

ANALYSIS OF MODULAR HOUSING TECHNIQUE PERCEPTION AND IDENTIFICATION ITS IMPEDIMENTS: A Review

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Abstract- *This research work was aimed to identify the current degree of utilization of modular building techniques in the construction sector, and to identify the Stakeholders perception of the barrier and benefits of using these techniques and also to investigate the impediments and motivation using these techniques by stakeholdes responses. A self-administrated survey was developed based on the factors as a primary research methodology. Different stakeholders randomly selected as a research theme, and various methods were utilized to achieve the research goal.*

Key words - Relative Important Index, Modular Housing, Prefabricated building, Construction Industry, Material

1. Introduction

Modular building is a unique construction method where individual volume or modules are constructed offsite, transported to the site location and then assembled the structure in such a way that it make a large module. Prefabrication constructions are mostly intended to remain stagnant in one location for their duration of useful life. Prefabricated building refers to three dimension 'volumes orooms' which include various combination of module like kitchens, bathrooms, wall making and various structures according to requirement of client. Research conducted in different countries has always found that a prefabricated technique in construction sector offers various advantages such as improving safety performance, reduced skilled worker and increased project quality with shorter project duration. According to Neale1993 and Gibb2000 report it is identify that using modular construction techniques improved labour productivity, shortened project schedules and effective equipment utilization. Similarly, the German researchers found that prefabrication method reduced negative impact on environment.

Prefabrication technologies are widely used in low rise buildings of different functional purposes: ware houses, office and household, sanitary and special purpose premises, etc. However, in recent trends, they have been utilizing in multi-storey and even in high-rise construction. Modular building combines various technologies based on rapid construction principles. In modern technologies, talking about the prefabrication components of the system, two main directions in the construction of modular construction can be differentiate: the use of separate elements of a frame system wall panels, beam and columns etc. that are produced in factory and assembled onsite; the benefits of 3D module (block containers) including unique engineering facilities, exterior and interior finishing and built-in furniture and equipment. The purpose of this study is to analyze modular housing within construction context and evaluate its features through Literature Review.

REVIEW OF LITERATURE

The main objective of **Tomas U. Ganiron Jr and Mohammed Almarwae (2014) [1]** was to give knowledge about the modular housing and also to find the where this technology can be used especially in an area where affordable shelter are not provided. According to study it is found that there are few challenges to construct modular houses but it is not create that much problem in overall work scenario. Modular housing takes very less time as compare to tradition mass construction which helps the property to rent faster and adds revenue to the structure.

Addey Sham Baharin, Mohammad Fadhil Mohammad, Muhamad Faiz Musa and Mohammad Reeza Yusof et al. (2016) [2], explains that Industrialized Building System (IBS) Modular System (MS) is a building construction technique where around 80 % of building material where manufactured in offsite factory controlled environment and at the last assembled of parts in final site for construction. This method will help to achieve good quality of life for community. Owner should also encourage developing this kind of method in future for quality living in society.

Elena M. Generalovaa, Viktor P. Generalova and Anna A. Kuznetsovaa (2016) [3] suggested that, the construction of modular building is analyzed from advanced countries. It is always found that the modular construction helps to shortens project cost, time and design in very unique way. The uses of prefabrication Construction are cost efficient, safe and eco-friendly. Modular buildings in Russia based on 3D Reinforced Concrete module block which helps to achieve quality of building life.

Jeffrey Molavi and Drew L Barral et al. (2016) [4], explains that modular construction guaranties more control over safety and quality of materials. However, some other concerns such as design involvement and coordination of the factory and Plant activities may be easily erode if an appropriate procurement method is not selected. During precast concrete construction for that period of time it required high skilled worker, complex design and complex techniques. Because this factors helps to improve modular design in certain way. To include this managerial task in a modular construction's equation, this study suggests a construction procurement method based on project type to achieve sustainable modular construction.

Diana Lopeza and Thomas M Froesea et al. (2016) [5], the authors addressed the research question, concluding that modular building method is little bit more cost effective than the panelized construction method for these particular case studies and under the given circumstances. It also provides a framework of the implications of both construction methods and a discussion of the compromise things when choosing the modular method over the panelled method.

Jinyue Zhanga, Yating Longa, Siquan Lva and Yunchao Xianga et al. (2016) [6], explains about the worldwide adoption of BIM has been seen as a way to improve growth of modular and industrialized construction in both the technical and management fields. Current practices in China have demonstrated that innovation in BIM-enabled modular design and the utilization of 3D laser scanning technology to ensure accurate geometric information of MEP systems. The application of BIM in the Chinese construction industry in the near future will provide more benefits of modular and industrialized construction, such as shorter construction period, safety work, material conservation and controlled environment.

2. CONCEPT OF PREFABRICATION OR MODULAR HOUSING

The inspiration of using prefabrication or modular method generally occurs because of customer requirement, good return of money from development and effective quality performance. Furthermore, the modular buildings has various benefits in social housing like speed of construction which help to improve production sale and decreased problem of congested in sites.

According to 1998 DETR Egan Report 'Rethinking Construction' greater invention in construction design and procurement will lead to client benefit and demonstrable savings. These Advantages help to find the value and cost of modular buildings as compared to traditional construction Prefabrication design widely used in different countries like Japan, USA and Scandinavia because they are using light steel framing for structural medium which leads to flexibility in robust architectural solutions and internal planning. Steel framing is very durable, accurate and free from long term movement.

Project owner always know how to use men, material and equipment to complete work in time. While modular structures help the contractor to get benefit from other sources because the product should be buy from plant so that it helps to get margin of profit for contractor. If we increased the used of prefabrication construction it will help 1both designer and manufacturer.

Modular techniques can compared with automobile manufacturing techniques because they both are producing in plant or factories. Modular Building design in such ways that it should be dismantle in any place with shorter duration of period. While not all modular homes change its place but it helps to achieve comfortable living in any area of the world with suitable measurement.

3. METHODOLOGY

The main reason of this study is to identify the benefits and to discover the various trends of modular housing.

- 1) The research strategy was made by selecting the research papers in which successful implementation of modular housing was presented and documented.
- 2) Approach was adopted to explore the published literature regarding Modular housing or prefabrication technology in construction.
- 3) Self-administrated questionnaire was developed for research objective.
- 4) Data Analysis had been done with this survey.

4.1 Data collection

The target population included civil engineering and building construction firms of Valsad district from Gujarat region of India. The Contractor, Architect, and engineers of Valsad district of Gujarat who work in Valsad were targeted for survey. The details of various stakeholders and total numbers of were collected through internet. These details were considered as size of population to decide sample size of study.

We distributed over a 143 questionnaires, out of which we received 87 questionnaires. The analysis of these questionnaires helped us calculate the Relative important index of each factors. We received responses from a pretty diverse group of Professionals i.e. contractors, architects, Engineers, etc.

Relative Importance Index Technique: It used determine the relative importance of the various Perception Factors. The same method is going to adopted in this study within various groups (i.e. contractors, engineers, & architects). The seven-point Scale ranged from 1 to 7 is adopted and transformed to relative importance indices (RII) for each factor as follows:

$$RII = \frac{\sum W}{A * N}$$

Where, W is the weighting given to each factor by the respondents (ranging from 1 to 7), A is the highest

Weight (i.e. 7 in this case), and N is the total number of respondents. Higher the value of RII, more important was the cause of delays.

Frequency index: a formula is used to rank factors of perception based on frequency of occurrence as identified by the participants.

$$\text{Frequency index (F.I) (\%)} = \frac{\sum a (n/N) * 100}{7}$$

Where, a is the constant expressing weighting give to each response (range from 1 for rarely up to 4 for always), n is the frequency of the responses, and N is total number of responses.

4.2 Result

Top 10 perception factors ranking by RII

The RII was computed for each factor to identify the most significant factors. The factors were rank based on RII values. From the ranking assigned to each factors of perception it was possible to identify the most important factors of perception in Indian construction industry. Based on ranking the 10 most important factors of modular housing techniques by RII method are

Table -1 Critical factors of perception by RII Method

| No | Critical Factors of Perception | RII |
|----|---|-------|
| 1 | Offsite construction techniques reduced environmental impact of construction operations | 0.783 |
| 2 | Offsite construction techniques reduced the project construction cost | 0.776 |
| 3 | Offsite construction techniques increases design cost | 0.743 |
| 4 | Offsite construction techniques increases safety performance | 0.742 |
| 5 | Offsite construction techniques reduced the need for skilled crafted worker onsite | 0.720 |
| 6 | Offsite construction techniques reduced the overall project schedule | 0.704 |
| 7 | Offsite construction techniques increases product quality | 0.668 |
| 8 | Offsite construction techniques increases the overall project cost | 0.666 |
| 9 | Offsite construction techniques increasing project design efficiency | 0.665 |
| 10 | The owner's negative perception of offsite construction techniques limits the use of those techniques | 0.655 |

4. CONCLUSION

The main outcomes of these papers say that there are a few challenges to modular technique like transportation restraints and limited design, but modular construction technologies are still widely used all over the world finding more and more applications. There is always a myth that high-rise residential house are only for the rich but modular construction technique change the behaviour of society. At last it allows modernizing modular systems and introducing them in Construction on a larger scale so that Energy-saving construction method can be used.

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