A COMPARATIVE STUDY FOR EVALUATION OF DIFFERENT FORM WORK SYSTEMS UTILIZATION IN CONSTRUCTION PROJECTS

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ABSTRACT

Due to the rapid development in economy of India over past decades. To meet the requirements of more housing projects are to be completed in a short duration of time. One of the major factor for timely completion of project is formwork used by the company. In the present study the key parameters like cost, speed of construction, quality achieved, cycle time etc. were identified role in selection of efficient formwork system is studied. So as to help new contractors who are entering into construction activities to complete the project with in allocated budget and duration. To do that a real time project was considered and all the parameters were studied and compared the results from different construction companies all over the India. The attempts were made to highlight the key parameters and type of formwork to be used for project was explained.

Key words: Formwork systems, MIVAN, DOKA.


1. INTRODUCTION

India is a developing country. Indian construction industry is second largest employer next to agriculture. Construction industry plays a major role in economic development of the country it impacts GDP growth rate by 11% (2015). Due to the increasing need of infrastructure with increase in population, need of efficient technology to make speed and economy constructions is a point of focus. To attain that formwork systems plays an important role. Formwork is a temporary construction to support structural members during concrete hardening stage to with stand oncoming loads like dead load of wet concrete, hydrostatic pressure of concrete and live loads due to labor and equipment, sudden impacts load due to vibrators, pouring of concrete...
and due to equipment operation etc. Though formwork support structural members and loads it should also give smooth and quality finish. As per construction industry point of view very important element in construction is formwork. With advance in recent technology the traditional formwork is replaced with suitable material based on cost, time, quality construction, waste generation and safety during process of work.

1.1. Need of Formwork in Construction Projects
The main factor behind success of any construction project depend on formwork system, it plays a major role in finishing the structure with in stipulated time bound. In-depth study is needed to find out best suitable formwork system by contractors during construction. It needs a vast experience and established players for selecting suitable construction formwork. With proper selection of formwork system cost of construction can be significantly brought down.

Factors effecting the selection of formwork system:
- Cost
- Quality
- Safety
- Cycle-time
- Building design
- Site constrains
- Available resources
- Contractors experience
- The abilities of labor
- No. of reputations
- Capital availability
- Method of hoisting

2. OBJECTIVE
- The main objective of this thesis work is to identify the key parameters governing the selection of different formwork systems.
- A survey on various types of formworks is to be done from different contractors with focus on critical factors like cost, quality, number of reputations and cycle-time.
- Formwork systems chosen for study are conventional, MIVAN and DOKA.

3. METHODOLOGY
The entire process consists of number of sequential steps. It begins with studying the literature to identify the various factors considered before the selection of formwork and preparing the questions for the questionnaire survey to be carried out. Further, the questionnaire prepared was distributed among different constructions in different regions. Finding out the importance given to various factors like cost, quality, safety, cycle time etc. during the selection of formwork. Finally, the collected data is analyzed and conclusions are drawn. A detailed methodology chart is shown below
A Comparative Study for Evaluation of Different Form Work Systems Utilization in Construction Projects

3.1. Types of Form Work Systems
As per Raymond Wong Waiman (2005) [1] in his paper classified papers based upon sizes location of use nature of operation or simply based on brand. Formwork is classified based upon material, type of structural member.

- Conventional formwork
- Steel formwork
- System formwork
- Aluminum formwork
- Tunnel formwork

3.2. Advantages and disadvantages of Types of Formworks

<table>
<thead>
<tr>
<th>Type of Formwork</th>
<th>Advantages</th>
<th>Dis-advantages</th>
</tr>
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<tbody>
<tr>
<td>Timber formwork</td>
<td>Durable, lightweight, economical, flexible for easy erection. It exhibits good thermal insulation so it can be used in cold climates. Its reusability varies from 10 to 12 times. Unique advantages of timber formwork: It can be built piece by piece so capable enough to form any concrete shape as per architectural</td>
<td>High labor cost. Usually varies from 30 to 40% of total cost of concrete slab per floor. High waste generation. 5% of waste is produced for a single use of formwork. Erection and dismantling is to be done piece by piece.</td>
</tr>
</tbody>
</table>
This system is economical for small scale projects with limited potential reuse. It has low initial cost and make up cost. Good for restricted site conditions less storage area and use of crane is difficult.

### Aluminum formwork
- Lighter in weight compared to steel formwork due to its low density.
- Large section can be made because the strength of aluminum in handling tension and compression is more than that of steel. It can be easily handled by unskilled labor. Reusability is more. Varies from 100-250.
- In case of high magnitude constructions where need of rapid erection, this system creates exceptionally fine quality finish and precise dimension good enough to receive painting directly without plastering in a very short time. Monolithic construction with few construction joints can be easily made.
- No changes can be made if ones fabricated.
- Initial cost is very high.
- Not economical for small and non-recitative works.

### Steel formwork
- Uses mostly in huge construction projects where large number of repetitions of same shuttering is possible.
- It is good for curved structures like columns, chimneys, tanks.
- It is strong, durable in nature.
- Its reusability varies from 100 to 120.
- Installation and dismantled with greater speed can be achieved with results in higher savings in labor cost.
- Water absorption is very less, so formation of honey combs can be minimized.
- Heavy to carry and handle.
- Not suitable for curved and new architectural shapes.

### Plastic formwork
- Unique shapes and patterns can be designed with excellent finishing with less or no surface treatment.
- No size limits
- More uses making it highly economical
- Light weight
- Easy to strip and handle.
- No need of skilled labor.
- Does not provide field fabrication by itself so design and planning must be carefully done.
- It is not suitable for heat applied curing of concrete.
- Strengthening material (fiber glass) is to be used to increase stiffness in construction of large and higher floor areas of multi storied buildings.

### MIVAN formwork
- Simple, fast, easily adaptable.
- High quality work with minimum maintains cost.
- It is a completely pre-engineered system where methodology is planned to its finest details.
- Early removal of formwork with air curing components are made with aluminum so they are light in weight number of reputations is very high it is around 250-300.
- Pre-engineering is needed for planning and execution.

### DOKA formworks
- It is Australian based company that produces timber, aluminum, and steel forms which has a wide application in all fields of construction sector.
- Preside planning is need before execution
- Skilled labor is need to handle the form work system.
A Comparative Study for Evaluation of Different Form Work Systems utilization in Construction Projects

4. RESULT & DISCUSSION

Method of selection of formwork possess a number of sequential steps involved. First of all, literature review carried out to identify various factors contributing for selection of various formworks, next questioner is carried out in different regions like Hyderabad, Mumbai, Pune, Bangalore, and Chennai to find important factors that effect the selection of type of formwork system. Some such major factors are cost, quality, safety, cycle time etc. All the above parameters were applied to study and identify the suitable formwork system on a live project of G+4 building from the collected data and conclusions were drawn.

4.1. Proposed plan of building for comparison of form work systems

A G+5 building is considered for construction and its plan and elevation are as follows the details of the building under choice

- Plan area of the slabs = 221.73 sq.m
- Size of beam = 0.23*0.4 sq.m
- Size of column = 0.3*0.3 sq.m
- Thickness of the slab = 150 mm

4.2. Comparison of Questioners Survey Data

The questioners were conducted in 22. Major companies like L&T, SPRE, Ramky, GDCL, NCC etc. in regions like Hyderabad, Bombay, Bangalore, Chennai and Pune to find out various factors like cost, quality, safety, cycle time etc.

Comparison of different parameters is presented as a bar chart shown below

- Figure 1 Floor Plan
- Figure 2 Elevation of the building
- Figure 3 Cost comparison of conventional, Miavan, Doka
- Figure 4 Quality comparison of Conventional, Miavan, Doka

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## MIVAN and DOKA systems

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<th>Safety Management</th>
<th>Number of repetitions</th>
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<td><img src="image1.png" alt="Graph" /></td>
<td><img src="image2.png" alt="Graph" /></td>
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**Figure 5** Safety Management Comparison of Conventional, MIVAN and DOKA Systems

**Figure 6** Number of Repetitions Comparison of Conventional, MIVAN and DOKA Systems

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<th>Cycle time</th>
<th>Labour requirement</th>
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**Figure 7** Cycle time comparison of Conventional, MIVAN and DOKA systems.

**Figure 8** Labour requirement Comparison of Conventional, MIVAN and DOKA

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<th>Stability</th>
<th>Requirement of Fixtures</th>
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**Figure 9** Stability Comparison of Conventional, MIVAN and DOKA.

**Figure 10** Comparison of Requirement of fixtures in Conventional, MIVAN and DOKA systems.

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<th>Testing procedures</th>
<th>Performance of concrete</th>
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<td><img src="image7.png" alt="Graph" /></td>
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**Figure 11** Comparison of testing procedures of conventional, MIVAN and DOKA systems.

**Figure 12** Comparison of Performance of Concrete for Conventional, MIVAN and DOKA
5. CONCLUSIONS

Based upon the survey and comparison from live project key contributing factors that plays a significant role in selection of formwork are cost, quality, cycle time, Number of reputations, safety, administration of change orders, performance of concrete. By comparing the above parameters through study and graphs from questioner, the following conclusions can be made:

- Cost adopted for MIVAN formwork is highest among the all formwork systems this is because of use of aluminum in making of formwork even though cost of MIVAN is high due to higher number of reputations the overall cost reduces which makes it favorable in repetitive kind of works.
- MIVAN gives highest Number of reputations compared with conventional formwork.
- Faster construction can be achieved with MIVAN formwork as cycle time of MIVAN is less compared to conventional formwork.
As per safety management MIVAN is the best in the industry compared with the others Formwork systems.

Changes can be easily accommodated for conventional when compared with MIVAN. Because MIVAN formwork is already customized and standardized.

Formwork system plays a crucial role in successful and timely completion of project. From the above analysis MIVAN formwork is the highly rated formwork system, because of its higher Number of reputations in use, with smooth and exact surface finish which brings down overall cost and also provides superior quality types of structures with less time.

In case of non-repetitive and availability of less labor and improper feasibility with site and storage area restrictions wood formwork is preferred to MIVAN formworks.

REFERENCES


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