

Prefabricated components in warehouse buildings



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The Malaysian construction industry is undergoing changes from an industry which employs conventional method to a mechanized and systematic system which utilizes the latest technologies. Prefabrication technology is a new construction method in the construction industry. This is vital for the future growth of the industry, given the trend towards global competition.

Prefabricated systems have been introduced in Malaysia by the application of pre-cast concrete in beam-column elements. Since the demand of building construction has increased widely, it is necessary to improve the construction method, which fasten up the building construction process.

Various types of building system are available in Malaysia. In general, IBS is a methodology which drives local construction industry towards the adoption of an integrated and encourages the application in the construction industry to produce and utilize pre-fabricated components of the building at work sites. Efficiency of construction process will be enhance, thus allowing a higher productivity, time, quality and cost efficiency (Abdullah et al, 1998).

The advantage of using prefabricated system in industrial building is derived from a piece-by-piece model approach, wherein standardization plays a significant role in achieving economies of scope from the many variations allowed. This is a specific implementation of prefabrication; the distinction being that the structures follow an assembly, disassembly, part replacement, re-assembly sequence as required during their lifecycle (A. Abdallah, 2007).

Prefabrication is the assembling components that made in a factory or manufacturing before deliver the components to the construction site. After completed the selected components in factory, the components will

transported to the construction site where the structure is located.

Prefabrication systems which introduced by Construction Industry Development Board (CIDB) were succeeded and applied the prefabricated technology into the construction industry. Prefabrication is defined as the structure constructed with minimal additional site work which the components are produced in a factory, assembled and positioned to form the structure (CIDB, 2003).

1.3 Aim

A study into the usage of prefabricated components in warehouse buildings throughout the past 10 years.

1.4 Research Question

- Is there an increase of the usage of prefabricated components in the past 10 years?
- What are the problems facing in prefabricated components for the usage in warehouse buildings?
- How does the usage of prefabricated components that give benefits to warehouse buildings, does it reduce the construction time and construction cost?

1.5 Objective

- To evaluate the problem of prefabricated components usage in warehouse buildings.
- To investigate the aspects of prefabricated components for warehouse buildings.

- To investigate the level of acceptance in the usage of prefabricated components in warehouse buildings.

1. 6 Scope of study

This research is basically covers the scope of the usage of prefabricated components in warehouse buildings. The efficiency of prefabricated components is measured by the time and cost efficiency. Furthermore, the usage of prefabrication components will be investigated to study the efficiency. Last but not least, prefabricated components manufacturer will be interview to analyze more detail and accurate data to the efficiency of the usage of prefabrication components.

To understand the usage of prefabricated components and the level of application in the construction industry. Research will cover on the efficiency of prefabrication components. Besides that, analyzing the time and cost efficiency of prefabrication components usage in a construction projects.

Other than that, this research may take a comparison between prefabricated components system and other types of building construction systems. Data analysis will be carried out for the comparison.

1. 7 Problem Statement

With the ongoing construction trend in Malaysia, that is still very comfortably using labour intensive and low technology methods of construction such, this has initially lead towards low productivity and inefficiency of work at construction site. The highly dependency on conventional building system and unskilled foreign workers has definitely contributed to low productivity of work, although they may be cheap, but they are not efficient and cause high

wastage. The quality of work has also been terribly affected due to unskilled working method that causes delay in construction projects. After completion of works, defects, structural failures and design inadequacies are some of the tell-tale sign of the current construction scenario that will always occur. In the end, these will lead to decreased in quality and waste of time in construction projects.

Since the demand of building construction has increased rapidly, it is necessary to innovate the construction method, which speeds up the building construction process. In general, prefabricated system that will reduce in construction time and cost, for instance, time is money. But prefabricated system is not always applied in the construction projects, conventional construction method are still preferable in the construction industry. Without understanding the benefits of prefabricated system, it included different types of components that can be used during a construction projects. Adoption of prefabricated system in construction industry is 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, thus allowing a higher productivity, quality, time and cost saving.

Although the prefabricated systems has promised to solve and improved the current construction method and scenario in Malaysia, but the this method has been low in gaining popularity, partly due to lack of awareness and coordination among the relevant parties. This will also lead to the low popularity of the usage of prefabrication components. “ Performance and quality in construction will be improved that the obligation of implementing <https://assignbuster.com/prefabricated-components-in-warehouse-buildings/>

Industrialized Building System, as well as to minimize dependency on unskilled foreign labours in construction site (Kamar; Abdul Hamid; Ghani and Rahim, 2007).”

In conclusion, it is hoped that the prefabricated technology can bring out the tremendous potential towards productivity improvement as it encompasses aspects of standardization, highly controlled and quality pre-fabrication components which complements the various programs to increase productivity and quality control through the adoption of prefabricated systems which can lead to the increase productivity of prefabricated components.

1. 8 Research Methodology

The research methodology included the qualitative and quantitative research. A qualitative research is “ subjective” in nature and it emphasizes meanings, experiences, description and so on. The qualitative research is applying in the survey for which have an attitude scale and measurement. For the quantitative research, it is “ objective” in nature and it defined as an inquiry into a social or human problem which is based on testing a hypothesis or a theory composed of variables, measured with numbers, and analyzed with statistical procedures, in order to determine whether the hypothesis or the theory hold true.

A primary data collected can be variable because it is obtained from different respondents. The case study is used when researcher is required to support the arguments and hypothesis. The results commonly are obtained from an

analysis of person, a group of person or a particular project. Those examples of primary data collection such as interview, survey and case study.

Secondary data is the data collected using desk study approach that is called “secondary data” because this data commonly obtained from other sources (Naoum, 1998). This data can be collected from other resources such as institution which the data are not stored in the library. Other examples are such as books, articles and journals which are published online and book store.

An interview is a process of “face to face” discussion among the researcher and the related parties who is able to provide data and information to researcher. Such parties can be the professional person, manufacturer, developer and others. The best way of conducting an interview is able to obtain the data accurately and information which supported strongly that are raised up by the researcher.

Whereas, the case study is a process of inspection and investigation that is carried out by the researcher in a place that are able to gain data and information to the researcher. Besides that, a case study that are conducted will be able to obtain the results and information accurately and conduct survey successfully.

2. 1 Introduction

Since the demand of building construction has increased widely, prefabricated systems have been introduced in the construction industry.

The construction method has to be innovated, which will speeds up the building construction process. Prefabrication System which introduced in

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Industrialized Building System (IBS) that will reduce in construction time and cost, thus the quality of work will be improved by using this system. The advantages of using prefabrication system in industrial building are derived from a piece by piece model approach (A. Abdallah, 2007). The choice of prefabricated components comes from the primary requirement to use automation tools both in the factory and on site. Efficiency of construction process will be enhance, thus allowing a higher productivity, quality, time and cost efficiency.

However, the challenges often occur in the efficiency of work, quality of work, are of productivity and the delivery of work. The construction industry is still applying labour intensive and low technology methods for construction which initially lead towards low productivity and inefficiency of work at construction site. The intensive use of foreign unskilled workers and low technology equipment has eventually affected the quality of work which results in defects, structural failures and design inadequacies of the construction projects. As a result, this has lead to unproductive practices and initially contributes to the late delivery of work.

Therefore, a new system must be replaced which has better advantages in terms of improving productivity, indoor quality, improvement of work durability and efficiency and overall cost reduction. The Prefabrication System which introduced in IBS with the promise of improving productivity rate and lowering construction costs are able to implement in the construction industry. In other word, the awareness of current trends and latest construction technology and innovation is essential. This is a system which the building components are prefabricated in factory or at site,

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with the usage of minimum in-situ construction to assembled and form the structure (Triksa, 1999).

In short, Prefabrication System which introduced in IBS is a construction method that offers economization of design, site work and materials, provides shorter construction time, saving in labour, better quality control, immunity to weather changes and the most importantly, the cost factor. It has been proven successful in some countries, namely Singapore, England, and the United States (CIDB, 1998). In Malaysia, the shorter construction time offered by IBS seems to be the panacea for the housing demand in Malaysia. It is hoped that the widespread understanding on the prefabrication system can further help to develop and promote prefabricated system as an innovative construction method in Malaysia.

2. 1. 1 Definition of Prefabrication System

Prefabricated system which introduce in industrialized building system can be defined in which building components are mass produced in factory or at site under minimal wet site activities and strict quality control. With the objective of maximizing production output, minimizing labour resource and improving quality which the process is an investment in facilities, equipment and technology. Building system is also defined as a various interconnected element that assembled together to enable the designated performance of a building (Warswaski, 1999).

Prefabrication system that produce building components either in factory or at site with the specification of dimension and standard size which will be transported to the construction site and assemble to form a building (Chung

& Kadir, 2007). The structure that is construct using a technique in which the components are manufactured in a controlled environment, positioned, transported and assembled with the usage of minimal additional site works (CIDB, 2003).

Prefabricating system generally follow an industrial production procedure that takes place in prefabricated plant. Thus high quality of building components can be reliably obtained under a more controlled production environment. Since standard sizes are commonly produced in prefabricating concrete, the repetitive use of formwork permits a speedy production of components at a lower unit cost. These forms and plant finishing procedures provide a better surface quality than it is usually obtained under field conditions. Prefabricated components may be assembled much more faster than conventional cast in-situ components, thereby reducing in construction time. The prefabricating process is also sufficiently adaptable, thus special shapes can be produced economically (Ahmed Abdallah, 2007).

Prefabrication can be defined as “ a manufacturing process, generally taking place at a specialized facility, in which various materials are joined to form a component part of a final installation” (Tatum, 1987). These prefabricated components often only involve the work of a single craft. Any component that is manufactured offsite and is not a complete system can be considered to be prefabricated.

Quality control and minimal on site activities can be achieved which the building components are produced either in factory or at site (Triakha, 1999). The prefabricated system includes the industrialized process by which

building components are fabricated, planned, transported and assembled on site (Junid, 1986).

According to CIDB (2009), building system in which structural components are manufacture in factory, on site or off site, assembled and transported with minimal additional site works to form a structure. Prefabricated system also defined as construction system which built using prefabricated components by mechanical equipment, formwork and etc that delivered to construction site for erection and assembly after it is complete manufacture in factory (Abdul Rahman and Omar, 2006). Parid Wardi (1997) asserted prefabricated system which uses industrialized production techniques either in the components that is produced or assembly of building.

The definition of prefabrication system is varies depending on IBS. Several authors may define the system as process or as techniques. The following table below (refer to Figure 1) is highlights the categories of definition. Besides, there are ontology position either can be terms as a approaches, products, innovation, improvements, modernization and new technology. The issue has been discussed in construction industry since the industrial revolution change the ways of human living and economic activities. Since the concept of improvement and quality take place in industry, the invention and innovation become significant to industry.

2. 2 Aspects of Prefabricated Components

The CIDB has put more efforts to encourage all of the construction company to utilize the prefabricated systems as new development method in order to improve building's quality and enhance labours performance. Since the

utilization of prefabricated systems is low in construction industry, advance research and improvement should be carry out to enhance and promote a valuable aspects of prefabricated systems (CIDB, 2003; CIDB, 2007).

It is encourage using prefabricated systems as a construction method in the construction industry. Since prefabricated systems provide numerous aspects such as reduction of unskilled labours, less wastage, less volume of site materials, increased environmental and construction site cleanliness and better quality control (IBS Digest, 2009).

Besides, the aspects of prefabricated systems can be discussed in term of time, cost and quality in construction industry. Faster completion of construction project can be achieved due to the usage of standardized prefabricated components and simplified installation process (IBS Roadmap, 2003-2010). Therefore, duration of construction period is able to reduced and saved due to speedy construction and installation.

Usage of prefabricated systems is able to achieve a lower construction costs due to the reduction of construction waste and prefabricated building components from manufacturers. It is able to reduce construction waste as the building components are fabricated off-site and assembled on-site with minimum labour usage.

Concurrently activities are obtained when the prefabricated components are manufacture off-site while other construction work can be conduct in construction site. Hence, the usage of prefabricated systems is able to speed up the construction work in the term of time. With the utilization of prefabricated systems, a better quality control can be achieved and produce

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a higher quality of construction. The dependency on foreign labours will be diminishing due to the requirement of specialist skilled labours during installation of prefabricated components (IBS Roadmap, 2003-2010).

In the prefabricated systems application, the construction time and cost can be reduced by the usage of prefabricated components as the components are manufactured off-site and be delivered to construction site for assembling. Reduce on the usage of foreign labour can be achieve due to the requirement of specialist skilled labour for the installation. Hence, a higher quality and improvement in performance of construction can be achieved.

2. 2. 1 Characteristic of Prefabricated Components

The overall cost for a construction project that uses offsite work can be less than a traditionally stick-built undertaking in current construction industry. This can be caused by a variety of factors in the usage of prefabricated components. The labour for onsite work may be reduced due to the requirement of specialist skilled labours during the installation of the building components (Carl et al, 2000).

Severe onsite conditions and weather problems can lead to construction delays, onsite interference and worker congestion can be avoided, increasing productivity and lowering costs of construction project. The onsite construction duration can be substantially shortened through the usage of prefabricated components. Other project works can be completed before going to the site and this will lead to construction schedule decreased.

Overall project safety can be improved through the usage of prefabricated components in the construction project. Prefabricated components were

installed piece by piece with minimum used of labours, while conventional method needs more labours in order to complete the construction cycle for example, formwork fabrication and formwork installation, reinforcement bar fabrication and reinforcement bar installation and etc (Indra Gunawan, 2005).

Prefabricated components that manufacture offsite will improve in quality. Controlled factory and production conditions and repetitive and activities, along with automated machinery can lead to a higher level of quality that can be achieved onsite. Usage of prefabricated components can potentially decrease environmental impact of the project that is partly due to reduced onsite construction duration and a decrease in the usage of labour requirements.

The common characteristics of prefabricated components are:

- Cost efficiency
- Time saving
- Higher Productivity
- Reduce remittance by foreign worker
- Quality control
- Reduce waste of construction material

2. 2. 1. 1 Cost Efficiency

Usage of prefabricated components will result in cost savings due to a greater productivity and less wastage of materials during the production of the building components which manufacture offsite and deliver to site for assembling. Besides, prefabrication components also can reduce

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construction cost in site supervision which most of the output are similar, skilled labour required on-site for installation, wastage of materials, formworks, scaffolding, and etc. The usage of system formwork made up of aluminum, steel, scaffolding and etc will provides a considerable cost savings (Bing et al, 2001).

2. 2. 1. 2 Time Saving

Usage of prefabricated components reduced the construction duration in which most of the products and components are completed offsite in factory before deliver to site. Besides, it can reduce the duration of construction work onsite that conduct by labours. Prefabricated components for on-site construction and off-site assembly can perform as parallel activities, which the operations are not affected by the weather condition. Prefabricated components are standardized and the installation procedures are simplified. Therefore, the usage of prefabricated components will result in reduce of construction time.

Prefabricated system which give faster construction time because of the construction element that manufactured in factory and foundation work can occur at site in the same time. This provides earlier occupation of the building, thus reducing interest payment or capital outlays (Peng, 1986).

2. 2. 1. 3 Higher Productivity

Prefabricated components that produce in factory or manufacture offsite are more productivity compare with the conventional construction method. The components are assembly on-site which result in better productivity. In addition, it is also convenience for site management and site inspection for <https://assignbuster.com/prefabricated-components-in-warehouse-buildings/>

the prefabricated method which the components are installed on the construction site. Hence, it will reduce in construction time as well as reduced the wastage of materials.

Local construction industry is driven towards the adoption of an integrated in the construction industry to produce and utilize prefabricated components of the building at the work sites. This will help to enhance the efficiency of construction process, allowing a higher productivity, time, quality and cost efficiency (CIDB, 2004).

2. 2. 1. 4 Reduce Remittance by foreign worker

In Malaysia, the conventional construction method is highly dependency on the unskilled foreign labours that are easily to employ from the neighbor countries such as Indonesia, Philippine, Vietnam and Myanmar. The utilization of prefabricated systems can reduce the dependency on foreign labours especially the semi skilled and the unskilled labours due to simplified construction method at the construction site. The lesser labours involved in the construction will result in shorter duration of construction time. The prefabricated components are usually standardize prefabricated in factory or off-site and delivered to the construction site for assembly, construction time will be reduce by using this method compare with the conventional cast in-situ method.

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 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).

According to the IBS Digest (April – June, 2005), a comparative productivity study has been conducted between projects that built using precast technology and conventional method. Three project sites are studied which two using precast technology and one using conventional construction method.

Prefabricated or precast structural components were installed piece by piece with minimum used of labours, while using conventional method required more labours in order to complete the construction cycle, for example formwork prefabrication and formwork installation, reinforcement bar fabrication and reinforcement bar installation, concrete placement and formwork dismantle (Indra Gunawan, 2005).

2. 2. 1. 5 Quality Control

Better performance and component fit between parts for prefabricated system, which the components required more accurate profile and dimension of components that manufacture in factory. Prefabricated components that manufactured in factory can easily be control and monitor in factory for critical factors such as temperature, stripping time, and etc. Quality is the main factors in prefabricated system, the components that are manufacture off-site are better in quality control. A Quality Assurance Department is to ensure that there is a complete quality procedure and maintained regularly will be well set-up by manufacturer to ensure strict compliance throughout the manufacturing processes (NSL Eastern Pretech, 2005). It is much easier to control the quality in the prefabrication factory compare with casting at site.

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Prefabricated components which produced higher quality of components attainable through specific selection and the use of advance technology with strict quality assurance control (Din, 1984).

2. 2. 1. 6 Reduce Wastage of Construction Material

Prefabricated components that are prefabricated in factory or off-site will reduce the wastage of construction material and this will provide a safety working platform for the workers in construction site due to the reduction of construction debris, site worker and materials. Fewer mistakes, misalignments and deviations will be made by applying prefabricated system in construction industry, this will result in less waste reduces costs spend on materials, handling, dumpster and etc. With the reduction of construction material wastage, this will lead to the decrease in overall construction cost.

IBS components offer minimal wastage, because the components such as precast columns were being prefabricated off-site. The entire component has been manufactured on the required sizes. Besides, the repetitive use of the construction material, for example, steel system formwork provides considerable are cost savings (Bing et al, 2001; Thanoon et al, 2003).

Higher degree of precision and accuracy in the production of prefabricated components with the utilization of machine will lead to reduction of material wastage (CIDB, 2003).

2. 3 Types of Prefabricated Components usage in Warehouse Buildings

The composite construction method and fully prefabricated construction method was adopting into current IBS construction projects. The concept of <https://assignbuster.com/prefabricated-components-in-warehouse-buildings/>

partial industrialized system is derived from the composite nature of full industrialization, and is used to describe a manufacturing strategy that selectively uses some industrializing aspects (Nurul A. H. et al, 2005).

Nurul A. H. et al (2005) also stated that, the fully prefabricated construction method will involve on the manufacture, assembly and connect concept. All of the designed fabrication components of the building will be manufacture off-site, assembly off-site and be delivered to the stated site on planned period.

Both of the type of construction method is specifically aimed to increase productivity and quality of work. There are various types of prefabricated components that has been designed and manufacturer for construction project. There are factors that need to be considering on the adoption of the prefabricated components in the usage of warehouse buildings.

The components which are commonly used in local warehouse buildings construction are:

- Steel framing systems
- Panel system

2. 3. 1 Steel Framing Systems

Frame system may be defined as the structures that carry the loads through their beams and girders to column and finally to footing or pilecap. In such system, the skeletal structures will help to reduce the number and sizes of load carrying members. The important feature is the capacity to transfer heavy loads over large spans. Therefore, it is used in the construction of bridges, parking lots, warehouses, industrial buildings and etc (Junid, 1986).

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Frame system is a system that use beam and column as the main structure member due to the function that support all of the building weight. The walls have to be light for easy installation to support the building (Badir et al, 1998).

In the development of construction industry, the usage of light steel trusses increased due to cost effective which profiled steel portal frame and cold-formed channels system as alternative choice for traditional hot-rolled sections. It is commonly used with precast concrete slab, steels columns and beams. Steel framing systems have always been the popular choice that used widely in the construction of skyscrapers (CIDB, 2003). The framing system is prefabricated in factory and delivery to the site with stated schedule. It is erected to the final location by using machinery, such as mobile crane and be join by special bolts, plates and welded with the structure.

The products of steel framing systems (refer to Figure 2) are included steel beams and columns, portal frame, roof trusses and etc (IBS Survey, 2003). These systems especially steel beams and columns are commonly used in construction industry in order to speed up the construction works.

2. 3. 2 Panels system

Panel system may be defined as the structures that carry load through large floor and wall panels (Junid, 1986). This system probabaly would be the most widely used prefabricated system which employed planar or panel-shaped elements for floor slabs, vertical supports, partitions and exterior wall.

Depending on the scale of projects, some panels may be fabricated at site

for easy transportation. Other panel systems available are such as wood, plastic, light weight metal and ferrocement materials.

In panel system, loads are distributed through large floor and wall panels where walls support the building weight. This system is applicable to building which functionally require a large number of walls such as apartment house, hotel and hospital. This system is not applicable to buildings with large spans or many stories (Badir et al, 1998).

According to Junid (1986), panel system may be defined as those structures that carry the load through large floor and wall panels. The panels can be made in various forms and materials and are normally prefabricated at factory. Concrete panel systems are extensively used in Europe for high rise building for ease of construction purpose. In Malaysia, this system is slowly gaining popularity in terms of low rise buildings.

The products of steel wall panels (refer to Figure 3) are included lightweight steel wall panel, metal wall panel and etc. There are another different concept in classifying the building (refer to Figure 4) that the components should be used as a basis for building classification hot-rolled steel sections which consists of frame system, panel system and box system (Majzub, 1977).

2. 4 Issues of Prefabricated Components usage in warehouse buildings

The adoption of prefabricated system which introduced in industrialized building system is still very low in construction industry. Particularly, there

are issues regarding to the usage of prefabricated components in warehouse buildings. The implementation of prefabrication system in loca