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(RESEARCH ARTICLE)

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Assessing the impact of conventional formwork and Mivan formwork on construction productivity and efficiency

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Abstract

The construction sector is continuously exploring innovative strategies to enhance productivity and efficiency. This research project centers on evaluating the use of conventional formwork and Mivan formwork in construction projects, aiming to improve construction productivity and efficiency. The primary objective is to compare the time and cost requirements of these two formwork systems to assess their impact on project outcomes. The study employs a mixed-methods approach, combining quantitative and qualitative analyses. A comprehensive review of existing literature is undertaken to gather knowledge on conventional formwork, Mivan formwork, construction productivity, and efficiency. Data is collected from construction projects that have employed both formwork systems, and key performance indicators such as project duration, labor productivity, material consumption, and costs are examined and compared. The findings will provide valuable insights into the advantages and limitations of conventional formwork and Mivan formwork. The analysis will identify the factors that influence productivity and efficiency in each system and highlight areas for potential improvement. The ultimate aim of this study is to provide guidance to construction professionals in making informed decisions regarding the selection of formwork systems, taking into account factors such as cost, time, labor requirements, and quality. Additionally, the research will contribute to the existing knowledge base on construction productivity and efficiency, offering recommendations to enhance project outcomes. By identifying the strengths and weaknesses of conventional formwork and Mivan formwork, this study seeks to drive advancements in construction practices and contribute to overall industry improvement.

Keywords: Mivan formwork; Specialized training**;** Quality control; Comparative analysis; Reusability; Project schedule

1. Introduction

In the construction industry, the traditional method of constructing concrete structures using conventional formwork has been practiced for decades. Conventional formwork involves the use of wooden frames and plywood sheets to create temporary structures or molds for pouring concrete. This method has stood the test of time and remains popular due to its versatility and ability to handle complex shapes and designs. Choosing the right formwork method is a crucial decision that significantly impacts various aspects of a construction project, including cost, timeline, and quality. The selection of an appropriate formwork system can optimize efficiency, productivity, and ultimately contribute to the success of the project. This study aims to assess the effectiveness and performance of conventional formwork in construction projects, with a focus on enhancing construction productivity and efficiency. By comparing the duration and cost of conventional formwork projects, valuable insights can be gained to improve project outcomes. Furthermore, this research will explore the factors influencing productivity and efficiency in conventional formwork, identifying areas

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where improvements can be made. The findings of this study will provide construction industry professionals with valuable guidance for making informed decisions regarding formwork selection, considering factors such as cost, time, labor requirements, and quality. The ultimate goal of this research is to contribute to the existing knowledge base on construction productivity and efficiency, driving advancements in construction practices and supporting the overall improvement of the construction industry.

2. Literature Review

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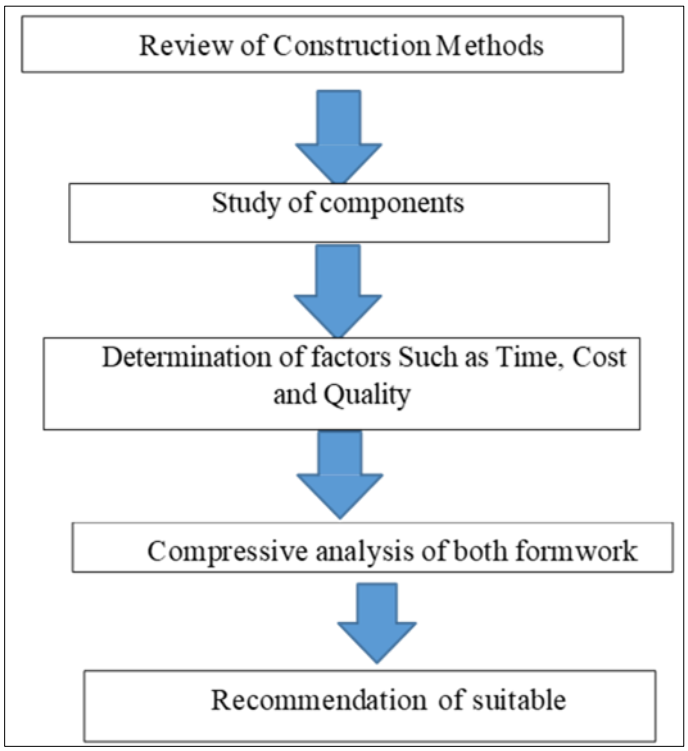
- Laghari, W., Baharum, M. R. & Mahamad, A. A. (2017). Enhancing productivity in construction industry: A critical review of lean construction.
- Nourbakhsh, P., Abbasi, R., Taheri, M. & Hejazi, T. H. (2020). Comparative Analysis of Conventional Formwork and Mivan Formwork System for Construction Projects in Iran. Civil Engineering Journal

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.

3. Methodology



3.1. Erection of Aluminum formwork

Figure 1 Erection of wall panel

Figure 2 Fixing of wall panel

Figure 3 Slab decking

Figure 4 Fixing of deck panel

Figure 5 Removing wall tie

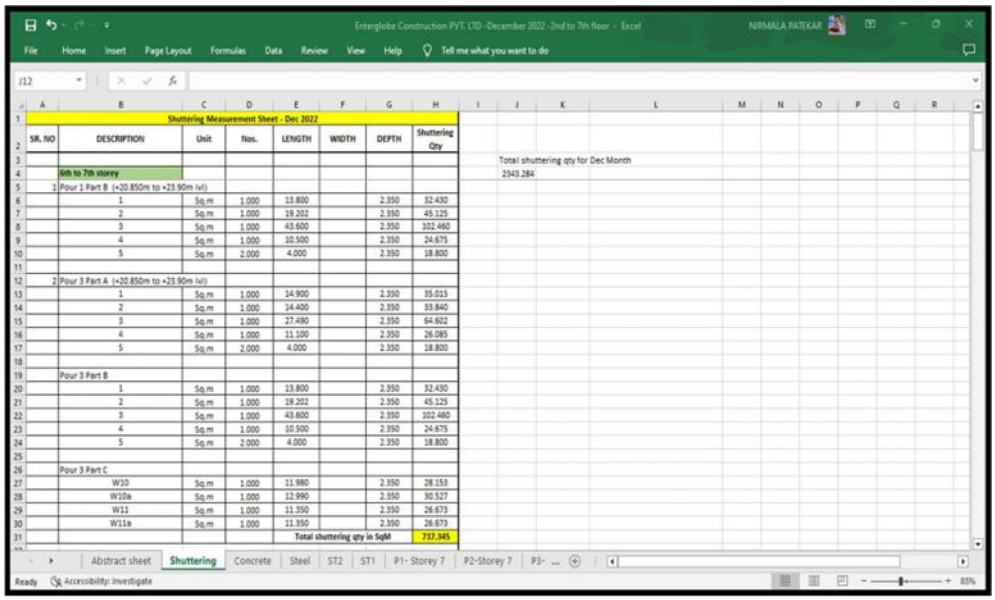
3.2. Erection of Conventional formwork

- Fixing of formwork Panels
- Fixing of Beam bottom
- Slab decking
- Supporting

Figure 6 Timber Plywood

Figure 7 Waler Beam

3.3. Experimental Study



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

Sheet 01 Excel Sheet for shuttering quantity

3.3.1. Shuttering area Calculation for A wing (Conventional Shuttering) Total

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

Figure 8 Conventional Shuttering Conventional

Material Requirement Cost & Labor Cost Material Cost Per SQM: 159 Rupees

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

3.3.2. 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

3.3.3. 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

3.3.4. Aluminum Material Requirement Cost& Labor Cost

Figure 9 Conventional Shuttering

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

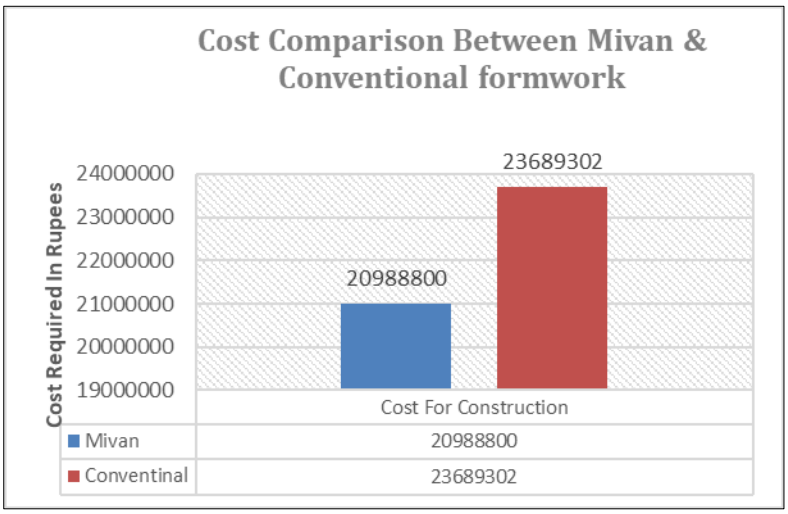
Labour cost for Formwork Making, shifting, lifting to any lead & lift, erection, support, for Column, beam & Slab conventional formwork area:350 rupees per Sqm

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 Ru



Graph 01 Comparison of cost

Advantages of using Mivan Formwork

- Time Savings: Mivan formwork, in particular, is known for its fast-paced construction process. The use of pre-fabricated components and systematic assembly techniques allows for quicker construction compared to traditional formwork methods. This time-saving advantage can lead to shorter project durations and earlier project completion.
- Cost Efficiency: Both conventional formwork and Mivan formwork offer cost advantages. Conventional formwork, with its use of readily available materials like wooden frames and plywood sheets, can be relatively cost-effective compared to more specialized formwork systems. Mivan formwork, although it may require higher initial investment, can result in long-term cost savings due to reduced labor and material requirements.
- Improved Quality: Mivan formwork, being a system that is precisely manufactured and assembled, can lead to higher quality concrete structures. The accuracy and consistency achieved through the use of Mivan formwork minimize variations and defects in the final output. This can result in superior finishes, improved structural integrity, and overall better-quality construction.
- Enhanced Safety: Both conventional formwork and Mivan formwork offer safety benefits. The use of standardized components and systematic processes in Mivan formwork reduces the chances of accidents and injuries. Additionally, the lighter weight and ease of handling in Mivan formwork can contribute to a safer working environment by reducing the physical strain on workers (Rai et al., 2019).
- Increased Productivity: The systematic nature of Mivan formwork and the use of pre-fabricated components can significantly enhance construction productivity. The repetitive assembly process and reduced reliance on skilled labor can lead to higher output rates and increased efficiency.
- Sustainability: Both conventional formwork and Mivan formwork offer sustainability advantages. Conventional formwork, especially when timber is sourced from sustainable forests and proper waste management practices are implemented, can be an environmentally friendly choice. Mivan formwork, with its reduced material consumption and potential for reusability, can contribute to resource conservation and minimize construction waste..

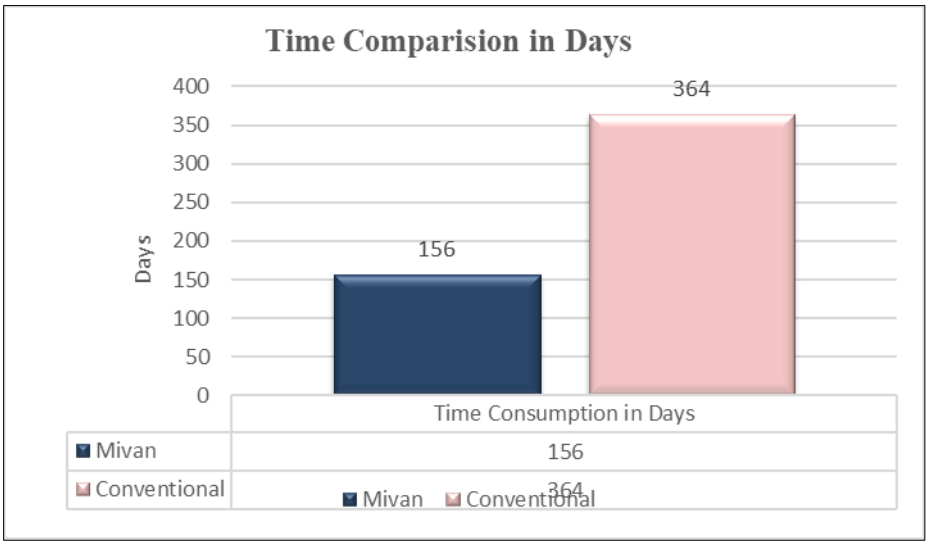
Disadvantages of using Mivan Formwork

- Initial Investment: Mivan formwork, in particular, often requires a higher initial investment compared to conventional formwork systems. The specialized components and equipment associated with Mivan formwork can result in higher upfront costs, which may pose a challenge for projects with limited budgets.
- Training and Skilled Labor: Mivan formwork, due to its specialized nature, may require skilled labor and proper training for its effective implementation. The need for trained workers proficient in Mivan formwork techniques can increase labor costs and may pose challenges in regions with a shortage of skilled workers.
- Design Flexibility: Conventional formwork offers more flexibility in terms of shaping and accommodating complex designs and architectural requirements. Mivan formwork, with its standardized components and assembly process, may have limitations in achieving intricate shapes or unique architectural features.

- Adaptability to Changes: Conventional formwork can be easily modified or adjusted to accommodate design changes or on-site alterations during construction. Mivan formwork, on the other hand, may require more planning and coordination to incorporate changes, as it follows a systematic assembly process.
- Suitability for Small-Scale Projects: Mivan formwork is often more suitable for large-scale construction projects where the benefits of speed and efficiency can be maximized. For smaller projects with limited resources or shorter durations, the higher upfront investment and specialized nature of Mivan formwork may not be justified.
- Reusability and Disposal: While both conventional formwork and Mivan formwork have the potential for reusability, Mivan formwork may require more careful handling and storage to ensure its longevity. Improper handling or lack of suitable storage facilities can reduce the reusability of Mivan formwork components. Additionally, the disposal of formwork materials, particularly plywood in conventional formwork, must be managed properly to minimize environmental impact.

Table 1 Time Analysis

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 02 Comparison of Days

4. Conclusions

- Mivan formworqk demonstrates significant benefits in terms of time savings, cost efficiency, improved quality, enhanced safety, increased productivity, and sustainability. Its systematic assembly process and use of pre-fabricated components contribute to faster construction, reduced labor requirements, and higher quality finishes. However, Mivan formwork may require a higher initial investment and skilled labor, and it may have limitations in design flexibility and adaptability to changes.
- Conventional formwork, on the other hand, remains popular due to its versatility and ability to handle complex shapes and designs. It offers cost advantages, particularly when using readily available materials. Conventional formwork allows for greater design flexibility and easier adaptability to on-site changes. However, it may require more labor and time, and the disposal of formwork materials must be managed properly.
- To enhance construction productivity and efficiency, a comprehensive assessment of the specific project requirements, budget constraints, available skilled labor, and desired architectural features is crucial. By considering these factors, construction industry professionals can make informed decisions about selecting the most suitable formwork system for their projects.

- Future research in this area should focus on further exploring the comparative analysis of conventional formwork and Mivan formwork, investigating their long- term cost-effectiveness, addressing any limitations of the formwork systems, and identifying strategies to overcome the challenges associated with their implementation. Overall, the assessment of formwork systems plays a vital role in optimizing construction productivity and efficiency, leading to successful project outcomes

Compliance with ethical standards

Acknowledgments

The successful completion of this research study, "Assessing the impact of conventional formwork and Mivan formwork on construction productivity and efficiency," was made possible through the collective efforts and contributions of various individuals and resources. We extend our heartfelt thanks to the construction workers, contractors, and project managers who willingly participated in interviews and provided essential data for this study. Their cooperation and willingness to share their firsthand experiences were instrumental in acquiring valuable and authentic information. We are grateful to the institutions and organizations that granted access to their academic journals, research databases, and reference materials. Their extensive resources facilitated an in-depth literature review, ensuring the study's credibility and relevance.

Disclosure of conflict of interest

No conflict of interest.

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