

Overview of industrialised building system construction essay



Industrialised Building System (IBS) began in early 1960s when Ministry of Housing and Local Government of Malaysia visited several European countries, at the same time evaluates their housing development program. (Thanon et al, 2003). After their successful visit in the year 1964, the Government had launched pilot project on IBS to speed up the delivery time and built affordable and quality houses.

The first pilot project was constructed at Jalan Pekeliling in Kuala Lumpur and about 22.7 acres of land was dedicated to the project comprising four blocks of 4-storey flats and seven blocks of 17-storey flats and comprising total about 3,000 units of low cost flats for the low and median income group and 40 units of shop lots. This public housing project was undertaken by Gammon/ Larsen Nielsen and this project are using the Danish System of large panels in a industrialised prefabricated system. The construction for public housing project was complete from 1966 until 1968 (around total 27 months) including the time taken in the construction of the around RM 2.5 million casting yard at Jalan Damansara (CIDB, 2006; and Thanon et al, 2003).

In 1965, the Government of Malaysia launched a second project, is a three blocks of 18-storey flats and six blocks of 17-storey flats and comprising total about 3,699 units and 66 units of shop lots along at Jalan Rifle Range in Penang. The public housing project was awarded to Hochtief/ Chee Seng and this project are using French Estoit System (Din, 1984). This public housing project was complete within 27 months.

If we are reference to the two pilot projects, a performance comparison between the IBS and the conventional system has been carried in terms of cost, productivity, quality, and time. According to the research, the first pilot project incurred 8.1% higher costs than a similar building and using conventional construction method, while the second pilot project was lower. In term of total construction speed, both of the public housing project required total 27 months to complete the whole project, inclusive of time required to set up the recasting factories. The total quality of building finishes was also found to be better than the using conventional construction method.

Another earliest using IBS in public housing project was at Taman Tun Sardon in Penang. These using IBS in public housing project total all about 1,000 units of 5-storey walk up flat and this project are using IBS precast component and system. The IBS precast component and system in the housing project was designed to the low cost housing by British Research Establishment and especially for the low and median income group. Almost at the same time at Edmonton in North London, there are using similar system was constructed and total amount about 20,000 BRECAST dwellings were constructed throughout UK from 1964 until 1974 (CIDB, 2006). The total all building design was very basic and quite simple and may not consider the aspect of serviceability such as the local or user needs to have wet toilet and bathroom (Rahman and Omar, 2006).

Many construction in the following years utilised precast wall panel system.

One can observed that IBS was engage at first place in the construction of low cost high rise residential building to overcome the increasing demand for <https://assignbuster.com/overview-of-industrialised-building-system-construction-essay/>

housing needs (CIDB, 2006). Nonetheless, the industrialisation of construction at the earlier stage was never sustained. Failure of early closed fabricated system made the industry afraid of changing their construction method. Some of the foreign systems that were introduced during the late 60s and 70s were also found not be suitable with Malaysia climate and social practices (CIDB, 2005).

Newer and better technologies were constantly being introduced than in the market. Wet joint systems were identified to be more suitable to be used in our tropical climate and it was also better to utilise the bathroom types which were relatively wetter than those in the Europe (CIDB, 2005).

In 1978, the Penang State Government launched another 1200 units of housing using prefabrication technology. Two years later, the Ministry of Defense adopted large prefabricated panel construction system to build 2800 units of living quarters at Lumut Naval Base (Triksa and Ali, 2004).

During the period of early 80s up to 90s the use of structural steel components took new turn particularly in high rise buildings in Kuala Lumpur. The usage of steel structure gained much attention with the construction of 36-storey Dayabumi complex that was complete in 1984 by Takenaka Corporation of Japan (CIDB, 2003 and CIDB, 2006)

In the 90s, demand for the new township has seen the increase in the use of precast concrete system in high rise residential building. Between 1981 and 1993, Perbadanan Kemajuan Negeri Selangor (PKNS) a state Government development agency acquired pre-cast concrete technology from Praton

Haus International based on Germany to build low-cost houses and high cost
<https://assignbuster.com/overview-of-industrialised-building-system-construction-essay/>

bungalows for the new townships in Selangor (CIDB, 2003; Hassim et al, 2009 and National IBS Survey, 2003). It was recorded then, around 52, 000 housing units was constructed using Praton Haus system (Triksa and Ali, 2004). In this booming period of Malaysia construction 1994 to 1997, hybrid IBS application used in many national iconic landmarks such as Bukit Jalil Sport Complex, Kuala Lumpur Convention Centre (steel beam and roof trusses and precast concrete slab: Victor Buyck Steel Construction), Lightweight Railway Train (LRT), KL Sentral Station (steel roof structure and precast hollow core: RSPA – Bovis), KL Tower (steel beams and columns for tower head: Wayss & Freytag), Kuala Lumpur International Airport (steel roof structure: KLIAB – Eversendai) and Petronas Twin Towers (steel beams and steel decking for the floor system – Mayjus JV and SKJ JV) (CIDB, 2006). It also includes the development and construction of new administration capital of Malaysia; Putrajaya and the first Malaysia cyber city; Cyberjaya.

Today in the Malaysian construction industry, the use of IBS as a method of construction is evolving. More local manufacturers have established themselves in the market. Many had acquired enough knowledge through technology transfer to build up own capacity in IBS technologies (PKNS Engineering, Setia Precast and Global Globe).

The local IBS manufacturers were mushrooming, although yet to operate in full capacity. The current IBS system used in Malaysia housing projects are large panel systems, steel frame, precast frame and formwork system. The IBS system is largely used for private residential projects in Shah Alam, Wangsa Maju and Pandan (Sarja, 1998), Dua Residency, KL, Taman Mount Austin and Tongkang Pecah, Johor (CIDB, 2006).

<https://assignbuster.com/overview-of-industrialised-building-system-construction-essay/>

It was reported that at least 21 manufactures and suppliers of IBS are actively promoting their systems in Malaysia. IBS move to the next step of the development through the establishment of IBS Centre at Jalan Chan Sow Lin, Cheras, Kuala Lumpur. The obligation to implement IBS serves both to improve performance and quality in construction, as well as to minimize dependency on unskilled foreign labour in the construction market.

2. 2 Classification of Building System

There are four types of building system in Malaysia according to Badir - Razzli building system classification. The building system can be are namely Conventional Column-beam- slab frame system with timber and plywood; Cast in-situ system with steel or aluminium as formwork; Prefabricated system and the Composite building system is shown as below. Each building system is represented by its construction technology, functional and geometrical configuration. There from the four systems, are identified as IBS excluding conventional building system.

Building System

Conventional Column-beam- slab frame system with timber and plywood.

Cast in-situ system with steel or aluminium as formwork.

Composite building system

Prefabricated system

Table Form

Tunnel Form

Panel system

Frame system

Box system

2. 2. 1 Conventional Construction Method

Conventional building method is defined as components of the building that are prefabricated on site through the processes of timber or plywood formwork installation, steel reinforcement, and cast in-situ. Conventional buildings are mostly built of reinforced concrete frames. The traditional construction method uses wooden formwork. It is much more costly for construction which includes labour, raw material, transportation and low speed of construction time.

2. 2. 2 Cast In-Situ Construction Method

This system is suitable for a country where unskilled labour is limited. There is no heavy machinery or high technology involved. The system is technically applicable to almost all types of building. Formwork is used as a mould where wet concrete is poured into a temporary system. The temporary system also acts as a temporary support for the structures.

The objective of an in-situ method is to eliminate and reduce the traditional site-based trades like traditional timber formwork, brickwork, plastering and to reduce labour content. A carefully planned in-situ work can maximise the productivity, speed and accuracy of prefabricated construction. Cast in-situ

method uses lightweight prefabricated formwork made of steel / fibreglass / aluminium that is easily erected and dismantled. The steel reinforcement is placed within the formwork as they are being erected and concrete is poured into the mould. When the concrete is set according to the required strength, the moulds are dismantled. The workers can be easily trained to erect the moulds and set the steel reinforcement. Its advantages over the traditional construction method include, low skill requirement, speedy construction, low maintenance, durable structure and less cost.

2. 2. 3 Composite Construction Method

The objectives of composite construction method (partially prefabricated) are to improve quality, reduce cost, and shorten construction time. The concept of partial industrialised system is derived from the composite nature of full industrialisation, and is used to describe a manufacturing or production strategy that selectively uses some industrialising aspects, while avoiding or postponing the use of others. The prefabricated construction method is combined in such a manner that the features applied could be prominently demonstrated, especially composing various works such as temporary facilities, building frames, building finishes, and equipments.

2. 2. 4 Prefabricated Construction Method

In this method of construction, all elements can be standardised are prefabricated in the factory. Normally, this method would involve the assembly of precast elements such as floor slabs, in-filled walls, bathrooms, staircases, and etc. into place for incorporation into the main units, columns and beams. This method of construction has reduced the amount of site

labour involved in building operations and increased the productivity of the
<https://assignbuster.com/overview-of-industrialised-building-system-construction-essay/>

industry. Precast building systems can reduce the duration of a project if certain conditions are met. The last three construction methods are considered as non conventional construction methods. These types of construction are specifically aimed at increasing productivity and quality of work through the use of better construction machinery, equipment, technology and materials.

2. 3 Classification of IBS and Apply to Public Housing

According to Badir et al. (1998), IBS can be classified according to several aspects:-

Classification according to structural system.

Classification according to material.

Classification according to relative weight of components.

2. 3. 1 Classification According to Structural System

According to Abraham Warszawski (1999), IBS can be classified according structural systematic aspects. IBS can be classified into three categories as:-

Linear system or frames (beams and column).

Panel system.

Rectangular or Boxes system or three dimensional systems.

Figure 1, 2, and 3 shows the concept of the system as classified above.

Figure 2: Panel System

Figure 3: Box System

Figure : Frame System

2. 3. 1. 1 Frame System

Frame system is system that use column and beam as the main structure member where column and beams support all the building weight. The walls need to be light and easy to install and concrete panels are introduces as flooring element.

2. 3. 1. 2 Panel System

In panel system, loads are distributed through large floor and wall panels where walls support the building weight. This system is applicable to buildings 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.

2. 3. 1. 3 Box System

The box system include those systems that employ three dimensional modules or boxes for fabrication of habitable units that are capable of withstanding load from various directions due to their internal stability.

2. 3. 2 Classification According to Material

2. 3. 2. 1 Timber

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

2. 3. 2. 2 Brick and Block work

Laying of brick or block are carried out in a mass at factory and transported to site or on site beside the building under construction in the form of panel and then erected.

2. 3. 2. 3 Steel

Steel construction essentially contains factors of prefabrication which is one of the criteria of IBS. Elements are jointed by welding, riveting or bolting on site. The large proportion of the strength to the weight allows a long-span or high-rise building.

2. 3. 2. 4 Reinforced Concrete

Reinforced concrete has high degree of availability, low material cost, durability, and fire resistance. There are two basic directions in development of reinforced concrete IBS component which is panelised components such as walls and floors and precast frame members such as columns and beams. Jointing at site is the key issue of this system.

2. 3. 3 Classification According to Relative Weight of Component

The IBS components can be classified according to their relative weight as in Table 1 below. Relative to weight of component should be used as a basic for building classification due to 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 on site.

No

General System

System

Production Material

1

Frame

System

Light weight frame

Wood, light gage metals

Medium light weight frame

Metal, reinforced plastics, laminated wood

Heavy weight frame

Heavy steel, concrete

2

Panel

system

Light and medium weight panel

Wood frame, metal frame

and composite material

Heavy weight panel

(factory produced)

Concrete

Heavy weight panel

(tilt up-produced on site)

Concrete

3

Box system

(modules)

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

Heavy box

(tunnel produced on site)

Concrete

Table 2: Building system classification according to relative weight of component. (Majzub, 1977)

According to CIDB (2001), the IBS is a construction process that utilizes techniques, products, components, or building system which involve prefabricated components and on-site installation. Base on the structure aspects of the system, IBS can be identified into five major groups:-

Precast Concrete Framing, Panel and Box Systems.

Precast concrete elements are the most common type. There are precast concrete column, beam, slabs, walls, lightweight precast concrete, and permanent concrete formwork. Besides that, it is also consist of 3D components such as balconies, staircases, toilets, lift chamber, refuse chambers and etc.

Steel Formwork Systems.

They generally involve site casting, and therefore subjected to structural quality control. So, it is considered as the “ low level” or “ least prefabrication” IBS types. However, this system does offer high quality finishes and fast construction with less site labour and material requirement. These include table forms, tunnel forms, tilt-up systems, beam and columns moulding forms and permanent steel formworks like metal decks.

Steel Framing Systems.

This system commonly used with precast concrete slabs, steel columns and beams have always been the popular choice and used extensively in the fast-track construction of skyscrapers. Recent development in this type of IBS includes the increased usage of light steel trusses. It is consisting of cost-effective profiled cold-formed channels and steel portal frame systems as alternatives to the heavier traditional hot-rolled sections.

Prefabricated Timber Framing Systems.

The products are including timber building frame and timber roof truss. While timber roof truss system are more popular, timber building frame system 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.

Block Work Systems.

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 light weight concrete blocks.