

PLANNING AND SCHEDULING OF SHUTTERING SYSTEM FOR MULTI-STOREYED BUILDING

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Abstract - In the process of developing our country the most significant sector in Indian economy is construction. In a construction project common type of temporary structures are used is a concrete formwork.. The wood, steel, aluminum and prefabricated forms mould are created and concrete is poured in them and allowed to harden. It is relatively quick in construction of the support structures and parts of the building which needs to be strong. Now days selection of suitable formwork for a construction is selected based on the factors like maximum usage, initial and maintenance cost, time required for erection and dismantling, suitability for labors to use. The standard of the construction industry is raised with the use of aluminum and prefabricated formwork. The main aim of this project is to determine which type of formwork is suitable for type of construction and which have less effect in project duration and cost.

Key Words: Theory of Constraints, Critical Chain project Management, Buffer Management and Microsoft Project.

1. INTRODUCTION

As we all know the formwork is a temporary structure, which as aim to support the concrete until it can stand by its own weight. A supporting structure including a mould or die is used to attain required strength by shaping and supporting the concrete to carry its own weight. Structure should be cable of carrying imposed, dead and live loads apart from its own weight. For proper prevention of leakage, cracking or uneven surface while it is setting, concrete shuttering is done. After the concrete has been set with the use of rods or other security components the piece of shuttering material is stored in place. Firstly a plan must be developed during the process of concreting and then which type of formwork need to be used should be determined. The most common type of formwork used is plywood, because it is less expensive, water resistant, it can be easily handled by the labours and can be easily transported to one place to another. In a construction project, the cost, speed and quality of a project are based upon the type of formwork used for building the structure. At present the use of modern formwork is becoming a trend, it is suitable for tall high rise buildings. Modern formworks might be costlier than the conventional types, but they have the ability to reduce the time duration of the project. Timber formwork were the first type of formwork to be used in the construction and later

plywood sheets were used with the advancement of technology. For slab, columns and beams the larger units of formwork were invented and the materials used was steel. The steel formwork used were very heavy in weight , to reduce the weight of formwork the material used were aluminum, plastic, fibre glass etc. The fundamental principle which apply to all types of formworks is selection of appropriate materials, standards of workmanships, ease of erection and stripping, proper care and maintenance so that the it can reuse for maximum number of times. By adopting new technology of formwork prevention of repairs and rehabilitation of structure will reduced.

Now in modern era the consumer selects the formwork material based upon its ability to be reuse number of cycle to get results in early completion with effective cost and better durability of super structure. The influence on concrete strength greatly depends on the rate of water absorption by the material of formwork, so it's necessary to choose the formwork wisely.

1.1 Conventional Formwork

Before the technology took place timber was the most used type of formwork in the construction project in India. And later as time progressed, plywood and steel formwork came in to existence due to the increase of cost of timber and also depleting forest reserves. The factors affecting the selection of type of material to be used depends on the nature of construction and availability of materials. The types of conventional formwork are:- timber, plywood, steel, plastic

1.2 Mivan technology

A Malaysian company manufactured the aluminium formwork. The index of any country could be consider as the progress made by the construction industry. Mivan technology is one of the most commonly used advanced technology all over the world. The use of conventional formwork for mass building construction was appearing to be very difficult task with increase in cost, time, labour requirement etc. For a quick and good quality durable structure in cost effective way, Mivan technology was used for mass construction. In India, the system with reasonably economical and easy for operation with skilled labour is suitable and adapted.

Mivan technology produces good quality structural work with maximum durability and minimum maintenance required. It is continuous casting of column slab and wall in one pour process of concrete. By the process of air curing earlier dismantling of formwork can be achieved. Aluminium is used to make all the components of formwork which makes it light in weight and also more number of times repetitions can be possible. As they are of light in weight dismantling can be done with ease and is simple, in other words it is short and simple cycle. This system as the complete methodology well planned to its finest details. The one of the main characteristics is that it makes the use of concrete as principal building material for the prime reason in cost and accessibility of cement and sand which are available easily. The use of appropriate grade of cement can be beneficial to build quality and strength, resistance to earthquake and fire, low noise transmission with the better thermal capacity, giving a longer life with minimum maintenance services.

1.2.1 Components of Mivan technology

Beam components

1. Beam side panel
According to the size of the beam the cutting is done to form a rectangular structure.
2. Prop head for soffit beam
For easy dislodging of the formwork V-shaped head is used.
3. Beam soffit panel
It support the soffit beam and is a plain rectangular structure of aluminium.
4. Beam soffit bulk head
It is used to carry the bulk loads.

Wall components

1. Wall panel
An aluminium sheet which forms the face of the wall is carefully and properly cut to fit the size of the wall.
2. Rocker
It is of L-shape and also a supporting component of wall.
3. Kicker
It act as a ledge to support and at the top of the panel it forms the wall face.
4. Stub pin
It helps in joining of two wall panel together.

Deck components

1. Deck panel
It forms a horizontal surface for safety of workers and for casting of slab.
2. Deck prop

It is a supporting component of deck and also it bears all the loads coming on deck. It is prop head with V-shaped form.

3. Prop length
It is a length of the prop and it depends on the slab length.
4. Deck mid
It helps in supporting and to hold the concrete in the middle portion of the beam.
5. Soffit length
It support the edges of the deck panel.

1.2.2 Working of Mivan technology

Step 1:- Shuttering detailed drawings is provided and before manufacturing or fabrication all the building architecture and structural drawings are freeze. If any revision in drawing during the execution of work it will be cumbersome.

Step 2:- When marking of columns is done by the surveyor, the fixing of Mivan shuttering is done after the reinforcement column work is completed

Step 3:- Reinforcement of beams, slabs and conduit work takes place after fixing and erection of vertical wall panels.

Step 4:- Pouring of concrete take place after the slab and beam shuttering with conduit work is done.

1.2.3 Features of Mivan technology

1. Sheet thickness and size of panel

- The concrete wall panel is 4mm thick.
- 2000*600, 2000*300, 1200*300, 850*300 are the standard sizes of panels.
- Any other required size as per the requirement can be manufactured and delivered to the site.

2. Load carrying capacity

- It has 7-8 tonnes per square meter capacity.
- Due to use of aluminium as a material, it is light in weight.
- It weigh around 18-20kg per square meter.

3. Striking time

- Vertical formwork - 12hours after concreting or when concrete attains a strength of 2N/mm²
- Horizontal formwork - 36hours after concreting or when concrete attains a strength of 10N/mm²

1.2.4 Advantages of Mivan Technology

- Uniformity in all components of structures.
- Casting of all structural member is done at a single pour of concrete.
- Scrap value is high.

- Can be erected using unskilled labours and without the removing of props, deck panel can be removed

1.2.5 Disadvantages of Mivan technology

- Due to casting of all members, any modification is not possible to carry out.
- Due to presence of shear wall, heat of hydration is high.
- Initial cost is high
- Not suitable for small scale projects.

1.2.6 Advantages of Mivan technology over conventional formwork

- More seismic resistance - For the structural member the box type construction provides more seismic resistance.
- Durability of concrete structure is more.
- Due to minimum number of joints, leakage of concrete is reduce and durability is enhanced.
- The carpet area is high due to thin shear wall.
- Finishing is smooth of slab and wall, hence eliminates the plastering work.
- Uniform quality of construction and uniform grade of concrete.
- No further maintenance required due to strong built concrete.
- Lesser labour required.
- As a better sound transmission co-efficient.

2. METHODOLOGY

With the help of set questionnaires data was collected. A case study was conducted on a residential building, to find the survey and to assist in providing the information about the building cost comparison study. Questionnaire method was adopted for the appropriate approach for this study the case study was conducted on a residential building which was using Mivan technology. The quantity of columns, beams and slabs have been calculated using excel sheet, the total quantity of columns, slabs and beams are collected and table is prepared to do comparison between the conventional and Mivan formwork. The rates of Mivan technology is taken and applied from the Mivan manufacturing company. The table is prepared to compare cost of conventional formwork and Mivan technology. With the help of Microsoft project software the duration and cost is calculated. And further conclusion is made on which formwork is cost efficient, speedy construction, better finished quality, low maintenance.

Hence to determine the importance of selection of formwork, a case study is taken to analysis and determine the best available and suitable technique and then with respect to cost and time a correlation is established.

- Selecting a typical floor plan and calculating the area quantity of columns, beams and slabs.
- Determining the various formwork can be adopted and their cost and time analysis can be calculated.
- The factors like duration, economy, strength etc are to be taken into consideration for selection of formwork.
- The total cost required for various formwork technique is calculated.
- Evaluation of time is done on the basis of per cycle time taken by the formwork

2.1 Area of cost reduction in formwork

- Planning for maximum number of reuse:- The cost of the total formwork can be reduced by designing the formwork for maximum reuse.
- Economical formwork construction:-
 - ✓ By using shop built formwork they provide greater efficiency in working condition and in use of materials and tools.
 - ✓ Reducing transportation cost by providing shop area on the site.
 - ✓ For larger number of reuse prefabricated formwork need to be purchased
 - ✓ Flexibility in regulating volume of work.
- Setting and stripping:- For quick and easy assembling and dismantling of formwork use of metal camps or special wedge pin are secured. The handling, erection and stripping process can be easier by providing handle, lifting grip etc.
- Cranes and hoist:- Size of formwork should be less than the capacity of the machinery equipped.
- Bar bending:- Before the installation, formwork should be design so that it should permit pre-assembling of the rebars.
- Placing of concrete:- For the wall construction, high lifts are required for placing and vibration of concrete.

2.1 Case Study

Project:- Residential building
 Location:- Mumbai
 Design Consultant:- J+W Consultant
 Built up area:- 675.779sqm
 Number of storey:- G+21 floors

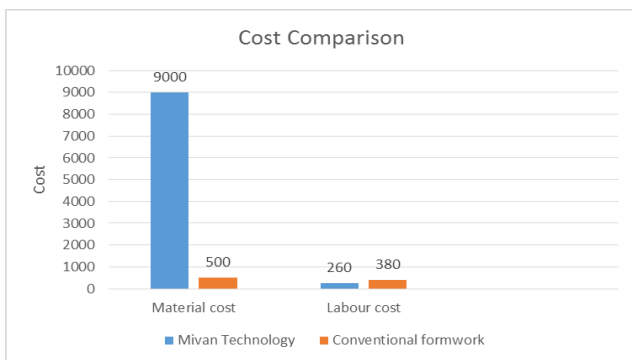
2.2 Cost Analysis

Table-1 Cost analysis and comparison

Sl. No	Description	Unit	Mivan technology	Conventional formwork
1	Material cost	Sq.	9000	500

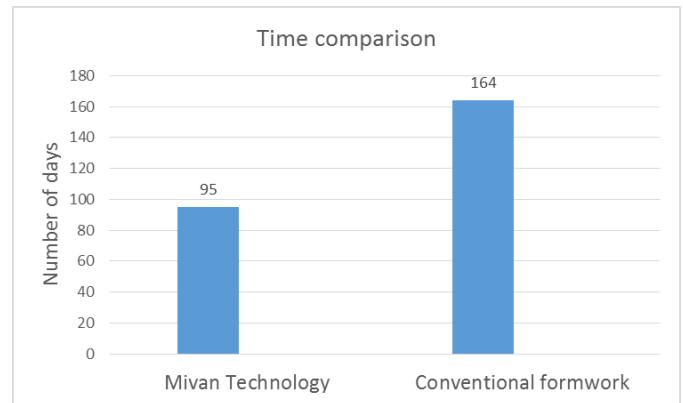
		mtr		
2	Labour cost	Sq. mtr	260	380
3	Number of repetitions		200-300 times	15-20 times
4	Minimum duration of slab cycle		10 days	21 days

Graph 6.1:- Cost comparison of formwork



project with the use of MSP 2013 software, analyzing the result and which method is suitable for residential building project is determined and measure are recommended to the organization for enhancing their project planning skills.

Graph -2 Time comparison of formwork using MSP(Microsoft Project)



2.3 Cost analysis of a residential building

Table-2 Shuttering quantity and cost comparison

Sl. no	Shuttering items	Shuttering quantity	Total Cost of Mivan Technology	Total cost of Conventional formwork
1	Column	40.38	363420	20190
2	Beam	24.2292	218062.8	12114.6
3	Slab	256.11	2304990	128055
			2886472	160359.6

2.4 Planning and Scheduling:-

In a construction project, proper planning and scheduling in detail is necessary for eliminating unnecessary delay of the project and also to have an alternative for the delaying of the projects. Due to improper planning and scheduling of a project, leads to substantial wastage of amount of time, money and resources. With globalization the construction project have become vast and complex. And with the help of project planning software huge amount of paper work for planning of any project is reduced. The desired result of a project cannot be achieved by providing better planning, proper organization and sufficient flow of resource. The organization need to be alert about their possible success and failure throughout the project. The main objective of this study is to plan, schedule and track a residential building

3. CONCLUSIONS

With the rise of the population of the country, the task of construction process as monumentally increased. As we all know the construction of high rise building is becoming a trend, and the process of construction of these high rise building takes more time and hence to reduce the duration and cost of the project advanced technology are adopted. The new advanced technology are manufactured for construction of multi storeyed project which leads to production of cost efficient and speedy construction of project. A Case study was conducted on a residential project and comparison between the conventional formwork and Mivan technology was analyzed and results were determined. It was determined that Mivan technology is suitable for large scale building projects and they can be reused for about 200-300 times. Even though the initial investment of Mivan technology is high, it provides cost efficient project and eliminated the need of plastering work as it gives a good surface finish compared to conventional type of formwork. The duration of project can be minimized by adopting Mivan technology. And hence it is concluded that Mivan technology is not suitable for small scale projects

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