

## **THE EXPERIENCES OF MALAYSIA AND OTHER COUNTRIES IN INDUSTRIALISED BUILDING SYSTEM**

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### **ABSTRACT**

This paper describes the experiences of Malaysia in the adoption of industrialised building system (IBS). The idea of using IBS in Malaysia was first mooted during the early sixties when the Minister of Housing and Local Government visited several European countries and evaluated their building systems performance. Then, in 1964, the government took a brave decision to try one pilot projects using IBS concept. The first pilot project was constructed on 22.7 acres of land along Jalan Pekeliling which included the construction of 7 blocks of 17 storey flats, and 4 blocks of 4-storey flats comprising about 3,000 units of low cost flats and 40 storey shop lots. The project was awarded to the Gammon/Larsen Nielsen using the Danish System of large panel industrialised prefabricated systems. The performance of the project was somewhat disappointed, which incurred 8.1% cost higher than the conventional building system. However, this did not stop the penetration and proliferation of IBS from other countries into the local construction market. It was reported that at least 21 of various manufacturers and suppliers of IBS are actively promoting their systems in Malaysia. The experiences of other countries in the adoption of IBS will also be discussed.

### **1. INTRODUCTION**

After the Second World War, the idea of industrialised building system (IBS) has received much attention in the devastated countries. Though, Malaysia did not suffer the impact of the war, the need to supply its population with affordable and quality houses has prompted the government to promote the use of IBS as an alternative to conventional building system. The objective of this paper is to document the experiences of Malaysia as well as other countries in the adoption of IBS.

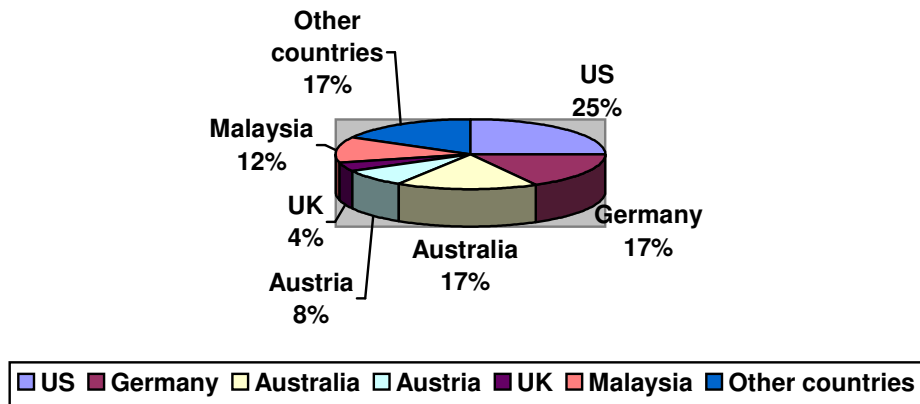
### **2. MALAYSIA'S EXPERIENCE IN IBS**

The idea of using industrialised building system in Malaysia was first mooted during the early sixties when the Minister of Housing and Local Government visited several European countries and evaluated their building systems performance. Then, in 1964, the government took a brave decision to try two pilot projects using IBS concept. The first pilot project was constructed on 22.7 acres of land along Jalan pekelling which included the construction of 7 blocks of 17 storey flats, and 4 blocks of 4-storey flats comprising about 3,000 units of low cost flats and 40 storey shop lots. The project was awarded to the Gammon/Larsen Nielsen using the Danish System of large panel industrialised prefabricated systems. Meanwhile, the second pilot project was built in Pulau Pinang 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 Jalan Rifle Range. The project was awarded to Hochtief/Chee Seng using the French Estiot System (Din, 1984).

With reference to the two pilot projects, a performance comparison between the IBS system and conventional system has been carried in terms of cost, productivity, and quality. It was discovered that the first pilot project incurred 8.1% higher cost than a similar building using conventional construction method, while the second project was 2.6% lower. In term of construction speed, both projects required 27 months to complete, inclusive of time required to set up the recasting factories. The quality of building finishes was also found to be better than the conventional construction method. In conclusion, the overall

performance of an IBS is competitive with the conventional construction method. Since then, the uses of IBS is more profound with the participation of private sector and public sector such as Housing Research Centre in Universiti Putra Malaysia aimed at promoting and developing novel building system.

It was reported that at least 21 suppliers and manufacturers are actively involved in the dissemination of IBS in Malaysia (Badir et al, 2002). Majority of the IBS are originated from the United States, Germany and Australia with market share of 25%, 17% and 17% respectively. Malaysian’s produced systems only account for 12%. This indicate that there is a considerable room for improvement in the area of research and development of IBS. Figure 1.0 shows the source of IBS in Malaysia according the origin of countries.



**Figure 1.0: Origin of IBS according to countries**

In Malaysia, the IBS are generally divided into four categories, namely:

- a) System formwork - table form and half-tunnel form
- b) Frame system – precast concrete and precast steel
- c) Panel system- sandwich panel, half-slab, hollow core slab and solid concrete panel
- d) Block system – interlocking block, hollow block, solid block and lightweight block

The table form system represents the major market share (32%) followed by the precast wall panel (21%). The precast frame system gains low popularity because it requires high construction precision and high start-up capital. The block system is mainly used for non-structural wall as an alternative to conventional brick and plaster.

### **3. EXPERIENCES OF OTHER COUNTRIES IN IBS**

#### **3.1 Japan**

The industrialisation of housing industry in Japan started in 1960’s and since then the market share has changed dramatically in the use of IBS. Construction of prefabricated houses in Japan represented about 20% of all houses in Japanese fiscal year 1999 (April 1999 - March 2000). Out of that, the steel framing system dominated the prefabricated market with a 73% share, the wood framing system with 18% while the reinforced concrete framing with a 9%. With reference to this, the wood-framed housing grew 2%, and steel-framed housing grew 3%, while concrete framed housing experienced a major setback of –12% as shown in Table 1.0. (Nagahama, 2000).

**Table 1.0: Prefabricated Housing Market Share in Japanese Fiscal Year 1999 (April 1999-March 2000).**

No	Framing Structure	Prefabricated Market Share, %	Growth Rate, %
1	Steel framing	73	+3
2	Wood framing	18	+2
3	Concrete framing	9	-12

Construction of houses by the Japan Prefabricated Construction Suppliers and Manufacturers Association, a 110 member industry group of housing manufacturers, represented 227,863 units, an increased of 1.1% in JFY 1999. In respect to this, most of the prefabricated construction industry concentrating in 3 major urban markets with constant population clusters, namely, the Kanto region (Tokyo-Yokohama), the Chubu region (Nagoya) and the Kinki region (Osaka and Hyogo). Nevertheless, the sales in this market experienced a decline of 0.8% from previous year as a result of the protracted economic recession accompanied by a decline in consumer spending. In spite of that, the Japan construction industry is still regarded as highly integrated and automated production equipment and facilities to manufacture house building components and offers home buyers both generic floor plans and custom order capabilities.

### 3.2 Argentina

In Argentina, the market for IBS was estimated at approximately U.S. 41.5 million in 1995 to U.S.65.9 million in 1996, an increased of 10% annual growth rate. Out of that, the total imported prefabricated materials were U.S. 22.5 million in 1996 of which the U.S dominated 70% of the import market as presented in Table 2.0 (Fournery, 1997).

**Table 2.0: Argentine market for industrialised housing system (in millions of dollars)**

No	Market	1995	1996	1997	Projected average annual growth rate, %
1	Import market	18	22.5	25.9	12
2	Local production	25	40	44	10
3	Export	1.5	2.8	4.0	8
4	Total market	41.5	59.7	65.9	10
5	Import from U.S.	12.6	15.8	18	15

Traditionally, the IBS concentrates on the low income group due to the requirement of affordable and short utility of life span houses. Indeed, the government intended to build a minimum 150,000 low cost unit during the period 1997-1999. Contrary to this, the high income group still prefers the conventional building method made up of solid block and plaster which can last more than a lifetime. However, the trend in this group is currently moving towards more industrialised housing that incorporate features such as thermal and acoustical insulation as well as efficient and environmentally friendly houses.

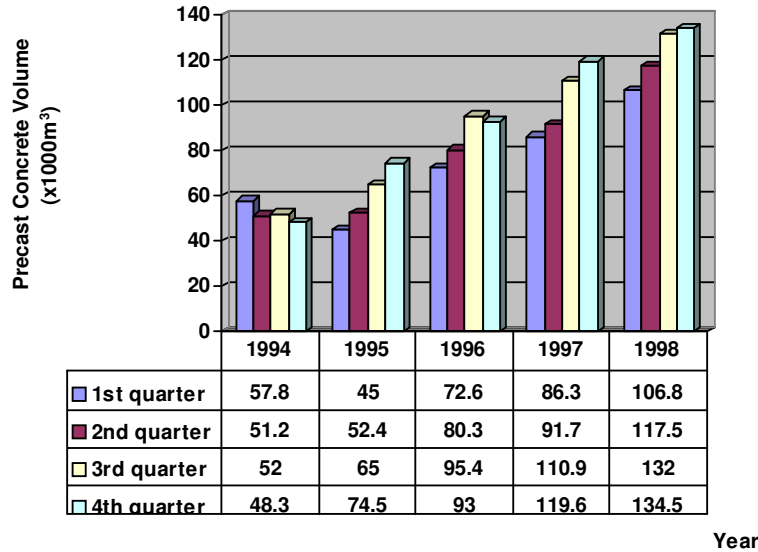
### 3.3 Singapore

The need for accomplishing large quantities of apartment in the early sixties has prompted the Housing and Development (HDB) of Singapore to adopt the IBS concept. In view of the critical demand, in 1963, the HDB had launched the first prefabricated method using a proprietary French large panel and fabrication system on a 10 blocks of standard 16 storey flats. However, the project experienced numerous technical and management problems and had to be completed by the conventional method finally.

Albeit, its earlier failures, the HDB was never looked back, indeed took a brave initiative to attempt the IBS again in 1973 and 1979 in view of the need for accomplishing the 100,000 dwelling units in the Fifth Building Programme target (1981-1985). As a result of continuous effort, the HDB has made a remarkable achievement in the adoption of IBS for the construction of the public housing program. Also,

through its ongoing comprehensive program and industry collaboration, the IBS able to gain substantial market in the construction industry in recent years as shown in Figure 2.0.

The HDB has introduced major innovation in the area of novel building systems which include ferrocement cladding system, prefabricated bathroom system, precast prestressed composite floor system, architectural precast facades and pre-cut and pre-bend reinforcement bars.



**Figure 2.0: HDB precast concrete implementation (Tat and Hao, 1999)**

### 3.4 Thailand

The market share for IBS in Thailand is growing very rapidly due to labour shortage and high interest rate. The major IBS are prefabricated wall and slab. The former system has been used for more than 20 years ago while the latter system has been used in the market for 10 years. Another system that gain popularity in the recent year is the autoclave aerated concrete which is a lightweight brick, known locally as Superblock. The annual growth rate of IBS in Thailand was about 30% in 1996. There are about 20 IBS suppliers in the market (Thai Farmers Research Center, 1996).

### 3.5 The U.K.

The use of IBS in U.K became more evident in the mid 1900's after the widespread destruction of housing stock during the Second World War. By 1960, over 165,000 precast concrete dwellings had been built ranging from small single story bungalow to large high rise buildings.

In 1999, the precast concrete represents about 25% of the market for cementitious products. This includes a wide range of products used in the construction industry such as suspended floors, structural, blocks, paving, bridges, cast stone, and architectural cladding. Of these products, the suspended floors represent the higher use with output in term of tonnes of product sold per annum.

On the other hand, the significant potential take-up of precast concrete is in the construction of ground floor housing with reported 60% of uses. Indeed, its utilisation experienced double market share between 1994 to 1999. In parallel with this trend, the precast concrete is trying to penetrate the upper floor houses. It is also predicted that the upper floor will take-up 40% of the new house by 2001. However, the conventional masonry construction still dominates the market share of 90% leaving the precast market with only 10% share. Therefore, there is a great potential for grabbing IBS market share in the U.K. construction industry (Jacqueline, 1999).

### **3.6 Australia**

The first precast concrete lighthouse was erected in 1904 at Bradley's Head, Sydney. In the early 1950s, the Australia government has invited the George Wimpey & Sons Ltd of the U.K to build houses using precast 'tilt slab' construction system to help overcome the acute shortage of accommodation in Canberra. The use of IBS in Australia became evident after the devastation of Darwin by Cyclone Tracy on Christmas Day of 1974. After the incident, about 425 cyclone proof precast concrete houses were built with a rate of one house per day. Despite the fabulous achievement of IBS, its acceptance is somewhat low in Australia because the public still prefer the conventional construction system (Anon, 2003).

### **3.7 Germany**

The IBS in Germany is well established and its internal competition is fierce as a result of technological advancement. The development of precast concrete is well recognised particularly in the area of precast internal and external wall as well as roof panel. Therefore, it is economically viable to set up factories solely dedicated to the production of precast concrete industry.

It was reported that 10% of the 250,000 dwellings in 1998 used precast concrete elements for 1-2 storey homes. Furthermore, the Unification has substantially increased the market share of precast concrete. Alone in the former East Germany, the reported precast market share was 24% in 1997. Albeit the value for precast concrete has increased by 10-15%, the profit is marginal partly due to internal fierce competition from factories based in the former East Germany (Jacqueline, 1999).

### **3.8 The Netherlands**

The precast concrete in the Netherlands represents 10% of the total housing market, although the conventional brickwall and masonry construction still prevail in the market. Nevertheless, the industrialised housing is steadily increasing its market share due to cost saving up to 30%. This phenomenon is also substantiated by standardised components, flexible manufacturing process, and improved industrialised building technique (Jacqueline, 1999).

### **3.9 The U.S.A**

In the U.S.A, IBS received widespread attention as early as the 1930s as evidenced by the construction of prefabricated steel house by General Homes, Inc. But the early dreams of rationalising the IBS faded quickly due to price in competitiveness, high capital and inconsistent local codes. However, the trend reversed after the Second World War due to the need to resolve critical shortage of houses.

In 1999, the prefabricated housing has gained substantial market share with 30% of all housings using this type of construction method. Although most of low rise housing is using timber framed, concrete precast system is being used intensively particularly in areas that are vulnerable to environmental hazards such as hurricanes and tornados. Indeed, the adoption of precast concrete faces resistance in the early state due to plain appearance of panels, risk of water penetration and difficulties of installing insulation. But, the trends has reversed as a result of advanced technology method such as improved concrete mixing techniques, improved moulds, availability of rigid foams and a improve range of surface finishes.

A study carried out by the PCA (Portland Cement Association) indicated that 70% of buyers select their house on the basis of cost/value alone. In other words, the benefits of architectural finishes, flexibility, thermal insulation were perceived as a secondary concern. However, the mindset of buyers has changed and the house buyers have taken those factors as well speed and ease of construction into consideration when purchasing a house, thus making the IBS a popular choice (Jacqueline, 1999).

### **3.10 Canada**

The need to be competitive in the construction industry has prompted the Canadian construction players to be proactive in the use of IBS. Though, Canada is perceived as among the world leaders in some areas of construction, there is little progress in the area of IBS partly due to small housing market with 150,000 units per year. This is evidenced by only 3% Canada's new housing using IBS as compared to 90% in Sweden (Finn, 1992).

### **3.11 Denmark**

In Denmark, about 80% of the detached houses produced since the mid-1960 were using IBS, most of it panelised system. The IBS in Denmark is aimed for domestic and export markets. For instance, its international contractors such as Jespersen & Son and Larsen & Nielsen have constructed large projects throughout the world using a prefabricated concrete system produced in local factories (Gibbons, 1986).

### **3.12 Sweden**

The Swedish construction industry is regarded as the most industrialised and developed in the world. In the mid-1960s, Sweden has projected a national mission of producing 1 million new houses within 10 years. The objective was achieved through the introduction of IBS. By 1983, 90% of all single-family houses were produced using IBS.

There are about 55 manufacturers offering IBS in Sweden. Apart from local market, Swedish manufacturers export houses to West Germany, Austria, Holland, Switzerland, Denmark, Finland, the Middle East and North Africa. Sweden's magnificent achievement in IBS as a result of direct government proactive policies which include substantial grant in research and development (US 200 million per year) (Gibbons, 1986).

### **3.13 Finland**

In Finland, about 60% of single-family houses were built using IBS. The growth of residential construction industry using IBS is 20% annually. The predominant form of IBS are small and modular panelised system (Gibbons, 1986).

## **4. BARRIERS TO THE ADOPTION OF IBS IN MALAYSIA**

In Malaysia, the construction industry has been slow in the adoption of IBS due to several reasons:

- a) Wide swings in houses demand, high interest rate and cheap labour cost, make it difficult to justify large capital investment. Contractors prefer to use labour intensive conventional building system because it is far easier to lay off workers during slack period.
- b) Fully prefabricated construction system requires high construction precision. Our labour forces still lack of skilled workers. Many of foreign skilled workers had left the country after the widespread crackdown on illegal foreign workers on July - September 2002. The new batches of foreign workers do not possess the required skill and have to be retrained.
- c) The construction industry is so fragmented, diverse and involve many parties. Consensus is required in the use of IBS during planning stage. However, the owners, contractors and engineers still lack of scientific information about the economic benefits of IBS.
- d) Lack of 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 degree in local universities seldom teach about the design and construction of IBS.
- e) The economic benefits of IBS are not well documented in Malaysia. Past experiences indicated IBS is more expensive due to fierce competition from conventional building system. Furthermore, there is an abandon of cheap foreign workers in Malaysia.
- f) The use of IBS in Japan and Sweden are so successful due to high quality and high productivity. But, in Malaysia, the scenario is different, most project constructed with IBS were low quality and high construction cost.
- g) Lack of incentive and promotion from government in the use of IBS. Many architects and engineers still unaware of the basis element of IBS such as modular co-ordination.

## **5. CONCLUSION**

The experiences in some developed countries such as Japan, Germany and the U.K. indicate that there is a great potential for IBS to progress as evidenced by their growing market share. Indeed, the successful of IBS in those countries is prompted by concern of home buyers about long term energy saving, indoor air quality, and other health and comfort related issues, and commitment of houses developers toward greater technological advancement and innovation. Clearly, if Malaysia wishes to imitate the success of those countries, a long term comprehensive policy towards the industrialisation of building and construction sector should be pursued.

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