



ANALYSIS OF EFFECTIVE SELECTION OF FORMWORK SYSTEM BASED ON VARIOUS FACTORS FOR CONSTRUCTION PROJECTS

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ABSTRACT

In a tall building reinforced concrete structures, the selection of an appropriate formwork system is a crucial factor for the success of the project. Formwork is defined as temporary structure whose purpose is to provide support for fresh concrete until it can withstand by itself. Thus, selecting an suitable formwork system affects the whole construction duration and cost, as well as subsequent construction activities. This study focused on identifying the qualitative factors affecting the selection of the formwork at various constructions from the literatures and the survey with the selected respondents. Questionnaire has been distributed to various Project Managers, Planning Engineers, and contractors. The data collected were analyzed using SPSS software. Based on the various factors the effective type of formwork was identified.

Key words: formwork system, high rise buildings, effectiveness.

I. INTRODUCTION

GENERAL

Formwork is the use of structures support to create structures out of concrete which is poured into the moulds. There are many different types of formwork used in construction, usually differing according to what the building requirements and challenges are in construction. Formwork is used by creating moulds

out of wood, steel, aluminum or prefabricated forms into which the concrete is poured. This is then allowed to harden and set after which it is stripped, or in the case of stay-in-place formwork it is left as part of the structure. Formwork allows contractors to cast and construct the main parts of a building which are required to be strong structure such as floors and walls, as well as smaller parts of a building such as stairs relatively quickly. The most important factor in terms of cost, quality and speed in a high-rise building construction project is the type of the formwork used in the project. [6] analyzed microwave waveguides and components such as microwave T junctions, circulators, attenuators and Isolators.

The first formwork type to be used is the conventional type formwork where the timber planks were supported on timber columns. With the advancement of technology it developed gradually and people used ply wood sheets instead of timber planks and steel pipes with jacks were used to support the ply wood. Then finally the whole system of formwork is made and initially the material used to it was steel and it was very heavy. Then the aim was to reduce the weight of the system and the materials for formwork have extended to aluminum, plastic, fiber glass...etc. A formwork system is defined as the total system of support for freshly placed concrete as well as supporting members, hardware, and necessary



bracing. The formwork system has a vital role to play especially in the high-rise structures in mechanizing the activities to achieve speed, increase the productivity and to utilize economy of scale in bringing down the unit cost

II. SCOPE

With the tremendous increase in need for mechanization in the construction methods there are number of factors to be considered in arriving at a decision of the most appropriate method and system or technology to be used for construction. In selection among different alternative methods and technologies for the faster and economical construction of buildings, it is necessary to formulate a base framework which aids to assist the planning team to choose the most appropriate system of formwork as per the specific requirement of the project.

III. OBJECTIVES

1. To identify factors affecting the selection of the formwork systems
2. To identify different systems of formwork, advantages, limitations and specific problems faced in using the formwork systems.
3. To develop a decision support system for selecting the appropriate formwork systems.

IV. FORMWORK SYSTEMS

Formwork is a mould or die used to shape and support the concrete until it attains sufficient strength to carry its own weight. Formwork is the largest cost component for a typical multistory reinforced concrete building. Formwork is the largest cost component for a typical multistory reinforced concrete building. Important aspects in the construction of tall structures include type of formwork system, method of concreting, geometric control, material handling etc. there are many ways a tall structure can be constructed using different formwork techniques like more than 5 stories steel formwork, steel frame with plywood formwork, aluminum formwork, plastic formwork, etc. details on the different systems, their advantages, disadvantages are discussed below

Conventional Formwork

This is the oldest type of formwork used in the construction industry. This type uses timber,

bamboo, masonry and carpentry in the construction. This type is very much suitable for small houses with two to three stories and still they are in use for such constructions. But this is not suitable for the big projects or high-rise buildings.

Wooden formwork

- Low initial cost, low experience factor, low weight is some of the advantages of this type
- Poor finish, high labor requirement, skilled labor requirement and consume lot of time are some of the disadvantages.

Steel Formwork

Mostly used in large construction projects or in situations where large number of re-uses of the same shuttering is possible.

- It is Suitable for circular or curved shaped structures such as tanks, columns, chimneys etc. & also used for structures like sewer tunnel and retaining wall.
- Strong, durable & have longer life. Reuses can be assumed to vary from 100 to 120.
- Steel can be installed & dismantled with greater ease & speed resulting in saving in labour cost. No danger of formwork absorbing water from the concrete and minimizing honeycombing.
- Proper maintains should be needed, material weight are some of disadvantages.

Mivan (or) Aluminium formwork

Forms made from aluminum are in many respects similar to those made of steel. However, because of their lower density, aluminum forms are lighter than steel forms.

- The formwork turns out to be economical if large numbers of reuses (above 300) are made in construction, integral and smooth finishing of wall and slab, fast construction
- Concrete surface finishes are good to receive painting directly without plaster.
- The major disadvantage of aluminum forms is that no changes can be made once the formwork is fabricated.

Plastic Formwork

- Plastic formwork system has a very low surface tensioned and so it does not stick to concrete making and reuse without any major cleaning work
- The system is very light weight and therefore easy to handle .It does not get spoilt in water so it can used



in anywhere the and given working conditions onsite it does not need a dry area to store

- There is no need to plaster apply putty and paint directly
- Repetition around 80 to 100 times.

RELATIVE IMPORTANCE INDEX (RII) ANALYSIS

The RII was calculated by using the formula as below

RII = Where,

w = weight of scale; A = highest weight ('5' in this case);

N = total number of respondent

V. METHODOLOGY

- Literature Review
- Identification of the factors influencing in selection of formwork systems.
- List out the various constrains and questionnaire prepared based on that constrains then surveying at different sites and finding the answers.
- Based on survey ranking the Factors Affecting the Selection of Formwork

VI. FACTORS INFLUENCING SELECTION OF FORMWORK SYSTEM

Adaptability & Flexibility (Fixable Sizes)

Formwork should be modular and adaptable for various sizes and shapes of the structural system, so that it can be used for many projects. Formwork should be viable for the particular project based on cost and availability.

Quality & Surface Finish

Quality of structural finish of the concrete is to be adequately addressed by strength of the formwork as well as its resistance to deformation. Architectural finish of the concrete depends on sheathing material used. The sheathing materials such as plywood, steel, aluminum, and rubber should be appropriately chosen based on the required finish and feasibility.

Availability

Material and supplier availability consider for avoiding shortage problems during execution.

Cost

This is a vital factor for deciding formwork system as one must know the capital provision for formwork in the project. On average about 35% of the total cost of any finished concrete unit or element can be attribute to its formwork; of this just over 40% can be taken for material for formwork and 60% for labour.

Type of Structure

The structure may be commercial building or a residential building and the system to be chosen is based on adaptability of formwork to suit the requirement.

Maximum Load Capacity

Formwork must be capable of safely withstanding without distortion or danger the dead weight of the fluid concrete is placed on it, labour weight, equipment weight and any environmental loadings.

Time Factor

Faster floor cycle is always desirable for contractors and owners. For contractors, faster floor cycle allows the contractor to finish on schedule or earlier which reduces the overhead cost. For the owner, faster floor cycle reduces the short term financial charges and allows early utilization of the constructed facility.

Accessibility to Work

Proper access to work place is an important requirement and sufficient space for the shifting of panels and storage.

Erection and Dismantling

Form panels and units should be designed so that their maximum size does not exceed that which can be easily handled by hand or mechanical means. In addition all formwork must also be designed and constructed to include facilities for adjustments, leveling, easing and de shuttering without damage to the form work or concrete.

Suitability of Work for Labours

Easy handling of form materials and work with comfortable that include lifting, erection and dismantling.



Accuracy

Formwork must be accurately set out so that the resulting concrete product is in a right place and is of correct shape and dimension. All joints in form work must be either close fitting or covered with form tape to make them grout tight. If grout leakage occurs the concrete will leak at that point. Leakages cause honeycombing of the surface.

Weather Condition

Vertical forming systems are sensitive to weather conditions. Typically, in vertical forming systems, the newly placed concrete is supported by the wall already cast below it. The lower wall section must gain sufficient strength to support the fresh concrete above. The rate of strength gain for the lower wall is influenced by ambient temperature, moisture content, and freezing and thawing cycles. Another factor that affects the economy of the selected system is the effect of stopping forming and concreting because of extreme weather conditions.

VII. DESIGN ANALYSIS

Factors	RII method	Rank
Quality and surface	0.86	1
Time factor	0.85	2
Lifespan	0.84	3
Cost	0.83	4
Safety	0.82	5

FACTORS	RII VALUE	RANK
COST	0.83	4
AVAILABILITY	0.70	7
SAFETY	0.82	5
ERECTION AND DISMANTLING	0.66	8
LIFESPAN	0.84	3
EASILY FIXABLE SIZE	0.62	10
QUALITY AND SURFACESMOOTH	0.86	1
TIMEFACTOR	0.85	2
SUITABILITY OF WORK FOR LABOURS	0.64	9
MARKET TREND	0.55	1
INACCESABLE TO SUPPLY	0.57	11
CLIMATIC FACTOR	0.53	13
DESIGN	0.71	6



VIII. CONCLUSION

The factors affecting selection of formwork were identified through literature study & experts opinion. This project received 30 respondents the collected data was analyzed through both Relative Important Index method and Microsoft excel. According to their rank indexes the top 5 factors has been ranked accordingly for 30 completed surveys. The top 5 factors are quality and surface smooth, time factor, lifespan, cost and safety. Based on these factors comparative table was prepared, from that decision was made. And this was analyzed on ongoing and completed projects it gives more than 90% accurate results

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