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A REVIEW ON FAST TRACK CONSTRUCTION USING MODERN FORMWORK SYSTEMS

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ABSTRACT

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. Conventional methods of construction can't cope up with the demands of infrastructural facilities with a high degree of quality control and quality assurance. The demand for residential housing is also on the increase and to cater for such demand also, conventional construction fails in providing required number of dwellings in time. Latest construction technology of fast and speedy construction is the only solution to this problem. Industrial construction system-the stat of the art technology is the only replacement over conventional system of construction to bridge the gap between demand and supply of residential houses. Infrastructure facilities such as roads, bridges, power etc.

Keywords— speedy construction, timely completion, quality control and quality assurance, infrastructural facilities, skilled and semi-skilled workers, fast track construction etc.

I INTRODUCTION

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. Conventional methods of construction can't cope up with the demands of infrastructural facilities with a high degree of quality control and quality assurance. The demand for residential housing is also on the increase and to cater for such demand also, conventional construction fails in providing required number of dwellings in time. Latest construction technology of fast and speedy construction is the only solution to this problem. Industrial construction system-the stat of the art technology is the only replacement over conventional system of construction to bridge the gap between demand and supply of residential houses. Infrastructure facilities such as roads, bridges, power etc.

Shortage/non availability of 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 adapting industrialized system of construction. This also avoids repairs and rehabilitation of structures before its expected life span. The normal process of construction scheduling involves the performance of a series of discrete functions, one after the other, in a predetermined sequential order. The customary logical order of these functions is programming, design, governmental approvals, bidding and negotiations, contract award,

construction, and finally, completion. This is shown on the first line of the accompanying diagram. Each activity is virtually is completed before the next may be commenced. To perform all of these functions will take a certain amount of time.

The usual way of shortening the time scale is by increasing productivity, that is, by completing each function as efficiency as possible and starting each new phase immediately upon completion of the preceding phase. Everything is done in proper order and no time is wasted. Another way of saving total elapsed time would be by compression of the time schedule. That is, by overlapping some of the functions, doing two things at the same time. This would be accomplished by starting a new phase of work where possible before the preceding phase is completed. Time saved by concurrent work will accumulate and appear at the end of the construction period in the form of early overall completion.

Organizing the project to produce early completion by the technique of concurrent or overlapping time scheduling is the essence of fast track construction.

II NECESSITY AND SCOPE OF WORK

2.1. Scope Of Work

Traditional build only type of contracts, where design and drawing are provided by the client to the contractor, is viewed by clients as time consuming, capital intensive and risky, especially for high cost infrastructure projects.

As the topic fast track construction is very vast, the scope of study is limited as far as this seminar is concerned. The scope of study of this seminar is limited to certain areas in fast track construction techniques as Form work systems.

2.2. Advantages

2.2.1. Speed

Speed of construction in case of industrialized constructions much more in comparison of conventional construction. 40 percent time can be saved in single storey house whereas 25 percent to 40 percent for multi-storied buildings. This is on account of simultaneous activities so-also time required for erection and de-erection of centering eliminated.

2.2.2. Cost Reduction

Better resource management, saving in labour and elimination of centering achieves 15% to 25% reduction in cost of construction.

2.2.3. Use of Scarce Material

Scarce materials are possible to be used since designs of standard components could be optimized.

2.2.4. Better Quality Control

Strict quality control can be exercised for production of building members.

2.2.5. Lesser Maintenance

On account of good quality of product very little maintenance is required.

2.2.6. High Productivity

Streamline organization, better working conditions and optimum use of resources results in improved productivity.

2.2.7. Assured Required Strength

Generally, because of the fact that handling stresses are more than working stresses and since the members are handled number of times before erection the members get tested for their strength.

2.2.8. Increased Output

High output of members on due to mechanization and hence reduction of gap between demand and supply.

III SYSTEM DEVELOPMENT

3.1Fast Track Construction Techniques

3.1.1 Formwork Systems

Concrete has proven to be the best construction material for various types of structure and the foundations, because of its inherent properties like fire resistance, resistance to weathering etc. Concrete allows unfettered, imaginative contemporary architectural design.

Formwork is died or mould for concrete. It is also a temporary structure to support concrete and construction loads until concrete sets and becomes self- supporting. This formwork is an important enabling work, which has to keep pace with the modernization of concrete construction.

The use of system formwork permits the casting of larger elements in a single pour. Such formwork systems have a number of advantages: They are stiffer and stronger than conventional formwork, are amenable to systematic design, permit large number of repetitions, can be easily and speedily erected and dismantled by less skilled crews, etc. All this leads to overall economy and faster construction as well as high quality of construction. For instance, the L&T Doka system formwork permits the casting of columns and walls up to 7 m height in a single pour. Tremie pipes are used for placing of concrete by crane bucket and for pumped concrete an elephant trunk is used. Needle vibrators with extra-long cables are used for effective vibration. While conventional methods of formwork for casting slabs demand provision of scaffolding or staging from the floor below, use of left-in, self-supporting steel formwork enables faster construction. While in the former case the floor below cannot be used for any other purpose as long as the staging is in place till completion of curing, the latter method helps in early release of the floor below for other activities.

Formwork Scenario in India

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

3.1.2 Need for 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.

3.1.3 System Formwork

There are many leading system formwork manufacturers in the world to name a few, Doka, Peri, Dunne, Mivan and Theysson Hunaback Noyek. Larsen & Tubro Limited (L&T) Doka Formwork system is one of the popular systems being manufacture in India.

Advantages:

1. Number of times reusable than timber.
2. Light weight.
3. Mechanization of construction.
4. Highest standard of safety.
5. Less labours.
6. Great accuracy and good finish.

Disadvantages:

1. Use of skilled labours is absolutely necessary as it is new technology.
2. This system cannot be used in small projects as it is not profitable.
3. It is somewhat difficult to use this technology, when there is large variation in forms.

3.2 Aluform Technology

Aluform 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). The concrete 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 Aluform 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 Aluform formwork for cast–in–situ fully concrete structure.

Stages - The system usually follows a four-day cycle

***Day 1*: -**The first activity consists of erection of vertical reinforcement bars and one side of the vertical formwork for the entire floor or a part of one floor.

***Day 2*: -**The second activity involves erection of the second side of the vertical formwork and formwork for the floor

***Day 3*: -** Fixing reinforcement bars for floor slabs and casting of walls and slabs.

***Day 4*: -**Removal of vertical form work panels after 24hours, leaving the props in place for 7 days and floor slab formwork in place for 2.5 days.

3.3 Tunnel Form Technology

Outinord is the world leader in the design, manufacture and supply of steel formwork systems. Outinord is formed in 1955 & pioneered Tunnel form construction technology from 1959. Outinord is certified by ISO 9001, Quality Certification**,** 1995.

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.

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 utilizing 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.

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. [6]

Advantages:

1. Lower labour cost.
2. Lower materials cost compared to ply & timber (ply wood is very expensive & repetition is low, whereas steel can be used as many as 500 times) Faster construction
3. One-day cycle is achievable by hot air curing.
4. After initial learning for about 12 cycles, activities become routine & fast
5. Easy placing & stripping.
6. Excellent concrete surfaces finish achievable.
7. Ideal for multi storied typical building.

Disadvantages:

1. Initial learning time for the labourer.
2. Accurate fabrication of form is required
3. Accuracy in assembling is required.
4. Operations are crane dependent.
5. Proper pre planning of architectural details required.
6. Requires good co-ordination between structural designer & form work (F/W) engineer.
7. Tower Crane Requirement for shifting of porticoes & wind wall panels from one phase to another
8. Shifting of rolling tacks & Gable platforms.
9. Lifting reinforcement cages for walls & slabs.
10. Shifting of Hot air blowers & tarpaulins.

IV CASE STUDY

Infrastructure development in India has set off in a major way in the last two Years and is witnessing impressive growth across various segments. Construction sector to be the biggest beneficiary of the infrastructure boom.

To construct this massive & huge sort of construction in a very short time we required to adopt Fast track methodology. By conventional method we required more time to complete the project, In this methodology we crash the duration of project by applying latest material, equipment which is effective, durable & apply faster way with balancing the quality. Although the Fast Track construction method has the potential of saving time, there can be no reasonable expectation of always saving money. The financial saving is primarily in the value of the time saved, if it materializes.

4.1 Case Study for Aluform Technology

Location of site – Victoria Garden, near Agakhan Palace, Kalyaninagar Pune.

Name of the contractor: - M/S Naiknavare Associates.

Technical details:-

- Time required to complete one floor 1 week.
- Area of one floor is 142.30 Sq. M (1531 sqft.)
- One slab of 50 cum is casted in 8 hours.

- Total labour required is 50, with much concentration on skilled labour.
- Cement used is of L&T company 53 grade.
- The concrete has the properties, Water Cement (W/C) ratio 0.53, Grade M20, Slump 120cm. 7 days strength with 1 day side formwork removal.
- The building is of 11 storey's, with 2 floors of parking.
- The cost of one flat was around 70 lakhs.

Site engineer: Mr. Walunj

Wall formwork in position with door openings

Wall formwork in position with window openings

Slab & beam support formwork

Finished Building

4.2 Case Study for Tunnel Form System

Some of the towers in L&T South city, Bangalore, a 19 floor residential building was constructed using Tunnel Formwork. The tunnel form system was identified as the most suitable formwork system for the construction of this multi-storeyed building. A floor in the building consists of 8 flats of approximately 92.90 Sq.M.(1000 sq.ft) each. The building is symmetrical in two perpendicular axes and there is a repeating module of quarter portion in the building. Since the area of a quarter is almost 185.80 Sq.M.(2000 sq.ft) which is too big for a single pour of tunnel form, it was decided to have two pours with two independent sets of tunnel form following each other closely with a lag of one day. There are non-repeating and sunken portions in toilets and corridors of the building, which had to be done independently by conventional formwork closely following the tunnel form. A tower crane located near stairwell was used for shifting the tunnel form material within the building for different pours.

At peak speed, the 8 pours of tunnel form in a floor were completed in 9 days' time, which is almost 1 flat per day construction speed. The accelerated curing was carried out using hot air blowers. If a conventional formwork system was used in the above building, each floor would have taken one-week time to complete if material was mobilized for one quarter of the floor. This means a floor would have 4 weeks' time to complete. So usage of tunnel formwork system could save on an average 2 weeks of construction time for every floor. This is almost 9 to 10 months of construction time saving for the 19 storied building.

We are present using tunnel formwork in our L&T Eden Park residential project in Siruseri, Chennai. Mechanization of Construction activity at site is the order of the day and Formwork is an important component which needs mechanization. By using System formwork or similar and advanced formwork like tunnel formwork requires less usage of skilled labour and faster cycle time can be achieved.

Mr.S.Gunasekaran,Head – Construction Engineering Services Cell,L & T, ECC Division, Manapakam, Chennai
Mr.K.V.Srikanth,Manager – Formwork Marketing,L & T, ECC Division, Manapakam, Chennai.

Construction is in Progress

Completed Construction of L&T

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

CONSTRUCTION PROCESS	RANK
Formwork	1
Finish Work	2
Concrete Work	3
Masonry Work	4
Material Handling	5
Scaffolding Work	6
Hoarding	7

Table Showing % of Material Wastage in Construction Rank: 1 – Most Waste , 7 – Least Waste

4.3 Comparison

Sr. No.	Characteristics	Aluform System	Tunnel Form Technology	Conventional Formwork System
1.	Speed of construction	Four days cycle per floor.	One days 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.	Application of the system	Useful for mass housing	Useful for mass housing	Useful for minor construction works
14.	Initial investment in the system	High	High	Less
15.	Costing of the system	Rs. 670 / Sq. M 10 to 15 % saving than conventional technique	Rs. 640 / Sq.M 15 to 25 % saving than conventional technique	Rs. 750 / Sq.M
16.	Economy in construction	Economical for mass housing	Economical for mass housing	Economical on small scale

V CONCLUSION

Many developments in construction techniques emphasizes us towards fast track construction. Briefly stated, fast tracking compresses the project schedule by running design and construction phases simultaneously. Fast-tracking streamlines permitting and construction so that custom buildings can be built, occupied and operational in as little as six months. This is at least 50 percent (%) less time than the typical non-fast-track construction time of 12-18 months or more.

By using Fast track construction techniques, we can complete quality work rapidly with less cost. By using Aluform 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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