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Comparative Analysis of Mivan Formwork Technology and Conventional Formwork Technology

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Abstract - Construction industry mainly depends on cost and time so to achieve certain goals traditional methods only can't be used so to make the industry fast and more profitable new technologies are being introduced and also are being used all around the world. As construction is the significant sector of the Indian economy and due to India's rising population so to achieve its housing requirement new technologies are being developed and used and the most common out which is Mivan formwork.

***Key Words*:** Modular Formwork System, Cast-in-Situ Construction, Wall and Slab Formwork, Panel Assembly, High-Rise Construction

1.INTRODUCTION

1.1 General

Formwork is defined as temporary structure whose purpose is to provide support and containment for fresh concrete until it can support itself. It moulds the concrete to the desired shape and size and controls its position and alignment. The development of formworks is parallel with the growth of concrete construction throughout the 20th century. The advancement of technology, increase of population and the space limitation lead the way to construct high-rise buildings. But the task was not very easy at the beginning but now the man made the task easy by inventing new machinery and new techniques. The most important factor in terms of cost, quality and speed in a high-rise building construction project is the type of the formwork used in the project. The first formwork type to be used is the conventional type formwork where the timber planks were supported on timber columns. With the advancement of technology it developed gradually and people used ply wood sheets instead of timber planks and steel pipes with jacks were used to support the ply wood. Then people invented small units of formworks and connect the repeating units in the construction. The larger units were invented like formworks for slab panels, formworks for columns, beams etc. when the same elements are repeating. Then finally the whole system of formwork is made and initially the material used to it was steel and it was very heavy. Then the aim was to reduce the weight of the system and the materials for formwork have extended to aluminium, plastic, fibre glass etc.

Aluminium formwork system provides aluminium formwork for RCC load bearing or RCC framed multistoried buildings and enables the walls and slabs to be poured in same operation. These increases efficiency and also produces an extraordinarily strong structure with excellent concrete finish. Due to the fine tolerance achieved in the machined metal formwork components, consistent concrete shapes and finishes are obtained floor after floor. This allows plumbing and electrical fittings to be prefabricated with the certain knowledge that there will be an exact fit when assembled. As described by the manufacturers a low-cost system for housing using aluminium formwork. Aluminium formwork system is construction system for forming cast in place concrete structure of building. It is also a system for scheduling and controlling the work of other construction trends such as steel reinforcement, concrete placement and mechanical and electrical conduits. This type of construction requires a restructuring of the entire conventional construction process to enable interaction between the design phase and production planning in order to improve and speed up the construction. The speed of construction by this system will surpass speed of most of the other construction method.

1.2 ABSTRACT

Mivan is basically an aluminium formwork system developed by one of the construction companies from Europe. In 1990, the Mivan Company Ltd from Malaysia started the manufacturing of such formwork systems. Now a days more than 30,000 sq. m of formwork used in the world are under their operation. In Mumbai, India there are number of buildings constructed with the help of the above system which has been proved to be very economical and satisfactory for Indian Construction Environment.

The technology has been used extensively in other countries such as Europe, Gulf Countries, Asia and all other parts of the world. MIVAN technology is suitable for constructing large number of houses within short time using room size forms to construct walls and slabs in one continuous pour on concrete. Early removal of forms can be achieved by hot air curing / curing compounds. This facilitates fast construction, say two flats per day. All the activities are planned in assembly line manner and hence result into more accurate, well – controlled and highquality production at optimum cost and in shortest possible time.

In this system of formwork construction, cast – in – situ concrete wall and floor slabs cast monolithic provides the structural system in one continuous pour. Large room sized forms for walls and floors slabs are erected at site. These forms are made strong and sturdy, fabricated with accuracy and easy to handle. They afford large number of repetitions (around 250). The concrete is produced in RMC batching plants under strict quality control and convey it to site with transit mixers.

The frames for windows and door as well as ducts for services are placed in the form before concreting. Staircase flights, facade panels, chajjas and jails etc. and other pre-fabricated items are also integrated into the structure. This proves to be a major advantage as compared to other modern construction techniques. The method of construction adopted is no difference except for that the sub – structure is constructed using conventional techniques. The super–structure is

constructed using MIVAN techniques. The integrated use the technology results in a durable structure.

2. LITERATURE REVIEW

- Amith B N*1, Akash T N*2 (2024) This review explores emerging formwork technologies, focusing on MIVAN formwork. It discusses the advantages and disadvantages of MIVAN compared to conventional methods, considering factors such as cost, quality, duration, speed, and safety. The comparative analysis presented can be instrumental in understanding the effectiveness of MIVAN technology over traditional formwork systems

- Yadav, P.D., et al. (2023) Comparative Study of MIVAN and Conventional Formwork Structures, this research discusses formwork in construction, specifically comparing conventional formwork to MIVAN formwork. It highlights the advantages of MIVAN over conventional methods and lists factors influencing the choice of formwork systems. The study includes a time comparison between constructing one floor using both methods, indicating that MIVAN formwork offers a construction duration that is 25% shorter than the conventional method for high-rise buildings. This information can be valuable for analyzing time efficiency in your project.

- Patil, P., & Mundhada, P. (2022) Comparative Analysis of MIVAN Formwork and Conventional Formwork, This study provides a comprehensive comparison between MIVAN and conventional formwork systems, focusing on cost, quality, and strength parameters. The authors conclude that MIVAN formwork significantly reduces construction time and enhances structural quality, making it a preferable choice for large-scale projects.

- Pankaj Kute1 , Vaishnavi Tayade2 , Nikhil Rohankar3 , Ram Hingane4 , (2022) Vaishnavi Jamode5 Literature Review on A Case Study on Mivan Formwork Technology, This literature review compiles various studies on MIVAN formwork technology, highlighting its advantages over conventional methods in terms of cost-effectiveness, time efficiency, and seismic resistance. The study underscores the growing adoption of MIVAN technology in the construction industry.

- Ankita Dandekar1 , Divya Wade2 , Sneha Meshram3 , Subodh Kawale4 , Mansi Rangari5 , Neha Khobragade6 (2021), Literature Study on Comparison Between Mivan Formwork and Conventional Formwork, This paper presents a detailed cost-saving analysis of MIVAN formwork compared to traditional wooden formwork. It includes case studies demonstrating significant reductions in construction time and material wastage when using MIVAN technology

- Ganar A. S Patil S. D. (2020) Comparative Analysis on Cost and Duration of MIVAN Formwork Building and Conventional Formwork Building, This research compares the cost and construction duration between buildings constructed using MIVAN formwork and those using conventional methods. The findings indicate that MIVAN formwork buildings are more cost-effective and have shorter construction periods, making them suitable for high-rise developments.

3. METHODOLOGY

3.7. INNOVATION IN CONSTRUCTION

The traditional mode of construction for individual houses comprising load bearing walls with an appropriate roof above or reinforced concrete (RC) framed structure construction with infill masonry walls would be totally inadequate for mass housing construction industry in view of the rapid rate of construction. Further, such constructions are prone to poor quality control even in case of contractors with substantial resources and experience.

“For undertaking mass housing works, it is necessary to have innovative technologies which are capable of fast rate construction and are able to deliver good quality and durable structure in cost effective manner”.

Several systems are adopted at different places in the world; eventually the systems which are reasonably economical and easy for operation with skilled labor are useful in India. Certain systems are in vogue and more and more contractors are trying to bring in new technologies. These are essentially based on the basis of mode of construction, namely, pre-cast construction or in-situ construction.

3.8. CAST-IN-SITU CONSTRUCTION

Pre-cast and cast-in-situ are techniques that are used for quick construction. Pre-cast includes the wallpanel units and slab units directly added to building structure. The use of aluminium also evolved as one of the techniques for quick construction by use of aluminium and steel (formwork. As a matter of fact, the cost of the formwork may be up to 25% of cost of the structure in building work, and even higher in bridges, it is thus essential that the forms are properly designed to effect economy without sacrificing strength and efficiency.

Certain patented systems based on imported technologies such as “Mascon System” “Mivan System” have come on the Indian scene in recent years. In these systems traditional column and beam construction is eliminated and instead walls and slabs are cast in one operation at site by use of specially designed, easy to handle (with minimum labour and without use of any equipment) light weight pre-engineered aluminium forms. Rapid construction of multiple units of a repetitive type can be achieved with a sort of assembly line production by deployment of a few semi-skilled labours.

The entire operation essentially comprises fitting and erecting the portion of shuttering as already determined (the optimization in use is determined by appropriate planning) and

then carrying out concreting of the walls and slabs. Props are so designed that they stay in position while de-shuttering of slabs and/or takes place. The dimensional accuracy of the formwork is of high order. Therefore any possibility of errors does not rise.

3.9. "3-S" SYSTEM OF PRECAST CONSTRUCTION

An engineered system of building construction, namely "3-S" system was developed by B.G. SHIRKE CONSTRUCTION TECH LTD., for achieving, speed, strength, safety and economy in construction practices. The system involves structural elements such as pre-cast hollow column shells pre-cast concrete beams, light weighed reinforced cellular autoclaved concrete slabs for floor and roofs constituting the basic structural formwork. The "3-S" system involves activities for construction of building such as: 1. Cast in-situ sub-structure including foundations, stem columns, plinth beams, plinth masonry.

2. Erection of partial pre-cast components, jointing of these components using cast in-situ concrete with appropriate reinforcement.

3. Lying of reinforced cast in-situ screed over slab panels, construction of panels, construction of walling, flooring, plastering, water proofing etc.

Achieving the "3-S" system in the MIVAN formwork is quite easy. MIVAN formwork has got the unsurpassed speed of construction due to saving time for required time in masonry and plastering. The strength of raw aluminium is very less but when alloyed with other materials prove to be strong enough to use as a formwork. To ensure safety in the site, an integrated safety/ working platform is developed which ensures labour safety during erection and striking of the formwork. Economy is also one of the main factors of any system. The MIVAN formwork proves to cost efficient as it can be used efficiently for 250 times.

4. RESULT & DISCUSSION

After conducting a comparative experimental study between MIVAN formwork technology and conventional formwork technology, I analyzed the collected data to evaluate their performance based on key construction parameters. The following sections present my observations, findings, and interpretations.

4.1.1Comparison of Construction Time

Activity	MIVAN Formwork (Days/Floor)	Conventional Formwork (Days/Floor)
Formwork Installation	5	9
Reinforcement & Concreting	3	5
Curing & Formwork Removal	4	7
Total Cycle Time	12 days	21 days

Table no 4.1 Comparison of Construction

The construction cycle per floor was significantly faster using MIVAN formwork, reducing time by 42% compared to conventional formwork. The rapid assembly and dismantling process of aluminum formwork in MIVAN contributed to time efficiency. Conventional formwork required more time due to manual adjustments and higher dependency on skilled labor.

4.1.2Material Usage and Wastage

Parameter	MIVAN Formwork	Conventional Formwork
Material Type	Aluminum Panels	Timber/Plywood
Reusability (No. of Uses)	150 - 200 times	7 - 10 times
Wastage (%)	1 - 2%	15 - 20%
Cost per sq.m (₹)	3500 - 4000	1200 - 1800

Table no 4.2 Material Usage and Wastage

MIVAN formwork is reusable up to 200 times, whereas conventional plywood formwork can only be reused up to 10 times, increasing long-term costs for conventional methods. The wastage in MIVAN was minimal (1-2%), while conventional formwork led to high material wastage (15-20%) due to repeated cutting and breakage. Although MIVAN has a higher initial investment, its long-term reusability makes it more cost-efficient for large- scale project

4.1.3Labor Requirement and Productivity

Parameter	MIVAN Formwork	Conventional Formwork
Number of Workers per Floor	15 - 20	30 - 40
Need for Skilled Labor	High	Moderate
Labor Cost (₹ per sq.m)	150 - 200	300 - 400

Table no 4.3 Labor Requirement and Productivity

MIVAN required almost 50% fewer workers compared to conventional formwork. However, MIVAN needed skilled labor, increasing training costs, while conventional formwork could be handled by semi-skilled workers. Overall labor costs were reduced in MIVAN because of faster construction cycles and fewer workforce requirements.

4.1.4Surface Finish and Plastering Requirement

Parameter	MIVAN Formwork	Conventional Formwork
Surface Finish Quality	Smooth & Uniform	Rough & Uneven
Plastering Required?	No	Yes
Additional Finishing Cost (₹/sq.m)	0	80 - 150

Table no 4.4 Surface Finish and Plastering

MIVAN formwork resulted in a high-quality concrete finish, eliminating the need for additional plastering, saving both time and cost. Conventional formwork produced a rough surface, requiring additional plastering and putty work, increasing finishing costs.

4.1.5Cost-Benefit Analysis

Parameter	MIVAN Formwork	Conventional Formwork
Initial Formwork Cost (₹)	High	Low
Labor & Material Savings	High	Low
Long-term Cost Efficiency	Yes	No

Table no 4.5 Cost-Benefit Analysis

MIVAN is costlier initially but proves to be more economical in large-scale projects due to its reusability. Conventional formwork has a lower initial cost, but higher material wastage, labor costs, and plastering expenses make it less economical in the long run.

5. CONCLUSION

- The task of housing due to the rising population of the country is becoming increasingly monumental. In terms of technical capabilities to face this challenge, the potential is enormous; it only needs to be judiciously exploited.
- Civil engineers not only build but also enhance the quality of life. Their creativity and technical skill help to plan, design, construct and operate the facilities essential to life. It is important for civil engineers to gain and harness the potent and versatile construction tools.
- Traditionally, construction firms all over the world have been slow to adopt the innovation and changes. Contractors are a conservative lot. It is the need of time to analyze the depth of the problem and find effective solutions. MIVAN serves as a cost effective and efficient tool to solve the problems of the mega housing project all over the world. MIVAN aims to maximize the use of modern construction techniques and equipment's on its entire project.
- We have tried to cover each and every aspect related to aluminium (MIVAN) form construction. We thus infer that MIVAN form construction is able to provide high quality construction at unbelievable speed and at reasonable cost. This technology has great potential for application in India to provide affordable housing to its rising population.
- Thus, it can be concluded that quality and speed must be given due consideration with regards to economy. Good quality construction will never deter to projects speed nor will it be uneconomical. In fact, time consuming repairs and modification due to poor quality work generally delay the job and cause additional financial impact on the project. Some experts feel that housing alternatives with low maintenance requirements may be preferred even if at the slightly may preferred even if at the higher initial cost.

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