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MANAGING FACTORS INFLUENCE DEFECTS ON INDUSTRIALIZED BUILDING SYSTEM (IBS) COMPONENTS TOWARDS SUSTAINABILITY CONSTRUCTION

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Abstract:
Industrialized Building System (IBS) is a one of the popular construction systems in Malaysia. It is a method of construction which involves prefabricated components and on-site installation of manufactured construction products using a specialized technique to create components or building systems. The aim of this study was to reduce defects on IBS components as well as to achieve a successful project. To achieve for the above aim, the following objectives have been identified which were to identify the factors that may lead defects on IBS components and to propose recommendations in order to reduce defects on the building components. For the first objective, an extensive literature review was conducted in a way to find most common factors which influence defects on IBS components among the scholars, while for the second objective all the data gathered from first phase interview were analyzed. The purpose of the objectives was to understand the factors influencing or the barrier which affect the occurrences of defects on building components. To make this research a success, there were four stages which were, the literature review, two methods of data collection where by data collection method through interview sessions as to validate a parameter and followed by second phase of data collection which was questionnaire survey, result, analysis and findings and lastly the conclusion and recommendation. For this paper, only the first phase of data collection method was discussed. The findings obtained showed that there are about five factors that influence defects on IBS components. The findings of this study help the manufacturers or contractors in industry to avoid defects on IBS components in achieving sustainability agenda in construction as outlined by Construction Industry Transformation Programme (CITP) 2016 as well asby Construction Industry Development Board (CIDB).

Keywords*:* Industrialised Building System (IBS); Factors Influence; Defects; Sustainability Construction

1.0 INTRODUCTION

The construction industry has started to embrace industrialized Building System (IBS) as a method of attaining better construction quality and productivity, reducing risks related to occupational safety and health, alleviating issues for skilled workers, dependency on manual foreign labours, and achieving the ultimate goal. It offers minimal wastage, fewer site materials, a cleaner and neater environment, controlled quality and lower total construction costs (Pan et al. 2008, Hamid et al. 2008 and Pan et al. 2007).

IBS is the way forward for the industry stakeholders to make leaps and bounds progress in the Malaysian construction industry. *Malaysian* Industrial Development Finance Berhad Research (MIDF) stated that IBS in Malaysia started in 1963.The Malaysian government nonetheless sees IBS as the new way forward in the construction industry. The IBS Strategic Plan was launched in 1999, while the IBS Roadmap was introduced in 2003. The government has mandated that government projects will carry 70% IBS content. Currently, the local IBS manufacturers are mushrooming, which enable the new generation of building to utilize IBS better.

2.0 PROBLEM STATEMENT

According to Kiong and Akasah (2013), without proper planning of design, manufacturing and construction defects may occur before, in construct or after the building was built. Crack is a common problem at all buildings. This is because constructors do not use proper material to connect two panels and do not follow a proper instruction. Even still in construction, crack might happen. Rahman and Omar (2016) said there are many low cost houses that were not maintained properly and this gave the negative impression and poor image to construction comapanies.

Furthermore, the contractor do not have sufficient knowledge about the quality of IBS which is far better than the conventional method. According to Kiong and Akasah (2012), the public have bad impression about the precast concrete due to the poor architectural design for the old pre-fabricated buildings such as Pekeliling Flats in Kuala Lumpur and Taman Tun Sardon, Penang. The lack of design such as the need for wet toilets and bathrooms lead to problems of leakage. Other than that, many low cost housing were not maintained properly and this gave the negative impression and poor image to the precast concrete buildings (Rahman and Omar, 2006).

3.0 LITERATURE REVIEW

Industrialized Building System (IBS) is one of the popular construction systems in Malaysia. It is a method of construction which involves prefabricated components and on-site installation of manufactured construction products using a specialized technique to create components or building systems. Industrialized Building System (IBS) is a new method of constructing building in the construction industry as a solution to improve construction image and performance (Yahya & Shafiei, 2012). In Malaysia IBS started with the establishment of the Ministry of Local Government and Housing in 1964 which is needed to provide low cost houses.

3.1 Overview of Industrialized Building System (IBS)

In 1966 and 1967 the first two constructed projects using IBS methods are in Jalan Pekeliling, Kuala Lumpur and Jalan Padang Tembak, Pulau Pinang. The Construction Industry Development Board (CIDB) has classified the IBS into six categories which are precast concrete, panel and box system, steel formwork system, steel framed buildings, roof trusses, block work systems and innovation system.

3.2 Overview of Defects on IBS Component

According to David (2007), defects may be considered to be a failing or shortcoming in the function, performance, statutory or user requirements of the building and might manifest itself within the structure, fabric, services or other facilities of affected building. A defect is generally described as deterioration, damages, default or deficiency (Olanrewaju & Abdul Aziz, 2015). As mentioned by Ahmad (2004) there are usually various causes and types of defects that affect the performance of a building. In Malaysia, high-rise buildings less than 10 years old would have structural defects that can cause danger to the residents and also to the public (Anthony, 2013). In fact, all new buildings have problems in defects.

3.3 Overview Factor Influence of Defects on IBS Components

According to Ahzahar et al (2011) failures and defects are common phenomena in construction industry. They are also generating controversies among parties involved. As a result, if this situation is left unanswered and untreated, it will lead to more serious problems in the future upcoming construction projects in Malaysia.

3.3.1 Lack of Maintenance

Ismail et al. (2015) state the implementation of a maintenance management system faced many issues due to defect repetition and lack of proper structure management planning.

3.3.2 Lack of Design

As aptly put by Kiong and Akasah (2013) the lack of knowledge in design for building could lead to safety issues. Without a proper method of design, negative impact on the precast building would be generated.

3.3.3 Poor Workmanship

Ahzahar et al. (2011) asserts normally workmanship problems are due to faulty of contractor. Poor workmanship is known as one of the main factors that lead to the building defects.

3.3.4 Procedure for Quality Control

Kiong and Akasah (2013) state it is important to ensure that the component is in good quality and will not lead to building maintenance issues after the building had successfully constructed.

3.3.5 Lack of Knowledge

Most of the available skill workers are still lack of appropriate technical skills and knowledge (Pan et al., 2004). It is difficult to attract new workers and train them with new IBS skills (Pan et al., 2004; Pan et al., 2007b)

3.3.6 Poor Project Planning

Poor project planning will reduce the contractor productivity and slow down the construction process .

3.3.7 Climatic

Weather related defects were caused by heat and ultraviolet rays, moisture from the rain, humidity in the air and wind load. Frequent expansion and contraction increase stress in material and without a proper defense system such may crack building.

3.3.8 Life Cycle of Building

Hrvoje and Sasa (2012) mentioned that costs of replacement and repairs are costs of activities that are undertaken to take into account changes to particular elements, materials and structures.

3.3.9 Human Activity and Vandalism

Softer building materials often invite vandalism. Wood, gypsum board and etc are common targets as scratches, crack and hole were found in these materials.

Table 1 below shows the summary of factors influencing defects on IBS components. There are 5 five main factors considered with regards to highest rating which is lack of knowledge, lack of maintenance, poor workmanship, poor project planning and lack of design.

Table 1: Summary of Factors Influence Defects on IBS Component

NO	AUTHOR	Lack of maintenance	Lack of design	Poor workmanship	Procedure quality control	Lack knowledge	Poor planning	Climate	Life cycle	Human activity & vandalism
1	Lewis (2000)	/								
2	Nasrun et al. (2014)	/								
3	Mat Deris (2007)	/								
4	Basiran (2002)	/								
5	Zul (2015)	/								
6	Rahman (2016)	/								
7	Ng et al. (2012)	/								
8	Nuzaihan, Naziah & Nurul (2016)		/							
9	Kiong and Akasah (2013)		/		/	/				
10	Lou & Kamar (2012)		/							
11	Ali and Wen (2011)			/						
12	Ahzahar (2011)			/						
13	Trent C. (2017)			/						
14	Wai K. & Sui P. (2005)			/						
15	N.A. Othman & M.A. Othuman (2010)			/						
16	Onyeizu et al. (2011)			/						
17	Ahzahar (2011)		/							
18	Pan et al. (2012)			/						
19	Chen et al. (2010)					/				
20	Hamid et al., (2007)					/				
21	Rahman & Omar (2006)					/				
22	Pan et al., (2004)					/				
23	Blismas & Wakefield (2009)					/				
24	Pan et al., (2007)					/				
25	IBS Workshop (2011)					/				
26	Room et. al., (2009)					/				
27	Hashim (2009)					/				
28	Hassim et al., (2009)						/			
29	Najuwa et al., (2016)						/			
30	Kamar et al. (2010)						/			
31	Pan et al., (2008)						/			
32	Ibrahim, H. et al., (2012)						/			
33	Rahman &Omar (2006)						/			
34	Dai et al. (2009)							/		
35	Faisal et al. (2006)							/		
36	Hrvoje and Sasa (2012)								/	
37	Koing and Sui (2006)							/		/
Total Arguement		**7**	**4**	**7**	**1**	**10**	**6**	**3**	**1**	**1**

Table 2: Structured Interview Question in Section B

CRITICAL FACTORS INFLUENCE DEFECTS ON IBS COMPONENTS	
Factor 1	**Lack of Knowledge**
a.	Does your organization agree that workers should have more intensive training programs? For example, integrating or assembling system.
b.	Do you think that poor technical knowledge may create a negative impact for the building quality? For example, not follow and used suitable material that have been given by manufacturer.
c.	Does your organization agree that workers should know about Building Information Modeling (BIM) application?
Factor 2	**Lack of Maintenance**
a.	Regarding on defects example, there are lots of problem in maintenance which do affect the building quality and operation. Does your organization agree with this?
b.	Does your organization agree that many projects are not maintained properly and this gives more negative impression and poor image to the IBS buildings?
c.	Does your organization agree that inspection work should be done during Defect Liability Period (DLP) for all buildings to be safe to occupy?
Factor 3	**Poor Workmanship**
a.	Does your organization agree that most defects in construction projects because of poor workmanship? For example, it does not follow the drawing or instruction that been given.
b.	Workmanship was classified as one of the most frequent non-conformance on construction site because improper monitoring by skilled labours. Do you agree?
c.	Does your organization agree to give an appropriate training to the workers to enlarging their experience also to get a good and quality project?
Factor 4	**Poor Project Planning**
a.	Poor planning will reduce the contractor productivity and slow down the construction process. For example, it does not follow the Critical Path Method (CPM).
b.	Does your organization agree that project have many mistakes because of poor planning? For example, rushing to finish the project because lack of time.
c.	Does your organization agree that failing to plan can lead unpredicted high risks and problems to the project? For example, not be completed on time.
Factor 5	**Lack of Design**
a.	Does your organization agree that IBS projects have many mistakes compared to conventional? For example, during services installation, air-conditioner and wiring.
b.	Does your organization agree that variation orders from client can affect the future works to become difficult and the defects can appear easily?
c.	Does your organization agree that Building Information Modeling (BIM) is a good application to check collision between IBS components?

4.0 METHODOLOGY

This stage is a first stage which involves desktop sourcing to find out some literature review as evidence to the research study conducted among scholars. It referred to some researchers that relate with this case study. On the second stage it consists of the issue and focused area of the research. The problems were related to the objectives of the study. The qualitative data collection is combined in Stage 2 as first phase of data collection method. Next in the third stage, it focused on the distribution of questionnaire as a quantitative data collection method. However, the development of conceptual frameworks and hypothesis making should be done first to ensure that all the variables gained from first phase data collection is positive. The quantitative data collection in Stage 3 is considered as second phase of data collection method. The fourth stage was conducted after completing the research hypothesis and distribution of the survey questionnaire forms. This stage provide results and analysis of data gathered from the study and feedback by the respondent. The aim and objectives of this study can be achieved with the results and analysis through the investigation made on the study in Stage 2 and Stage 3.

5.0 ANALYSIS AND FINDINGS

The results and analysis for this research were collected through a few methods which was interview session as first phase data collection and distribution of questionnaire survey forms at the second phase of data collection. The critical factors that were obtained from the justification of this research are as the main factors which are lack of knowledge, lack of maintenance, poor workmanship, poor project planning and lack of design. Each of the main factors has their own sub factors. The structured interview questions consist of two (2) sections of data collection which are Section A and Section B. Both of the respondents were asked the very same question. For Section A, the respondent were asked about their demographic profile and then followed by the question from Section B about the several critical factors that influence defects on Industrialised Building System (IBS) components based on their experience on that particular area.

The result of the structured interview question on identification factors that may lead defects on Industrialized Building System (IBS) building by the Respondent 1 (R1) and Respondent 2 (R2) are marked as in the Table 3.

Table 3: Structured Interview Analysis

RESPONDENT	Factor 1			Factor 2			Factor 3			Factor 4			Factor 5		
Respondent 1	√	√	√	√	X	√	√	√	√	√	√	√	√	√	X
Respondent 2	√	√	√	√	X	√	√	√	√	√	X	√	X	√	X

Based on the data gathered from first phase interview session, it shows that all the information gathered among the scholars in literature review process is relevant in the industry. However, there are several questions which are not relevant where factor 2b, both of the respondents agreed that IBS project which was not maintained properly will bring negative impact to the building. Other than that, factor 5c also were disagreed by the respondents where there is no relation of BIM application as to check with the IBS components collision.

5.0 CONCLUSION

In order to achieve first objective, there are two different manufacturers selected that have to identify main factors that influence defects on IBS components. There are five (5) main factors that influence defects on IBS components which are lack of knowledge, lack of maintenance, poor workmanship, poor project planning and lack of design that involve in the questions. In this study, the pattern of repeating ideas was demonstrated based on the frequency of each issues highlighted by the interviewees. Based on the result from the structured interview question, there are several sub factors that contributes as additional data collections. It can help to achieve the aim of the study which is reducing defects on IBS components. Lastly, Industrialised Building System (IBS) is one of the popular construction systems in Malaysia. There are many advantages when using IBS components which are faster, can reduce wastage etc. Thus, the findings of this study will help the manufacturers or contractors in industry to avoid defects on IBS components for the future.

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