

A REVIEW PAPER ON COMPARATIVE DELTA ANALYSIS OF STRUCTURAL QUANTITIES FOR DIFFERENT CONSTRUCTION SYSTEMS

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Abstract: Construction industry is considered as one of the most important industries in India. It is well known that most construction projects are done through conventional technique but Precast technique is a new one for the construction industry particularly in India. Construction industry replacing its method of implementing conventional methodology by various new innovations in the process of construction and selection of materials. The main aim of this project is to find out an optimal construction system which has a cost-effective design by doing a delta analysis for Mivan, Precast and Hybrid System. This study is essential as no research has been conducted related to structural indices, prior to construction planning phase of a project these structural indices are the main deciding factor as which system would be more economical. In this study an attempt is to be done to ascertain which system would be economical in terms of structural behaviour and structural coefficient.

Keywords: Construction systems, Delta analysis, precast system, mivan system, hybrid system, structural coefficient, structural quantities, structural behavior.

I. INTRODUCTION

Construction technology involves the choice of materials and the 'technology and techniques' used in construction. Several construction methods have been developed and improved over past few years in order to improve overall performance in construction projects. One of these methods are known as Precast concrete construction (PCC) and hybrid concrete construction (HCC). These methods of construction are ultimately used to achieve faster and more cost-effective construction. The decision between construction methods is based on many factors, such as project time, cost, quality, safety, environmental performance and socio-economic aspects (labor). Project time and cost are however, the most important of these factors.

Precast concrete is a construction product produced by casting concrete in a reusable mould or "form" which is then cured in a controlled environment, transported to the construction site and lifted into place. The concept of precast (also known as "prefabricated") construction includes those buildings where majority of structural components are standardized and manufactured in plants by industrial methods, at a location away from the building, and then transported to the site for assembly. These components are manufactured for mass production in order to build a large number of buildings in a short time at low cost.

Hybrid concrete construction is a combination of precast concrete and cast in-situ concrete to obtain the supreme benefits of their different construction qualities. However, the use thereof is limited in India, and in-situ concrete construction remains the conventional method of construction over Hybrid system and Precast system. Hybrid concrete construction is a method of construction which integrates precast concrete and cast in-situ concrete to make best advantage of their different inherent qualities. The accuracy, speed and high-quality finish of precast components can be combined with the economy and flexibility of cast in-situ concrete. Hybrid concrete construction produces simple, buildable and competitive structures. The combination of in-situ and precast concrete has numerous benefits in the construction industry. The one material compensates for the drawback of the other. In-situ concrete construction is known as the most economic framing option, while precast construction promotes time savings on construction and better product quality. Combining these two materials provides for greater overall economy.

Delta analysis identifies the difference between the indices of structural quantities in terms of steel, concrete and precast accessories etc., In other words, delta analysis is simply the difference in a certain quantity. The Delta analysis is done to compare the difference between the structural quantity variables in each structural member. For carrying out delta analysis a detailed BOQ is prepared for structural quantities i.e., steel, concrete and precast accessories etc., each and every item is listed in BOQ and indices (structural coefficient) are calculated. On the basis of indices, the comparison is done for different systems.

Indices used as a parameter to determine the cost of the project and it is also known as structural coefficient, it is the ratio of structural quantities i.e., steel, concrete and precast accessories etc., to the corresponding built-up area of the building. Any change in the indices of structural quantities will affect the overall cost of the project

II. RESEARCHES RELATED TO ANALYSIS OF QUANTITIES OF MIVAN, PRECAST & HYBRID SYSTEMS

Buildings are usually built with conventional methods where all necessary construction materials printed in a construction project, such as concrete columns and beams were cast directly on the project. There are a few things that concern in conventional methods, namely the long construction time and less clean, Quality control is difficult to be improved, as well as the basic material of formwork is increasingly expensive and scarce construction costs become more expensive. Today began the construction of

many buildings using precast method. Precast system is a system development fabricated building components / printed first in the factory or in the field, then arranged on the ground to form a unity building.

In comparison to cast-in-situ techniques, the precast construction technology offers advantages such as cost saving, time savings, quality enhancement, less labour required, enhanced safety and reduced wastage. The setup of precast yard requires very high initial investment, so in India investors should promote this technology. The design & planning is very critical in this technique because design cannot be changed once project is started. So, precautions need to be taken during planning and designing stage.[4]. The precast concrete system is economical (cost effective) than cast in place concrete system (conventional). But still there are some conditions of use for example: quantity of construction distance of construction site from precast manufacturing plant, type of building. For standard size construction precast is ideal. The main limitation of use of precast concrete construction is to transportation of members from manufacturing site to where it is going to be assembled. The cost of transportation is considerably high.[15]

The criterion for selection is based on the most economical solution. The quantities of works, i.e., concrete, are treated as independent variable. The outcome of this research is, transportation & shifting cost of precast members considerably affective on total cost of construction which help to assist decision makers and engineers to compare both concrete construction methods early in the construction planning phase of a project [14]. The two main factors that are the basis of any construction systems are time and cost. In any construction project time and cost are the most important factors that have to be given more importance. If any delay occurs in the project these are the factors that get affected directly. It is found that the cost of precast construction is 1.4% higher than that of the conventional construction. The precast construction can be completed at a rate of 15.17% earlier than the conventional construction.[9]

In case of cost overall cost required for constructing the building using precast concrete method is reduced by 20% when compared to conventional method. Economies are generated through reduced requirements for formwork, access scaffolding and less reliance on wet trades. Reduced on site - supervision by the main contractor is also a saving. Compared to cast in situ, the following savings can be expected Formwork 75% less, Scaffolding 75% to 90% less and Wet concrete 90% less. Factory production ensures increased accuracy and quality of finish and decreases weather dependency. Compared with cast in situ structures, site labour is reduced by between 50% and 80% using precast. Work for following trades is reduced by between 30% and 50% depending upon finishes [3]. The percentage efficiency value precast method to conventional methods in 3-10 storey building 12.67% -15.05% (efficiency with foundation) and 16.30% -18.7% (efficiency without foundation). The percentage of efficiency construction costs with the foundation the highest are in the 3-storey building, while the lowest are in the 6-storey building. But the percentage of construction cost efficiency without foundation highest is at the 6-storey building, while the lowest are in the 10-storey building.[5]

The costs of formwork in beams, reinforcement in beams and concrete in beams for both in situ and precast are the same in all the facilities. This is because from the sketch below, formwork, reinforcement and concrete in beams are common to both floors (i.e., precast and in situ floors). However, the costs of formwork, reinforcement and concrete in slab for the in situ are high as compared to the precast prestressed beam and block slab. This account for the high cost of conventional in situ slab. In all the facilities the precast slabs were cheaper with 35% saving on slab of residential facility, 29% saving made on slab of health facility, 26% saving on the slab of the commercial facility, 19% savings on slab of secondary school block and 11% savings on tertiary institution.[17]

The studies revealed that, on average, the precast concrete slabs were 23.22% cheaper than cast-in-place concrete construction and precast columns were 21.4% cheaper than cast-in place concrete construction and that for precast concrete columns were on average 21.4% cheaper than cast-in-place columns, especially for large scale production.[10]

The prefab construction for individual double storey residential building cost is 13% more than the conventional construction. This is main drawback for prefab construction which is not economical to construct in this case. At the same time the prefab construction is easy to work and reduces the project duration, is reduced by 63 days when compared to the conventional. It's the main advantages for prefab construction and also it helps when there is labour shortage.[8]

Hybrid construction is being used in more than 50% of new multi-storey buildings, once the traditional domain of cast-in-situ concrete and structural steelwork. precast concrete is ideally suited to hybrid construction as it may be readily combined with other materials, such as steel, cast-in-situ concrete and masonry for the benefit of the building process at large. by suing precast concrete as the dominant material in hybrid construction, on-site operations are considerably reduced because there is less wet concrete to place, fewer loose reinforcing bars to fix and fewer structural components and formwork to erect. Various study claims that hybrid construction when compared with traditional systems can save between 10% and 20% construction time.[6]

III. SUMMARY AND CONCLUSION

1. These studies essentially provide a better understanding of the good performance capabilities of Precast, Hybrid and Mivan System. In any technology, Economies are generated through reduced requirements for formwork, access scaffolding and less reliance on wet trades.
2. The adoption of precast compared with traditional construction demonstrated significant advantages, such as improved quality control, reduction of construction time, construction waste, dust & noise on site, and labour requirement on site. In addition, it results in higher useful gross floor area which contributed to significant cost benefits.
3. The direct cost required for precast construction is very less as compared to cast – in – situ constructions. This can be achieved when the production unit is very near to site, repetitions of form/mould of buildings indirectly demands the use of same mould again and again, which in turn reduces the cost of the building.
4. The evaluation is new; most of the studies have been done abroad and there is a need for such studies in our country.
5. No specific considerations have been given to Precast & Hybrid construction practice in terms of delta analysis of structural quantities.
6. There are studies and researches going on to identify the time & cost saving construction practice.
7. More Studies Specific to the type of technology is the need of today to evaluate the effect on the technology on the basis of analysis of the building behaviour and cost indices/structural coefficients.

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