

COMPARISON OF STEEL AND TIMBER FORMWORK SYSTEM USED FOR BUILDING PROJECTS ON THE BASIS OF QUALITY, COST AND SPEED

¹Khawaja Zohaib Quadri

¹PG Student, Construction Technology & Management, Al-Falah School of Engineering & Technology, Al-Falah University Faridabad, Haryana, (India)

Abstract : *The type of formwork system used is the factor which determines the success of construction project construction in terms of quality, cost and speed. Completing the project with estimated cost, time and specified quality is a measure for successful delivery of the project to the customer, but almost all the building projects in our country are not lucky, which can be successfully delivered to the customer. The underlying problems include relative cost, delay in construction, and relatively high value compared to low quality of prepared concrete. The types of formwork used for poor performance of the construction sector can be used with the use of low quality practices and practices of the formwork system. Pointing the use and practices of formwork system, this study has been studied in comparison to steel and timber formwork regarding the cost, quality and timing of completion of selected building construction projects. The study was conducted by selecting building projects from various sites under construction during the study period. Projects include various types of buildings such as office, commercial, apartments, multipurpose, hospital buildings. In order to receive relevant data in the projects, questionnaires and interviews were conducted which help in achieving the objectives of this thesis. Formwork rental companies and regulatory bodies were also interviewed.*

Research findings indicate that the average meter square cost of steel formwork is more than the timber formwork, cost difference varies depending on the type of variation, for example the cost of steel beam formwork is 20% higher than wood beam formwork. And column is 25% more than steel formwork, taking the average difference compared to the cost of steel formwork is 22.5% more. Research conclusions about the speed of construction indicate that the steel formwork provides the fastest phase of construction and the modern structure of the finished concrete makes the surface good with the quality of the system.

IndexTerms: *building construction, formwork, cost, quality, speed, concrete, project management, projects, estimation*

I. INTRODUCTION

All the companies involved in the construction industry and the contractor want to successfully complete the project in the end. To define a successful construction project which includes completing the project within less time, cost and proper performance and fewer injuries during construction. Therefore, the cost of management of successful building construction projects, speed quality and construction security is required. In terms of cost, speed, quality and security formwork system, the main factor is to complete the construction project. Selecting the poor quality of formwork system to reduce the cost of the project will directly affect the speed and quality of the other aspect. Similarly, when the goal is entirely at the speed of construction, the remaining factors are affected in construction projects. As a result, the quality of concrete is determined by the selection of the formwork used on the types of content used in the site work and formwork system. Workmanship affects the cost and speed of construction. The right formwork is to control the proper design and use of the system and it maximizes the use of formwork.

II. RESEARCH OBJECTIVES

The aim of this research work:

- The cost comparison of the timber and steel formwork systems used for the construction of projects.
- Comparing quality of prepared concrete made by wood and steel formwork system used for building projects.
- To compare the construction of construction projects in wood and steel form.

III. SCOPE OF THIS RESEARCH AND STUDY AREA

The scope of this research is limited to the structural elements of building projects such as columns, beams, slabs, shear walls and stairs which are inserted in the construction site. In addition, this research will be based on the comparison of two types of formwork for concrete elements. Its purpose is not to prove that one product is better than the other, but to determine which systems, steel panels or wood panels are better.

Research is organized for a variety of types of building such as:

- a. Office
- b. Hospitals
- c. Apartment
- d. Schools
- e. Multipurpose

IV. LIMITATION

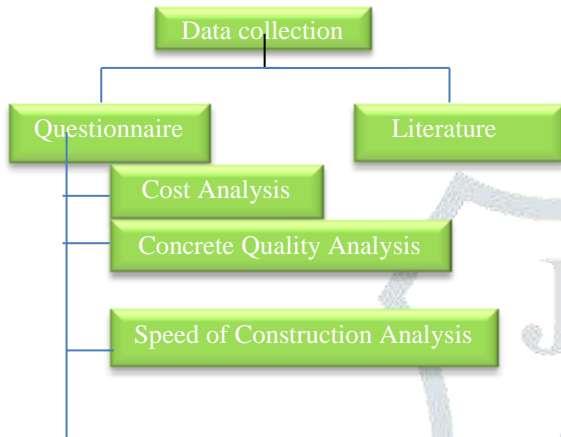
This research study is limited to comparison between steel and timber formwork systems for building, based on the cost, quality and speed of construction, thus in this research study did not include other issues such as safety and construction of scaffolding.

V. DESIGN OF QUESTIONNAIRE

The questionnaire was designed based on the combination of both the review and the literature, which relates to the type of formwork used in construction sites based on the cost, quality and speed of construction of the building project. Researcher's knowledge on current formwork manufacturing practices at construction sites. This questionnaire has four parts. The structure of the questionnaire was composite structure, which means the combination of structured (closed) and unorganized (open) type of questions. The questionnaire were structured or closed type questions. But more information is obtained to get more information to get more information. These spaces are provided under each question.

VI. RESEARCH METHODOLOGY

The questionnaire was designed based on the combination of both the review and the literature, which relates to the type of formwork used in construction sites based on the cost, quality and speed of construction of the building project. Researcher's knowledge on current formwork manufacturing practices at construction sites. This questionnaire has four parts. The structure of the questionnaire was composite structure, which means the combination of structured (closed) and unorganized (open) type of questions. The questionnaire were structured or closed type questions. But more information is obtained to get more information to get more information. These spaces are provided under each question.



VII. DATA ANALYSIS

Analysis of the collected data through questionnaires and results and discussion is presented in three major parts:

1. Cost Analysis
2. Concrete quality analysis
3. Speed of production analysis

1. Cost Analysis

The cost of formwork and its labour cost is an important part of the solid structural frame. Formwork costs are influenced by its initial cost, re-using cost and storage costs. These factors have been addressed in this questionnaire analysis and described below. In relation to the initial cost of formwork system, the respondent was asked to select wood or steel formwork for various structural elements of the building such as beam, column, slab, staircase and shear wall considering the initial cost of the formula. The wooden formwork was analysed using the table to show the rate of steel formwork.

Table 4.1 (average cost of timber formwork Rs. per square feet)

Structural element	beam	column	slab	stair	Shear wall
R 1	40	42	45	40	45
R 2	40	40	40	40	40
R 3	42	40	45	42	45
R 4	44	42	44	44	44
R 5	38	40	40	38	42
R 6	45	45	45	45	45
R 7	50	45	42	45	45
R 8	42	45	48	42	50
Average Steel cost	42.6	42.3	43.6	42	44.5

Table 4.2 (average cost of timber formwork Rs. Per square feet)

Structural element	beam	column	slab	stair	Shear wall
R 1	22	22	22	22	22
R 2	20	22	21	21	22
R 3	25	24	24	25	24
R 4	22	22	23	22	23
R 5	24	24	24	24	24
+R 6	24	25	25	24	24
R 7	23	23	23	23	23
R 8	24	25	25	25	24
Average Timber cost	23	23.37	23.3	23.2	23.25

Table 4.3 (average cost difference for steel and timber formwork Rs. per square feet)

Structural element	Steel formwork average cost	Timber formwork average cost	difference
Beam	42.6	23	19.6
Column	42.3	23.37	18.93
Slab	43.6	23.3	20.3
Stair	42	23.2	18.8
Shear wall	44.5	23.25	21.25

Table 4.4 (conventional timber v/s steel formwork)

Description	Aspect in consideration	Timber (average cost)					Steel (average cost)				
		beam	column	slab	stair	s.wall	Beam	Column	Slab	Stair	s.wall
Labour cost	Cost / sq. ft	23	23.37	23.3	23.2	23.25	42.6	42.3	43.6	42	44.5
Minimum duration cycle	Days	12	12	15	15	10	12	12	15	15	10
Quality	Surface finish	Comparative poor than steel					Form finish				
Surface application	Plaster/naked	External plaster needed					No need of plastering				
Workability	Material handling	Ease (depend on the labour no.)					Moderate (depend on the equipment used)				

2. ANALYSIS OF CONCRETE QUALITY

Comparing on the basis of quality of finished concrete formed by steel and timber formwork system, these factors addresses:

- Discoloration
- Dimensional accuracy
- Smoothness and regularity of concrete surface and
- Major quality problem at the time of stripping.

The final question of this part is for issue of quality, the respondents were asked to list the problem of major quality in their respected projects. The major quality issues listed by the respondents are: -

- Inappropriate coastal formation
- Honey comb in concrete
- Minor changes in ready-made concrete dimensions
- Lubrication and regularity problems
- Discoloration
- Getting out of the forged concrete
- Immoral surface
- Difficulty at varying time

3. ANALYSIS OF SPEED OF CONSTRUCTION

Formwork system has been prepared to reduce the cost of construction projects. To compare the speed of construction by steel and wood formwork systems on this concept:

- create time,
- Stripping time and
- Productivity of construction work

The type of formwork used in the construction of projects does not affect the time for removal of that form, but one thing to isolate time is how quickly concrete achieves desirable power, in turn, in the types of cement and projects depends on the mixture of usage. In this way we can understand from the report that the type and status of the formwork used in the project can affect productivity. Most respondents believe that modern formworks such as Peri and Mivan improve the productivity of the product as it can be easily handled by more area, less weight and by workers, which will increase productivity.

Structural Element	Stripping time	
	STEEL FORMWORK	TIMBER FORMWORK
BEAM	21 DAYS	21 DAYS
COLUMN	12-24 HOURS	12-24 HOURS
SLAB	21-28 DAYS	21-28 DAYS
STAIR	21 DAYS	21 DAYS
SHEAR WALL	12-24 HOURS	12-24 HOURS

VIII. RESULTS AND DISCUSSION

Since the main purpose of this study is to compare the structure of steel and wood on the basis of cost, quality and closing time for the construction of projects, and to reach this point, to which point the system has the cost, quality and closing time There are more advantages. Considering the analysis of these three factors in chapter four, the following conclusions have been taken based on the results of the analysis through questionnaires: -

- From the survey of initial cost analysis of formwork, it shows that wood formwork is cheaper than steel formwork. Most respondents are in favour of buying steel formwork on wooden formwork systems, because the number of recycling of steel formwork is more than wood or plywood formwork. And steel formwork increases productivity over wood or plywood formwork.
- As per the requirement of standard size responsive plywood, the carpenter cuts down the plywood.
- There is no substitute for adjustment in wood and plywood formwork. If this happens then they will affect the quality.
- In steel formwork they come with standard size and are also adjustable with size.
- On the other hand, on the basis of the cost of the formwork system rental cost, according to the survey report high class contractors or companies like to buy steel formwork due to the number of reuse properties. Therefore, on the basis of analysis conclusions, not all respondents are suggested to work with wood formwork on rental basis, they will increase the overall cost.
- Rate analysis is done with the standard rate, which is provided by Indian standards. The average per foot square cost of steel formwork is more than the timber formwork system. The average cost of steel formwork for beam construction is 19.6 rupees more than wood formwork for building beam, column steel formwork cost is Rs 18.93 more than the timber formwork for column construction and steel slab formwork cost, which is 20.3 more than the slab formwork construction. For stair case, the cost of steel formwork is more than 18.3 rupees compared to plywood or timber formwork which is used for stairs. And for shear wall steel formwork, the cost of wood or plywood is 21.25 rupees.

- The findings about reducing the cost of project steel cost work system can be a solution for this. But this will only consider the cost of building projects for the high rise building which is in nature in nature. This is due to its combination properties of steel formwork, even for the beam and slab, less prop is used which is easy to maintain. And easy to rent is also available.
- Concrete steel is a great option based on the full quality of the formwork, but sometime it will increase the cost of projects. Therefore, the good finishing of plywood concrete is another option for quality when they are designed like Perry or Mini Formwork Design. This will provide better finishing quality and will resist the problem of discoloration. Low growing building is not a good option for the best quality of concrete prepared in the steel formwork, it will only increase the cost of projects. So it is better to use modern timber formwork systems such as medium density fibre board and plywood.
- Modern wood formwork systems, such as plywood and medium density fibre board, have a smooth surface which helps in removing formwork from concrete surface, which will provide better sophisticated quality of concrete.
- The type of formwork used to build projects on the basis of productivity level affects the productivity of the labour force.

Modern timber formwork systems like mid-density fibre board and plywood improve productivity of labour force. Factors affecting productivity of labour force such as less time required for maintenance, larger format size and smooth formwork for modern formwork systems than steel formwork system helps improve the productivity of face labour force.

IX. FUTURE STUDY

Future studies should focus on the effectiveness of the formwork on the productivity of the crew. In this study research, the factors of formwork maintenance, panel size and formwork face touched the factors of formwork systems, and it requires research to determine the impact of the formwork on productivity.

Here are some points for future research for further study to improve the understanding of formwork for the construction of projects:

- Study on the effectiveness of the type of formwork system on the productivity of the crew.
- Impact of the formwork maintenance, the panorama of formwork and the impact of the formwork on productivity.
- and the cost of formwork in projects life cycle.

REFERENCES

- [1] Abebe Dinku. (2007). A Text book of Building construction. (1st ed.)
- [2] K.N JHA
- [3] Formwork for Concrete book **IS: 6461 (Part 5)-1972.**
- [4] Alamin, B. (1999). Analysis of construction loads on concrete formwork
- [5] Doka framed formwork. Frami 300 product catalogue. 2005. Doka formwork international.
- [6] Hanna, A.S. (1999). Concrete formwork system. (1st ed.). New York: Marcel Dekker, Inc.,
- [7] Hurd, M.K. (1995). Formwork for concrete AC1 SP-4. (6th ed.). Detroit, Michigan: American Concrete Institute.
- [8] Jensen, D.A. (1986). Choosing a forming system for concrete floors and roofs. Concrete Construction, 8 1(1), 5-12
- [9] Niekerk, A.J. (2009). Concrete elements
- [10] Concrete Reinforced Steel Institute (CSIR),
- [11] Hanna and Senouci (1995)
- [12] Antony D. Radford and John S. Zero (1988)
- [13] Emad EIBeltagi, (2011)