Comparative study of residential building using mivan formwork and conventional formwork and time and cost optimization using these technologies

Sanesh Tanaji Atole
Department of Civil Engineering, Dr. Vishwanath Karad MIT World Peace University, S.No.124, Paud Road, Kothrud, Pune-411038, Maharashtra, India

Abstract

In development of any country infrastructure plays an important role. India is a developing nation and in its development construction industry plays an important role. It contributes a large amount of money to country's Gross domestic product (GDP). India's population continues to grow fairly steadily as the years progress. India is expected to surpass China in coming years. Therefore, in upcoming years huge demand for residential and commercial buildings. So, in order to cope up with the increasing demand clients wants fast track construction with low cost of construction with no compromise with the quality of construction. Formwork accounts for 25 to 30% of total cost of construction and also plays an important role in time required for completion of project. Also, quality of construction is also a factor which depends on formwork. Therefore, it is important which formwork to be use for construction. This paper attempts to compare detailed cost and duration estimate of commercial and residential building constructed using Mivan formwork and conventional formwork and to find out which formwork is economical in different situation. Two complex constructions projects in Uttar Pradesh i.e., Everest and Kailash enclave were considered for this study.

Keywords – Comparison, Conventional, Cost and Time analysis, MIVAN, Formwork

1.Introduction

Formwork also known as shuttering in many countries is a temporary support which is provided to steel and concrete till the time concrete attains adequate strength to withstand its own weight and construction load that may act on it. Formwork is also provided so that concrete achieve desired shape. Choosing a right formwork for construction is as important as choosing right amount of steel and concrete in structural members because formwork for concrete structure has large impact on cost and time [1]. Also, the overall quality of construction depends largely on formwork. Sometimes in few projects it has been seen that cost of formwork exceeds the total cost of steel and concrete combined. So, while choosing the type of formwork for construction it important to see number of reuses of the formwork, finishing of concrete surface after removal of formwork and resale value of formwork [2]. Therefore, before starting of any project, it is important to analyze which formwork will be economical.

1.1. Mivan formwork

1.2. Mivan formwork is an aluminum formwork which is developed by a company known as Mivan Company Ltd. The advantage of using Mivan formwork is that it reduces construction time and also increases durability and strength of structural members (Fig.No.2).

1.2. Conventional formwork

Conventional formwork is made up of timber and plywood. Though the plywood has relatively short life span it is still use extensively in construction of concrete structure (Fig.No.1).

Fig. No.1 Conventional Formwork.

Fig.No.2. Mivan Formwork.

2.Methodology

Estimation in construction industry is probable total cost of any construction work that is to be done in future. Estimation of any work is important because through estimation we can anticipate cost of that work to be done and can make decision accordingly whether to proceed with that work using the same technology or to change the technology depending upon estimated cost of work [3,4]. Methodology used in this paper involves estimation of quantity by using architectural and structural drawing obtained from the site and questioning site engineers and workers for more information.

2.1. Estimate of different quantities are calculated by different methods. These methods are as follows -

2.2. Long wall-short wall method

This method is used to calculate quantities like earth work, foundation, brickwork etc. In this method wall along length of room is considered as long wall and wall perpendicular to long wall is short wall.

Length of wall = Center to center distance between wall + half the width on one side of wall + half the width on other side of wall.

Length of short wall = Center to center distance between wall + half the width on one side of wall+ half the width on other side of wall.

Quantity = length of wall*width*height of wall

2.3. Bar bending schedule formula

This method is used to estimate the reinforcement required for construction of different structural members using structural drawing of the building.

First calculate reinforcement length of the member

Then add development length to the reinforcement length to get total length of bar

Then calculate no of bars by dividing length or width of section with center to center between the adjacent bars

Total length of bar = No of bars*Total length of bar

2.4. Cubical content method

This method is used to estimate cubic content of the building. In this method to calculate cubic content length width and depth of structural members are calculated and then added together to get total volume.

Volume = length*width*depth

For plastering work perimeter is calculated and then it is multiplied by height of room – area of doors and windows

3.Comparison based on time

Table.3.1. ESTIMATE OF TIME FOR AREA OF 12,600 SQUARE FT USING CONVENTIONAL FORMWORK AND MIVAN FORMWORK BELOW PLINTH LEVEL

Sr.No	ACTIVITY	TIME (IN DAYS)
1	Line out	1
2	Excavation	3
3	Levelling	2
4	PCC	2
5	Line out for footing	2
6	Reinforcement of footing	7
7	Shuttering of footing	5
8	Concreting of footing	3
9	Column line out	2
10	Column reinforcement fixing	5

11	Column shuttering	5
12	Column concrete	5
13	Deshuttering of footing	2
14	Deshuttering of column	2
15	Backfilling below plinth level (Including compaction and watering)	10
16	Plinth beam PCC	2
17	Plinth beam reinforcement	6
18	Plinth beam concrete	5
19	Total	83 days
	Since the many activities are done simultaneously therefore the number days is reduced by few days	23 days
	Total	60 days

Table.3.2. ESTIMATE OF TIME FOR ONE FLOOR OF AREA OF 12,600 SQUARE FOOT USING CONVENTIONAL FORMWORK

Sr. No.	Activity	Time (in days)
1	Column Shuttering and Deshuttering	5
2	Reinforcement	5
3	Concreting of column	3
4	Beam and slab shuttering and Deshuttering	12
5	Reinforcement	6
6	Beam and slab concreting	3 + 7 days it is left to achieve strength
7	Deshuttering	3
8	Brickwork	30
9	Internal plastering	30
10	External plastering	45
11	Electrical Work	13
12	Door and window installation	6
13	Plumbing work	7
14	Tilling work	8
15	Internal painting	10
16	External painting	15
	Total	208 days

Table.3.3. ESTIMATE OF TIME FOR ONE FLOOR OF AREA OF 12,600 SQUARE FOOT USING MIVAN FORMWORK

Sr. No	ACTIVITY	TIME (IN DAYS)
1	Column (&wall) Shuttering and Deshuttering	3
2	Reinforcement	10
3	Beam and slab shuttering and Deshuttering	16
4	Reinforcement	10
6	Beam, column and slab concreting	7
7	Brickwork	-
8	Internal plastering	-
9	External plastering	-
10	Electrical Work	7
11	Door and window installation	6
12	Plumbing work	7

13	Tilling work	8
14	Internal painting	10
15	External painting	15
	TOTAL	100 days

4. COST COMPARISION

Table.4.1. ESTIMATE OF COST FOR ONE FLOOR OF AREA OF 12,600 SQUARE FOOT USING CONVENTIONAL FORMWORK

Sr. No	Description	Rate per sqft	Total cost (in lakhs)
1	Concreting	253	31.878
2	Steel	256	32.256
3	Masonry Work	108	13.608
4	Plastering Work	90	11.34
5	Waterproofing Work	27	3.402
6	Tiling Work	170	21.42
7	Painting Work	50	6.3
8	Doors	53	6.678
9	Windows	50	6.3
10	Lift	77	9.072
11	Plumbing and Sanitation	54	6.084
12	Electrification	153	19.278
	Total		151 LAKHS

Table.4.2. ESTIMATE OF COST FOR ONE FLOOR OF AREA OF 12,600 SQUARE FOOT USING MIVAN FORMWORK

Sr. No	Description	Rate per sqft	Total cost in (lakhs)
1	Concreting	423.84	53.2298
2	Steel	158.57	19.97
3	Masonry Work	37.38	4.68
4	Plastering Work	2.48	0.31199
5	Waterproofing Work	23.48	2.95
6	Tiling Work	68.92	8.68
7	Painting Work	55.89	7.04171
8	Doors	11.81	1.48860
9	Windows	32.61	4.108
10	Lift	44.96	5.66
11	Plumbing and Sanitation	68.59	8.64
12	Electrification	106.70	13.44
	TOTAL		119.878 lakh

5. Result and comparison

External finishes: There is no need for plastering of walls in mivan formwork as the finishing of wall is smooth as compared to conventional formwork where the finishing of wall is not smooth and hence plastering is required.

Cost comparison: Using mivan formwork results in 20-25% cost reduction as compared to conventional formwork and the reason for the cost reduction is that in mivan formwork there is no need for plastering and brickwork as compared to conventional formwork where plastering and brickwork is required (Fig.No.3,4).

Speed of construction: Time required for construction of building is approximately half using mivan formwork as compared to conventional formwork because of step-by-step completion of various construction activities.

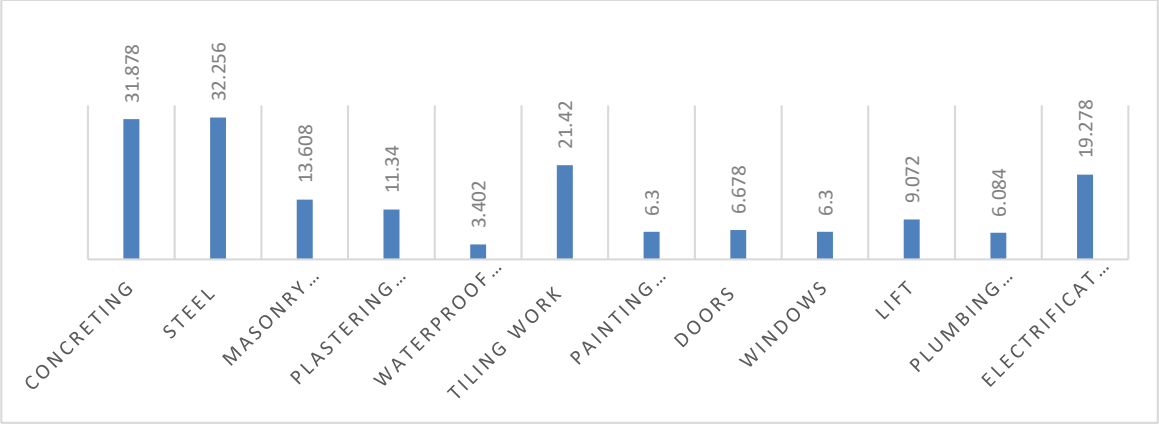

Fig.3.Showing cost for one floor of area 12,600 square feet using conventional formwork (Cost in Lakhs).

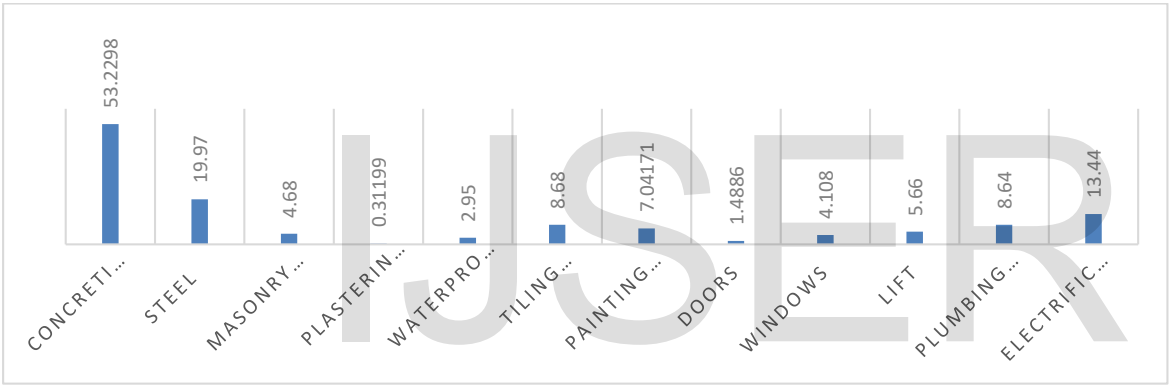

Fig.4.Showing cost for one floor of area 12,600 square feet using Mivan formwork (Cost in Lakhs).

6. Conclusion

Based on the detailed survey and estimation it can be concluded that mivan formwork is far more superior method as compared to conventional formwork for affordable and efficient construction [5]. Moreover, the number of reuses using conventional formwork is 7-8 while using mivan formwork can be used repeatedly [6,7]. The only drawback of using mivan formwork is that it is economical to use in typical floor structure and moreover initial the cost of investment is very high. However, mivan formwork conquers the issues of fixes and alteration because of ill-advised workmanship also mivan formwork can be said the most suitable framework for skyscraper and gigantic development projects. Hence it can be concluded that mivan formwork is economical for projects of repetitive and massive in nature or else conventional formwork system would be economical. In conventional formwork the maintenance cost is too high as it requires frequent repairs of plasters of wall and ceilings, painting of outer and inner walls due to leakages however, in mivan formwork the maintenance cost is negligible as the walls and ceiling are made up of high-quality concrete which do not require frequent repairs.

REFERENCES

[1]. Amrut Manvi, Sandeep Gouripur1, Pooja Sambrekar, Ramanjeetkaur, Dr. Kishor S. Kulkarni "Cost Comparison between Conventional and Flat Slab Structures" Irjet Volume: 02 Issue: 03 | June-2015.

[2]. "Emerging Trends in Formwork and Scaffolding", CE & CR, Sep 92, Pg.46-49.

[3]. Y.B. Sangale, Prof. R.V. Devalkar "Construction cost Comparison between Conventional and Industrialised Building System in Nashik", International Journal of Modern Trends in Engineering and Research, 720 -725, 2014.

[4] Desai D.B. "Emerging Trends in Formwork - Cost Analysis & Effectiveness of Mivan Formwork over the Conventional Formwork" IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) ISSN: 2278-1684, PP: 27-30.

[5] D.M. Wijesekara "Cost Effective and Speedy Construction for High-Rise Buildings in Sri Lanka by using Aluminium Panel System Formworks", ACEPS – 2012.

[6] Ketan Shah, (2005) "Modular formwork for faster, economical and quality Construction", Indian Concrete Journal, Vol-79, pg. 6-23.

[7] Information on http://www.mivan.com

[8] DSR 20119-20, Government of Maharashtra, PWD Department.