular. Over the last four decades, the industry construction has been experimenting with various constructions (IBS DIGEST, 2007). Through the transformation of Malaysia's construction sector based on strategy 5-M (Manpower, manpower, materials, construction materials, method, methods, money-finance and marketing-marketing) with the aim of having the industry industrialized building and achieving Open Building Systems in 2010 (CIDB, 2003).

Transforming the construction sector is very important in ensuring the success of the achievement of Vision 2020 (IBS DIGEST, 2007). The Ninth Malaysia Plan (2006) also emphasizes the use of alternative building materials and technologies in the IBS and design based on the concept of modular coordination in housing development. The Plan also has begun using IBS components in house development with affordable price and project 9 government buildings. Several incentives were given to the use of IBS. For

example, the minimum percentage requirements for use of IBS in government project construction. In addition to the minimum percentage of IBS are also needed to CIDB exemption. Housing developers, who utilize IBS components more than 50%, will be given full exemption from levy CIDB (CIDB, 2003).

2.2 IBS DEFINITION

Industrialized Building Systems (IBS) is a system method of construction components which are produced in controlled conditions (at the factory / on site building) is transported, installed in construction works using labor minimal. (Ministry of Finance, Malaysia, 2003). There are five types of IBS have been identified, namely, System Pre-Cast Concrete, Steel Frame System, System Molds, Timber Frame System and System Block.

2.2.1 Classification of Building Systems

This section will focus on the classification system established buildings in Malaysia and abroad.

There are four types of building systems in Malaysia (Badir et al 1998). Conventional building systems named column-beam-slab system with Wooden Frame and Light Board for Moulds, Casting System on site with iron or aluminum as mold, System Restructuring and Composite Building System as shown in Figure 2.1. Each system shown is based on the technology of building construction, and used their geometric configuration.

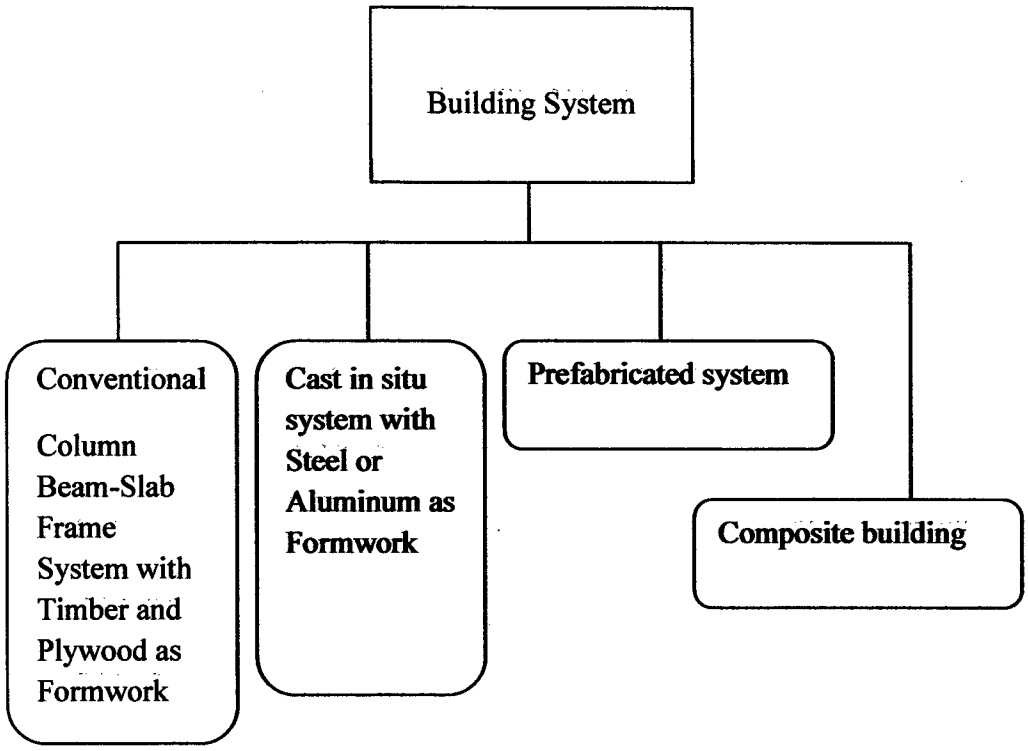

Figure 2.1: Types of building system in Malaysia (Majzub, 1977)

However, Majzub (1977) have a different concept to the classification system of the building. He explain that the relative weight of the components necessary to use a basis for classification of buildings which constitute the system architecture, system and system panel box as shown in Table 2.1. Weight factors include the effects of transmission capacity component and also impact on the production of components and its erection on site. This classification is not suitable in Malaysia as it was found not enough to incorporate with system building thriving lately.

No.	System	System	Production material
1	Frame system	Light weight frame	Wood light gage metal
		Medium light weight frame	Metals, reinforced plastics, laminated woods
		Steel frame	Concrete, Heavy steel
2	Panel system	Light and medium weight panel	Wood frame, metal frame and composite material
		Heavy weight panel (factory produce)	Concrete
		Heavy weight panel (produce on site)	Concrete
3	Box system	Medium weight box (mobile)	Wood frame, light gage metal, composite
		Medium weight box (sectional)	Wood frame, light gage metal, composite
		Heavy weight box (factory produced)	Concrete
		Medium weight box (produced on site)	Concrete

Figure 2.2: Building system classification according to relative weight of components (Majzub, 1977)

2.2.2 Pre-Cast Concrete Systems

It is among the most favored types of IBS in the construction industry countries. Divided into two main types, frame and bearing wall structures. Typical component in the structure of the frame is beams, columns, slabs and non-load bearing walls. Typically, these components are manufactured off-site using machines and molds. The second type load bearing wall system, offer a more convenient system of slabs and walls. The second components can be manufactured in a factory or made on site and the types of popular at this time whilst the Technical Advisory first type is made more flexible structure and sustainable.

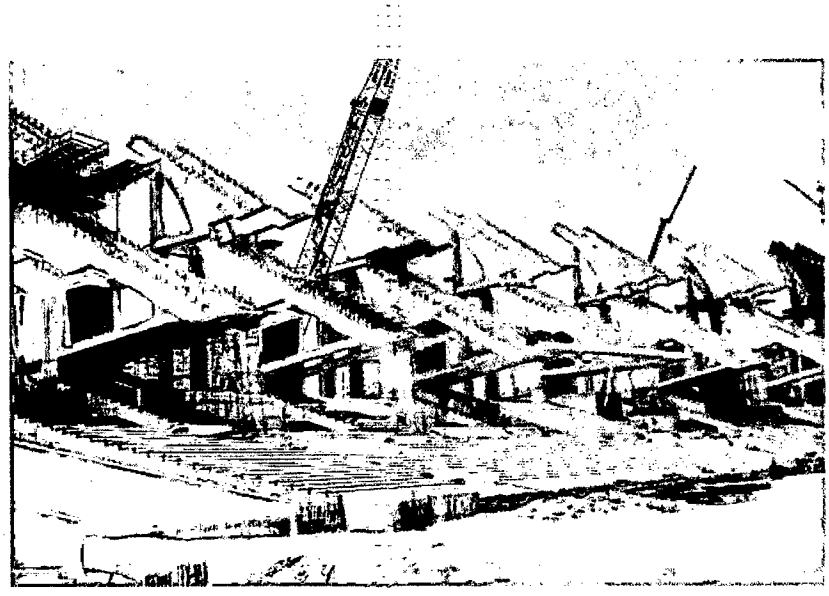

Figure 2.3: Precast concrete system

2.2.3 Steel Frame System

The system is primarily for roof trusses so popular in the country this. Structural steel is suitable for high-rise buildings and is typically used with slabs and wall panels in the precast concrete structure hybrid with quick time. Structural components in steel frames are divided into two types which are hot and cold rolled steel, based on the process and materials in manufacturing. It offers a faster site installation and workforce reduction when compared with other types of IBS.

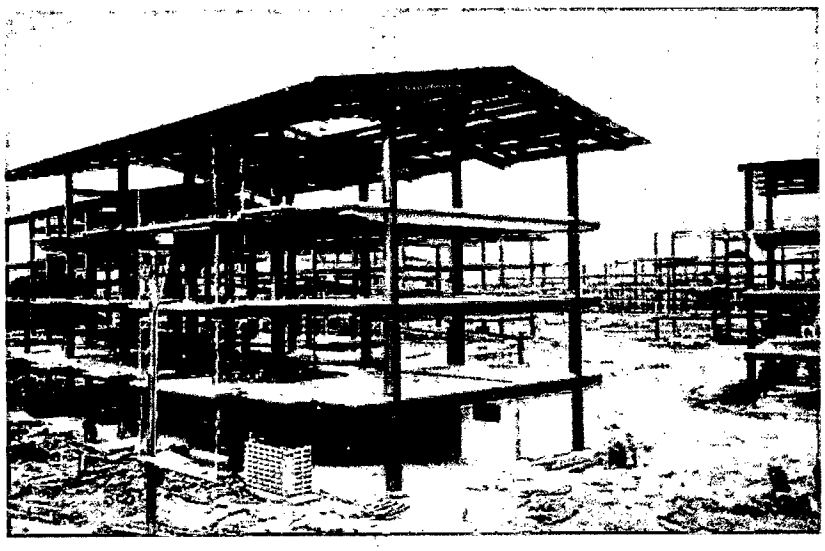

Figure 2.4: Steel frame system

2.2.4 Steel Formwork Systems

They generally involve site casting, and therefore subjected to structural quality control. So, it is considered as the "low level" or the "least prefabrication" IBS types.

However, this system does offer high quality finishes and fast construction with less site labor and material requirement. These include tunnel forms, tilt-up systems, beam and columns molding forms and permanent steel formworks like metal decks.

Figure 2.5: Steel formwork system

2.2.5 Timber Frame System

The products are including timber building frame and timber roof truss. While timber roof truss systems are more popular, timber building frame systems also have its own niche market where it is offering interesting designs from simple dwelling units to buildings requiring high aesthetical values such as chalets for resorts.

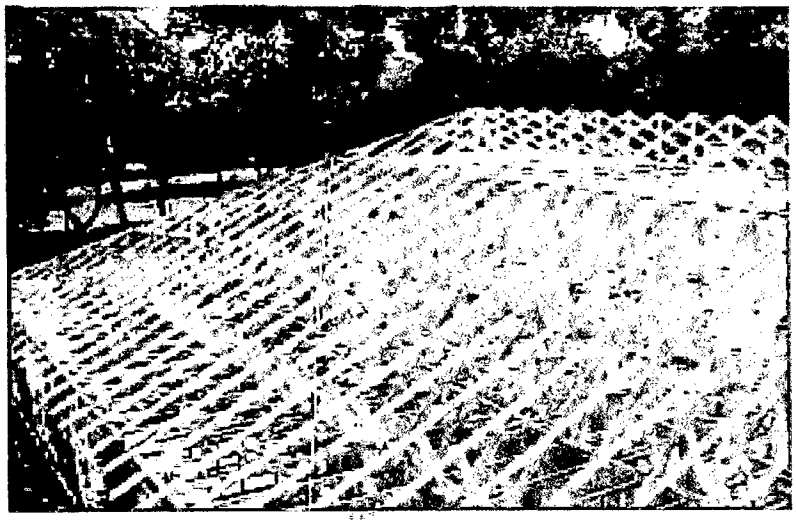

Figure 2.6: Timber frame system

2.2.6 Block work System

By using this effective alternative system, the tedious and time-consuming traditional brick-laying tasks are greatly simplified. The construction method of using conventional bricks has been revolutionized by the development and usage of interlocking concrete masonry units (CMU) and lightweight concrete blocks.

Figure 2.7: Block work system

2.3 Strengths, Weaknesses, Opportunities and Challenges in IBS

Construction of IBS can be assessed and there are a number of strengths, weaknesses, opportunities and challenges in IBS. All these factors can impact member to use IBS in the country and then to take immediate problem solving promotes the use of IBS in the country.

2.3.1 Strengths of IBS

New innovative construction system especially IBS has some good and positive impact on the construction industry in Malaysia.

First of all, the use of IBS can reduce dependence on foreign labor, particularly skilled and unskilled workers. This will overcome the problem of the influx of foreign workers in Malaysia.

Construction using IBS can reduce time and cost. IBS production can be start with the earthworks after design had been approved. It is also not affected by weather conditions due to nature environment monitoring in conventional method. In some projects, usually a fast time to complete a project is not required, uniform time delays can be caused by an obstacle such as financial decisions on the management of construction.

IBS more controlled because of the quality of the production are strict quality control on materials, production processes, curing temperature and so on. Mix concrete and time can be monitored and supervised the removal and production of high quality components and aesthetic value.

IBS usage can reduce the use of conventional wood and thus more protected environment. IBS element of the production process designed to minimize repetitive turn waste produced in factories and construction sites.

IBS elements produce a secure workplace to employees and minimize the risk of a fatal accident. This is due to the lack of congestion and reduction of labor workers on construction sites.

2.3.2 Weakness of IBS

There are several weaknesses that can be taken in implementing IBS. IBS construction requires high initial capital investment to pay for equipment, steel mold, outside technology, vehicles and employee salaries for the installation process.

Use of IBS requires some command organization where the cost of money in the form of size consistency, improve building control through research, product quality and so on. Additional costs are also involved in the training of workers on unskilled and semi-skilled labor to enable them to participate actively in the construction of IBS. However, training will be wasted if workers decide to return to their home countries as well as labor exchange and training of new employees is wasteful.

IBS allows contractors and manufacturers who implement this technology to monopolize the market. This is because most companies are still reluctant to change because of high investment costs. Then, small and medium industries were reluctant to be involved and this change will lead to unhealthy competition among them.

Conditions of site are also taken matter with the use of IBS. IBS components delivered to the construction site involving vehicles and heavy equipment for the installation process. Construction site must have a good road surface and temporary sites for heavy vehicle and then more money is needed to improve road conditions. The distance between the construction site and plant must be taken into account for the economic production site.

Finally, the vehicle used to carry IBS components should be designed to allow vehicles carry a large panel. Designed trucks must meet suitability and at the same time in

accordance with rules of the road. Typically, the vehicle can carry the weight of the parts, the length and depth of IBS components specified in the rules of the road.

2.3.3 Opportunity in IBS

The use of industrialized building proves to be reducing a lot of skilled and unskilled labor involved in the construction site. This is evident in Israel where the study was conducted to compare between IBS and conventional construction methods 1984. Results showed that the use of IBS bring more savings in labor on site and save up to 70% of total construction cost of 5% to 8% compared to the conventional method (Warszawski, 1999).

The same situation occurred in Singapore, full use of prefabricated system provides labor savings of 46.5% compared with the conventional method (Cheong, 1997). This will reduce dependence on foreign labor workers but no means involve the deployment of manpower. IBS use can contribute to enhancing the professional workforce in Malaysia. One that can be improved is the design knowledge in IBS components and design tools. Studies can be conducted to study the ability of structures and systems that are more effective in building. Technology in the design of the machine can be improved according to the local industry and rely on new technology to be learned. Develop our own technology in terms of design, equipment and technology must meet the local construction industry. New design to meet local social conditions, local weather, local materials and traditional building should be a priority. Design of framework concrete structures IBS under responbilities of architects, design engineers and contractors to obtain optimum economic, fast construction and high specification to project (Elliot, 2003)

IBS industrial manufacturing processes to be learned in detail so that they can meet local needs in terms of producing fast, quality and cost savings. Consistency of the manufacturing process through molding components can increase the diversity of production without a huge production cost (Salvador et al., 2002; Starr, 1965; Child e al.,