

Cost, Schedule and Quality Comparison of Prefabricated Shuttering Material and Plywood Shuttering Material for RCC Structure

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Abstract: Construction industry growing day by day and new innovation and technology comes everyday especially in RCC structure people are innovating in shuttering material. In building construction major activity which consume max percentage of cost and time is RCC, if we are innovating some new techniques or material then we have to consider cost, quality and time factor very critically if we neglect one of this three then it leads to a certain losses. We must do a feasibility check in terms of comparison of old technique or material with new innovation for cost, schedule and quality. For checking feasibility of “prefabricated shuttering material for casting column with slab and beam” here is a comparison of cost, schedule and quality comparison of prefabricated shuttering material and plywood shuttering material for RCC structure. The shuttering material for which we are doing feasibility check is Prefabricated G.I. & M.S. frame with plywood sheets, using this Shuttering material we can cast column with slab & beam. As we are casting columns with slab & beam it reduces time. And joints will be monolithic and gets smoother finish at junctions.

Index Terms: Cost comparison, schedule, quality, prefabricated, shuttering design, innovation, structure, performance

I. INTRODUCTION

Construction industry growing day by day and new innovation and technology comes everyday specially in RCC structure people are innovating in shuttering material. In building construction major activity which consume max percentage of cost and time is RCC. RCC is a key activity for starting successor activities. People are trying to reduce duration of RCC so that they can save money in overheads and can deliver project as early as possible. For RCC mainly steel, concrete and shuttering material. Different types of shuttering material available in market like plywood shuttering, aluform, tunnel formwork etc. every material is used in specific conditions only and each one has its own pros and cons and limitation. Selection of right shuttering material for a project is essential for economical and timely completion of project. For that we must compare different shuttering material in terms of cost, quality and schedule, here is a comparison for two different shuttering material. As in traditional construction practice with plywood shuttering material we are casting columns first then we are casting slab and beams it takes more time. Another new Prefabricated Shuttering material for casting column with slab & beam the shuttering material is basically made up of G.I. and M.S. frame in which beam bottoms frame and slab panels frame are fabricated in G.I. and beam side frame and column side frame are fabricated in M.S. and plywood is fixed in frame with rivet and filled outer gap by black silicon. Its initial cost is more than wooden formwork, but it has more repetitions and takes less time in construction, has more scrap value then wooden shuttering. It will prepare offsite and brought to site for direct application.

II. LITERATURE REVIEW

1. Kishan Chandrala “Study of Prefabricated Shuttering Material for Casting Column with Slab & Beam” (2019)

Now a days every builder and customer wants building completes in lesser time, in any building construction RCC takes more time and every activity is obviously dependent on RCC as in traditional construction practice we are casting columns first then we are casting slab and beams it takes more time and cost both and casting columns with slab & beam is not possible in wooden formwork. As the title of this paper suggest Prefabricated Shuttering material for casting column with slab & beam the shuttering material is basically made up of G.I. and M.S. frame in which beam bottoms frame and slab panels frame are fabricated in G.I. and beam side frame and column side frame are fabricated in M.S. and plywood is fixed in frame with rivet and filled outer gap by black silicon. Its initial cost is more than wooden formwork, but it has more repetitions and takes less time in construction. It will prepare offsite and brought to site for direct application.

2. Miss. Renuka Hangarge, Mr. Ashish Waghmare, Mr. Shridhar Patil, “Comparison of Conventional, Aluminium and Tunnel Formwork” (2017)

Construction industry is having biggest role in economy of India. In recent times, if we look at the global economy and growth of population in India, land acquisition has become more difficult. To fulfill the need of shelter of this growing population and increasing industrialization, speedy construction is the necessity of time. Same time, due to inadequacy of land Vertical growth is preferable than Horizontal one. Formwork plays an important role in construction of the buildings. It constitutes 20% cost and 60% time of the total construction. This project does the comparison of the Conventional Formwork, Tunnel Formwork and Aluminum Formwork systems.

3. Bhagyashri Wani “Analysis of New Formwork Technology Adopted on A Construction Site in Pune” (2017)

To fulfil the housing and infrastructure requirements of increasing population, in last few decades Indian construction industry has grown in large amount. With the introduction of multinational companies in Indian construction sector, accuracy and speed of work has increased. Now-a-days to cope up with the demand is becoming crucial. Conventional construction methods are economical, but they are unable to give required quality work and speed. Hence, in today's date there is a need to think on latest construction technology. Formwork is an important part of construction which takes almost 30-35% of total cost of construction. The various new technologies of formwork systems are introduced which helps to increase the overall economy, high quality construction and speed of construction. In this paper, analysis of new formwork technology implemented on site is done and it is proven that how it is more useful than the previous method of formwork technology.

III. DETAILS

One residential building of 22 floors having 7900 sqft area per floor is considered Here for comparing both shuttering materials. Shuttering area specifications are as below.

Shuttering Area			
1	Slab	5996	sqft
2	beam bottom	1925	sqft
3	beam side	4579	sqft
4	Lift	991	sqft
5	column	3820	sqft
6	staircase	525	sqft
	Total shuttering area	17836	sqft
	Total built-up area	7900	sqft

A) COST COMPARISON**1) Plywood shuttering material**

Plywood shuttering material is a traditional Shuttering used for RCC. In which carpenter make beam bottom and beam side frame from plywood and silver patti and for slab directly rest on square tube which is placed on cup lock scaffolding or there is different supporting material available in market here cup lock scaffolding is consider for comparison for keeping same supporting system for both shuttering for outer part of building to support beam side silver wood is used.

Following table shows how much cost require for plywood shuttering for considered building.

Plywood shuttering material costing				
Sr.no	Material description	Required qty	Unit	Amount
1	Silver Patti	1036	Cft	472427
2	Silverwood	155	Cft	72230
3	Plywood cost	557	Nos	1159328
4	U jeck	689	Nos	62871
5	MS Props 2 mtr for Beam bottom	450	Nos	526500
6	Cop lock (vertical) 2.5 mtr old material	689	Nos	475410
7	Lesser (Horizontal) 1100 mm new making	1132	Nos	249040
8	Lesser (Horizontal) Odd size	244	Nos	52460
10	Base plate 600 mm	689	Nos	569459
11	Lift woller	124.5	Rmt	67255
12	Shikanja	750	Nos	45000
13	Ms square tube	1925	Rmt	340186
14	Column woller	563.64	Rmt	304478
		Total amount	Rs.	4396644
		Rate per shuttering area	Rs. /sqft	246.5
		Rate per slab area	Rs. /sqft	556.5

2) Prefabricated shuttering material

Shuttering material is basically made up of G.I. and M.S. frame in which beam bottoms frame and slab panels frame are fabricated in G.I. and beam side frame and column side frame are fabricated in M.S. and plywood is fixed in frame with rivet and

filled outer gap by black silicon and all frames are fix to each other by nut bolt , U clamp, edge clip and wedges. supporting system is cup lock system only U jack replace by slab panel head.

Following table shows how much cost require for prefabricated shuttering material for considered building.

Prefabricated shuttering material costing				
Sr.no	Material description	Required qty	Unit	Amount
1	Beam side shuttering	426	Sqm	942714
2	Beam Bottom (2 sets)	179	Sqm	458522
3	Shuttering plate	557	Sqm	843196
4	Lift shuttering	92	Sqm	210776
5	Column shuttering	355	Sqm	767849
6	Beam bottom Resting Bracket 150 mm(old)	99	Nos	5420
7	Beam bottom Resting Bracket 200 mm(old)	832	Nos	60736
8	Beam bottom Resting Bracket 300 mm(old)	68	Nos	6205
10	Beam bottom outer Resting Bracket 330X790 mm	150	Nos	30660
11	Beam bottom outer Resting Bracket 590X300 mm	150	Nos	24090
12	Beam bottom outer Resting Bracket 590X450 mm	100	Nos	18250
13	Beam bottom resting prop plate 150 x 150	450	Nos	41063
14	Slab Prop plate for 1150 x 1150 plate resting	689	Nos	62871
15	Beam side corner 100 x 100 x 515 mm	202	Nos	62671
16	Beam side corner 100 x 100 x 715 mm	30	Nos	10950
17	Beam side Column corner 100 x 50 x 515 mm	50	Nos	9125
18	Beam bottom fixing Wedge Clip	2026	Nos	30390
19	Easy clamp & GI Nut bolt for column	2500	Nos	150000
20	Easy clamp & GI nut bolt for Beam side	950	Nos	57000
21	Easy clamp & GI nut bolt for Beam side	630	Nos	37800
22	MS Props 2 mtr for Beam bottom	450	Nos	526500
23	Punching angle for Column	366	Rmt	69211
24	Punching angle for Lift	43	Rmt	8131
25	Cop lock (vertical) 2.5 mtr old material	689	Nos	475410
26	Lesser (Horizontal) 1100 mm new making	1132	Nos	249040
27	Lesser (Horizontal) Odd size	244	Nos	52460
28	Base plate 600 mm	689	Nos	569459
30	Beam side waller	117	Rmt	63203
31	Lift waller	124.5	Rmt	67255
32	Column waller	563.64	Rmt	304478
33	Staircase	48.832	Sqm	68592
		Total amount	Rs.	6284027
		Rate per shuttering area	Rs. /sqft	352.3
		Rate per slab area	Rs. /sqft	795.4

Now all values are available for comparison, following table shows prefabricated shuttering cost initially more than plywood shuttering.

Description	Cost	Rs. /sqft
Prefabricated shuttering	6284027	795.4
Plywood shuttering	4396644	556.5
Difference	1887383	239

We must see all aspect and use of shuttering material only initial cost is not the only criteria for decision. All shuttering material can be used for a certain repetition only. So, it also impacts on overall costing. Plywood shuttering can give maximum 12 repetition after that we have to replace old plywood with new plywood. But in prefabricated shuttering material it has more than 25 repetitions because plywood is fixed with rivet and black silicon due to this plywood edges are not exposed so it gets less damage if require, we can flip the side of plywood for reuse also.

Hence as we selected a building which require 22 repetition, if we use plywood shuttering then we have to replace plywood, silver patti & silver wood after 12 repetition, supporting material can be use without any additional cost. As discussed, prefabricated shuttering material has almost 25 repetition, so no extra cost involved.

In prefabricated shuttering, other than scaffolding or supporting material (asset) all M.S. and G.I. material has a 30% scrap value and for Wallers 50% salvage value if we don't want to use or may after certain repetition we have to replace it at that time we get scrap value of material back which is as per following table

Sr.no	Material description	Material cost	Scrap value
1	Beam side	471284	141385
2	Beam bottom	229518	68855
3	Slab shuttering	574144	172243
4	Lift shuttering	116573	34972
5	Column shuttering	380197	114059
6	Staircase	41295	12388
7	Other material	305449	61090
8	Beam side woller	63203	31602
	Total cost (Rs.)	2181664	636595

Description	cost	Rs. /sqft
prefabricated shuttering material cost - plywood shuttering material cost	1887383	239
plywood, silver Patti & silver wood replacement cost in Plywood shuttering	1703985	216
scrap value of MS and GI material used after 25 repetition (if we want to use it for only one building)	636595	81
Benefit of using prefabricated shuttering material against plywood shuttering material	453197	57

Add into this with prefabricated shuttering material we are casting column, beam, slab and above slab starter in one pour, so no concrete wasted. But in plywood shuttering we cast starter, column, slab separately so chances of wastage are more and only once we require concrete in prefabricated shuttering material so concrete labor gang also required per slab only once.

B) SCHEDULE COMPARISON

Schedule comparison	
Prefabricated shuttering material	Plywood shuttering material
Column casting with slab and beam so separate column casting time saved	Separate time require for column casting
Slab cycle is 10 days	Slab cycle is 15 days
Casting column starter with slab saves one day	Casting column starter separately requires extra one day
Factory made so no shuttering board making time require	Shuttering board making require
No cross-supporting time require	Cross supporting time require

C) QUALITY COMPARISON

Quality comparison	
Prefabricated shuttering material	Plywood shuttering material
Column casting with slab and beam no joints between them	Column casting separate so joints occurs
Get finished surface after deshuttering	Get unfinished surface after deshuttering
In less support gives better result and less checking required	More supporting requires more observation
Only one joint per slab because casting starter with slab	Three joints per slab

CONCLUSION

As the requirement of fast track construction, we should evolve from old methods and techniques we need to think how we can reduce the construction time with consideration of cost and quality also. so, as we all know RCC is taking major time and cost in construction and as discussed in this paper prefabricated shuttering material would be a game changer for moderate costing projects. As per comparison of plywood shuttering material and prefabricated shuttering material considering all aspects prefabricated shuttering material is beneficial. By using prefabricated shuttering material, we can increase quality of work because as we are casting columns with slab & beams so whole concrete will be monolithic, ultimately, we can reduce time, cost and increase quality.

REFERENCES

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