

## COST COMPARISON ON INDUSTRIALIZED BUILDING SYSTEM (IBS) AND CONVENTIONAL METHOD FOR SCHOOL CONSTRUCTION PROJECT

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**Abstract:-** Industrialized Building System (IBS) can be defined as one of construction method that can upgrade the quality and productivity of the construction by using better or less machineries, equipment, materials, and extensive project planning. IBS can be classified into many types, depending on each country. Five types of IBS that were commonly used in India for structural elements such as wall, roof truss, beam, column, and slab are precast concrete system, reusable formwork system, steel framing systems, prefabricated timber framing systems, and block work systems. One of the barrier for IBS implementation in India that are currently facing by most of construction industry players is the negative thought of implementing IBS is not cost effective compared to conventional method. Hence, the study which focused on school construction project was done to determine the cost comparison based on technical data collection and analysis between IBS which using half slab with conventional method for slab structure and also to determine the perception from the industrial players on IBS and conventional method through questionnaire surveys. From the results obtained, the difference (in percentage) for both construction methods which also can be said as the percentage of reduction in cost for the calculated floor slab is 11.9%. This shows that IBS offers a good reduction in cost compared to conventional system.

**Index Terms:-** IBS, FRAMING SYSTEMS

### I. INTRODUCTION

Construction sector in India is one of important and productive sector. As a developing country, this sector plays a major role for the economic growth and also to upgrade the quality of life and living standard of Indian (Khan, 2014). In year 2006, the expenditure due to the funding of building construction and improvements of

infrastructure such as schools, hospitals, and government living quarters by the Federal Government was RM35.8 billion compared to year 2007 which was RM 40.6 billion (CIDB, 2008). The increasing of the expenditure was partly due to increasing price of the building construction materials. As the Indian construction sector keep on expanding, it is going through a transitional change to a more systematic and mechanized system, prefabrication technology and upgrading the skills of workers compared to conventional technologies as a trend towards the global competition (Haron, 2005; Chan, 2011). Rahim et al. (2013) explained four major parts of construction methods that usually were used in the construction industry which are conventional method, full fabrication method, cast in-situ method (formwork system), and composite construction method

### IBS in India

In India, prefabricated construction has started almost 40 years ago but there was no proper plan formulated by the Government for the industrialization of construction until the inception of the IBS Roadmap 2003-2010 by CIDB (2003).

As to remain competitive in the era of globalization of construction sector and to align the construction technology development with the IBS Roadmap, government has promoted the usage of IBS in the local industry with the collaboration of CIDB as the scenario for the local construction industry during that time is low in quality and productivity (Rahman, 2006).

IBS was first implemented in India in early 1980's when Ministry of Housing and Local Government of India visited several European countries and evaluated their housing development program (Thanoon et al., 2003). After their

successful visit in 1984, the Federal government built some pilot projects using the IBS such as 3,009 units of flat in Bangalore, Karnataka in 1986 comprising seven blocks of 17 stories flat, and 3000 units of low-cost flat and 40 shops lot and 3,741 units of flat. The project at Bangalore was awarded to Gammon and Larsen Nielsen using Danish System of large panel of prefabricated system. The project only took 27 months to complete, which was from 1986 to 1988 including the time taken in the construction of the RM 2.5 million casting yard at Jalan Damansara (CIDB, 2006; CIDB, 2003; Thanoon et al., 2003).

### **COLLABORATIONS AT THE DESIGN STAGES**

Without having to quote the statistics, it is quite evident that concrete is the material of choice for building construction works in this country by a significant margin. As such, when industrialised building systems are discussed in the industry, the comparison is always between the conventional cast in-situ concrete construction and the off-site factory casting of precast concrete construction. Fully aware that IBS covers more than just deploying the concepts of precast construction in the building works, the approach of this paper is to follow the local trend and to limit the discussion on the issues of IBS implementation to those related to concrete structures. The intention of this approach is to stay as relevant as possible to the local construction environment and hopefully by so doing, able to exert the full impact through the publication of this paper.

### **II. LITERATURE REVIEW**

The concept of mass production of quality building is termed as Industrialized building system (IBS)". Among the benefits of using IBS are: speed, quality and economics, all of which are required so as to meet the large demand for housing. In order to develop techniques for mass produced houses, India needs to access itself to the world's most modern building system, building materials and housing products (Waleed et al., 2003). The IBS, which enables on-site prefabricated or pre-cast building components manufactured at factories, will enable cost saving and quality improvement through the reduction of labour intensity and construction standardization. Apart from this, it offers minimal wastage, less site materials, cleaner and neater environment, controlled quality, and lower total construction cost (CIDB, 2003).

One fact which seems to have the common consensus of all the stakeholders of IBS in India is that, the implementation of IBS in Indian building construction industry is still very low compared to the conventional methods. It is most intriguing to find out why: which set the author to this paper.

The purpose of this paper is to conduct a critical review on the IBS implementation in construction industry as a whole. The review focused on the advantages and barriers factors on the IBS implementation.

### **III. METHODOLOGY**

#### **Survey**

In the survey data collection, questionnaire has been used and structured questionnaire survey has been distributed out to the construction industry players and researcher, who have been involved in IBS projects to investigate their knowledge and perception towards IBS.

To make the survey can be easily reached by the respondents; the survey was also conducted online. The link of the questionnaire survey was shared through email and other electronic devices application. Some of the survey was mailed to the Public Work Department in Putrajaya via hardcopy.

From the survey data collection, all the data were presented in the table form or graph form to have more understanding and the relationship of each questions such as respondent's opinion, number of project involved using IBS and awareness of advantages on using IBS can be easily observed.

#### **Technical data**

To have more understanding on the construction costs which uses IBS method, the evaluation of the existing school data had been carried out.

The technical data such as bill of quantities, construction drawing, and the work programme of the selected school projects has been collected and evaluated as these technical data had provided the necessary information on the school building information.

For the construction of the slab by using IBS material which is half slab, few elements were considered in the calculation

of the cost per area or per volume of the slab which are:

1. Concrete for topping
2. Half slab panel
3. Formwork for topping
4. Fabricated reinforcement bar/ BRC
5. Grouting

As for the conventional method, only three elements are taking into the calculation of the cost construction which are:

1. Slab concrete
2. Reinforcement bar
3. Formwork

The elements chose for both construction methods are based on construction of slab structure scope of work. This is to ensure that the comparison was made based on "apple to apple comparison" and not with other works or materials which was not in the similar scope.

#### **IV. RESEARCH METHODOLOGY**

This paper is a preliminary study to a PhD research on IBS implementation among the contractors. This paper has been divided into four parts. The first part deals reviews and analyse the current state of IBS implementation including the barriers, push and pull factors and enabling factors which affected IBS implementation. The second part investigates literatures conserving the CSFs for contractors to embrace into IBS construction. The third part is report on pilot study to validate CSFs and the final part is discussion and conclusion derives from evidence commencing both the literature reviews and the pilot study. First, the paper use literature review to investigate existing evidences conserving CSFs in IBS implementation.

Then, the paper applies unstructured interview and open discussion within the pre-determined context to validate the CSFs.

The qualitative method permits informal setting that natural reflects the reality of what happen in the real setting. This approach also allows the researcher and the participants to probe each argument in details and obtain rich and more

complex data in term of tacit knowledge, perception and human experience in which cannot be measured in quantitative approach. The authors imposed a careful selection process of the participants which has need a compulsory high degree of knowledge and direct practice in the area of IBS to construct some validity and robustness of the method. The authors also appointed an experience moderator to lead the discussion and to avoid any 'leading question' which can influence the data validity. In addition, the authors have ensured that the participants are aware of the aims, objectives and methodology of the study.

Though the paper make some action to establish validity and reliability in constructivism setting, caution must be applied as the findings might not be representing the whole scenario construction industry thus more data collection need to done. Therefore, the result is inconclusive but rather a call for debate and obtains more feedback from the audience. Further data collection is required to determine exactly how CSFs effect the transformation of IBS contractors.

#### **Survey**

This section gather all information related to the analysis and relationship from the respondents by the questionnaire which related to the perspective of IBS and conventional method. There were 110 of respondents answered the questionnaire surveys. From the survey by questionnaire, position of the respondents was divided into several parts which are Engineer, Architect, IBS Researcher, Project Manager and BS Manufacturer. It was found that 64% of the respondents are Engineers, 14% are the developers, 9% from IBS researchers followed with 5% from manufacturers while 4% from project managers and quantity surveyor

#### **V. CONCLUSION**

Despite all the obstacles and barriers that was faced by the construction industry players as well as the government bodies to ensure the implementation of IBS in India run smoothly and successfully, India still standing bravely to chase the continuously innovates the construction industry with this new modern method of constructions. The challenges arise has slowly been overcomes by the construction industry players to achieve a high quality standardization of IBS in India and fully utilizing the IBS system in all the construction projects following the IBS Roadmap 2011 - 2015 missions. In addition, based on the

survey made by CIDB from May 2008 until October 2010, it has reportedly stated the positive impacts and the effectiveness of IBS implementation in government projects. Based on the cost evaluation made, it can be concluded that IBS has shown the advantages in the cost reduction on slab structure of the school construction project. The costs calculated were based on the construction of ground floor slab which is conventional method and the first floor slab which used half slab (IBS method) to complete the construction. The cost difference is 11.9% of reduction on IBS method compared to conventional method. As stated in the earlier chapter, IBS has offer the reduction of unskilled workers, especially foreign workers on the construction site. Since conventional method has depended intensely on the usage of general workers, IBS has been introduced in India to overcome the dependency of foreign workers in the construction industry. Therefore, this study can be a starting point for any researchers to investigate more on the advantages of IBS compare to conventional method which then can be used as a benchmark for construction industry players to realize and widely use IBS as their construction method. Based on the literature review, there are nine (9) potential success factors and eight (8) barriers that had been found for the success of IBS implementation in India. With these factors identified the author attempted to weigh the benefits of IBS and the reasons for not fully realizing the benefits in the Indian IBS context. This brings the author to conclude that there is insufficient research work being done to highlight the benefits and the reasons for IBS lack of implementation in Indian construction industry.

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