Industrialized Building System (IBS) As a Green Construction Method in India as Compare to Conventional Construction Method Case Study InNashik.

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Abstract: *This study is conducted to the Comparison between the two construction methods. It is carried out through case two studies in nashik on construction sites, distribution of a total 35 interviewing respondents those are related to this construction methods. The case studies for this research were carried out at nashik construction sites on MAHADA construction project. In This city Two case studies used Industrialized Building System method (IBS) And conventional construction method like a traditional method of construction. According to the questioner survey the result is obtained by, it can be surmised that the Industrialized Building System is a more to advantages as compare conventional construction methods. According these advantages are (IBS) required minimum time for construction, overall cost is minimum, labour requirements is less, good site conditions and the highly production component of the building as compared to conventional methods. This study also calculates to the survey of minimum wastage of material and also less environmental impact and also its sustainable Construction and management. A scoring is calculated to compare advantages and disadvantages of IBS through average index method. Conclusion is found that IBS method is more sustainable than CBS method. IBS method used for this project found more reliable, time & cost saving and flexible for management.*

Index Terms -Comparison of IBS and CBS Building system.

Introduction. An industrialized 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. IBS can be defined as a construction system which components are manufactured in a factory, on or off-site, positioned and assemble into structures with minimal additional site work (CIDB, 2003a). Since the first project of IBS in year 1964 till today, IBS in Malaysia is not well accepted by the construction parties because of failure [6]

The industrialized building system shows to be a success. Not only it was efficient in accelerating the construction of housing projects, but it also improved the quality and affordability of the projects in which the IBS was deployed [5]. Based on different reference materials accepted by authorities in the construction fraternity, we have several ways of defining the IBS Despite the IBS being well-known and accepted by most construction firms due to its theoretical advantage in terms of speed, safety. [1]

As such, the workable definition needs to be developed for the research fraternity and practitioners. Though many of the prefabrication and industrialization terminologies are still in use, Industrialized Building System (IBS) is become a term to represent those terminologies in the Malaysian construction industry. The term IBS is widely used by the practitioners, researchers and the government in this country to represent industrialization in construction.[4]

I) Types Of Industrialized Building System (IBS):

1. **Pre-cast Concrete Framing, Panel and Box Systems:** The most common group of IBS products is the pre-cast concrete elements – pre-cast concrete columns, beams, slabs, walls, "3-D" components (e.g. balconies, staircases, toilets, lift chambers, ref use chambers), lightweight pre-cast concrete, as well as permanent concrete formworks.[4]
2. **Steel Formwork Systems:**Considered as one of the "low-level" or the "least prefabricated" IBS, as they generally involve site casting and are therefore subject to structural quality control, the products offer high quality finishes, and fast construction with less site labour and material requirement. These include - tunnel forms, tilt-up systems, beams and columns moulding forms, and permanent steel formworks (metal decks) [5].
3. **Steel Framing Systems:** Commonly used with pre-cast concrete slabs, steels columns and beams, steel framing systems have always been the popular choice and used extensively in the fast-track construction of skyscrapers. Recent development in this type of IBS includes the increased usage of light steel trusses consisting of cost effective profiled cold-formed channels and steel portal frame systems as alternatives to the heavier traditional hot-rolled sections.[5]
4. **Prefabricated Timber Framing Systems:** Among the products listed in this category are timber building frames and timber roof trusses. While the latter are more popular, timber building frame systems also have its own niche market; offering interesting designs from simple dwelling units to buildings requiring high aesthetical values such as chalets for resorts.
5. **Block work Systems:** The construction method of using conventional bricks has been revolutionized by the development and usage of interlocking concrete masonry units (CMU) and lightweight concrete blocks. The tedious and

time consuming traditional brick-laying tasks are greatly simplified by the usage of these effective alternative solutions [4].

Ii) Research Methodology.

Since the data needed consist of the overall construction cost for a particular construction project, interviews with some of the selected respondents regarding the main objective of the topic were conducted for the data analysis stage. An overall data of the construction cost for the conventional and the industrialized building system were collected from the chosen consultant company. This data is basically for the analysis of comparison for the two different types of the construction system. It would indirectly strengthen the information obtained through the interview that need been done.

- **Method of Analysis:**

All data obtained was analyzed by descriptive and analytical methods. Data was analyzed using the Index. Average Method as follows.

$$\text{Average Scoring} = \frac{\Sigma ai * xi}{\Sigma xi} \quad (1)$$

Where: a_i = constant

Xi= variables representing respondents' frequency. [15]

Iii) Data Collection And Analysis.

According to the scenario of the Indian construction industry, plenty of data is available in form of experience, statistical records, and some data are generated through questionnaire and interviews. The data has been collected through case study of G+7 prefabricated IBS building. The project is of residential buildings with 2 towers. The sites consist of tremendous quality work with reputed contractors for construction work. The data collected from site is used to compare time, cost, quality and waste minimization of project and comparison will be carried out between IBS method and conventional method.[2]

IV) Comparative Study Between IBS And Conventional Construction

A comparative study was conducted between IBS construction and conventional wet construction to compare performances in terms of time, cost, quality and utilization of manpower. High-rise building projects which adopted IBS and conventional methods of construction were selected for case studies. The findings suggest that construction using IBS prefabricated systems can reduce the overall cost, time, manpower and produces better quality housing than the conventional method. Environmentally, IBS also facilitates waste minimization and reduction, thus further highlighting its positive economics, while reductions in overall man power requirements may also bring about less dependency on foreign labour.

IV) Results analysis.

The figure 5.1 shows that's the cost of conventional Building system is 'Rs. 77332100" and the cost of Industrialized building system is 'Rs.78088711" .The cost difference of these two building system is 'Rs.756611".This is the minor difference of these two building system.

Table shows cost comparison of IBS and Conventional system for various factors

Sr. No	Description of Item	Cost of IBS	Cost of Conventional
1	Approval Of Drawing	780887.11	773321.00
2	Foundation And Plinth	11713306.65	8720358.50
3	Super Structure And Compound Wall	54662097.7	58724690.00
4	Sanitary And Plumbing	4490100.883	5234620.00
5	Electrical Works	2444176.654	2252390.08
6	Lift And Lift Room	2436367.783	2400000.00
7	Architectural & Engineer Fees	1561774.22	2627788.42
8	**Total Cost Of Project**	**78088711**	**77332100.00**

V) Comparison Of CBS And IBS Scheduling.

During data collection the scheduling of the project had collect from the contractor which is prepared according to the IBS system method. The detail study of IBS system is carried out and scheduling of conventional method is prepared. After preparing the schedule of both methods the time comparison is analyzed to select best method among from the both method. The below table no. 5.6 shows the comparison of IBS and CBS method.

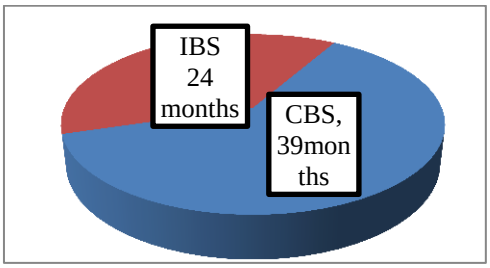
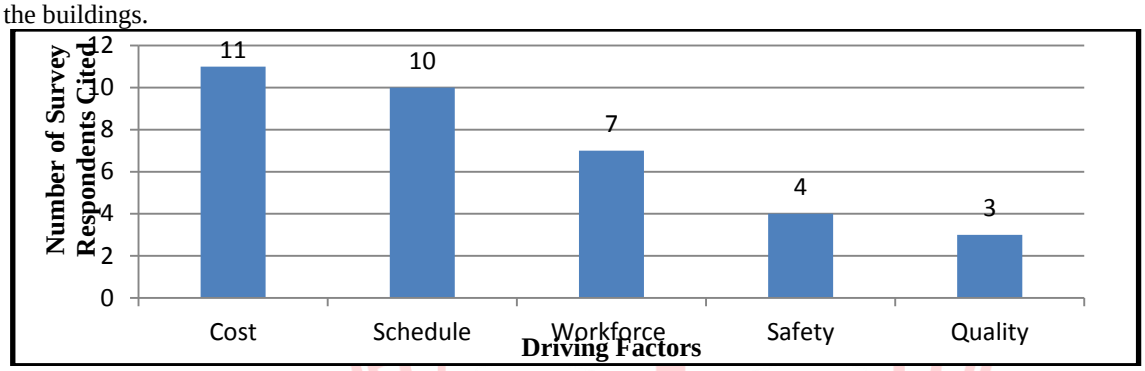


Figure 1 **Comparison of CBS and IBS Scheduling.**

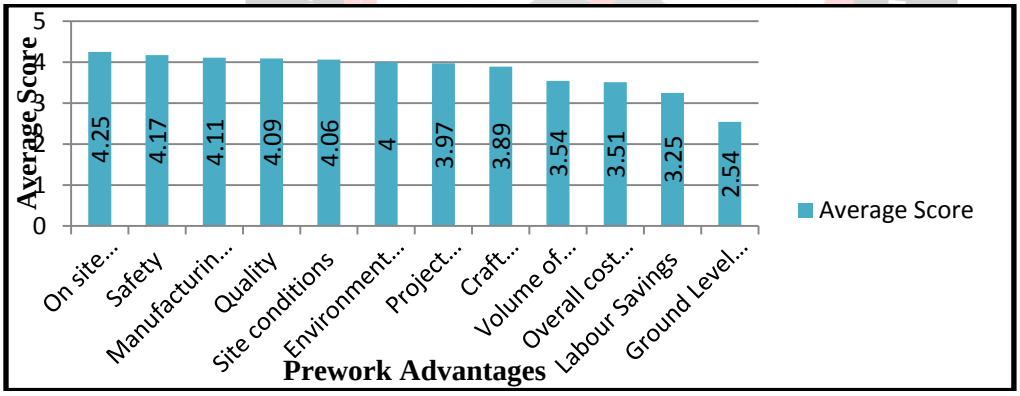
The above figure shows Time difference in months between IBS and CBS method, The IBS required 24 month for completion of project. While in CBS required 39 months for completion of same project.

Data collection through Questioner survey and analysis

This part explores the data provided by the surveys in an in-depth manner and IBS score of studied buildings. Each question is broken down and analyzed independently of the others. Then for each topic, the group of corresponding questions and their analyses are summarized. As a reminder, a blank survey for reference is provided in Appendix and with finding of the IBS score of the buildings.



The data is collected through questioner survey for comparing the various works between IBS and CBS method. It is important to have some sense of the relative importance of the advantages of prefabrication. Question 5 states, "Rate the following possible advantages of prefabrication as compared to traditional stick-built construction." For the study, survey participants were asked to rank twelve known advantages of prefabrication a Likert scale with 3 being the same as stick-built,



Reducing onsite labor congestion, with a score of 4.25 followed by safety, with a score of 4.17, is indicated to have the biggest relative advantages over stick-built work. It may be noted that the initial ground level work is almost same for prefabrication and conventional building work which having value of 2.54, which is the least advantageous point.

Table 5.6 Rate the significance of possible impediments to the use of prefabrication

No	Scale	Rating					No. of respondent T= (35)	Average index	Ranking
		1	2	3	4	5			
1	Amount of pre-planning.	0	0	0	14	21	35	4.6	1
2	Inflexibility.	5	10	5	5	10	35	3.14	5
3	Change in project	6	5	16	4	4	35	2.85	6

	risk.								
4	Transportation.	0	0	5	15	15	35	4.28	2
5	Amount of project coordination.	0	4	6	8	17	35	4.08	3
6	Procurement.	4	2	14	7	8	35	3.37	4

Impact on the Workforce

One of the main goals of this research project was to measure how prefabrication affects the construction workforce. The impact on labor is not easily established; yet such information may still be useful for effective workforce utilization. Many factors could have been studied. Four labor factors were chosen consistently as both important and quantifiable: productivity, wages, safety, and skill level.

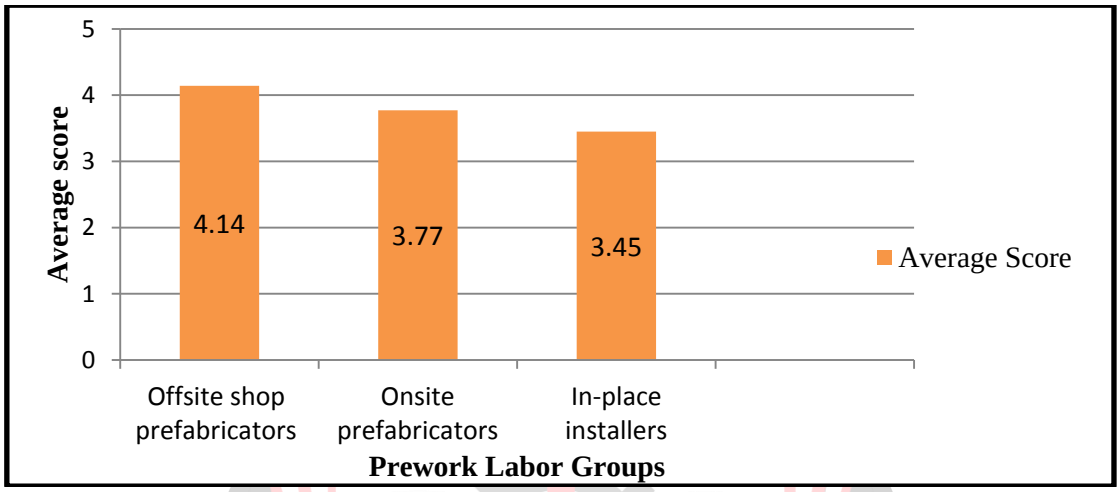


Figure 5.7. Productivity of Pre-work Compared to Conventional Productivity

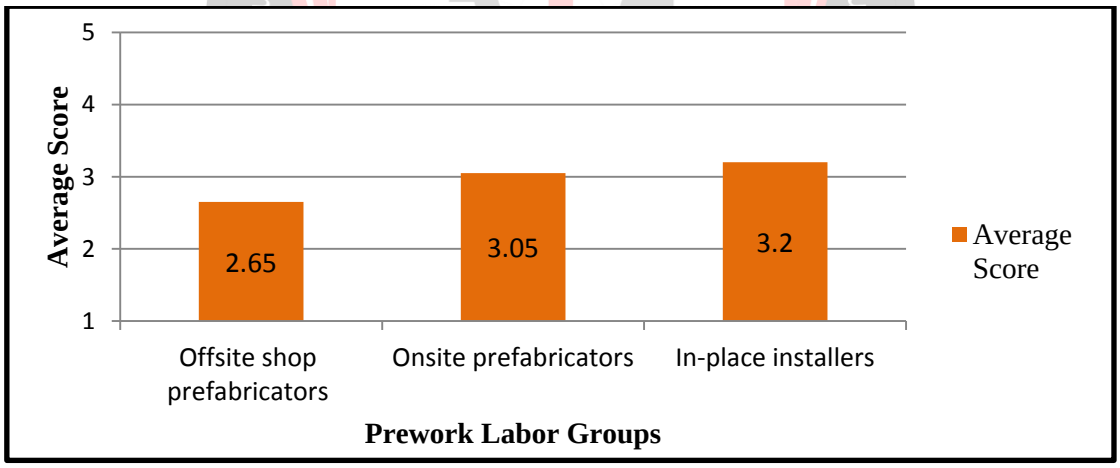


Figure 5.8. Labor Cost of Pre-work Compared to Conventional Rates

VI) Scoring system for IBS building

Prosperity and high economic growth in Malaysia have created a high demand for construction activities. As a consequence, this has attracted a huge number of foreign workers into this country to take up employment on site as unskilled labor doing manual jobs. Despite their contributions, the country is in a quagmire with a host of problems such low quality works, delays, wastages, social problems, diseases, etc.

- **THE IBS CONTENT SCORING SYSTEM (IBS SCORE)**

i) Maximum IBS Score for a building is **100 points.**

ii) The IBS Score is made up of the following components:

- **Part 1 –Structural Systems** (Maximum score is 50 points)

Points are awarded for various types of structural system used e.g. precast concrete beams and columns, steel, prefabricated timber, etc. [31]

- **Part 2 – Wall Systems** (Maximum score is 30 points)

Points are awarded based on various types of wall systems used e.g. precast concrete panel, glass, dry partition; block work, etc. [31]

❖ **Part 3 – Other Simplified Construction Solutions** (Maximum score is 20 points)

Points are awarded based on usage of other simplified construction solutions e.g. standard components based on MS 1064, standardized grids, other 3D prefabricated components such as prefabricated toilets, staircases, etc.

iii) The formula

IBS Score = Score for structural systems+ Score for wall system+ score for other simplified construction system

$$50\sum\left[\frac{Q_S}{Q_{ST}}F_S\right]+30\sum\left[\frac{Q_W}{Q_{WT}}F_W\right]+S \qquad (2)$$

Where:

QS - Construction area of a structural system
QST - Total construction area of building
FS - IBS Factor for structural system from Table 1
QW - Length of a wall system (external or internal wall)
QWT - Total wall length (external and internal wall)
FW - IBS Factor for wall system from Table 2
S - IBS Score for other simplified construction solutions.

Average score of building (A+B) =70.19

Higher IBS Score is more than 70 is reflection of a higher reduction of site labour, lower wastage, less site materials, cleaner environment, better quality, neater and safer construction sites, faster project completion as well as lower total construction costs The method of determining the IBS Score is designed to be a simple but effective process. Points are awarded based on the IBS Factors of the structural and wall elements used. The presence of high repetitiveness in the design as well as other simplified construction solutions shall also contribute to the total score. The points are summed-up to give the IBS Score of a building. IBS score for the whole project development that consists of a group of buildings is also provided. One of the important milestones in the development of IBS policy in Malaysia was the circular letter by the Ministry of Finance dated October 2008 that directly emphasized the full utilization of IBS in the development and construction of government projects. This include the policy on the use of IBS components in government projects must not be less than 70% of the IBS Score and insist that IBS must be incorporated as part of the contract document for tender..

Waste Minimization and Reduction: The objective of this study is to compare IBS with conventional construction in terms of cost, time, quality and minimization and reduction of waste. From site observations, waste reduction and improved quality control are among the important benefits of using prefabricated systems and interlocking block.

Conclusions

1. The IBS (Industrialized building system) is studied and understands that it is more effective and reliable than CBS (conventional building system).
2. The five types of IBS are determined and it is found that it having various advantageous like builds ability, less wastage, reduced construction cost completion of project on time and less maintenance cost.
3. The benefit of using IBS for construction project is saving construction time and material. IBS system also reduces environmental impact on project. But initial cost of project is found for IBS is Rs. 7, 80, 88,711.00 which is higher than CBS Rs. 7, 73, 32,100.00. The total initial cost of project gets higher by Rs.7, 56,611 in IBS.
4. The project time duration of project is compared IBS with CBS and found that IBS requires 24 months and CBS requires 39.25 months to complete the project. Total Time saved by IBS method is 15.25 months.
5. According to experts rating for advantages, it is found that out of 12 factors, on site labor congestion is highly rated 4.25 and lowest rating for ground level work is 2.54. The ratings for disadvantages found that out of 6 factors, Amount of pre-planning is highly rated 4.6 which shows this factor requires more study to reduce the impact on project and Procurement is found lowest rated in list by 2.85.
6. The IBS system is compared with CBS system for productivity, labor cost, safety and skill level.

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