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Comparative Study of Jump Formwork with Conventional Formwork

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Abstract – Jump formwork is the latest technology used for construction of high rise building. This paper analysis the comparison of conventional and jump formwork with a live project to compare the various parameters. This paper studies the role of advanced formwork systems in high-rise construction and analyzes this role in shaping not only the progress of concrete activities, but the entire construction sequence.

Keywords – Jump Formwork, High Rise Construction Technique, Latest Formwork Technology.

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1. INTRODUCTION

Jump formwork is a special type formwork for vertical concrete structures that rises with the building process. While relatively complicated and costly, it can be an effective solution for buildings that are either very repetitive in form such as towers or skyscrapers or that require a seamless wall structure. Formwork system has significant role in the construction process, making the right decision by choosing the appropriate formwork system. Different systems have their own advantages but one needs to choose a formwork which best supports individual project requirement.

In tall-building construction with reinforced concrete structures, enormous efforts for enhancing formwork efficiency are invested in ensuring successful project completion. Formwork operations represent approximately 25% of the total construction duration and directly affect subsequent construction activities, such as electrical, mechanical, and finishing work. To secure the business value of the project, tall-building projects also require reduced cycle times per floor, so many modular formwork systems with standard-sized and prefabricated forms, such as aluminum forms and Sky deck(PERI GmbH, Weissenhorn, Germany)are used to make formwork erection easier. Furthermore, systems with mechanical devices such as auto climbing systems (ACSs) are introduced for automating the formwork construction process. As trends toward simplification of structural systems and lack of skilled labor continue.

One of the more-useful alternatives for improving the productivity of horizontal formwork. In applying the table formwork method, the lifting system is one of the crucial factors affecting productivity and costs for table formwork operation. The rental of the lifting system accounts for a large portion of the total formwork costs, and the capacity and operating processes largely determine the idle time between activities. The tower crane (T/C) method is used generally for vertical transportation of table forms with other materials. However, this lifting method causes productivity losses by frequent idle times occurring at the stripping floor because the T/C has to support table forms during their transportation and installation. Moreover, an increase in lifting loads for the T/C can lead to an increase in the planned cycle times for the concrete framework. To address these problems, several construction sites have recently usedindependent lifting systems. To lift the table forms, the system raises the lifting platform itself through independent lifting masts (DOKA GmbH, Amstetten, Austria) or uses a winch attached above the platform (PERI GmbH, Weissenhorn, Germany), which enables the crane-independent transportation of table forms. However, the initial setup of these systems requires much time, and the initial cost increases significantly because of their complicated configurations and heavy weight. Moreover, subsidiary work for raising and fixing the system itself might be repeatedly required, depending on the progress of construction work.

- Generally, jump formwork systems comprise the formwork and working platform for cleaning/fixing of the formwork, steel fixing and concreting.
- Jump formwork, often described as climbing formwork. It is suitable for construction of

multi-floor vertical concrete elements in high rise structure, such as shear walls, core walls, lift shaft and bridges pylons.

- It is highly productive system design to increases speed and efficiency while minimizing labor and time.

TYPES OF JUMP FORMWORK SYSTEM:

1. Normal jump or climbing form
2. Guided – jump form
3. Self- climbing jump form

2. LITERATURE STUDY

[2.1] Naveen V. Chikkaveerayanavar & Naresh Patil – (2017): 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 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.

[2.2] A.Sharmila & A.Aaron Christober – (2016): This study is to focus on identifying the qualitative factors affecting the selection of the formwork at high rise buildings from the various literatures and the interview with the selected respondents. Questionnaire has been prepared with keep in mind about residential and commercial projects only and the questionnaire will be distributed to various Project Managers, Planning Engineers, and contractors in Chennai, Bengaluru, Coimbatore and Erode. Developing a decision support model for formwork, incorporating all the major constraints, that will help whether the resources is necessary and feasible at site.

[2.3] Hisham A. Abou Ibrahim & Farook R. Hamzeh – (2015): The importance of advanced high-rise formwork systems in streamlining the workflow of concrete and other downstream activities, allowing for better resource allocation, more waste reduction, smaller work batches, less inventory, and safer working environment.

Advanced formwork systems provide innovative solutions for today's complex high-rise developments, and open the doors for greater improvements in construction methods. Future studies can link the use of advanced systems to the implementation of lean ideals on high-rise projects, such as waste reduction, Take time calculation.

[2.4] Hisham A. Abou Ibrahim & Farook R. Hamzeh – (2015) : This paper describes an advanced scheduling methodology that is part of a research program devoted to the topic of Location Based Repetitive Scheduling Method for housing projects in India. Now a day there is a cut throat competition in all fields of Engineering and construction in India. To gain the success in the field of construction in these evolving times, project managers must emphasize efficiency in all aspects of their operations, including resource flow process, mainly the labor crew performance. Most often project manager has to plan location based repetitive projects.

[2.5] Ramesh Kannan.Ma & Helen Santhi. Ma (2013): One of the most important requirements is the advancement in forming technology. Though the conventional or traditional method of forming high-rise building is economical, it suffers seriously on the time, quality, safety and sustainability factors.

The advanced systems known as climbing formwork was introduced later. The climbing formwork is relatively new technology developed from the slipform in late 1960s. A valid comparison of different climbing formwork with the conventional formwork is done for the lift core-wall in the 20 storey high-rise building model using Building Information Modeling (BIM).

3. METHODOLOGY

COMPARATIVE STUDY OF JUMP FORMWORK WITH CONVENTIONAL FORMWORK

For comparative study of advance formwork and conventional formwork. Jump form was selected as representative of advanced formwork and it is compared with timber formwork. Comparative study is then carried out by selecting a suitable working plan of a building. The plan is selected such that the shuttering area for timber formwork is 1769 sq. m. and for Jump form it is 2400 sq. m. The area calculated for both form works are the shuttering area for same floor area.

Following parameters were compared,

1. Shuttering area
2. Reinforcement binding
3. Concrete with RMC
4. Brick masonry

5. Internal plaster

6. External plaster

Quantities for comparison for both formworks are calculated for all items and work which require formwork.

3.1 Assumption:

Following assumptions are obtained from data collected by site visit at OMKAR 1973, Worli.

1. Jump form we consider **35** repetitions.

2. In conventional shuttering consider **10** repetitions.

For both systems concreting is done with RMC using concrete pump and Tower crane. No external plaster is required for jump form system.

VARIOUS PARAMETERS CONSIDER FOR COMPARATIVE STUDY

3.1.1 Cost

Calculation for Conventional Shuttering

The surface area of timber formwork is **1769** sq. m.

Consider 100 sq. m. of Timber Formwork

Particulars	Unit	Quantity	Rate (Rs)	Amount (Rs)
Plywood	NO.	38	2560	97,280
Wooden Patti	SQ.FT.	0.85	485	412.25
Wooden Chabi	SQ.FT.	0.34	530	180.2
Others	UNIT	255.5	280	71,540
Total				**1,69,420**

Hence for 1 sq. m. the cost of formwork is Rs.1,694.20

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The total surface area is 1,769 sq.m.

Hence cost of conventional formwork for 1 floor

= 1,769 X 1,694.20

=Rs.29,97,039.8

Since the no. of repetitions for conventional formwork is 10,

Hence Cost of conventional formwork system is **Rs.2,99,703.98**

CALCULATION FOR JUMP FORM SYSTEM

The surface area for Jump form system is 2400 sq. m.

Consider 100 sq. m. of Jump form shuttering

Particulars	Unit	Quantity	Rate (Rs)	Amount (Rs)
PLYWOOD	NO.	38	2,560	97,280
CLIMBING BRACKET	NO.	24	6,000	1,44,000
SUSPENDED PLATFORM	NO.	8	1,200	96,000
CLIMBING CONE	NO.	96	300	28,800
ANCHOR CONE	NO.	50	540	27,000
OTHERS	NO.	350.8	280	98,224
TOTAL=				4,91,304

Cost of construction in Rs. (Lk)

Hence for 1 sq. m. the cost of formwork is Rs. 4,913.04

Cost for 1 sq.m. is Rs.4,913.04

The total surface area is 2400 sq.m.

Hence cost of conventional formwork for 1 floor = 4,913.04 x 2,400

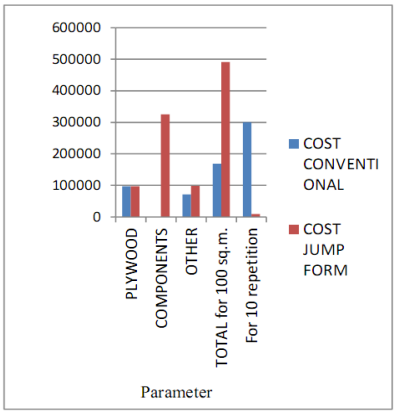
=Rs.1,17,91,296/-

Since the no. of repetitions for Jump formwork is 35.

So that after 10 repetitions for Jump formwork is = (10 x 3,36,894.1714) /35

= 96,255.47/-

Hence Cost of Jump formwork system after 10 repetition is Rs.96,255.47/-



Graph 1: Cost of construction

3.1.2 Time

CALCULATION FOR CONVENTIONAL FORMWORK

Total area 150 m^2

For 1 day work

1 carpentor + 2 labour = 5 m^2 area covered

Manpower output = 150/5

=30 days

Required days = 30/3

= 10 days

Hence for 150 m^2 area 3 carpentors and 6 labours complete the work in 10 day

CALCULATION FOR JUMP FORMWORK

Total area 150 m^2

For 1 day work

1 carpentor + 2 labour = 50 m^2 area covered

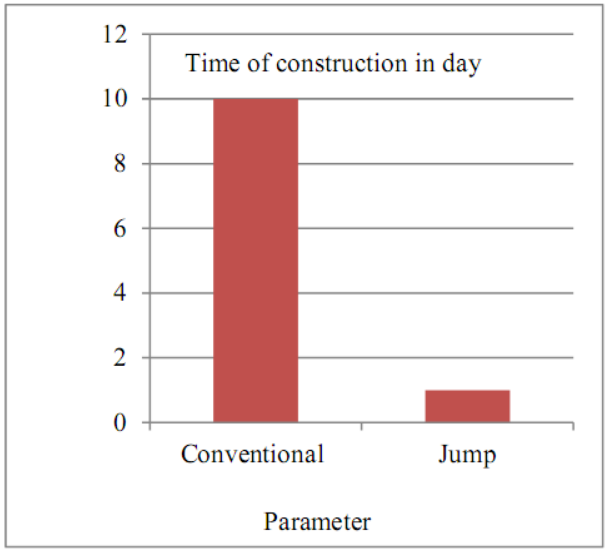
Manpower output = 150/50

=3 days

Required days = 3/3

= 1days

Hence for 150 m^2 area 3 carpentors and 6 labours complete the work in 1 day



Graph 2 Time of construction (for 150sq.m)

CONCLUSION:

From the above project data we concluded the following points,

- Since the initial cost of jump form system is more but due to more number of repetitions it is more than 31.13% economical as compare to conventional type.
- Jump form system is time saving process& it save 10% time than conventional type formwork.
- Jump form system gives good finishing and aesthetic view.
- Due to all above factors jump form system is more advisableespecially for high rise construction.

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