



# CONSTRUCTABILITY OF CONCRETE FORMWORK SYSTEMS

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**ABSTRACT** : Vertical development is the ideal solution to meet the demand of land for the fast growing urban population in India. It is the construction of tall structures such as high-rise buildings, sky scrapers and sky towers etc., rather than constructing laterally to accommodate large population in quiet a lesser area.. 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). From the developed 3D BIM model, the cost, time, quality, safety and sustainability factors of both conventional and climbing formwork are explored in detail by quantitative and qualitative indices

**Keywords--Building Information Modeling; climbing formwork; constructability; high- rise building;vertical development**

## 1.INTRODUCTION

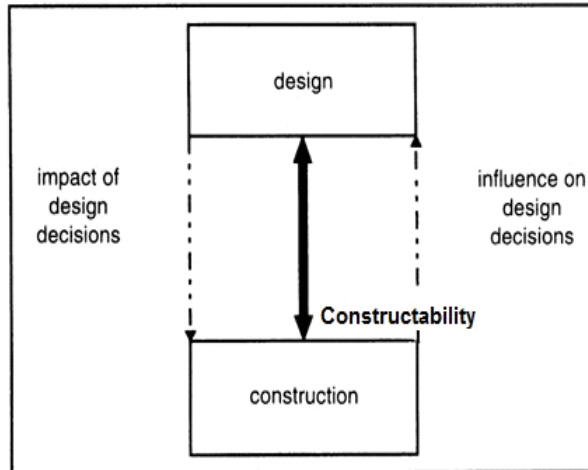
Formwork is more than a mould; a temporary structure that supports its own weight and that of the freshly placed concrete as well as the construction live loads. The main objectives of the formwork are Quality, Safety and Economy. The traditional or conventional timber formwork could not account for all the three objectives, thus the modern formwork system known as Engineered Formwork System or System Formwork is preferred. System Formworks are built of prefabricated modules (standard timber beams) with the metal frames and patented plywood sheathings. Since 1980, the concept of system formwork is improving tremendously due to the advancement in forming technology and fabrication process. New and innovative materials such as Plastic, FRP (Fibre Reinforced Polymer), Aluminium, etc are used as an alternatives for the timber components.

## CONSTRUCTABILITY

Constructability as defined by the **Construction Industry Institute (CII), USA**, “is the optimum use of construction knowledge and experience in planning, design, procurement and field operations to achieve the overall project objective.”

Constructability is a project management technique to review construction processes from start to finish during pre-construction phase. It is to identify obstacles before a project is actually built to reduce or prevent error, delays and cost overrun.

The objectives of the constructability are determined by the scope which the constructability is intended to cover. The **Construction Industry Research and Information Association (CIRIA)** limited the scope of the constructability to the relationship between design and construction.



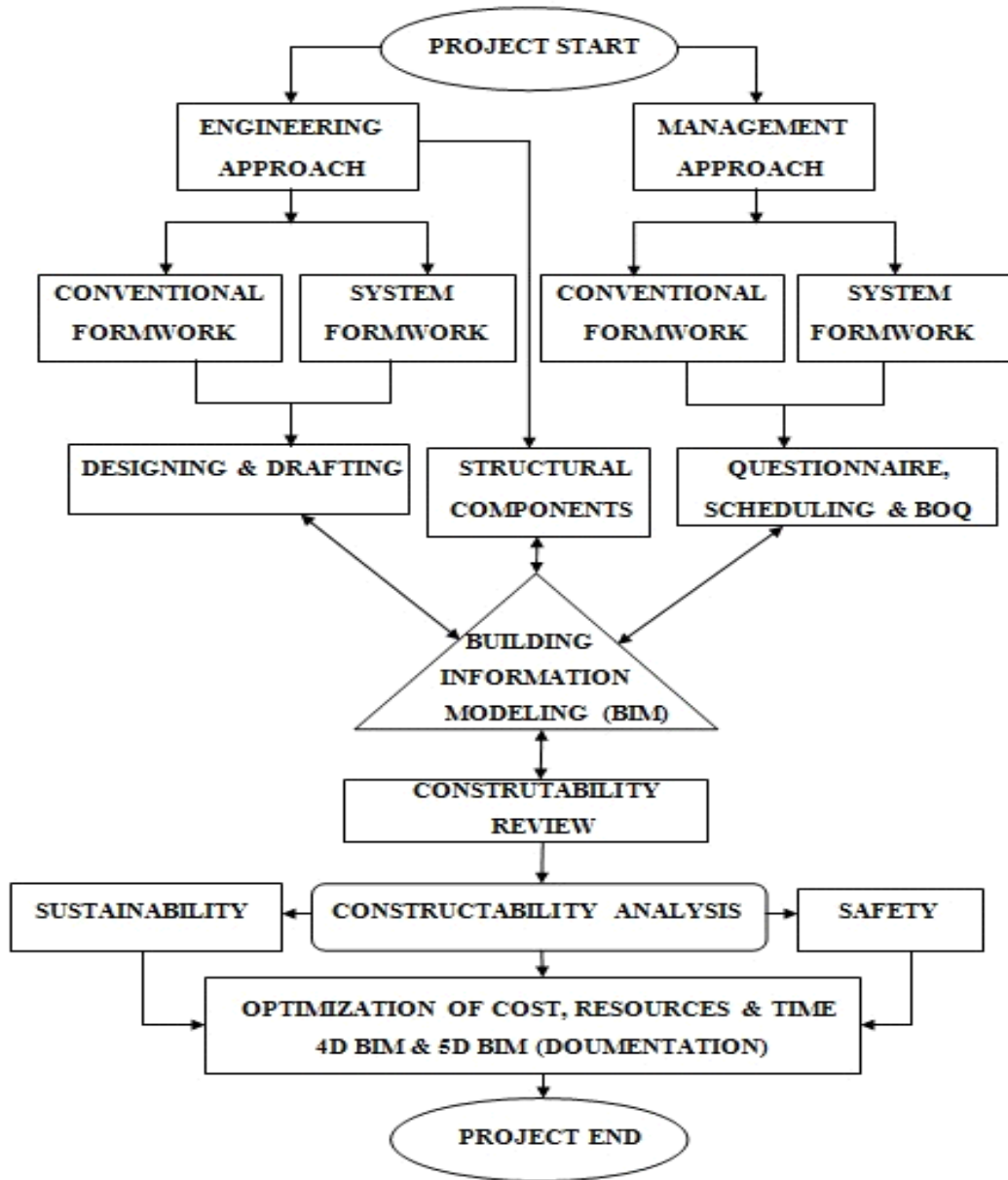
### The scope of Constructability by CIRIA

The scope of the constructability as illustrated above is quite narrow, viewing constructability purely as a design-oriented activity. This narrowly focused approach may fail to realize the full potential of the concept. Thus a workable concept of constructability needs to be developed which recognize many factors in a project environment which impact on the design, construction processes and the link between design and construction and the maintenance of the building.

The essence of this modern approach is that constructability can be enhanced by individual participants exploiting construction knowledge to maximize opportunities and develop best options to meet project objectives in a co-ordinated way. Thus by co-ordinating the constructability principles among the client(s), project team member(s), personnel the constructability can be implemented. This can be achieved by a technique called **Building Information Modeling (BIM)**.

**PROJECT METHODOLOGY**

The conceptual framework adopted for this project is



**Flow Chart illustrating the Project Methodology**

**CONSTRUCTABILITY CONCEPT**

**Constructability** as defined by **Constructability Committee, ASCE**, “is the process of providing experienced construction personnel’s input into construction projects at pre-construction stage itself to enhance the construction process.”

## **CONSTRUCTABILITY ANALYSIS**

Constructability Analysis is as an analytical, creative and strategic organization function focusing on the most important factor to the overall success of a Construction Project. The use of constructability analysis provides an opportunity for input from the constructability review to the construction personnel to insure that efficient, economical, and quality solutions are reached.

The necessary objectives that are to be considered for the efficient constructability analysis are as follows: To evaluate and recognize the characteristics of the construction project, To understand and apply alternative project delivery systems such as: design/build, design/build/operate/transfer, design/bid/build/warranty, To understand and apply total quality management and value engineering concepts, To define and apply constructability concepts, prefabrication, preassembly, and modularization techniques, To define and apply a process to implement constructability, To understand and apply maintainability and operability concepts.

The reason for incorporating the constructability analysis is to achieve the overall success of the project which not only involves bottom line but also the quality and schedule as well. Preliminary construction analysis can solve single problem prior to construction but more than one potential problem can be rectified by the constructability analysis.

The elimination of “potential” change issues before they have a chance to become “actual” change issues is the key objective of constructability analysis. Simply, constructability analysis can make construction process better. The better the construction process, the more efficient the project will run. The more efficient the project runs, the better the quality will be achieved. The optimum quality, the best is the project delivery.

## **SCOPE FOR FURTHER STUDIES**

The 3D BIM model of structural components considered in this report are the generalized model however for advanced research on formwork systems; more complex 3D BIM models are developed for studying more additional parameters.

The formwork systems presented in this report are custom made for the purpose of this research and it is more simplified systems, thus for a detailed study on the actual formwork systems, the readers are advised to incorporate the available patented formwork systems in the BIM.

The other types of formwork systems such as climbing formwork system, slipform and other movable type of formwork systems can also be incorporated using the BIM.



### Application of climbing formwork family in the 3D BIM Model

Besides the formwork, the falsework associated with the construction of formwork such as scaffolding, shoring and other formwork accessories can also be incorporated to study the temporary structures of the concrete construction as a whole.

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