

A STUDY REPORT ON COST, DURATION AND QUALITY ANALYSIS OF DIFFERENT FORMWORKS IN HIGH-RISE BUILDING

K.Loganathan¹, K.E.Viswanathan²

¹Student M.E. (CE&M), Erode Builder Educational Trust's Group of Institutions, Kangayam-638108, India.

²Assitant Professor, Department of Civil Engineering, Erode Builder Educational Trust's Group of Institutions, Kangayam-638108, India.

Email:logulogank@gmail.com

Abstract: The selection of a suitable formwork system in high-rise building construction is a crucial factor to success the project on time. So the selecting a suitable formwork system to affects the entire construction cost, time and quality of construction. The objective of this study is to identify the different formworks used for the construction of high-rise building. And also analyzing the advantages, limitations and site-specific problems in usages of such formwork in tall building. For that, five ongoing projects are selected and data is collected to identify how each type will affect the project cost, project duration and project quality from selection of formwork. This will helpful for the contractor to choose appropriate formworks for construction project.

Key Words – Formwork, high-rise building, cost, duration and quality

1. Introduction

Formwork is defined as temporary structures to support the concrete until it support itself. It moulds the concrete to different types of formwork used in construction, generally differing according to the building requirements. Formworks are generally made by wood, steel, aluminium or prefabricated forms into which the concrete is poured[1]. The formwork used to cast the structural elements such as, columns, beams, slabs and shear walls also used for smaller parts of building such as stairs, etc. Selection of formwork in high-rise building is depend upon, the main factors such as cost, time and quality. [2]. In the conventional type of formwork the timber planks were supported on timber columns. Now a day's technology is developed gradually, people used plywood sheet instead of timber planks and steel probs with jacks are used to support[3]. Then people invented small units of formwork and connect the repeating units in the construction. Then lastly system of formwork is made and initially steel was used and it was very heavy[4]. Then plan is to reduce weight of formwork system, for that material of formwork has changed to aluminium, plastic, etc.

2. Objective

The main objective of the proposed work is

- Identification of different system of formworks.
- To find out the which factors affecting the selection of the formworks.
- To evaluate and compare the formworks and equipment's cost, duration and quality.

3. STEPS INVOLVED IN METHODOLOGY

Step 1: Selection of topic.

Step 2: Study of literature is available in the form of books, journals to get proper understanding of the issue.

Step 3: List out various books required for reference and related topic, collect literatures and carry out clear methodology.

Step 4: Making a list of companies to approach.

Step 5: Identification of different system of formworks used in high-rise building.

Step 6: Identification of factors influencing the selection of formworks from literature review and experts.

Step 7: Interviews with experts, contractors, for identifying the factors influencing the selection, advantages, limitations and problems faced at site.

Step 8: Case study analysis of the ongoing high-rise building.

Step 9: Analyzing formworks cost, duration and quality.

4.Types of formwork

A.ConventionalFormwork

This is the oldest type of formwork used in the construction industry. This type uses timber, bamboo, masonry and carpentry in the construction. This type is very much suitable for small houses with two to three stories and still they are in use for such constructions. However, this is not suitable for the big projects or high-rise buildings.

B.ModernConventionalFormwork

In modern conventional formwork more advanced materials are used and they can reuse for several times. The differences of both types are that steel props and various types of jacks (U jacks, T jacks) are use as supports in the formwork instead of timber supports and ply wood sheets is use instead of timber planks on slab decks, beams and columns.

C.SteelFormwork

Mostly used in large construction projects or in situations where large number of re-uses of the same shuttering is possible. It is Suitable for circular or curved shaped structures such as tanks, columns, chimneys etc. & used for structures like sewer tunnel and retaining wall. Strong, durable & have longer life. Reuses can be assume to vary from 100 to 120.Steel can be installing & dismantle with greater ease and speed resulting in saving labour cost. No danger of formwork by absorbing water from the concrete and minimize honeycombing.

D.Mivan(or)Aluminiumformwork

Forms made from aluminum are in many respects similar to those made of steel. However, because of their lower density, aluminum forms are lighter than steelforms.The major disadvantage of aluminum forms is that no changes can be made once the formwork is fabricated.

5. Factors influencing selection of formwork system

The factors influencing the formwork systems were identified are as shown below.

The four broad categories are:

- General factors
- Building aspects
- Job specific
- Local conditions

The factors, which fall under each category, are:

A. General factors

- Adaptability & flexibility (fixable sizes)
- Duration & repetition (lifespan)
- Quality and surface finish
- Availability
- Cost
- Safety
- Supply

B. Building aspects

- Type of structure
- Maximum load capacity

C. Job specific

- Time factor
- Accessibility to work
- Erection and dismantling(de shuttering)
- Suitability of work for labours

D. Local condition

- Weather condition

- Skilled labour requirement

6. Data Collection

The studies have been carried out in the various companies and it has been indicated as,

Project A- True value homes
Project B- Sri Dhaksha projects
Project C- Gannon Dunkerly & Co ltd
Project D- Sri Jay Construction

The project A work includes construction of 12 numbers of towers, each comprising of 2 levels of basement/podiums and 15 floors including 2BHK and 3BHK flats. The formwork details of the project are given in Table below; which can helps to determine difference between the formworks in high-rise building.

TABLE 1.1 Project A Formwork details

S. No	Description	UOM	Aluminium
1	Size of panel	Ft	2×7
2	Cost of product	Rs/sqm	7500
3	Skilled labour	Rs/day	470
4	Unskilled labour	Rs/day	350
5	Productivity	Sqm/manday	6-8
6	Weight of penal	Kg/sqm	20
7	Maintenance cost	Rs/sqm	10
8	Number of repetition	No	150-200
9	Salvage value	Rs/kg	120
10	Additional items	----	Tie rod, wing nut

The project B work includes construction of 3 numbers of towers, each comprising of 2 levels of basement/podiums and 9 floors including 2BHK and 3BHK flats. The formwork details of the project are given in table below.

TABLE 1.2 Project B Formwork details

S. No	Description	UOM	Steel
1	Size of panel	Ft	3×2
2	Additional items	----	Prop support, jockey and nut-bolts
3	Cost of panel	Nos	850
4	Cost of jockey	Nos	1100
5	Cost of span	Nos	2000
6	Cost of product	Rs/sqm	4000
7	Skilled labour	Rs/day	650
8	Unskilled labour	Rs/day	400
9	Productivity for slab and beam	Sqm/manday	1.5-2
10	Productivity for columns	Nos	20-25
11	Weight of penal	Kg/sqm	30
12	Maintenance cost	Rs/sqm	15
13	Number of repetition	No	30-40
14	Salvage value	Rs/kg	25

The project C, Construction of commercial building (shopping mall) at Sivanandhamill, Coimbatore. The formwork system used in this

project is steel formwork. Formwork details are given in the table below. It shows the various types of specifications involved in the various kind of formwork system.

TABLE 1.3 Project C Formwork details

S. No	Description	UOM	Steel
1	Size of panel	Ft	4×8
2	Cost of product	Rs/sqm	1800
3	Skilled labour	Rs/day	650
4	Unskilled labour	Rs/day	400
5	Productivity	Sqm/manday	2.5-3
6	Weight of penal	Kg/sqm	28-35
7	Maintenance cost	Rs/sqm	15
8	Number of repetition	No	10-12
9	Salvage value	Rs/kg	0

The project D, construction of apartment building at Coimbatore. The formwork system used in this project is wooden formwork. Formwork details are given in the table below, which can helps to determine difference between the formworks in high-rise building.

TABLE 1.4 Project D Formwork details

S. No	Description	UOM	Steel
1	Size of panel	Ft	3×2
2	Additional items	----	Prop support, jockey and nut-bolts
3	Cost of panel	Nos	850
4	Cost of jockey	Nos	1450
5	Cost of span	Nos	2400
6	Cost of product	Rs/sqm	4500
7	Skilled labour	Rs/day	650
8	Unskilled labour	Rs/day	400
9	Productivity for slab and beam	Sqm/manday	1.5-2
10	Productivity for columns	Nos	20-25
11	Weight of penal	Kg/sqm	30
12	Maintenance cost	Rs/sqm	15
13	Number of repetition	No	30-40
14	Salvage value	Rs/kg	25

7. Data Analysis

A. Cost comparison of formwork

The following table shows the cost comparison between the various formworks presently used in the construction sites.

Table 1.5 Cost Comparison of Formwork

Type of formwork	Unit	Rates
Wooden	Sqm	3000
Steel	Sqm	4500
Aluminium	Sqm	7500

The figure shows the graphical representation of the above study rates at different rates of formwork. The chart shows the aluminum formwork is economical when the use of cycle. The steel formwork is economical than the other formwork.

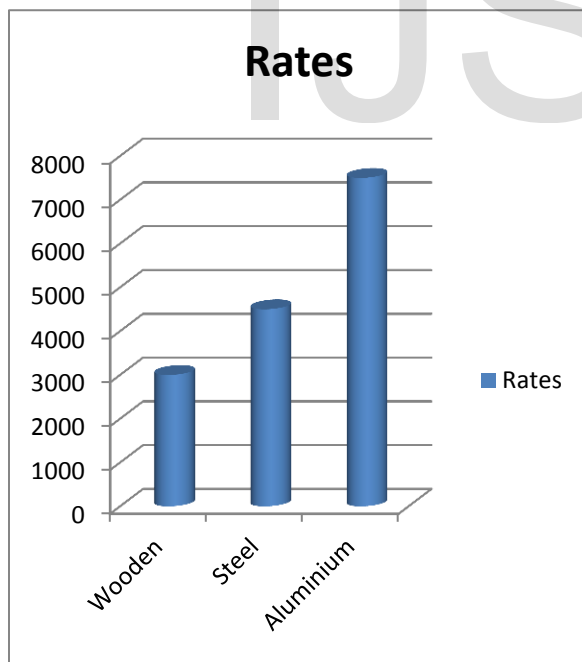


Figure 1.1 Cost Comparison of Formwork

B. Scrap value of formwork

The scrap value is also going to in consideration for the maximum return. The

companies of aluminium formwork are dealing in such a way that maximum return at the relative interval. The deals based on use. The aluminium formwork is economical because of rate of return is high. The following table shows the percentage of scrap value between the various formworks presently used in the construction sites.

Table 1.7 Scrap Value of Formwork

S.No	Formwork	Scrap value in %
1	Conventional	10%
2	Steel	30%
3	Aluminium	50%

C. Time of formwork

Table 1.6 Wooden Formwork

S.No	Structural Element	Time Period (Days)
1	Wall, column and vertical sides of beam	1-2
2	Slabs	3
3	Beam	7
4	Removal of probs to slab	
	(1) Upto 4.5 m	7
	(2) over 4.5 m	14
5	Removal of probs beam	
	(1) Span upto 6m	14
	(2) Span over 6m	21

Formwork is made from aluminium are in many respects similar to those made of steel. However, because of their low density, aluminium formworks are lighter than steel forms, and this is their most important advantage when compared to steel.

The major disadvantage of aluminium forms is that no changes can be made once the formwork is fabricated and the time of construction is done in the cycle of days of construction.

The figure 1.2 shows the 8 days of construction with aluminium formwork technique.

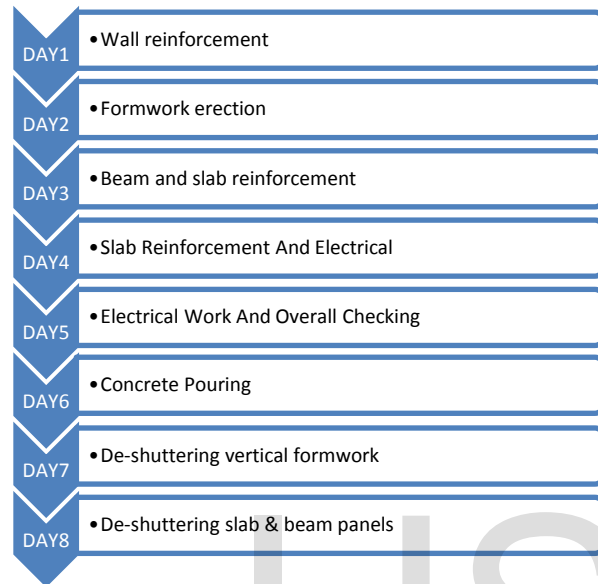


Figure 1.2 Aluminium Formwork

8. Conclusion

There are several types of formwork are available in construction industry. The data collected from different companies to compare the cost, duration and quality of different types of formworks. From the analysis, initial cost for aluminium formwork is high when compared to other types. While comparing with duration, productivity, quality and repetition, aluminium formwork is an effective technique for mass construction project. For typical floors aluminium formwork is economical since number of repetition are high and labour cost is comparatively less when compared with other types. At the same time aluminium, formwork is not effective for smaller project. Based on the project type and floor heights formwork can be chosen.

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