Comparison of the use of Traditional and Modern Formwork Systems

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ABSTRACT

Formwork, which holds and supports wet concrete till such time it cures, is a very vital element in concrete construction. With the globalization of Indian economy and introduction of multinationals in India for the construction and nations pride program of golden quadrilateral, it has become foremost to have speedy construction and timely completion of projects. Now days, low waste modern formwork systems for superstructure construction are commonly adopted. Formwork system affects on the cost, time, and quality of project delivery. But still these formwork systems are not much used in India and most of the contractors do not like to shift to the latest technology as they have the doubt of facing losses in the project and they are very much familiar with the existing formwork type, the conventional type. At the same time they believe that these formwork systems are bit expensive.

This paper aims to compare merits and demerits by using a conventional timber formwork system and modern formwork systems. The comparisons include costs, time, and quality of these systems. For better understanding of this topic, different construction sites are studied where most advance techniques in formwork are used and the data collected from these sites is presented in order to give comparison between modern formwork and traditional formwork system.

Keywords: formwork; Conventional Timber Formwork; modern formwork systems.

1. INTRODUCTION

Indian construction industry has started using some of the world class technologies. Several formwork systems are in use at different places in the world; eventually the systems which are reasonably economical and easy for operation with skilled labour are more useful in India. Formwork system has significant role in the construction process, making the right decision by choosing the appropriate formwork system could lead to response to sustainable construction. Different systems have their own advantages but one needs to choose a formwork which best supports individual project requirement.

Shortage/non availability skilled and semi-skilled workers results in problems of cost and time over-runs, inferior construction, poor finishes leakages, corrosion of structures etc. this can be avoided by adopting modern formwork systems. This also avoids repairs and rehabilitation of structures before its expected life span.

2. FORMWORK SCENARIO IN INDIA

- Low technology
- Labour intensive
- Labour-unskilled, migratory, traditional and family oriented
- Absence of monitoring body.

3. CONVENTIONAL FORMWORK

This usually consists of standard framed panels tied together over their backs with horizontal members called waling. The waling is provided with the basic function of resisting the horizontal force of wet concrete. One side of the wall formwork is first assembled ensuring that it is correctly aligned, plumbed and strutted. The steel reinforcement cage is then placed and positioned before the other side of the formwork is erected and fixed. Plywood sheet in combination with timber is the most common material used for wall formwork. The usual method is to make up wall forms as framed panels with the plywood facing sheet screwed on to studs on a timber frame. This allows for the plywood to be easily removed and reversed and used on both sides so as to increase the number of reuses. The wall forms are susceptible to edge and corner damage and must be carefully handled. Special attention must be given to comers and attached piers since the increased pressures applied by wet concrete could cause the abutments to open up, giving rise to unacceptable grout escape and a poor finish to the cast wall.

4. NEED FOR MODERN FORMWORK SYSTEMS

The earliest formwork systems made use of wooden scantlings and timber runners as it enabled easy forming and making at site. But these wooden scantlings and timber runners tend to lose their structural and dimensional properties over a period time and after repeated usage thus posing safety problems.

Many of the accidents take place in Reinforced Cement Concrete (RCC) construction because of inferior formwork and scaffolding.Now focus has to be shifted to other key factor “Formwork”, to face the challenges for the completion of fast track projects. By going in for system formwork, substantial savings are possible by faster return on investments.

5. MODERN FORMWORK SYSTEMS

1. MIVAN Technology
2. Tunnel Formwork
3. Climbing formwork
4. Flex formwork
5. Heavy duty tower system
6. Slab formwork
7. Column formwork system

For residential & commercial projects mostly MIVAN & Tunnel Form is used because of less cycle time as compare to all these form work systems. The scope of study of this paper is limited to only MIVAN Technology & Tunnel Formwork.

6. MIVAN TECHNOLOGY

MIVAN is a aluminium formwork technology. MIVAN system is 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). Theconcrete is produced in RMC batching plants under strict quality control and convey it to site with transit mixers.

Formwork systems for buildings are classified as either horizontal or vertical formwork. Horizontal formwork systems are those used to form the horizontal concrete work (slabs or roofs), while vertical formwork systems are those used to form the vertical supporting elements of the structure, e.g., columns, core walls, and shear walls.

Due to the fine tolerances achieved in the machined metal formwork components, consistent concrete shapes and finishes are obtained floor after floor, building after building, confirming to the most exacting standards of quality and accuracy. This allows plumbing and electrical fittings to be prefabricated with the certain knowledge that there will be an exact fit when assembled. The dimensional accuracy at the concreted work also results in consistent fittings of doors and windows.

The system of Aluminium forms has been used widely in the construction of residential units and mass housing projects. It is fast, simple, adaptable and cost – effective. It produces total quality work which requires minimum maintenance and when durability is the prime consideration. This system is most suitable for Indian condition as a tailor–made aluminium formwork for cast–in–situ fully concrete structure.

Fig.1: Mivan Formwork

7. TUNNEL FORM TECHNOLOGY

It is a highly efficient Industrialized System of On-Site Construction, which enables putting-up stable structure on a 24-Hour cycle basis Tunnel form is a formwork system that allows the contractor to build monolithic walls and slabs in one operation on a daily cycle. It combines the speed, quality and accuracy of factory/offsite produced ready-mix concrete and formwork with the flexibility and economy of cast in-situ construction.

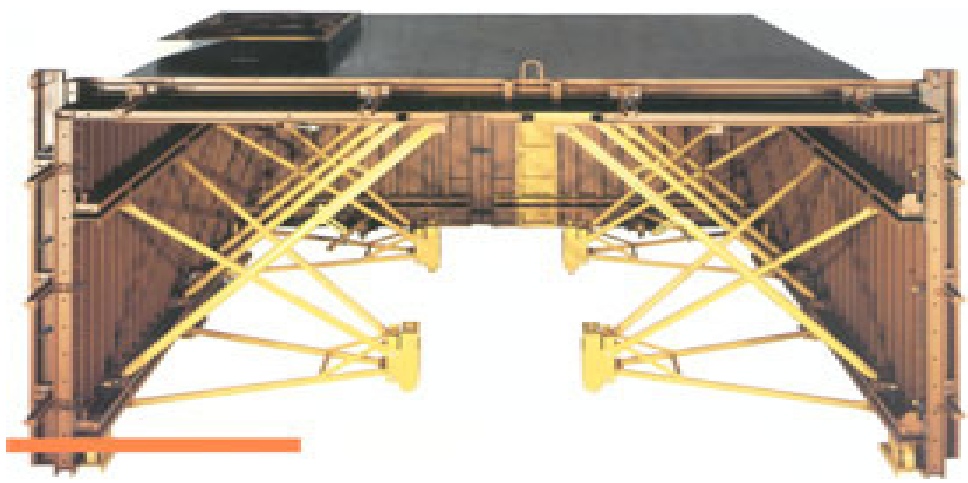

Fig.2: Tunnel Formwork.

This fast-track method of construction is suitable for repetitive cellular projects, such as hotels, apartment blocks and student accommodation. It offers economy, speed, quality and accuracy, as well as utilising the inherent benefits of concrete, such as fire and sound resistance.

Tunnel Formwork System: Tunnel formwork system is one type of construction techniques used for multi storied building construction to reduce cycle time and also the slab & the wall are cast monolithically. Its components are made of steel. Its usefulness also stems from the fact that no starter concrete is required for walls; it allows easy alignment and de-shuttering, hot air curing to enable early stripping and favours a standardized working sequence to improve labour productivity.

Fig.3: Half Tunnel Formwork.

Tunnel form can accommodate room widths from 2.4 to 6.6m. When rooms are wider (up to 11m), a mid-span table is incorporated between the tunnels. The main component of the system is the half tunnel. Manufactured entirely from steel, including the face of the form, the half tunnel provides the rigidity and smooth face necessary to produce a consistently high quality finish to the concrete. When two half tunnels are put together this creates a tunnel. The tunnel sections come in two lengths, 1.25 and 2.5m. These are fixed together to produce a tunnel length that suits either the building dimensions. The tunnel is tailored to the room width and height by the inclusion of infill sections which are sacrificed at the end of the job. These are not loose fittings but are an integral part of the tunnel.

8. MATERIAL WASTAGE IN CONSTRUCTION

Table 1: Percentage of Material Wastage in Construction.

Description	Percentage (%)
Formwork	27.5
Finish Work	20.0
Concrete Work	13.3
Masonry Work	13.1
Material Handling	10.1
Scaffolding	8.9
Hording	7.1

Table 2: Ranking for wastage of materials at site

(Rank 1 – Most Waste, 7 – Least Waste)

Construction Process	Rank
Formwork	1
Finish Work	2
Concrete Work	3
Masonry Work	4
Material Handling	5
Scaffolding Work	6
Hoarding	7

9. COMPARISON

Sr. No.	Characteristics	MIVAN System	*Tunnel Form Technology*	Conventional Formwork System
1.	Speed of construction	Four days cycle per floor.	One day's cycle per floor.	Min. cycle time is of 21 days.
2.	Quality of surface finish	Excellent. Plastering is not required	Excellent. Plastering is not required	Bad. Plastering is required
3.	Pre-planning of formwork system	Required	Required	Not required
4.	Type of construction	Cast-in-situ Cellular construction	Cast-in-situ Cellular construction	Simple RCC framed construction
5.	Wastage of formwork material	Very less	Very less	In great amount.
6.	Accuracy in construction	Accurate construction	Accurate construction	Accuracy is Less than Modern Systems

7.	Coordination between different agencies	Essential	Essential	Not necessarily required
8.	Resistance to earthquake	Good resistance	Good resistance	Less than Modern Systems
9.	Removing of floor slab forms without removing props	Possible	Possible	Not possible
10.	Need of any timber or plywood	Not required	Not required	These are the main components
11.	Re-usage value of formwork	250 – 300	300 – 350	Maximum 50
12.	Suitability for high rise construction	Very much suitable	Very much suitable	Not suitable
13.	Initial investment in the system	High	High	Less
14.	Economy in construction	Economical for mass housing	Economical for mass housing	Economical on small scale

10. CONCLUSION

Different formwork systems provide a wide range of concrete construction solutions that can be chosen to suit the needs of a particular development. Traditional formwork for concrete construction normally consisted of bespoke solutions requiring skilled craftsmen. This type of formwork often had poor safety features and gave slow rates of construction on-site and huge levels of waste – inefficient and unsustainable. Modern formwork systems, which are mostly modular, are designed for speed and efficiency. They are engineered to provide increased accuracy and minimize waste in construction and most have enhanced health and safety features built-in. The main systems in use are Mivan technology and tunnel form. This guide sets out their key features – process efficiency, safety, sustainability and other considerations – in order to help construction professionals to take advantage of them to achieve modern, efficient concrete construction.

By using MIVAN system & Tunnel Form system we can achieve cost reduction in less time. By reducing cycle time than conventional method overall financial cost saving can be achieved.

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