ISSN 2063-5346

ENHANCING CONSTRUCTION PRODUCTIVITY AND EFFICIENCY ASSESSMENT OF CONVENTIONAL FORMWORK AND MIVAN FORMWORK IN CONSTRUCTION PROJECTS

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Article History: Received: 03.04.2023 **Revised:** 25.04.2023 **Accepted:** 15.05.2023

Abstract

The construction industry is constantly seeking innovative approaches to enhance productivity and efficiency. This study focuses on the assessment of conventional formwork and Mivan formwork in construction projects with the objective of enhancing construction productivity and efficiency. The research aims to compare the duration and cost of these two formwork systems to determine their effectiveness in improving project outcomes. The study utilizes a mixed-methods approach, combining quantitative and qualitative analyses. A comprehensive literature review is conducted to gather existing knowledge on conventional formwork, Mivan formwork, construction productivity, and efficiency. The methodology involves data collection from construction projects that have employed both formwork systems. Key performance indicators such as project duration, labor productivity, material usage, and cost are analyzed and compared between the two systems. The findings of this research will provide valuable insights into the benefits and drawbacks of conventional formwork and Mivan formwork. The analysis will identify the factors influencing productivity and efficiency in each system and highlight areas where improvements can be made. The study aims to guide construction industry professionals in making informed decisions regarding the selection and implementation of formwork systems.

Keywords: *Mivan formwork, Specialized training.*

Introduction

Traditional method of constructing concrete structures Conventional formwork is a process of building temporary structures using wooden frames and plywood sheets to create molds for pouring concrete. This method has been used for decades and is still popular today due to its versatility and ability to handle complex shapes and designs. Choosing the right formwork method can have a significant impact on the cost, timeline, and quality of your construction project.

Literature Review

1) **Cost and time comparison of construction using traditional timber formwork and modern formwork systems" by J. Y. Chan and C. K. Wong (Engineering, Construction and Architectural Management, 2006)**: This study analyzed the cost and duration of construction using conventional formwork and modern formwork systems for high-rise buildings in Hong Kong. The results showed that the modern formwork system, which included Mivan formwork, was more cost-effective and time-saving than conventional formwork.
2) **Comparative study of conventional formwork and Mivan formwork system by Harshil Parikh and Pritesh Patel (International Journal of Scientific and Research Publications, 2014):** This study compared the duration and cost of construction using conventional formwork and Mivan formwork for a residential building in India. The results showed that Mivan formwork was more cost-effective and time-saving than conventional formwork.
3) **Comparative study of conventional formwork and Mivan formwork in construction of residential buildings" by Kavita Jain and Renu Mathur** (International Journal of Engineering Research and Applications, 2015): This study compared the cost and duration of construction using conventional formwork and Mivan formwork for a residential building in India. The results showed that Mivan formwork was more cost-effective and time-saving than conventional formwork
4) **An Analysis of Formwork System Performance in Residential Construction Projects" Authors: Zhang, L., Li, Q., Ding, G. Published in: Journal of Construction Engineering and Management, 2016** This research analyzed the performance of different formwork systems, including conventional and Mivan formwork, in residential construction projects. The study compared the duration, cost, and quality of construction using various formwork systems. The research highlighted the benefits of Mivan formwork in terms of time and cost savings, as well as improved quality control compared to conventional formwork.
5) **A Comparative Study of Conventional and Mivan Formwork Systems in Commercial Building Construction" Authors: Gupta, S., Singh, V., Kumar, A.** Published in: International Journal of Engineering Research & Technology, 2017. The research found that Mivan formwork significantly reduced the construction time, resulting in overall project cost savings. The study emphasized the importance of skilled labor and effective project management for successful implementation of the Mivan formwork system.

OBJECTIVES

1. To determine the optimal formwork system for building construction,

by thorough assessment of factors.

- Duration
- Cost
- Quality

2. Evaluate the cost-effectiveness of conventional formwork and mivan formwork in construction projects.
3. Recommendations for improving construction productivity.
4. Study for analyzing identification of best practices.

Methodology

Flow chart:

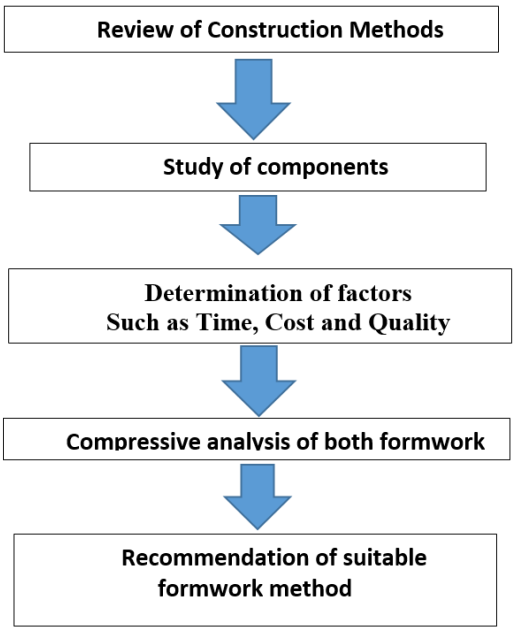


Figure 01 Flow Chart

Erection of Aluminum formwork

Following are the steps of formwork erection

1) Kicker Fixing
2) Wall component fixing
3) Beam bottom fixing
4) Slab deck panel fixing
5) Prop length fixing

Figure 02 Erection of wall panel

Figure 03 Erection of wall tie

Figure 04 Slab decking

Figure 05 Fixing of deck panel

Figure 06 Removing wall tie

Figure 07 Timber Plywood

Erection of Conventional formwork

1) Fixing of formwork Panels
2) Fixing of Beam bottom
3) Slab decking
4) Supporting

Figure 08 Waler beam

Experimental Study

Analysis of Duration and Cost for following plan

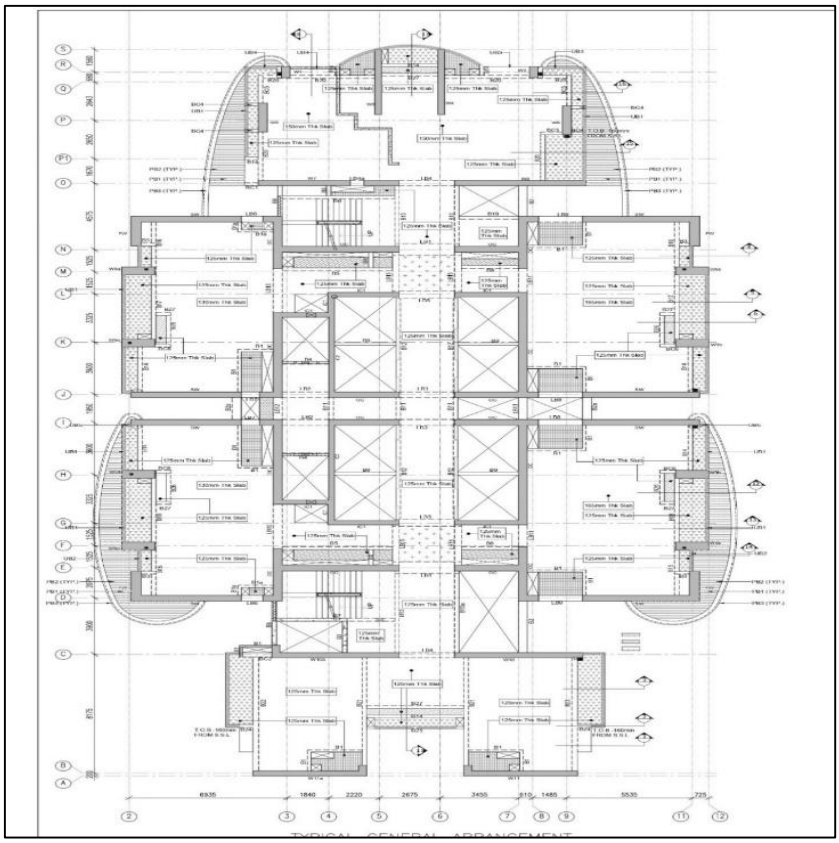
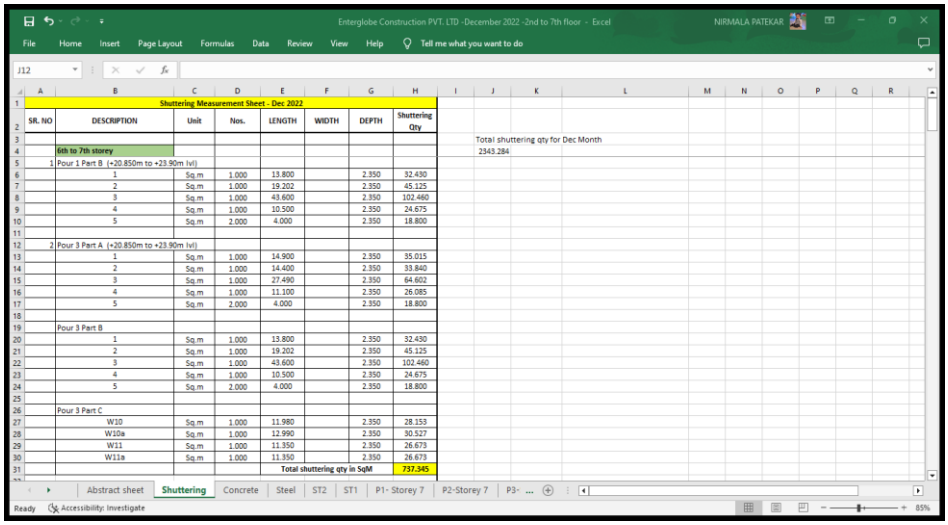


Figure 09 Plan



Shuttering Measurement Sheet - Dec 2022

SR. NO	DESCRIPTION	Unit	Nos.	LENGTH	WIDTH	DEPTH	Shuttering Qty
	6th to 7th storey						
1	Pour 1 Part B (+20.850m to +23.90m lvl)						
	1	Sq.m	1.000	13.800		2.350	32.430
	2	Sq.m	1.000	19.202		2.350	45.125
	3	Sq.m	1.000	43.600		2.350	102.460
	4	Sq.m	1.000	10.500		2.350	24.675
	5	Sq.m	2.000	4.000		2.350	18.800
2	Pour 3 Part A (+20.850m to +23.90m lvl)						
	1	Sq.m	1.000	14.900		2.350	35.015
	2	Sq.m	1.000	14.400		2.350	33.840
	3	Sq.m	1.000	27.490		2.350	64.602
	4	Sq.m	1.000	11.100		2.350	26.085
	5	Sq.m	2.000	4.000		2.350	18.800
	Pour 3 Part B						
	1	Sq.m	1.000	13.800		2.350	32.430
	2	Sq.m	1.000	19.202		2.350	45.125
	3	Sq.m	1.000	43.600		2.350	102.460
	4	Sq.m	1.000	10.500		2.350	24.675
	5	Sq.m	2.000	4.000		2.350	18.800
	Pour 3 Part C						
	W10	Sq.m	1.000	11.980		2.350	28.153
	W10a	Sq.m	1.000	12.990		2.350	30.527
	W11	Sq.m	1.000	11.350		2.350	26.673
	W11a	Sq.m	1.000	11.350		2.350	26.673
				Total shuttering qty in SqM			737.345

Total shuttering qty for Dec Month
2343.284

Figure 10 Excel Sheet of Measurements

Shuttering area Calculation for A wing (Conventional Shuttering) Total Shuttering Quantity of slab and beam per floor: 845.084 Square meter.

Total Shuttering quantity considering Column, Slab & Beam for 1 floor: 1806 sqm

Total no of floor: 13no's = 13 X 1806 = 23,478 sqm shuttering area. (For A wing)

Figure 11 Conventional Formwork

Conventional Material Requirement Cost & Labor Cost

Material Cost Per SQM: **159** Rupees

Total Approx material cost of conventional: **37,28,410** Rupe

Labor Cost

Labour cost for Formwork Making, shifting, lifting to any lead & lift, erection, support, for Column, beam & Slab conventional formwork area :**1009** rupees per Sqm

Total Labour Cost: **1,99,56,300** Rupees

Total Cost

Material And Labour Cost Per SQM: Rupees

Total Area: 23,478 Square meter = 23,478 X 908

Total Cost for Conventional shuttering work of A wing: **2,36,89,302** Rupees

Aluminum Material Requirement Cost & Labor Cost

Figure 12 Mivan Formwork

Shuttering area Calculation for B wing (Mivan shuttering)

Total Shuttering Quantity of slab and beam per floor: 845.084 Square meter.

Total Shuttering quantity considering Column, Slab & Beam for 1 floor: 1806 sqm

Total no of floor: 13no's = 13 X 1806 = 23,478 sqm shuttering area. (For B wing)

Material Cost

Total Shuttering quantity considering Column, Slab & Beam for 1 floor: 1806 sqm.

Material Rate Per Sqm for aluminum shuttering: 7000 Rupees

Total area : 1806 X 7000

Total Material Cost for aluminum shuttering: **1,26,42,000** Rupees.

Labor Cost

Labour cost for Formwork Making, shifting, lifting to any lead & lift, erection, support, for Column, beam & Slab conventional formwork area:**350** rupees per Sqm

Total Labour Cost: **83,46,800** Rupees

Total Cost

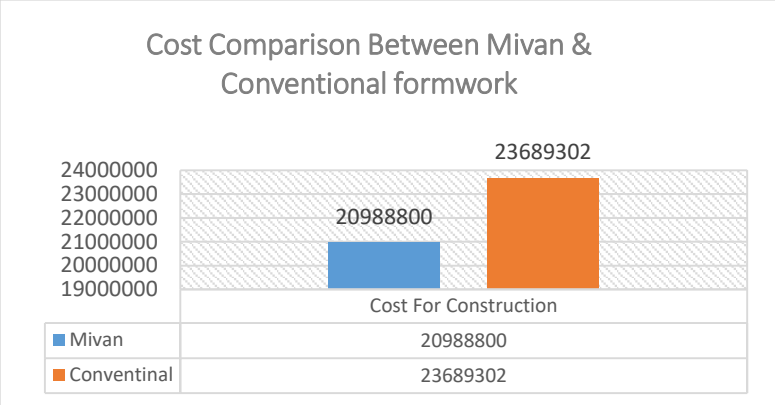
Material And Labour Cost Per SQM: **888** Rupees

Total Area: 23,478 Square meter = 23,478 X 888

Total Labour Cost: **83,46,800** Rupees

Total Material Cost for aluminum shuttering: **1,26,42,000** Rupees.

Total Cost aluminum shuttering work of B wing: **2,09,88,800** Rupees



Graph No 01 Comparison of cost

Analysis of Time

Formwork Assembly Time:

- Aluminium Shuttering: The standardized panels and components of aluminum shuttering allow for quick and easy assembly. Depending on the project complexity, aluminum shuttering can be assembled up to 4 times faster compared to conventional shuttering.
- Conventional Shuttering: Conventional formwork typically involves assembling timber or plywood sheets, which can be more time-consuming due to the need for precise cutting, fitting, and fastening of individual components.

Reusability and Stripping Time:

- Aluminum Shuttering: Aluminum shuttering is designed for multiple reuses. After the concrete has cured, the formwork can be quickly stripped, which saves time for subsequent pours and reduces overall construction duration.
- Conventional Shuttering: Conventional formwork often requires more time for stripping due to the need for carefully removing nails or screws and disassembling the formwork, especially when working with timber components.

Time calculation for Aluminium shuttering

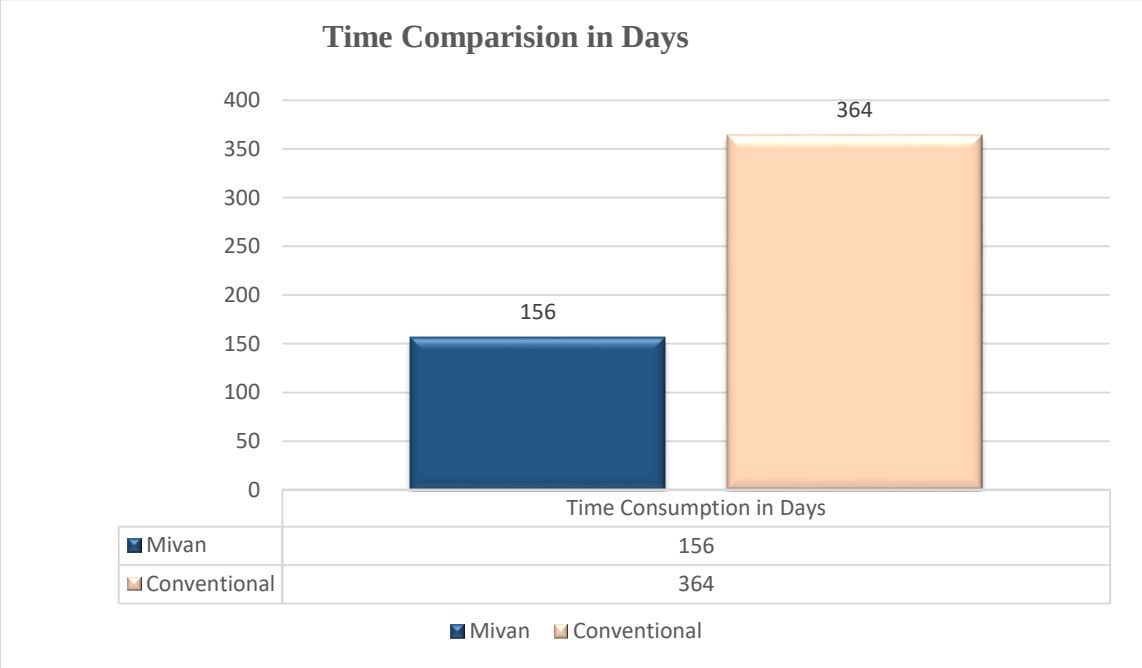
- Total number of Floor = 13
- Number of aluminum formworks sets available at site= 1 full set
- 1 full set requires 12 days to complete concreting of one floor with 2 sets of back propping.
- Number of days required to complete 13 floor = 156 days.

Time calculation for Conventional shuttering

- Total number of Floor = 13
- Number of conventional formworks sets available at site= 1 full set
- 1 full set requires 28 days to complete concreting of one floor.
- Number of days required to complete 13 floor = 364 days.

Table No 01 Comparisons of factors

Description	Unit	Conventional	Mivan
Tine	Days	364	156
Material Cost	Rupees	37,28,410	1,26,42,000
Labour Cost	Rupees	1,99,56,300	83,46,800



Graph No 02 Comparison of Days

CONCLUSIONS

1. Construction Productivity: Mivan formwork demonstrates enhanced construction productivity compared to conventional formwork. The standardized and reusable components, streamline the construction process and reduce assembly time. This leads to faster project completion and improved productivity.
2. Construction Efficiency: Mivan formwork offers higher construction efficiency compared to conventional formwork. The use of components and integrated features for reinforcement and services placement minimizes on-site labor requirements and simplifies construction activities. This results in reduced construction time, improved workflow, and increased overall efficiency.

3. Cost Considerations: While Mivan formwork may require higher initial investment compared to conventional formwork due to the specialized components, it can yield cost savings in the long run. The faster construction timeline, reduced labor requirements, and potential for reusability contribute to overall cost efficiency, making Mivan formwork a viable option for construction projects.
4. Quality Considerations: Both conventional formwork and Mivan formwork can achieve high-quality construction results. However, Mivan formwork provides better control over dimensional accuracy and surface finishes due to the standardized nature of its components. This can lead to improved quality outcomes and higher customer satisfaction.
5. Project Suitability: The choice between conventional formwork and Mivan formwork should consider the project-specific requirements and constraints. Factors such as project scale, complexity, duration, budget, and labor availability should be taken into account to determine the most suitable formwork system

References

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