

A Study of Cost comparison of precast concrete vs. Cast-in-Place

Vaishali Turai

Department of Civil Engineering
Dr. D.Y. P.S.O.E.T, Pune, India
vaishaliturai710@gmail.com

Prof. Ashish Waghmare,

Department of Civil Engineering,
Dr. D.Y. P.S.O.E.T, Pune, India
ashish.waghmare@dypic.in

Abstract— The Indian construction system is going to become a modernized, cost efficient and achieving advance technique. The paper based on cost comparison of precast concrete vs. cast-in-place (i.e. traditional) concrete. How total cost of construction by precast concrete system is less than the cost by use of cast-in-place concrete. Cost of any construction is directly varied with time of construction. As we know the Precast is manufactured in factory (i.e. in controlled environment) with required quality, can easily mix, cure with good quantity. Precast concrete is manufactured in factory and transport to site. The strength of precast concrete is achieved in greater extent by using high technology, controlled system. For precast construction less manpower is required, labors are required only to joint precast members. That means indirectly saving cost on labors. In precast concrete construction wastage of materials is negligible as compared with cast-in-place concrete. There is no need of curing on site after erection of members because members are cured in factory for desired days. There for the time (in days) is saving in construction which will reduces the cost of construction. Precast construction increase the quality of work, save time, reduced the cost of construction required for maintenance of work. The cost on shuttering and deshuttering is eliminated by using precast will result into saving total cost of construction. The cost of rework due to improper work, faulty construction method, unskilled labor, material quality, onsite environmental problem can be eliminated by using precast members.

Keywords — Cost and time comparison, reduction in time, waste management, cost efficient, quality improvement, manpower reduction, speedy construction, controlled manufacturing conditions.

I. INTRODUCTION

As the population continuously growing rapidly, so the need of rapid or fast construction is requirement of future generation. Precast concrete construction methods are become feasible and alternatives method or solution in such applications likes buildings and bridges. The primary benefit of precast construction is the speed of construction (i.e. reduction in time of construction), waste management, and cost efficient construction. Precast elements can be cast in controlled environment conditions at a pre casting yard in advance of when they will be required, stocked, and transported to the construction site carefully as required. The structure can then simply be assembled precast elements. The construction of members or element is design by industrial method. In general, precast construction systems are more economical when compared to conventional (i.e. cast-in-place) residential construction (apartment buildings). The use of tools, heavy machinery, and other modern equipment, usually automated, in the production of precast element, interchangeable parts and products. As the precast elements are manufactured in controlled environment there is a elimination of weather effects on it. For construction of similar type of building precast is very much economical option in point of cost saving and time reduction. [1]



Figure 1 Manufacturing of Precast members in controlled environment i.e. in factory [14]

Now a day's many developing countries looking for quality product of construction and increasing the productivity of precast element. Precast concrete is the ideal solution for residential because the structure of residential buildings are somewhat standard so the construction of same type of elements are easy and result in to cost saving on if its production is in bulk. Precast concrete provides durability, flexibility, sound, durable and versatility with cost effectively. Precast concrete construction required less construction process which saves money on financing costs. Cost saving on labor policies, skills development of employ, providing training to them is major factors. Maintenance cost will also reduce in precast concrete construction.

Operation	Precast	Cast-in-place
	Number of Day	Number of Day
Excavate, Backfill, Connect, etc	Same	Same
Pour, Cure, Strip Base	1	2
Pour, Cure, Strip Walls		2
Pour, Cure, Strip Top		2
Damp proof all Exterior Surfaces		1
Install on site	Additional	Included
Total Duration in Days	1	7
Price (Furnish and Install)	1,30,000/-	91,000/-

Total Cost of Ownership (TCO)	1,30,000/-	91,000 +???
-------------------------------	------------	-------------

Table no-1 Time comparison of precast vs. cast-in-place concrete [15]

Cost Element	Precast	Cast in Place
Price	1,30,000/-	91,000/-
Cost of Additional Time (Delivery)		
6 days at 21,645/-	0	1,30,000.00
Discounted 50% for conservatism	-0	-65,000.00
Cost Savings Additional Time	0	65,000.00
Cost of General Conditions (Service)		
6 days at 32,500/-	0	1,95000.00
Discounted 50% for conservatism	-0	-1,95000.00
Cost Savings Additional Time	0	97,500.00
Total Cost of Ownership (TCO)	1,30,000/-	2,53,500.00

Table no-2 Cost comparison of precast vs. cast-in-place concrete [15]

II. RELATED WORKS

Recent works on the concept of precast (also known as “prefabricated”) construction includes those buildings where the majority of structural components are standardized (i.e. of same size and designed) and produced in plants (factory) in a location away from the construction site where it is going to be assemble (building), and then transported to the site. These members are manufactured by industrial methods based on bulk production in order to construct a large number of buildings in a short duration result into low cost. Less cost on labor workforce, the use of tools, machinery, and other equipment, usually automated, in the production of standard, parts and products. Precast building systems are more economical when it compared with Conventional type multistory residential construction buildings. [1]



Figure 2 Manufacturing of Precast members in bulk [14]



Figure 3 Manufacturing of Precast members are transported to site for assemble [14]

Applications of precast concrete structural systems for the construction of low-cost apartments have gained vast progress worldwide, and so to speak. This is due to the fact that precast concrete systems have several advantages compared to the conventional cast-in-situ concrete systems like cost effective, required less time than conventional. [2]

Many developing countries have been looking towards improving the quality of the products of construction and increasing the productivity of the construction sector with greater use of mechanization (i.e. machinery), prefabrication technology and upgrading the skill of workers to improve the productivity, improve quality, and over come with a shortage of skilled labor. Speed of construction of precast walls and floors were favorable compared to conventional in-situ systems. Reports of cost savings of 10% of the structure costs by using precast walling and flooring were common. Objective of precast technology or prefabrication in general is to increase productivity of project, company and industry level, reduce construction time, reduce wastage and improve quality. The precast system of hollow core planks and inverted-T beams work out to be approximately AU\$416 per square meter and a large proportion of this cost is attributed to the casting in

factory, supply and transportation of these precast components to the building site. Site labor and machinery (cranes were the largest single cost item) constitute only a quarter of the total cost. The cost comparisons clearly indicate that the choice of inputs for construction is market dependent, and that financial incentives to increase the adoption of prefabricated components must be coupled with a reduction in the supply of cheap migrant labor. [3]

Precast concrete solutions can provide construction elements that are made of recycled materials that generate small amounts of waste through the manufacturing and erection phases. The use of precast concrete requires significantly less resource on site as all elements are designed and manufactured in conditions that are not affected by weather. Precast concrete solutions can help the construction industry to reduce the waste generated on site by up to 50% compared to more traditionally managed construction sites. Precast concrete has gained an impressive market share that, in terms of annual turnover, equals the sum of the cement and ready-mix markets. Precast concrete has the advantage over traditional onsite concrete methods as there is no need for elaborate scaffolding. Precast concrete does not require the fabrication of bespoke shutters on site and their subsequent discard to landfill after use. [4]

The use of precast concrete in framing systems is widespread in many countries, particularly for single-story or low-rise industrial buildings. Rapid and economical construction, high allowance for quality controls, and less labor required on-site have led the pre casting of reinforced concrete elements. [5]

The use of precast building system has various advantages over the conventional construction method. A few examples of the advantages are the reduction of the site labors, less wastage, less volume of building materials increased environmental and construction site cleanliness. Apart of that, PBS also provide a safety at construction site and more organized construction site, and reduces the time of completion in construction. All these indirectly signify that the PBS is much more economical in terms of construction cost than the cast-in-place system, even though the construction cost involves all matters either initially or throughout the building's life. And the focus of this study will be on generating a construction cost comparison projects using conventional construction method and the projects using PBS. [6]

In precast construction, as the components are readymade (manufactured in controlled environment) self supporting result into shuttering and scaffolding cost is eliminated with a saving in shuttering total cost of construction. In conventional methods, the shuttering gets damaged due to its repetitive use because of frequent cutting on the other hand, the mould for the precast components can be used for large number of repetitions thereby reducing the cost of the mould per unit. In precast construction, similar types of components are produced fast, resulting in increased productivity and economy in cost too. Since there is repeated production of similar types of components in precast construction, therefore, it results in faster

execution, more productivity and economy. The execution is much faster than the conventional methods, thereby, reducing the time period of construction which can be beneficial in early returns of the investment. [7]

When looking for a cost effective solution for construction precast is always first choice. Cost of Raw materials relatively inexpensive and level of construction can be decided by local conditions and availability of resources. Making precast efficiently in factory it saves time. As it saves time it obviously saves cost. [8]

Precast is manufactured in a controlled casting environment, quality can be controlled and monitored easily. Weather effect factor is eliminated since it is manufactured in a closed environment. Less Labor will be required to install and it does not require skilled labor, which will turn into decrease in the overall project cost. The Greatest advantage to precast is that it can be installed immediately with no need for waiting for it to gain strength and modularity like cast in place. Furthermore it's easy to make copies of the same precast by maximizing the repetition of using the same mold. This will allow for a faster construction process and substantial completion date. [9]

In a building the all components like foundation, walls, doors and windows, floors and roofs are the major components, which can be studied individually based on the needs thus, increasing the speed of construction and reducing the construction cost. The major current methodology of construction systems considered here are namely, structural block walls, mortar less block walls, prefabricated roofing components like precast RC planks, precast hollow concrete panels and precast concrete are considered. [7]

A wider adoption of precast construction methodology result into overcome environmental issues like dust, nuisance created by on site concrete mixing plant, excessive noise, waste from materials and muddy site runoff. The precast concrete is made feasible by adaptation of advance equipment for transportation of members. [10]

Precast has improved the efficiency and cost effectiveness of concrete construction while at the same time it minimize disruptions for their upgrading programs. [11]

If properly designed and executed, pre-cast can give to much better quality of work. The overall cost impact of pre-cast has therefore to take all these factors into consideration. With the rising costs of labor and less assurance of dependable skilled manpower, the trend is that pre-cast construction will become increasingly competitive compared to cast-in-place construction .By using new method of construction like better construction machinery, equipment, materials and extensive pre-project planning can increase productivity and quality of work.[12]

Precast is an industrialized way to build. It means transfer of work from sites to factories. This improves productivity and quality and reduced construction time of a building. In short,

precast concrete lowers total cost of construction in greater extent. Precast also has lower lifetime costs than any other building solution. It is possible due to high quality of industrially produced products. Compared to cast-in-situ, precast uses less cement, less water, less steel, and less labor. It produces less waste on the site and in the factory. This makes CO₂ footprint of precast much smaller than in cast-in-situ construction. [13]

III. CONTRIBUTION

But in India there is a comparatively minimum use of precast concrete than other country. May be because of less awareness about it. To aware the people about use of precast concrete it is important to solve their doubts.

In my paper my contribution about will be clearly stating the cost effectiveness of precast concrete by comparing all factors include in construction project from start to end of project. The including parameters will be comparing cost of precast concrete vs. cast in place concrete (i.e. conventional) on following:

- Cost comparison on
- Material wastage at site.
- Labors policy, training, skills development.
- Money required for safety at site.
- Time required for completion of project.
- Heavy equipment cost machinery cost.
- Transportation cost.
- Rework if required.
- Money required achieving quality work.
- Shuttering material manufacturing cost, maintenance cost shuttering and deshuttering cost.
- To find out how precast is cost efficient than cast in place.

IV. CONCLUSION

From the above studies & opinions, it can be concluded that the precast concrete system is economical (cost effective) than cast in place concrete system (conventional). But still there is 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 form manufacturing site to where it is going to be assembled. The cost of transportation is considerably high. The transportation shall be carefully done, precast members edges shall not be damage while transporting.

REFERENCES

- [1] Svetlana Brzev, " PRECAST CONCRETE CONSTRUCTION", British Columbia Institute of Technology, Canada, Teresa Guevara-Perez, Architect, Venezuela.
- [2] "THE USE OF PRECAST CONCRETE SYSTEMS IN THE CONSTRUCTION OF LOW-COST APARTMENTS IN INDONESIA", H.N.Nurjaman, Associate Professor of Civil Engineering, University of Persada, Jakarta, Indonesia, B.H. Hariandja, Professor of Civil Engineering, Bandung Institute of Technology, Bandung, Indonesia,

H.R. Sidjabat, Chairman, Indonesian Association of Precast and Prestressed Engineers, Jakarta, Indonesia.

- [3] Toong Khuan Chan,"COMPARISON OF PRECAST CONSTRUCTION COSTSASE STUDIES IN AUSTRALIA AND MALAYSIA", Faculty of Architecture Building and Planning, the University of Melbourne, Parkville, Melbourne, VIC 3010, Australia.
- [4] Waste & Resources Action Programme," Waste Reduction Potential of Precast concrete Manufactured Offsite".
- [5] Emanuele Brunesi, Roberto Nascimbene, Davide Bolognini and Davide Bellotti,"Experimental investigation of the cyclic response of reinforced precast concrete framed structures", PCI Journal | March–April 2015.
- [6] Mohd Syazwan Md. Rahim, Nuzul Azam Haron," Construction Cost Comparison Between Conventional and Formwork System for Condominium Project", IJASCSE, Volume 2, Issue 5, 2013.
- [7] RINKU TAUR and VIDYA DEVIT,"LOW COST HOUSING", ACSGE-2009, Oct 25-27, BITS Pilani, India.
- [8] Elematic Oy & Peikko Group, WWW.PEIKKO.COM.
- [9] Ramy Labna- CM OPTION, Advisor prof. Sowers "THESIS PROPOSAL", 12/16/2013.
- [10] L. Jaillon and C.S.Poon," Advantages and Limitations of Precast Concrete Construction in High-rise Buildings: Hong Kong Case Studies", CIB World Building Congress 2007.
- [11] Thesis Chan T K , " Comparison of precast construction costs – case studies in Australia and Malaysia",Egbu, C. and Lou, E.C.W. (Eds.) Procs 27th Annual ARCOM Conference, 5-7 September 2011, Bristol,UK, Association of Researchers in Construction Management, 3-12.
- [12] Nuzul Azam Haron, Ir. Salihuddin Hassim, Mohd. Razali Abd. Kadir and Mohd Saleh Jaafar,"Building Cost Comparison between Conventional and Formwork System: A Case Study of Four-storey School Buildings in Malaysia", American Journal of Applied Sciences 2 (4): 819-823, 2005, ISSN 1546-9239.
- [13] http://www.google.co.in/search?q=elematic&oq=elemati&gs_l=mobile-heirloom-serp.1.0.0j0i10l4.4831.12621.0.15211.8.7.0.1.1.0.759.4686.5-6j1.7.0...0...1c.1.34.mobile-heirloom-serp.2.6.3921.c11O AeIMTg4.
- [14] Abdulilah AlHuthiel,Abdulrhman AlAli, Abdulaziz AlSaif," PRECAST CONCRETE", King Saud University college of Engineering Civil Engineering Department.
- [15] <http://precast.org/2010/05/why-precast-costs-less/>.