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Modular Prefabrication in Construction Sectors in Multi-Storey Buildings

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Abstract - *My project report is to investigate whether modular prefabrication is essential in multi-story buildings, and how the Indian construction industry benefits and the usages that affect the implementation of modular prefabrication. Besides tackling the constraints, the advantages and applications of this technology worldwide, reasons important for implementing modular prefabrication are also addressed and demonstrate that it is beneficial than a traditional approach. The factors to be considered while there is emergency housing needed Thus, Modular prefabrication is subjected as an implementation.*

Keywords: Modular Prefabrication, Multi-storey buildings, Emergency Housing, Implementation.

1. Introduction

The Research, beginning with the context of Modular Prefabrication, its drivers and challenges such as:

1) Factors to be considered to show modular Prefabrication is advantageous compared to Conventional method
2) Factors considered using modular prefabrication to provide housing needs in emergency situation in multi-storey buildings
3) Factors considering constraints to adoption of modular prefabrication

1.1 Modular Construction

Modular construction is a procedure in which structures are produced off-site in factories under stringent quality controls while adhering to the same building laws and regulations as traditional construction methods.

It's is a process by which a building is erected on site using the same materials and designing the same codes and specifications as conventionally built installations under regulated plant settings – but only in half a time. Buildings are produced in "module," which are installed on site to represent the same design goal as the most complex installation – without compromising.

1.2 Off- Site Manufacturing

The productivity and profitability of the building and civil engineering industry relies mainly upon offsite design. In order to evaluate, benchmark and assess the development and proliferation of advanced building technologies, it is important that prefabrication, pre-assembly and off-site manufacturing lead to construction.

The construction procedure that involves the planning, designing, fabrication, transportation of fabricated building items and its assembling on the site with great speed and a high degree of finish. This degree of precision is far better than on-site construction.

2. Literature Review

Modular Prefabricated Building in Modular Buildings and Modern Construction says, it analyses the specialized world experience in the design of modular buildings. It is stressed that modular architecture has the ability to minimize project planning and engineering time, reduce costs and increase construction efficiency.

The construction of modular buildings is cost-effective, safe and environmentally sustainable. In the regulated conditions of the factory, it is called modular construction, by means of the same components, codes and specifications as the traditional building, and standards as a conventional construction method.

3. Data Analysis

Likert scale data helps to study the cluster of attitudes about the subject matter and falls under multiple conceptual measures, i.e., in plain terms, ordinal variables.

It is essential to understand the order and the ranking of values is not indicative of the differences between one another. By the *Table 1* it is determined by,

Expression for MR (Shahzad & Mbachu, 2013)

$$MRj = \sum_{k=1}^{5} \left(R_{pjk} \times \%R_{ik} \right)$$

Figure -1

MRj = Mean rating for attribute

Rpjk = Rating at point k (Fluctuating from 1 -5)

Rjk% = Percentage response to rating point k, for attribute j.

The limitation with MR > 2.5 is noteworthy, and MR < **2.5** is considered as an unimportant limit.

Level Importance		
5- Strongly agree	5- Very highly critical	5- Very high effect
4- Agree	4- Highly critical	4- High effect
3- Moderate	3- Mildly critical	3- Mild effect
2- Disagree	2- Lowly critical	2- Low effect
1- Strongly disagreed	1- Not critical	1- Very low effect

Table - 1

3.1 Factors to be considered to show modular Prefabrication is advantageous compared to Conventional method:

From the literature review it was found that modular prefabrication method is advantageous when compared to conventional methods of construction. Also, a set of factors were identified to show the modular prefabrication techniques is beneficial and were analyzed using the feedback from the stakeholders and experts in the India construction industry. The following table shows the factors along with their corresponding Mean ratings.

From the *Table-2*, the following factors such as modular prefabrication enhances the aesthetic appearance in multi-storey buildings, modular prefabrication will increase the structural quality of multi-storey building construction, higher quality of product, modular prefabrication will increase the indoor quality in multi-storey building construction, service installations in multi-storey buildings, and modular prefabrication reduces the cost of building multi-storey buildings were identified as more significant factors with mean ratings more than 2.5 and to be considered to buttresses the fact that modular prefabrication is beneficial compared to conventional **(Siggner, 2015)**. All the other facrotrs excluding the above mentioned were identified insignificant as their recoreded mean value is less than 2.5.

Factors to be considered to show modular Prefabrication is advantageous compared to Conventional method	Level of Agreement					
	SA	A	Moderate	D	SD	MR
	5 (%)	4 (%)	3 (%)	2 (%)	1 (%)	
Modular prefabrication enhances the aesthetic appearance in multi-storey buildings	11.11	33.33	27.78	27.78	0.00	2.72
Modular prefabrication will increase the structural quality of multi-storey building construction	10.53	47.37	21.05	15.79	0.00	2.63
Higher quality of product	16.67	38.89	27.78	5.56	5.56	2.61
Modular prefabrication will increase the indoor quality in multi-storey building construction	5.26	42.11	42.11	10.53	0.00	2.58
Modular prefabrication accommodates more service installations in multi-storey buildings	11.11	44.44	22.22	22.22	0.00	2.56
Modular prefabrication reduces the cost of building multi-storey buildings	23.53	29.41	17.65	29.41	0.00	2.53
Modular prefabrication increases the ease of design of multi-storey buildings	27.78	16.67	38.89	16.67	0.00	2.44
Modular prefabrication will reduce the amount of rework in multi-storey building	16.67	38.89	38.89	5.56	0.00	2.33

Table – 2

3.2 Factors considered using modular prefabrication to provide housing needs in emergency situation in multi-storey buildings:

The rebuilding of housing after disasters has become a key issue, with many natural disasters including earthquakes, cyclones, forest fires and tsunamis that are threatening human ecosystems around the world for post Disaster's housing by **Gunawardena, T., Tuan, N., Mendis, P., & Aye, L. C. (2014)**. Prefabricated modular architecture will increase the time required to offer permanent housing dramatically. Because of the intrinsic feature of this modular structure, time-efficiency may also be an attractive method for restoration of housing after catastrophe. By statistically analysing the results from the survey, the mean value was obtained for all of the answers and in most questions the factor was more than 2.5, thereby showing that the future use of modular

prefabrications in emergency housing is feasible in India with the current resources.

Provide housing needs in emergency situation in multi-storey buildings	Level of Agreement					MR
	SA	A	Moderate	D	SD	
	5 (%)	4 (%)	3 (%)	2 (%)	1 (%)	
Modular prefabricated houses provide a comfortable indoor environment in times of disaster/emergency.	40	40	10	0	0	1.45
Modular prefabricated houses are produced faster to meet emergency housing needs in times of disaster/emergency.	45	40	15	0	0	0.71
Modular prefabricated houses can be reused in multiple disaster occurrences.	30	40	20	0	5	1.30
Mass modular prefabricated housing production is possible to meet the high demand for housing/shelter in times of disaster/emergency.	30	30	40	0	0	0.83
Modular prefabricated houses are readily available in the local construction market to meet disaster/emergency response.	15	25	15	35	5	1.36
Modular prefabricated houses are a less expensive housing option for users (e.g., cheaper to procure) in times of disaster/emergency.	15	30	35	15	0	1.19
Using Modular prefab technology helps in avoiding	30	35	30	5	0	0.89

Table – 3

3.3 Factors considered using modular prefabrication to provide housing needs in emergency situation in multi-storey buildings:

Their first aim is to examine the implementation and limitations of the modular prefabrication technology in Indian construction facilities. The constraints were determined from the comprehensive literature review and the participants received input from the dispersed sample survey. The limitations and their mean scores are seen in table 4 above.

There is a strong evidence that equal loan and mortgage requirements for prefabricated buildings with the maximum mean ranking of 3,32 are substantial restrictions in Indian modular prefabrication. In addition, the second and third major restrictions, with nearly equal mean values, are defined as favorable construction legislation promoting prefabricated construction and an increase client's demand for customization of buildings. Many other restrictions were found negligible with the average ranking below 2.5.

Factors considering constraints for adoption of modular prefabrication	Level of Agreement					MR
	SA	A	Moderate	D	SD	
	5 (%)	4 (%)	3 (%)	2 (%)	1 (%)	
Fair loan and mortgage conditions for prefabricated buildings	15.79	21.05	21.05	10.53	21.05	3.32
Favourable (new) building regulations supporting prefabricated construction	0	42.11	36.84	21.05	0.00	2.79
Increased client demand for customization of buildings	21.05	31.58	21.05	10.53	10.53	2.74
Increased government support for prefabricated construction	15.79	26.32	42.11	15.79	0.00	2.58
High cost of land acquisition for low rise building construction	26.32	36.84	15.79	15.79	0.00	2.42
Increased level of innovation in the India construction industry	21.05	31.58	36.84	10.53	0.00	2.37
Increasing population relative to land availability (High density population)	21.05	31.58	36.84	10.53	0.00	2.37
Shortage of construction workers in India construction industry	31.58	42.11	15.79	5.26	5.26	2.11
Inadequate housing provision (Including commercial buildings)	21.05	57.89	21.05	0	0	2.00

Table – 4

4. Conclusion

The main objective of this study is to see if a modular prefabrication system is needed for building multi-story buildings in India and whether modular prefabrication methods are required for building multi storey buildings in India, and how this technology is beneficial to the Indian construction industry in multi-storey buildings. Factors related to the Indian construction industry have been established from the responses and found that these limitations are mainly responsible for the use of technology in the building sector.

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