Industrialized building system (ibs) | literature review

CHAPTER 2: LITERATURE REVIEW

2. 1 Introduction

The objectives of this chapter will identify and study into the details and provide the literature review of Industrialized Building System (IBS). In this literature review of building system will also be covered in this chapter. The contents will focus on definitions of IBS, characteristic of building in Malaysia with application of IBS, advantages of IBS and disadvantages of IBS. The 5 types of widely used IBS in Malaysia project will be study in this chapter. In addition, the comparison of suggestion method which use of IBS in different building in Malaysia will be carried out in this chapter. Besides that, the systematic solution by applying IBS in current Malaysia projects which able to reduce waste during construction project life cycle which able to create and heading toward friendly or eco environment compare to conventional method will be carried out in this chapter.

2. 1. 1 Definition of IBS

“ According to Dietz (1971), in the early literature defined IBS as the whole process of all the subsystems and components make full utilized of industrial production, transport and assembly technology.” The IBS system is actually apply in construction industry is mainly to reduce input and generate more output by maximize or fully utilized the production, transportation and assembly during construction stage which indirectly save up a lot of time and costs for the process of above. (Dietz 1971)

“ Meanwhile according Warszawski (1999), IBS defined as a set of interrelated elements, to take collective action that the designated and

performance of the building. In additional, IBS is defined as a process of investment in facilities, technology and equipment, to minimize the amount of labour in the site, to improve the quality of building and to increase the speed of construction.” From here we noticed that not only time and cost is being save up but indeed quality also can be improve by applying IBS. (Warszawski 1999).

“ According to Parid (1997), IBS defined as a industrialized production technology used by the system, whether in component production or assembly of building.” (Parid 1997)

“ The interpretation from Esa et al (1998), IBS as continuous use of the system, so that the manufacturing use end-user to reduce waste of resources and enhance the value of each building craftsmen”. (Esa etal 1998)

According to CIDB, IBS is a construction process that transferring the substantial activities from site to factory where the building components are manufacture in factory then delivery to site and assembled at site. This is the process that involve prefabricated the elements of building in factory by using machine or formwork and on-site installation.

2. 1. 2 Classification of IBS

“ In early stages, Badir (1998) proposed four types in Malaysia with Badir-Razali classification. These building systems which is conventional system, cast in situ system, composite building system and the prefabricated system is shown in Figure 2. 1.” Each building system is composed of representatives of the respective construction methods, thus further through

its construction characteristics of the technology, features and geometry. (Badir 1998)

Figure 2. 1 : Types of building system according to Badir-Razali classification in Malaysia (Badir 1998)

IBS also can be classified according to several aspects:

According to structural system

According to material

According to relative weight of component

2. 1. 3 Classification according to structural system

Panel system

The loads are distributes by the large floor and wall panel where the building loads is support by wall in panel system. This system is suitable for those building are required large wall and this system is not suitable to building with large span.

Frame system

In frame system, the building loads are support by column and beam. The walls used is required light and easy to fix and concrete panels are introduces as flooring element.

Box system

The box systems is include those systems that make use of three-dimensional modules or boxes for fabrication of habitable units that are able of withstanding load from various directions due to their internal stability.

2. 1. 4 Classification according to material

Timber

The prefabrication of timber consists of two types which are ready-cut plus shop fabrication of joints (column and beam) and structural panels only consists of walls and floors without column and beam.

Steel

All the steel elements are prefabricated in factory then only transport to site to joints by welding or bolting at site. The large proportion of the strength to the weight allows a long-span or high-rise building.

Reinforced concrete

Reinforced concrete has high degree of availability, durability, low material cost and fire resistance. There are two basic trends in development of reinforced concrete IBS components which are precast frame members such as columns and beams and panelised components such as walls and floors.

Brick and block

Brick and block for IBS are prefabricate and lay in factory then only transported to site and last erected at site. With this will ease the construction works at site.

2. 1. 5 Classification according to relative weight of component

IBS components can be classified according to relative weight. Majzub explained that the relative weight of components should be used as a basis for building classification because the factor of weight has significant impact on the transportability of components and has influence on the production method of the components and their erection method at site. Table 1 is shown the building systems classification according to relative weight of component. (Majzub, 1977)

Table 1: Classification according to relative weight of components (Majzub, 1977)

2. 1. 6 Types of IBS and apply to building in Malaysia

“ Based on CIDB (2003) the classification of IBS in Malaysia is broken down into five categories, which is a precast concrete frame panel and box system, steel formwork system, steel framing system, block work system and timber frame system “. IBS is a construction process that use of technology, products, components and on-site installation of building system. From the structural classification five of IBS display section, which are mainly classified according to some modifications, the main groups in Malaysia by CIDB. (CIDB 2003)

2. 1. 6. 1 Precast Concrete Framing, Panel and box system

Precast concrete components are the most common prefabricated elements in Malaysia. The precast concrete elements are the concrete product that manufactured in a controlled environment and being transported to the

construction site for installation. There are precast concrete for columns, slabs, lightweight precast concrete, permanent concrete formwork, and beams. Besides that, it also consists of 3-D components such as staircases, toilet, balconies, lift chamber and etc.

High degree of flexibility is one of the advantages of the system in regards of larger of larger clear span between column, resulting in wider open space and freedom of greater areas.

Precast concrete wall system consisting og precast floor and load-bearing walls of building. The load-bearing walls and slabs are transfer to construction site for erected. The system is preferred simple and easy flexibility with due to the restriction of removal of load bearing will making it a lesser degree of flexibility. The carefully good coordination and design between builders and designer, the erection process is very fast, and the number of wet trade in the field can be reduced significantly.

2. 1. 6. 2 Steel Formwork Systems

This is the system formwork which is designed by manufacturer to replace a conventional timber formwork. The steel formwork is manufactured in the plant and then assembled on construction site. The steel reinforcement and service conduit will be installed on site before the steel formworks are installed. the installation is very easy by using simple support system. It can be described as a mould which the wet concrete can be poured into the mould and form the required shape, these steel formwork systems are subjected to quality control.

This type of IBS method is considered as the ‘ low level’ in the construction industry. The steel formwork system that used in beams, permanent steel formworks, tunnel forms and column moulding forms.

2. 1. 6. 3 Steel Framing Systems

Steel is a strong rigid materials, suitable for a high degree of flexibility across the structure of long term construction and rehabilitation of the architectural details of the framework construction. The components of steel framing system are rolled into standardized sizes. The component are then manufactured which involves cutting, drilling, shot blasting, welding and painting.

Steel frames are erected, welding and the tightening of bolt after they are fabricated. The steel framing systems has been a popular choice, and is widely used in fast track construction project, the system commonly used with precast concrete slab, steel columns and beams.

2. 1. 6. 4 Prefabricated Timber Framing System

In the early 1970s, single storey low cost terrace houses mostly built of pure timber frame and wood which sitting on three feet high plastered brick walls and taking advantages of simple raft foundation due to the high weight superstructure. These prefabricated timber framing systems is using the timber in the construction industry for the building. Usually the timber framing system are consists of timber building frames and timber roof trusses. Steel plate is being used during prefabrication of timber to join members of truss. All members needs to be treated with anti pest chemical.

2. 1. 6. 5 Block Work Systems

The time consuming traditional brick laying tasks are generally simplified by using block work systems. Interlocking concrete masonry units (CMU) and lightweight concrete blocks are involved in block work system. Fabricated and cured of the components take place in the plant. The elements are normally used as bricks in structures and interlocking concrete block pavement

2. 1. 7 Advantages of IBS for public housing

There are many advantages of implementing IBS. according to CIDB (2003), compares to conventional method. Following are brief descriptions on a number of advantages where using IBS for the public housing:-

Advantages

Description

Reduce construction time

- IBS will requires less construction time
- Because both the site work and the fabrication of element can take place concurrently work at site only the erection of IBS components.
- So, this leads to earlier occupation of the building.

Save cost

- Reducing on-site workers significantly labor cost for contractors. (Wisam 2005).

- Minimizing cost of transferring waste materials due to quality control and reducing waste material. (Noraini 2009).
- Exemption of the Construction Levy for housing developers who utilize IBS components exceeding than 70%. (CIDB 2005).
- Provides earlier occupation of the building, thus reducing interest payment or capital outlays (Peng, 1986 cited in Mian, A. T. E, 2006).

Saving in labour

Because the IBS components are produced in factory and higher degree of using machine so will reduce of labour dependency of labour and cut down the cost of labour.

According to Abraham Warszawski

(1999), the labour savings in prefabricated elements may amount to about 80% of their conventional requirement.

So, will reduced the total foreign workers need in the construction industry.

Optimized use of materials

Higher degree of precision and accuracy in the production can be achieve by using machine to produce IBS components and consequently reduce material wastage.

So, the wastage at site will be reduced if using the IBS.

High quality and better finishes

- Quality control is an ever-increasing requirement in all construction.

- Controlled environment in factor, superior material selection and high mechanized technology lead to high quality controlled products. (Din 1984).
- High aesthetic end products through the processes of controlled prefabrication and simplified installations has maintained and ensured the quality of work in the construction industry (CIDB-(2), 2003 cited in Mian, A. T. E, 2006).
- Better quality control since production in factory is under heltered environment.
- Better quality will reduce the maintenance expenses because prefabricated components require less repair and preventive maintenance.

Construction operation less affected by weather

- The fabrication of IBS components will not be effected by climate changes it is done in factory and only erection of the components take place on site
- Faster project completion due to rapid progress under all weather construction.

Flexibility

- Different systems may use different prefabrication construction methods.
- IBS will provide more flexibility in the deign of precast element.
- By the flexibility in Architectural design (Warszawski, 1999).

Increase site safety and neatness

- This method neater and safer site condition can be obtain thru this method.
- Promote safe and systematic factory working environment as minimal workers, materials and construction waste is requires on site. (CIDB 2003).
- Construction process can be less thru using IBS components especially for the wet work at site.

2. 1. 8 Disadvantages of IBS for public Housing

Although there are a lot of advantages of IBS, however there are limitations for this system to be use too. Nothing in this world is perfect, so as using IBS. disadvantages of IBS are as follows:-

Disadvantages

description

High initial capital cost

- The initial capital cost of IBS is usually higher than conventional method.
- The initial cost is includes the casting beds, cost of constructing the factory and support machinery.
- This method only can be achieved when undertaking large demand for housing project.

Problem of joints

- These methods are very sensitive to the errors and sloppy work.

- Water leakage between joints is often the major problem when IBS is being used.
- This problem is clearer in Malaysia where raining occur rapidly throughout the year.

Sophisticated plants and skilled operators

- The prefabrication system relies heavily on sophisticated plant, when skilled operators are required to the fabrication process coordinate and maintain.
- The entire project would be on a stand still if any of the section breakdown.

Site accessibility

- One of the most important factors of the implementation of IBS is the site accessibility.
- IBS requires sufficient site accessibility to transport IBS components from factory to the site.
- According to Warszawski (1999), the transportations cost of prefabricated elements from plant to their construction site, amount to 3% to 5% of their total cost for distances not exceeding 50kn to 100km.

Large working area

- Building construction using IBS required a large working area for the tower crane, factory, storage and trailers for the IBS components.
- Most construction in order areas are often congested and fail to provide the area required.