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DEFECT IN THE INDUSTRIALISED BUILDING SYSTEM (IBS) BUILDING

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Abstract

The construction industry plays a major role in our country's economic growth. However, the industry is not without weaknesses. The challenges often occur in the area of productivity, efficiency, quality and the delivery of work. The intensive use of foreign unskilled workers, low technology equipment and out dated construction methods, have eventually caused low productivity and inefficiency of work at construction site. Industrialized Building System (IBS) is one of the improved building systems that is being introduced in the construction industry. The aim of this research is to determine the major type of building defects, causes and solution in the Industrialized Building System (IBS) building, although it carries many advantages. In many cases the multi storey buildings are not maintained properly, thus contributing further to poor image of Industrialized Building System (IBS) buildings. Given this situation, these buildings will require proper workmanship and materials to be used to rectify above problems. Therefore, this study will be carried out to investigate and identify the real defects which occurred and contaminated Industrialized Building System (IBS) system. The two case studies are to observe the real defect of this system. The interviews were also conducted by the researcher in order to identify the type and causes of defects that have occurred in Industrialized Building System (IBS) building. The findings researcher gets that the main problems of defect are caused by shoddy workmanship and poor supervision during construction show.

Keywords : Building Defect, Industrialized Building System (IBS), Construction

1. Introduction

The Malaysian construction sector now is too comfortable with conventional in-situ or “wet” construction. The practice employs large number of workers doing manual construction jobs. The availability of manual labours, especially the abundant of cheap workers coming from neighbouring countries, has sustained this type practice and making prefabrication or mechanisation in construction unpopular. Early efforts by the government to promote usage of prefabrication as an alternative to the conventional and labour intensive construction method have not been very successful. Failures of early “closed prefabricated systems” made the industry afraid their changing their method of construction. Some of the foreign systems that were introduced during the 1960s and 1970s in Malaysia were also found not to be suitable with our climate and social practices. Nevertheless, newer and better technologies were constantly being introduced in the Malaysian market.

A re-branding of the concept of prefabrication through the usage of the term, “Industrialised Building Systems (IBS)”, was then exercised by the government; in particular CIDB Malaysia. Differentiating it from the typical prefabricated system, and with better productivity, quality and safety, IBS has managed to create a better response from the industry. IBS goes far beyond than being just a modern method of offsite construction, as it also added the flexibility concept of Open Building through its standardisation of elements. The principles of Modular Coordination (MC), as stated by the Malaysian Standard MS 1064 are applied. The lego toys have similar concept where a few standardized shaped being used to produce unlimited designs.

Before the IBS system fully implemented in our construction industry, the main factor have to considered is the defect and deterioration can be avoided.

A building defect may be defined as an imperfection, deficiency or fault in a building element or component which adversely affects its functional performance or appearance (British Research Establishment, 1977). According to Qazweeni and Daoud's (1991) research on concrete defects in a 20-year-old office building concluded that chemical attack and poor workmanship caused defects and that laboratory testing yielded inaccurate results and thus could not be relied upon for predicting defects. They stated that chemistry could be used to predict concrete defects. Qazweeni and Daoud's research also suggested that many building defects are latent in nature and do not appear early in the construction stage.

Defects mean an imperfection that causes inadequacy or failure. Most of the buildings in Malaysia use building materials which are easily available locally. In the care, conservation, and maintenance of buildings, understanding the nature of the building materials and accurate diagnosis of defects is most important. This is because buildings are, like older people, vulnerable to all sorts of diseases. Therefore, in order to tackle the diseases, conservation architects, contractors, specialized engineers and those involved in building conservation should first become familiar with the building materials in common use. (A.Ghfar Ahmad, 2004).

The quality of the workmanship is another aspect that has been giving contractors a bad name. The Construction Industry Development Board (CIDB) is supposed to wrestle this issue by requiring all relevant laborers or those in a similar trade to undergo a skills training programmed conducted by the CIDB Academy.

Defects in new buildings or structures are so common that Malaysians do not bad an eye anymore, or one could say they are immune to news of these defects when highlighted. Now one might ask, how were these defective buildings/structures allowed to be occupied assuming that they have met the requirements of building by-laws and are certified fit for occupation. For one, lack of enforcement and supervision contributed to these defects. However, a good project management team acting on behalf of the client should be able to look after the interest of its clients by making sure the contractors do not compromise on the quality of the workmanship through its resident engineer. As far as maintenance is concerned, our industry is one step behind the developed countries where service life planning is carried out in accordance to ISO15686 during the design stage. Interestingly enough, Malaysia is a member of the drafting of the ISO through SIRIM. (Siti Hamisah Tapsir, 2007).

Traditionally, we are only concerned with the financial burden of getting the building erected and we are not made aware of the yearly maintenance cost, the operational cost and replacement cost. At times, the total cost of these three elements might surpass the construction cost. Insertion of life cycle assessment and costing during the design stage can save building owners from a lot of trouble and financial burden. Malaysians should learn from the defects in buildings/structures and include service life planning in the design process.

2. Literature Review

2.1 Industrialised Building System

Industrialised Building Systems (IBS) is systems which use industrial production techniques either in the production of components or assembly of the building or both (Parid Wardi, 1997; cited by CIDB, 2000). It is a system where buildings are reduced to a number of common constituent parts, where most of it can be prefabricated or manufactured in long term productions runs, frequently away from the construction site.

According to Badir-Razali building system classification (Badir et al. 1998), IBS is a construction process that utilises techniques, products, components, or building systems which involve prefabricated components and on-site installation. From the structural classification, there are five IBS main groups identified as being used in this country, and these are:

i. Pre-cast Concrete Framing, Panel and Box Systems

Pre-cast columns, beams, slabs, 3-D components (balconies, staircases, toilets, lift chambers), permanent concrete formwork, etc;

ii. Steel Formwork Systems

Tunnel forms, beams and columns moulding forms, permanent steel formworks (metal decks), etc;

iii. Steel Framing Systems

Steel beams and columns, portal frames, roof trusses, etc;

iv. Prefabricated Timber Framing Systems

Timber frames, roof trusses, etc;

v. *Block Work Systems*

Interlocking concrete masonry units (CMU), lightweight concrete blocks, etc.

The use of IBS assures valuable advantages such as the reduction of unskilled workers, less wastage, less volume of building materials, increased environmental and construction site cleanliness and better quality control, among others. These advantages also promote a safer and more organised construction site, and reduces the completion time of construction. Many world-class Malaysian developers have chosen IBS over the conventional methods for important projects such as the Petronas Twin Towers, Putrajaya, KL Sentral and KLIA.

2.2 *Building Defect*

British Research Establishment, 1977 said that, building defect may be defined as an imperfection, deficiency or fault in a building element or component which adversely affects its functional performance or appearance. The recent research, conducted by the Building Research Establishment (BRE) Advisory Service and based on its database of building defects, identified the seven main types of defect (Fig. 1.0). This is based on Construction Quality Forum (CQF), which operates a defects database.

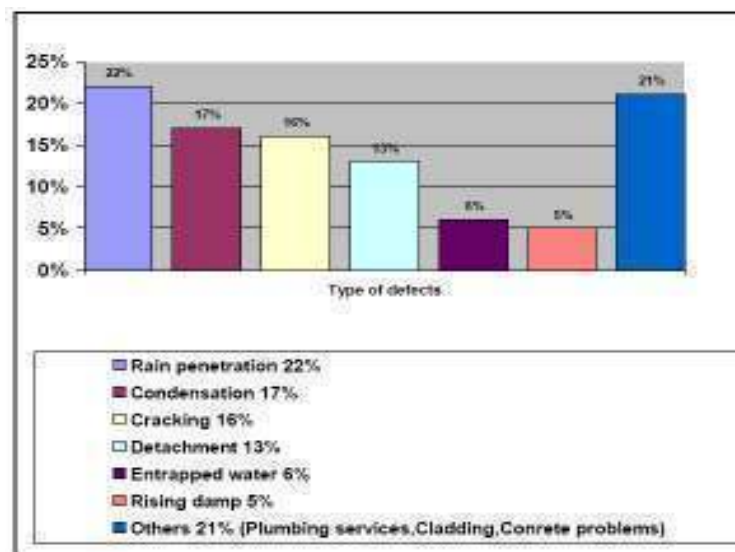


Figure 1.0 Types of Building Defect
Sources : Building Research Establishment (BRE) Advisory Service

There are various type of defect happened in the building. There are dampness, cracking, detachment or peeling, leakage in plumbing services and concrete problems. The major problems or causes that usually occurred have been identified. Based on this study, the problems or causes of defects occurs in building of Malaysia are leakage, rising damp, rain penetration, condensation, movement and biological agents. The high humidifies increase the risks of corrosion and damage to textiles. Further, the same problems on defects consistently recur in similar structures under similar conditions of exposure, which suggests that the defects might be the result of an inadvertent but repeated use of unsuitable details/ or practices in designed and constructions. Each defect occurs in several forms, each form having a different significance. As a result, some of the solutions have been determined such as damp proofing treatments. Therefore, defects can at least be reducing, so there is much can be done to counter the defects and avoided it for the future building. Thus, adequate supervision on the works that contractors do to minimize the faults and defects should be done.

3. **Discussion**

For the purpose this study, the author had assessed two numbers of IBS building had been selected in Malaysian Peninsular as a case study in order to achieve the study. The case studies are 3-4 Storey Dahlia 2 Hostel Building at Universiti Teknologi Mara, Perak and Kristal A Hostel Building at Universiti Teknologi Mara, Pulau Pinang. The comparison of the types of defect for each building and come out with solutions to get better result and quality in future implementation. Comparative study and analysis on the both case study also discussed. Based on the methodology that had been chosen, the result of the analysis revealed the following:



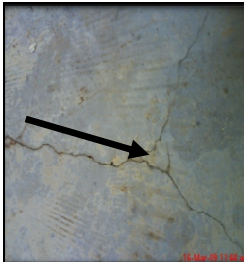

1. The first objective is to determine what the IBS and types implemented in Malaysian construction industry. IBS can be defined as a system in which concrete components, prefabricated at site or in factory are assembled to form the structure with minimum in-situ construction. There are several types of IBS implemented such as precast concrete framing, slab and wall panel system, steel framing, steel formwork, ‘fuvy’ formwork, prefabricated timber framing and blockwork system. The IBS was implemented at Malaysia in 1966 with two project which Pikeliling Flat at Kuala Lumpur and Rifle Range Road Flats at Penang. Nowadays, the government targeted 70% of construction in each project at Malaysia will used the IBS system.

2. The second objective of this study is to overview types of building defects. The severity of a building defect and the associated levels of damage, deterioration or decay currently present or expected to affect the building and its occupant are similarly related to the perceptions and expectations of the owner and occupier. The defect, or the action required to reduce or remove its effect on the building, will typically be ranked according to a pre-determined set of priorities for repair, maintenance or other works to improve either performance or capability.

3. Two (2) case studies to be analyze which are Dahlia 2 Hostel UiTM Perak and Kristal A Hostel Building at Universiti Teknologi Mara Pulau Pinang. The types of defects and probable causes occurred in which are leakage, dampness, cracking and peeling, detachment, concrete problems in walls and others. Due to the age of building, problem in roof that makes heavy rain slips into jointing and cause the wall and floor in dampness. Dampness due to condensation creates stainness, it is cause by inappropriate ventilation. Factors that cause cracking in building are when building components are restrained, their strength is often exceeded by stresses arising from movement in the materials, and cracking results.

3.1 Comparative Study And Analysis Between Case Study 1 And Case Study 2

Table 1.0 : Types of defects

No.	Types Of Defects	Case Study 1 (Dahlia 2 Hostel At Uitm Perak)	Case Study 2 (Kristal A Hostel At Uitm P.Pinang)
1.	Decay and dampness at ceiling panel		
2.	Cracking at floor slab		





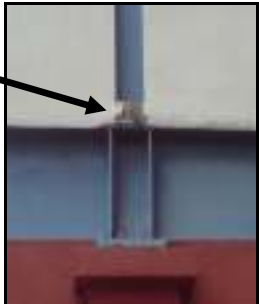
3.	Fungus and dampness at concrete staircase and wall		
4.	Peeling and cracking of wall plaster		
5.	Concrete Stain/Wastage		NIL

Table 2.0 : Analysis on types of defects

No.	Types Of Defects	Case Study 1 (Dahlia 2 Hostel At Uitm Perak)	Case Study 2 (Kristal A Hostel At Uitm P.Pinang)
1.	<u>Decay and dampness</u> i. Due to rain penetration ii. Due to condensation	/ /	/ x
2.	<u>Cracking</u> i. In wall ii. In floor slab	x /	/ /
3.	<u>Fungus and dampness</u> i. Due to rain penetration ii. Due to condensation	/ x	/ /
4.	<u>Peeling off</u> i. Wall finishes ii. Floor finishes	/ x	x /

5.	Concrete Stain/Wastage	/	x
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Based on Table 2.0, it shows that decay, dampness, cracking, fungus, peeling of finishes and concrete stain are the major factor that cause defect in the analysed building. For Dahlia 2 hostel building cracking happened in floors of the building. Cracks occur either between or within components. Factors that cause cracking in building are when building components are restrained, their strength are often exceeded by stresses arising from movement in the materials, and cracking results. Besides that, due to the age of building, problem at the roof makes heavy rain slips into jointing and cause the wall and floor in dampness. Dampness due to condensation creates stain in ceiling and wall finishes. It is also caused by inappropriate heating and ventilation too.

While Kristal A hostel building defects also happened when cracking at brickwall or jointing component at floor slab. The main problem is the dampness on ceiling panel due to failure of water proofing membrane and roof covering. This problem happened due to poor workmanship and supervision during construction stage. Detachment of material used in building such as peeling off floor tiles. It's happened almost in the Kristal A Hostel. It's also caused by shoddy workmanship and supervision.

3.2 Solution

Table 3.0 : Analysis on solution of defects

NO.	TYPES OF DEFECTS	SOLUTION	
		CASE STUDY 1 (DAHLIA 2 HOSTEL AT UiTM PERAK)	CASE STUDY 2 (KRISTAL A HOSTEL AT UiTM P.PINANG)
1.	<u>Decay and dampness</u> i. Due to rain penetration ii. Due to condensation	Repair the leakage and provide damp- proof course treatment for rain penetration and dry lining for dampness due to condensation	
2.	<u>Cracking</u> i. In wall ii. In floor slab	Hacking and resurface the floor with cement render	Hacking and resurface the soffit of floor with skim coat
3.	<u>Fungus and dampness</u> i. Due to rain penetration ii. Due to condensation	Repair the leakage and connection at roof covering. Replace with new ceiling sheet	
4.	<u>Peeling off</u> i. Wall finishes ii. Floor finishes	Replaster the wall and repaint	Replace new floor tiles and fix with strong cement screed
5.	Concrete Stain/Wastage	Remove the concrete stain and clean the existing surface	-

Table 3.0, show the solutions taken by maintenance department of the case studies in preventing and remedy the defects. It can be summarize that dampness due to rain penetration and condensation can be prevent by applying treatment on damp proof course or dry lining. For cracking it happened at Dahlia 2 and Kristal A hostel. The method of remedy by hacking back the affected area and resurface with new cement render and skim coat respectively.

For peeling off or detachment, it can be seen that material used for floor finishes in Kristal A hostel which is floor tiles can be replaced by replacing it with the new ones and strong cement screed. Stainness can be repair by hacking the area affected and repainting the wall to give a good appearance.

4. Conclusion

From the comparative table shown above, it can be conclude the building defect has less occur for teacher's quarters building. It's no cracking defect detected during the condition and dilapidation survey conducted. The defects for such element caused the failure of water proofing due to shoddy workmanship and lack of supervision by the design consultant. There are also no concrete stain happened in the quarters. Many defects occurred in the IBS buildings can

be minimized if the responsible party to the building and person in the construction industry and has taken much attention about the problems. It is worth considering what can be done to minimized and avoids the defects to the IBS System. There are:

1. Clear expectations of each person roles and responsibilities, which each of the parties know their own responsibility will reduce the occurrence of building defects in IBS System.
2. Moreover, to reduce and circumvent the defective work in IBS towards the satisfaction of the occupants to the IBS buildings are the important thing which is the periodical maintenance to the IBS buildings. The practices to reduce and circumvent the defective work should be implemented so that the defects to the buildings can be minimized.
3. The requirements to improve the buildings delivery system in IBS buildings for example good site supervision and control during the installation and construction stage, competent workers and supervisions team during the periodical maintenance should be implemented to reduce the occurrence of buildings defects in IBS System.
4. Specialized and additional engineering knowledge in construction industry, mostly regarding to the IBS System is equally important. The technical team, design team and manufacture should power their knowledge in the IBS System to construct a good IBS system and avoid the failure to the system during the installation stage.
5. Correct diagnosis in every types of defects should be done by specialist contractor whether a satisfactory repair is possible, or, in extreme cases, economically worthwhile.
6. To improve performance or capability of maintenance staff, the defect with action to be taken should be ranked according to a pre-determined set of priorities for repair especially in emergency, major and minor maintenance works.
7. Preventive maintenance programme should meet the criteria which are cost effective, meet statutory or other legal requirements, meets a client need from an operating point of view, reduce the incidence of running maintenance necessitating requisitions for work from the user to achieve the value of maintenance and justification.

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