

ISSUES AND CHALLENGES IN THE IMPLEMENTATION OF INDUSTRIALISED BUILDING SYSTEMS IN MALAYSIA

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ABSTRACT: The Industrialized Building Systems (IBS) Roadmap 2003-2010 published by the Construction Industry Development Board (CIDB) outlines several well-thought strategies and aggressive steps to promote the use of IBS in Malaysia. The government is taking the leading role to persuade the construction industry to engage a more systematic approach and methodology in construction. It is a strategic change in the construction industry and the effort started in 1998. Besides the aim to gradually reduce the dependency on foreign labour and saves the country from losing out foreign exchange, IBS provides the opportunity for the players in the construction industry to develop a new image of the construction industry to be at par with other manufacturing industries such as car and electronic industries. With the present conventional methods of construction, the industry is always associated with many unprofessional practices. The adoption of IBS promises to elevate every level of the industry to a new height and image of professionalism. By adopting IBS, efficient, clean, safe, professionally managed and handled by professionals and workers with relevant skills, proper coordination and management, precision, innovative and quality will be appeared as new attributes to be associated with the construction industry. The industry players are expected to venture internationally and one of the pre-requisite to compete globally is to offer quality, efficient and professional services and again IBS can be an excellent option. Although some of IBS have been introduced in Malaysia as early as in 1960's, the industry as a whole seems quite reluctant to exploit the use of IBS. A recent survey carried out on the use of IBS in Malaysia reveals some of the issues and challenges, which require attention from different parties.

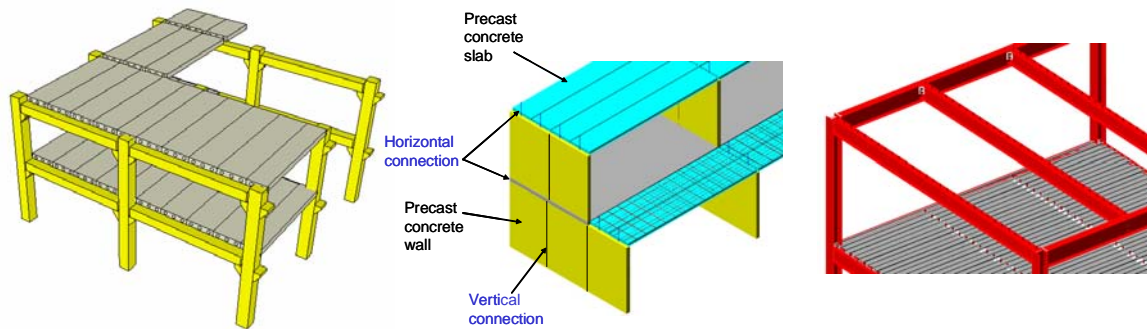
1.0 Introduction

Industrialised building system (IBS) is a construction system that is built using pre-fabricated components. The manufacturing of the components is systematically done using machine, formworks and other forms of mechanical equipment. The components are manufactured off-site and once completed will be delivered to construction sites for assembly and erection.

In Malaysia, Construction Industry Development Board (CIDB) has classified the IBS system into 5 categories as follows:

- i). precast concrete framed buildings
- ii). precast concrete wall buildings
- iii). reinforced concrete buildings with precast concrete slab
- iv). steel formwork system
- v). steel framed buildings and roof trusses.

In this paper, however, only three systems of IBS are discussed namely the skeletal precast framed , precast wall and steel framed structures (see Figure 1).



(a). Skeletal precast concrete framed structure (b). Precast concrete Wall (c). Steel framed structure
Figure 1

The IBS systems as mentioned above are not new in Malaysia. For example, precast wall system has been adopted in Malaysia as early as in the late 60s. Even though the IBS systems have been in existence for a long time but there are still many unresolved issues. Some of the issues are the ability of the industry players to equip with necessary technical knowledge in order to adopt IBS in their projects. Examples of this lacking are clearly reflected in the quality of the completed projects and there are situations where IBS could not be continued due to unavailability of relevant technical experts. This paper discusses those issues and suggests appropriate approach in overcoming them.

2.0 Issues of IBS

2.1 IBS as mass construction method.

The term 'IBS' is often misinterpreted with negative meaning as it is always linked with industrialized buildings that were built in 1960s. These buildings are normally associated with pre-fabricated mass construction method, low quality buildings, leakages, abandoned projects, unpleasant architectural appearances and other drawbacks. Due to the poor architectural design, the old pre-fabricated buildings have given the public, bad impression about precast concrete.

There have been quite a number of cases where the use of IBS had lead to such drawbacks. For example, in the case of Pekeliling Flats in Kuala Lumpur and Taman Tun Sardon, Gelugor, Penang (see Figure 2). These two early pre-fabricated flats were constructed in mass to produce low cost accommodation for lower income groups. In the case of Taman Tun Sardon, the IBS precast system was designed by British Research Establishment, UK for low cost housing in tropical countries. However, the design was very basic and not considering the aspect of serviceability such as the need for wet toilets and bathrooms. Lacking in this design consideration leads to problems of leakage that becomes the common issue with precast buildings. In addition, in many cases the low cost housings are not maintained properly, thus contributing further to the poor image of IBS buildings.



(a). *Pekeliling Flats, Kuala Lumpur* (b). *Taman Tun Sardon, Gelugor, Penang.*
Figure 2

2.2 Lack of involvement from small contractors

From the survey it is found that many small contractors are reluctant to adopt IBS system and prefer to continue using the conventional method of construction. This is due to the fact that small contractors are already familiar with the conventional system and for them the technology suit well with small scale projects and therefore not willing to switch to mechanized based system. Furthermore small contractors lack financial backup and are not able to set up their own manufacturing plants as it involves very intensive capital investment. In this case, financial issues become the main obstacle for small contractors to move forward with the IBS system. On the other hand, however, many big players in IBS industry have shown good track records in building successful IBS projects. This shows that IBS is a feasible system provided the parties involved have the capabilities to carry out the work related to IBS such as analysis, design and manufacturing of IBS components.

2.3 Lack of knowledge and exposure to IBS technology

Lack of knowledge in structural analysis and design of pre-fabricated components among civil engineers and those related to construction discourages further the implementation of IBS system. Unlike steel structures, the subject of precast concrete design is normally not delivered to undergraduate students in many universities. As a result, many junior engineers are not really familiar with the precast concrete technology as compared to structural steelwork.

Knowledge in construction technology is equally important. There are cases, where building projects are awarded and constructed using IBS system but were carried out with many difficulties. The most common problems encountered are improper assembly of the components that normally involved the beam-to-column and column-to-base connections. These problems arise due to the fact that the parties involved in the construction underestimate the important of accuracy in setting out the alignment and levelling of the bases. Basically, accurate levelling and alignment of the bases are the two most important aspects for the successful rapid erection of precast concrete components.

Other related technical issues are lack of knowledge capability in designing the details of ties and connections of the pre-fabricated components particularly in precast concrete construction. Poor connection system may cause problem to site work such that the connections cannot be joined properly due to poor construction details (see Figure 3).



Figure 3 Poor connection system leads to issues of comfort and safety.

In the case of steelwork structures, there are many cases where buildings were designed to imitate the conventional reinforced concrete structural system. This concept results in exposed steel beams and columns. Eventually this invites many serviceability problems such as leakage (see Figure 4). Rain water can easily seep into the internal building through the joint between the wall and steel beam. Dampness leads to corrosion to the lighting system and the steel beam.



Figure 4 Steel beam should not be exposed to as in the case of concrete beam.

3.0 Successful Implementation of IBS Projects

With the advanced knowledge in computer aided design, IBS buildings can be designed and visualised analytically prior to the actual construction. The 3-dimensional drawings can be developed to provide accurate component dimensions and hence ensure buildability. Erection and construction procedures can also be simulated and properly planned with the use of computer softwares. Feasibility studies on the different building systems can be performed without incurring much cost. Problems during construction can also be observed and predicted. Any rectifications to the component design can be done before the manufacturing process. These computer tools contribute to a well-planned and systematic IBS system.

In relation to the advancement in computer-aided design, IBS buildings built in Malaysia in the 1990s have shown significant improvement in terms structural performance and architectural aspects. Some of these structures have become the showcases and even the icon of the country.

One good example is the Brickfields Secondary School 1. The school is located in a busy and limited access site. With such construction constraints and to expedite construction

period, a building system utilising about 75% of pre-fabricated components of precast concrete beams, columns, hollow core slabs and solid planks were adopted. The precast concrete skeletal framed IBS system is also widely used in many other projects. Figures 6 and 7 show the precast concrete buildings that were built using precast concrete components of beams, columns and slabs.



Figure 5 During and after construction of Brickfields Secondary School (I), Kuala Lumpur.



Figure 6 During and after construction of Jaya Jusco, Tebrau, Johor Bahru



(a). Subang Square, Subang Jaya



(b). Millennium Hall, Seberang Prai

Figure 7

Another successful examples of IBS systems using precast concrete load bearing wall system are Senawang Police Quarter (see Figure 8(a)), teachers' quarters in Kuala Kangsar (see Figure 8(b)) and government quarters in Putra Jaya (see Figure 8(c)). A total of 10,000

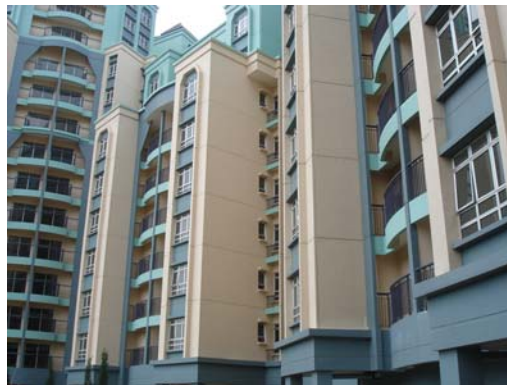
units of teachers' quarters were built throughout the country using the standard structural and architectural design.



(a). Police quarters, Senawang



(b) Teachers' quarters, Kuala Kangsar



(c). Government quarters, Putrajaya.



Figure 8

In the case of steel structures, there are also many successful IBS projects. Figure 9 shows the KLCC convention centre, an icon building in the prestigious Kuala Lumpur city centre. The building was built using a combination of prefabricated steel roof truss with composite steel deck flooring system.



Figure 9 During and after construction of KLCC Convention Centre.

4.0 Challenges in the IBS construction industry

It can be seen that contractors that have capability in providing total solution of IBS system carried out many successful projects. This reflects that proper design and planning considerations promise good IBS building systems. However, there are many challenges to achieve this target and the main ones are described in sections 4.1 to 4.5.

4.1 Designing a Feasible IBS System

IBS system if properly designed can deliver a more efficient construction process due to many advantages such as greater speed of construction, simpler construction process, reduced environmental impact and reduce reliance on traditional labours. Therefore the challenge is to provide a feasible and innovative IBS system that is acceptable to those involved with construction as well as the users.

In order to achieve a feasible IBS system, the aspect of standardization should be incorporated in designing the system. The standardisation can include the use of standard connections, standard beam and column sizes. Standardisation of components may be incorporated to reduce the cost of manufacturing. By implementing standardization, many errors in production or erection due to variability can be reduced. Standardisation may lead to improvement in quality, decrease variability and increase the ease of manufacturing.

In this case, the challenging aspect related to a feasible system is the manufacturing of the components. For example, the steel mould used to form beams and columns must have high degree of precision to produce accurate and consistent dimensions of width, breadth and length and other related dimensions. The mould should be of high quality with enough durability and strength and not easily becomes dented or buckled during compaction of the concrete. In the case of mechanical connections, the built in connection accessories to be cast in the concrete component, must be located precisely prior to concreting. Similarly any sleeves or opening in the component must be done accurately.

4.2 Investment on Heavy Equipment for Mechanized Construction System

The successful IBS construction system has some degree of dependency to heavy and special equipment such as cranes. The high initial cost in setting up the manufacturing plant as well as the cost of transportation has reduced the margin of profit. It has been noticed that despite all the advantages of adopting IBS, a significant portion of the construction industry players still has a biased perception on IBS system. It is admitted presently that switching to IBS would not guarantee significant savings in the cost especially with the small volume of buildings constructed. However, IBS has demonstrated that the savings in the construction time is able to compensate the higher construction cost incurred.

4.3 Awareness

In order for IBS system to be understood and used widely, the challenge is to create mechanism of awareness. Many contractors and even engineers are not well aware of the IBS system and not involved with the use of any IBS system in their construction methods. Therefore, in order to create awareness among practicing engineers and contractors, campaign to reassure that IBS systems are able to provide fast, economical and high quality products should be carried out. The awareness campaigns may include seminars and short courses. For example, CIDB in collaboration with universities, manufacturers and professional bodies have carried out extensive seminars and roadshow to give exposure to contractors and engineers about the IBS system. Also, hands-on trainings in specialised works such as operating cranes

and welding works are also conducted to provide specialised and trained workers in the IBS industry.

4.4 Knowledge

Specialized and additional engineering knowledge will be required to design, manufacture and construct a good IBS system. All parties involved from designers to erectors must have enough knowledge about the pre-fabricated component based construction. In terms of design, the engineers must have competent knowledge in analysis and design. In the construction field, the contractors and site engineers must have enough knowledge on the safe and accurate methods of erecting and assembling loose components into a global structure.

At university level, the students should be taught structural design principles, material technologies and construction practices related to IBS system such as precast concrete structures. Some local universities are currently improving their curriculum by adding new topics related to IBS in the existing syllabus. For example subjects related to precast concrete design and construction are also offered as elective for final undergraduate and graduate students. Apart from that, testing and research have to be conducted to prove feasibility of design. Knowledge gained from advanced research may elevate the level of understanding on the behaviour of IBS structure and consequently the level of confidence.

Engineers with good technical knowledge in analysis, design, manufacturing and construction have the ability to produce systematic IBS systems. If the components are skillfully designed, erection can be carried out efficiently. Furthermore, complying with good practices in design and construction leads to high quality precast concrete structures. In this aspect, the challenge is to produce many good and reliable manufacturers and erectors with such knowledge capabilities to be part of the IBS construction team.

4.5 Adoption of IBS System

The government through CIDB has embarked the IBS Roadmap 2003-2010 that outlines several well-thought strategies and aggressive steps to promote the use of IBS in Malaysia. To facilitate further, the government has encouraged the use of IBS for the construction of new government quarters. Contractors adopting the IBS system are given incentive such as levy exemption based on the percentage of IBS usage in a project. The government is taking the leading role in persuading the construction industry to adopt a more systematic approach and methodology in construction. The effort, started in 1998, is a strategic change in the construction industry.

If IBS is adopted, efficient, clean, safe and innovative are some of the new attributes that will be associated with the construction industry. With these outstanding features, plus attributes such as professionally managed and handled, workers with relevant skills, proper coordination and management as well quality will inevitably make IBS an excellent option for those involved in the industry to become global industry players in the international arena that demands high quality, efficient and professional services.

5.0 Conclusion

Survey on IBS system has been conducted through out Malaysia in 1996. The purpose of this survey is to gather information on IBS buildings in Malaysia. Besides that, a visual inspection study was also conducted to observe of any problems related to IBS system.

IBS features potential construction system for the future with emphasis on quality, higher productivity and less labour intensive. Besides the aim of gradually reducing the dependency on foreign labour and saving the country's loss in foreign exchange, IBS provides the

opportunity for the players in the construction industry to project a new image of the industry to be at par with other manufacturing-based industry such as the car and electronic industries.

The adoption of IBS promises to elevate every level of the construction industry to new heights and image of professionalism. Finally, IBS should be seen as the modern methods of construction where modern and systematic methods of design, production planning and mechanized methods of manufacturing and erection are applied.

6.0 Acknowledgement

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