Speed up construction ibs systems

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Introduction

In this chapter, the author reviewed works done by others through journals, articles, newspaper cutting, and quotes from authors and online articles collected. IBS system is a process to speed up the construction work and to minimize the dependency of labour on site.

The objective of this study is further discussed about the barriers of contractor in implementing IBS. Besides that, this chapter also will focus on the basic review of IBS such as definitions, background, types and characteristics in IBS and have a basic introduction about the detail of IBS.

‘ Industrialised building’ is the term given to building technology where modern systematized methods of design, production planning and control as well as mechanized and automated manufacture are applied (Ingemar Lofgren and Kent Gylltoft, 2000)

While ‘ Building system’ mean a building system includes design rules and a product system whose parts have compatible interfaces, thus permitting the use of several alternative components and assemblies is assured by means of a dimensional and tolerance system as well as connection and joint (Ingemar Lofgren and Kent Gylltoft, 2000)

Definition of IBS

There was no commonly accepted or agreed definition of IBS. Several authors have defined IBS as process or a technique. Blimas et. al. (2006) and Pan et. al. (2008) defined that IBS is often referred by literatures as off -site construction, off-site production, industrialised and automated construction.

Warszawski (1999) explain in detail that an industrialized process is and investment in equipment, facilities, and technology with the objective of maximizing production output, minimising labour resource, and improving quality while a building system is defined as a set of interconnected element joint together to enable the designated performance of a building.

Another definition by Trikha (1999) claimed that IBS also may be defined in which all building components such as wall, floor slab, column and staircase are mass produced either n factory or at site under strict quality control and minimal on site activities

Another definition that clarified by Junid (1986) where IBS as process by which components of building are conceived, planned and fabricated, transported and erected at site. The system includes balance combination between software and hardware component. The software elements include system design, which is complex process of studying the requirement of the end user, market analysis and the development of standardise component, establishment of manufacturing and assembly layout and process, allocation of resources and materials and definition of a building designer conceptual framework. The software elements provide a prerequisite to create the conducive environment for industrialised to expand.

According to Juunid (1986), the hardware elements are categorised into three major groups. These include frame or post and beam system, panel system, and box system. The framed structures are defined as those structure that carry the loads through their beams and girders to columns and to the ground whilst in panel system load are distributed through large

floor and wall panels. The box systems include those system that employ three-dimensional modules (or boxes) for fabrication of habitable units are capable of withstand load from various directions due to their internal stability.

CIDB defined IBS as construction system whereby the components are manfactured in a factory, on-site or off-site, then positioned and assembled into structures with minimal addtional site work.

Classifications of IBS

This section will focus on the classification of the building system that are published internationally and in Malaysia

There are four types of building system under IBS in Malaysia and there are namely conventional column-beam-slab frame systems with timber and plywood as formwork, cast in-situ system with steel or aluminium as formwork, prefabricated system and the composite building system is shown in figure 2. 1. Each building system is represented by its construction technology, functional and geometrical configuration (Badir et al, 1998). (cited at Thanoon et. al., 2003)

According to Majzub (1977) has different concept in classifying building system that is the relative weight of the components should be used as a basis for building classification shown in figure 2. 2. The factor of weight has significant impact on the transportability of the components and also has influences on the production method of the components and their erection method on site. This classification method is found to be inadequate to incorporate other building system flourish recently.

There are five types of IBS had being used in Malaysia:

(IBS Road Maps 2003-2010)

Type 1: Pre-Cast Concrete Framing, Panel and Box System

The most common group of IBS products is pre-cast concrete of elements in construction industry. For example, there are including columns, beams, slabs, Three-Dimension (3D) components (balconies, staircase, toilet, lift chambers), permanent concrete formwork, and so on. (CIDB, 2005). Pre-cast concrete framing, panel and box system is under categories of prefabricated system. The advantage using this is because it cans minimum waste due to work environment in factory is easier to control. Panel system is use for the construction of interior walls and exterior walls offer speed of construction in many ways. For box system will achieve ultimate objective of industrialization that is a maximum saving of human labour on site.

Type 2: Steel Formwork Systems

This system considered as least prefabricated IBS, as they generally involve site casting and subject to offer high quality finishes and fast construction with less site labour can come in tunnel formwork, beams, columns, and slab moulding forms permanent steel formworks (metal decks) and so on. (CIDB, 2005) The steel formwork is prefabricated in the factory and then installed on site.

Type 3: Steel Framing System

This system always be the popular choice and used intensively in the fast-track construction of skyscrapers. Recent development in this types system included the increased usage of light steel trusses. Steel is non combustible

material and improves fire safety and reduces amount of structural damages in the event of a fire happen. Example: Steel beam, columns, portal frames, roof trusses. (CIDB, 2005). Steel framing also consider as prefabricated system and it to be erected whereby welding at joints are conducted. This system cans faster the progress construction.

Type 4: Prefabricate Timber Framing System

While the latter are more popular, timber building frame offering interesting designs from dwelling units to buildings requiring high aesthetical values such as chalets for resorts

Example: Timber frame, timber roof trusses (CIDB, 2005). The advantage of the system is mainly in the interior flexibility, as large space can be used for different functions and can be easily changed or modified according to the use.

Type 5: Block Work System

This system has revolutionizes by the development and usage of interlocking concrete masonry units (CMU) and lightweight concrete blocks. The tedious and time-consuming traditional brick-laying tasks are greatly simplified by the usage of there effective alternative solutions. Block work system also consider under prefabricated system. The benefits of block work system are faster construction and increase bricklayer longevity. Moreover, it’s also increased energy savings like lightweight concrete’s resistance to heat flow is twice of medium and heavy weight concrete, it’s mean that less heating/cooling energy is needed.

Characteristics of IBS

It is important to have the following characteristics only consider to be accepted as part of the IBS and ensure the achievement of proven benefits of IBS. Each of them will be discuss briefly at below (CIDB 2008):

- Industrial production of components though pre-fabrication; or highly mechanized in-situ processes. For example, permanent steel formwork
- Reduced labour during pre-fabrication of the components and site works.
- Modern design and manufacturing methods involving information Technology such as the usage of Computer Aided design (CAD) and Computer Aided Manufacturing (CAM)
- Systematic Quality control such as ISO 9000 principles
- Open Building Concept i. e permitting the hybrid applications, and adaptable to standardization and Modular Coordination (MC)

Implementation Level of IBS in Malaysia

The use of IBS have various advantages such as the reduction dependency of foreign workers, less wastage, less volume of building materials, increased environmental and construction site cleanliness and better quality control compare to conventional method.

These advantages also promote a safer and more organised construction site, and reduce the completion time of construction. Many world-class Malaysian developers have chosen IBS over the conventional methods for important projects such as the Petronas Twin Towers, Putrajaya, KL Sentral, and KLIA. (IBS Roadmap, 2003 -2010)

Even so, the usage level of IBS in building is still low. From a survey conducted by CIDB Malaysia, the usage level of IBS in the local construction industry stands at only 15% (IBS Survey 2003). The early efforts of the Government to encourage the use of IBS in the construction sector has yet to garner a good response, and this sector is still practicing conventional construction methods that have proven time and again to be wasteful, dangerous and messy. Relatively, the low labour cost in this country is the root cause of the industry failing to reform and being complacent with the current level of productivity, quality and safety. (IBS Roadmap, 2003 -2010)

Moreover, according to the newspaper the star 2009 stated that Jamilus explained that IBS was a construction technique in which components were manufactured in a controlled environment (on-site, off-site), transported, positioned and assembled into a structure with minimal additional site work. Beside that, out of 1, 400 contractors in Johor, there only 4% of it are using this systems. Moreover, he said that since year 2008, there only 51 contractors in the state have been reported to use the IBS system in their building projects and the number were expected improve in time. (The star, 2009)

Malaysia’s Experiences in IBS

The usage of IBS is not new in the Malaysia construction industry. The idea using IBS in Malaysia was first purpose during the early 60’s when the Minister housing and Local Government visited several European countries and evaluated their building system performance. At the time, the government makes a big decision to give a try on a two pilot projects using IBS concept. The first project, Pekeliling Flat was constructed along Jalan

Pekeliling with construction of 7 blocks of 17 storey flats, and 4 blocks of 4 storey flats comprising around 3, 000 units of low cost flats and 40 storey shop lot and this project using large panel industrialized prefabricated systems. On the other hand, the second project was built in Penang with the construction of 6 blocks of 17 storey flats and 3 blocks of 18 storey flats comprising 3, 699 units and 66 shop lots along the Jalan Rifle Range and this project was using the French Estiot System (Din, 1984).

Even though the first implementation IBS was not successful due to the failure to keep within cost estimation but there are some successful adoption too. Among the significant projects that implement IBS are including KL Sentral. KL Convention Centre, KLIA, etc

Following is the Successful implemented of IBS throughout Malaysia (CIDB Malaysia, 2003)

Year 2007 – Stormwater Management and Road Tunnel (SMART Tunnel), Kuala Lumpur

– The Spring Shopping Mall, Kuching, Sarawak

Year 2006 – Kuching International Airport, Kuching, Sarawak

– Persada Johor International Convention Centre, Johor Bahru

Year 2005 – Serdang Hospital, Serdang, Selangor

– The Curve, Mutiara Damansara, Selangor

Year 2001 – Kuala Lumpur Sentral (KL Sentral), Kuala Lumpur

– Likas Stadium, Kota Kinabalu, Sabah

Year 1998 – Kuala Lumpur International Airport (KLIA), Sepang, Selangor

– Malawati Indoor Satdium, Bukit Jalil, Selangor

Year 1997 – Petronas Twin Tower, Kuala Lumpur

– Bukit Jalil, Bukit Jalil, Salangor

Year 1984 – Daybumi Complex, Kuala Lumpur

Year 1981 – High end bungalows and low cost houses throughout Selangor

The Advantages for IBS adoption in Construction Industry

There are some several advantages using IBS (MCRJ, 2009)

1. Reduce Remittances by foreign worker:

The Government aimed to achieve 100 percent usage of IBS and to reduce to 15 percent or approximately 50, 000 of foreign workers in the construction industry by 2010. With the current foreign workers totaling 227, 000, the remittances of the foreign workers amounted to about 7. 5 billion. It is expected that the Government would be able to reduce the remittances with the full implementation of IBS. (Bernama. com, 2006)

2. Enhance Efficiency of Construction Process and Higher Productivity:

IBS is a methodology whereby a local construction industry is driven towards the adoption of an integrated and encouraging key players in the construction industry to produce and utilize pre-fabricated and mass production of the building at their work sites. This will help to enhance the

efficiency of construction process, allowing a higher productivity, quality, time and cost saving. (CIDB, 2004)

3. Produce Better Product:

IBS promises elevated levels of expertise throughout the industry, from manufacturers, installers, engineers, planners, designers, and developers. The benefits of IBS will ultimately produce better products for the population (CIDB, 2003)

4. Reduce Wastage, Less Site Materials, Costs, Cleaner and Neater Environment:

The IBS, which enables on-site prefabricated or pre-cast building components manufactured at factories offers minimal wastage, less site materials, cleaner and neater environment, controlled quality, and lower total construction cost (CIDB, 2003). For example, the repetitive use of system formwork made up of steel, aluminium, etc and scaffolding provides considerable cost savings (Bing et al. 2001).

5. Higher Quality of Component:

An industrialised building system component produces higher quality of components attainable through careful selection of materials, use of advanced technology and strict quality assurance control (Din, 1984)

6. Reduce Labour at Site:

Prefabrication takes place at a centralised factory, thus reducing labour requirement at site. This is true especially when high degree of mechanisation is involved (Warszawski, 1999)

7. Faster Completion:

An industrialised building system allows for faster construction time because casting of precast element at factory and foundation work at site can occur simultaneously. This provides earlier occupation of the building, thus reducing interest payment or capital outlays (Waleed et al., 2003)

8. Not Affected by Adverse Weather Condition:

Construction operation is not affected by adverse weather condition because prefabricated component is done in a factory controlled environment (Waleed et al., 2003)

9. Flexible Design:

An industrialised building system allows fexibility in architectural design in order to minimise the monotony of repetitive facades (Warszawski, 1999). An industrialised building system provides flexibility in the design of precast element as well as in construction so that different systems may produce their own unique prefabrication construction methods (Zaini, 2000)

Barriers of Adoption in Malaysia Construction Industry

IBS can replace the conventional building system which is labour oriented However, since the first project of IBS not well accepted by construction parties because of fail to deal with the risks such failure of keep within the cost estimate. For example, the first project incurred 8. 1 % higher costs than a similar building that using conventional construction method, while the second project was 2. 6% lower than the cost. Both projects also completed in 27 months in term of compare to the construction speed but are inclusive the time of set up the recasting factories too. When come to the

quality, the conventional method seems have better quality than IBS. In conclusion, there is a competitive with conventional construction method.

Even though IBS is good to implement due to its advantages but the implementation of usage level is still very low. According to Waleed et. al. (2003), the common consensus of all the stakeholders of construction in Malaysia is that, the IBS implementation in Malaysian building construction industry is still very low compared to the conventional methods. This is due to several reasons(MCRJ, 2009):

1. Costs and Return Investment:

Wide swings in houses demand, high interest rate and cheap labour cost, make it difficult to justify large capital investment. At present there is an abundance of cheap foreign workers in Malaysia and contractors prefer to use labour intensive conventional building system because it is far easier to lay off workers during slack period. The economic benefits of IBS are not well documented in Malaysia and the past experiences indicated IBS is more expensive due to fierce competition from conventional building system.

2. Lack of skilled and knowledgeable manpower:

Fully prefabricated construction system requires high construction precision. Malaysian labour force still lack of skilled workers in IBS implementation.

3. The Practices:

The construction industry is very fragmented, diverse and involves many parties. Consensus is required in the use of IBS during planning stage.

4. Knowledge based:

Lack of Research & Development (R&D) in the area of novel building system that uses local materials. Majorities of IBS in Malaysia are imported from developed countries, thus driving up the construction cost. Engineering degrees in local universities seldom teach about the design and construction of IBS.

5. Low Quality:

The use of IBS in Japan and Sweden are so successful due to high quality and high productivity but it sis the opposite in Malaysia. Previous projects constructed with IBS concept were of low quality and high construction cost.

6. Lack of Incentive and Awareness:

Due to the lack of incentive and promotion from government in the use of IBS, many many architects and engineers are still unaware of the basic elements of IBS such as modular co-ordination.

7. Lack of Scientific Information:

An IBS system can only be acceptable to practitioners if its major advantages are valuable compared to the conventional system. However, up to date, there is inadequate corroborative evidence to substantiate the benefits of IBS system. It is therefore, arguable that the implementation of IBS is particularly hindered by lack of scientific information (Badir et al., 2002)

8. Wastage of Material:

Standardization of building elements faces resistance from the construction industry due to aesthetic reservation and economic reason. One good

example of this is when a 300mm thick modular standardized floor slab has to be used although a 260mm thick floor slab can achieve the similar structural performance. This results wastage of material (Waleed et al., 2003)

Summary of the Chapter

Nowadays in Malaysia, IBS still being developed and applied in new building. Mean while, the implementation level is still very low what has anticipate by the government. The purpose of IBS is very clear as an alternative for conventional method and also reduces the dependency of labour, and increase the performance in time, cost, and quality. The Government of Malaysia promote IBS component to the construction industrials.

In the literature review have proved that there are many benefits of IBS but still is low usage among contractors and the implementation of using IBS level is still very low.