DESIGN AND COST COMPARISON OF REINFORCED MASONRY AND CONCRETE BUILDING STRUCTURES

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Abstract

Precast concrete is well known technology in which some standardized units which are manufactured in factories are used for fast construction. Though the technology is developed many years ago but the implementation is not up the mark in our country. In this study we have carried out detailed study of various concepts of precast, go through number of literature & found the facts associated with it. We have taken one building as a case & Design the same building as a precast building & Traditional Cast in-situ building. Here we have made cost analysis as well as feasibility check on basis of costing & Duration. For more practical study we have visited the two ongoing construction sites of Precast & cast in-situ & gathered required information, From this analysis It is remarkably seen that the cost of precast building is significantly reduces & duration of construction is also much lesser than traditional method. From all this study we can be conclude that the precast concrete system is economical than conventional cast in place method but still there are some conditions which we have to take care of while using precast, those are quantity of construction, Distance of site from manufacturing unit, Type of building etc.

Key Words: Precast concrete, Cost of Precast, Cost & Time analysis etc.

1. INTRODUCTION:

Earlier Roman builders use concrete for construction of culverts, tunnels etc. Now a day's pre-cast technology include a variety of architectural and structural applications which can be used in various element of building. The process was invented by city engineer John Alexander Brodie, Actually idea was not taken up broadly in Britain Yet, it was adopted all over the world, The Precast Concrete industry focuses on utility, underground, and other non-pre-stressed products, and is represented primarily by the National Precast Concrete Association. In this study we have gone through precast structural concepts, structure suitability, feasibility, & cost & time analysis of precast structure. We have also made comparison of both precast & Traditional cast in situ construction method on the basis of selected case. The detailed design of precast & RCC building is prepared & costing of both is compared.

2. METHODOLOGY

Literature review: To study the construction techniques of precast and traditional method we have gone through various research papers, books, Case study & Visits In the reference of our work we have visited two constructions sites & Study the similar cases. One is of precast construction & Second was for RCC Structure the actual implementation of precast work is been observed & site difficulties were discussed with engineers & Project manager.

Analysis: In this work we have made cost comparison as well as feasibility check for precast construction on large scale. Also

few advantages & Drawbacks are identified by us.

Design: In this study we have made Precast Design of a 12 storied building, sincere attempt is made here to follow the standards. Also for comparison we have made the typical RCC design of the same building & compare it with precast one. Cost comparison: After design calculations we have find out the cost of both the structures (i.e RCC & Precast) & made comparison of both. For calculation the market rates are considered. From above Process we have come to the conclusion about the precast construction & related facts about execution & economic aspects. & detail conclusions have been drawn in the report.

3. DESIGN CONCEPT FOR PRECAST SYSTEM

Structural Concept: Taking consideration of cost economy, build ability and the structural concept developed consists of

• Conventional foundations comprising footings, raft slab or piles and pile caps.

• Precast concrete non-load bearing walls.

• Precast concrete floor system, either: - Precast concrete beams and precast slabs with a composite in-situ topping or precast concrete walls with precast concrete slab system

Design of Precast Building: Here we have considered a 12-storey office building for design of precast building. The structural system of the selected office block is based on skeletal frame consisting of a framework of beams and slabs, columns. The structural frames are the most common system due to the advantage of greater flexibility in the building & functionality. These are also widely used as precast members because of their behaviors against forces & movements of structural elements however it is important to understand the physical effects of these forces and how they are transferred through the complete structure. We have designed precast columns, beams, staircases, walls and their connections have been selected to illustrate as many as possible of the types of design in a building project for which calculations may have to be prepared. The drawings and calculations provided by us are preliminary one. They can be act as illustrative examples for others and more detail analysis is required, while implementation of project.

Description of Building The building is a 12 stories commercial & office block including car parks, shopping malls and service apartments. A typical floor of the building measures around 72 m x 24 m & having 8 m building grids in both directions is shown in Figure. The design floor-to-floor height is 3.6 m. Staircases, lift cores and other building services such as toilets etc. are included & the cast in-situ construction is provided wherever necessary.

Structural System: The building is considered partially as cast in situcosstruction for tasking advantage of regularness in building grids. Beside acting as load bearing walls. staircase wells and lift cores also function as stabilising cores for the superstructure. The precast components consist of hollow core slabs, beams. columns and staircase flights. a. Hollow core slabs The design of hollow core slabs is based on class 2 prestressed concrete structures with least 2 hours fire retention. The hollow core slabs

are 215mm thick & cast with concrete. Each unit is designed as simply supported with minimal 100 mm seating at the support. b. Precast beams: Precast beams are used in the office area are 540mm deep. The beams, which are un-propped during construction, are seated directly on column corbels and they are designed as simply supported structures. For Limiting the cracking of the topping concrete at the supports, site placed reinforcement is provided.

Precast columns:

Here for this structure, columns are of size 500 mm x 700 mm and with base plate connection at every alternate floor. That is designed as pin-ended at the ultimate limit state. The base plate connections are designed so that they are enabling to withstand moment capacity of column to behave as a two story cantilever. The advantage of base plate connection is to eliminate heavy column props and result in a safe & Easy execution. A sufficient tolerance is necessary for in-situ reinforcement at the time of execution so 50mm gap is designed for column to column at the beam support regions. Every column is to be casted in the direction of precast beam with Reinforced concrete corbels with T25 dowel bars which are prevents topping beams when we laid the precast slabs while execution. All columns are to be considered braced in both directions.

RCC Design for same building: We Have Also made RCC Design for the same structure. The Details of RCC Design are as follows. The following image shows

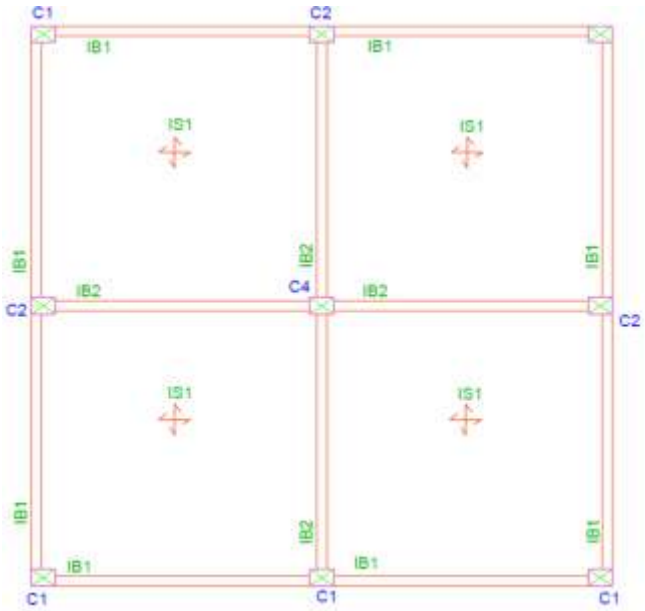

Figure 01 Showing Slab units considered for Design

4. COST COMPARISON & TIME EFFECTIVENESS

Particular	Precast	RCC
Construction speed	Very rapid speed of erection. Rapid construction on site.	Comparatively slow construction On site casting, so reinforcement laying & fixing, formwork, setting of concrete required time.
Quality control	Good quality control.	Quality may affect due to site conditions, due to bad supervision, unskilled labor.
Environmental conditions	Weather is eliminated as a factor-you can cast in any weather and get the same results, which allows you to perfect mixes and methods	Environmental conditions like temperature, humidity can affect on performance of concrete.
Labor Requirement	Less labor is required and that labor can be less skilled	More Labors required on site in case of RCC.
Manufacturing conditions	High quality can be achieved because of the controlled conditions in the factory.	RCC is to casted on site & the site conditions are not regularized, so it may affect on strength.
Quantity discount	Since a Precasters can buy materials for multiple projects, quantity discounts can lower costs	The owner can only buy small required quantity so quantity discount is not that much.

Cost & Duration Comparison: 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 Ides buildings and bridges. The primary benefit of precast construction is reduction in time of construction. Waste management and cost efficient construction. 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 stability, Flexibility, sound durable and adaptability with cost efficiency. Precast concrete construction required less construction process which saws money on financing costs. Cost minimization on labor policies, skills, development of employ, providing training to them is main factors. Repairs cost also reduces in precast concrete construction. The following table shows the comparison of precast & cast in situ on basis of duration.

5. CONCLUSION

As we have seen various methods of precast, Design, case studies of precast & it is found that, the design comes out as economical if proper care while designing is taken. We have design the same building by traditional & precast method & Notice the Cost & completion duration It is remarkably seen that the cost of precast building is significantly reduces & duration of construction is also much lesser than traditional method. From all this study we can be conclude that the precast concrete system is economical than conventional cast in place method but still there are some conditions which we have to take care of while using precast, those are quantity of construction, Distance of site from manufacturing unit. Type of building etc. we have identified that for standard & Repetitive work precast is the best option to choose. In observation the most important thing is to be observed project is in precast construction technique is the time effective it require less time to construct. It requires skilled worker and qualified contractor, Lower initial cost especially for large project. We can achieve better concrete quality control and lighter concrete unite. The main limitation of precast is transportation from place of

manufacturing to place of site where it is to be fixed.

REFERENCES

[1] Elias Issa Saqan, Evaluation of ductile beamcolumn connections for use in seismic-resistant precast frames, Faculty of the Graduate School of the University of Texas at Austin, 1995

[2] Bindurani, P, A. Meher Prasad, Amlan K. Sengupta, Analysis of Precast Multi storeyed Building

[3] R. Vidjeapriya and K.P. Jaya, Behavior of Precast Beam-Column Mechanical Connections under cyclic loading, Asian Journal Of Civil Engineering (Building And Housing) Vol. 13, No. 2 (2012), 2011

[4] P. K. Aninthaneni and R. P. Dhakal, Conceptual development: low Loss Precast Concrete Frame Building System with Steel Connections, 2014 NZSEE Conference, New Zealand, 2014.

[5] Sarakot Asaad Hasan, Behaviour Of Discontinuous Precast Concretebeam-Column Connections, University of Nottingham, 2011

[6] M. N. Kataoka, M. A. Ferreira, A. L. H. C. El Debs, A study on the behavior of Beam column connections in precast concrete structures: Experimental analysis, Ibracon Structures and Materials Journal, Volume 5, Number 5, 2012.

[7] Can Akogul and Oguz C. Celik, Effect of Elastomeric Bearing Modeling Parameters on the Seismic Design of Highway Bridges with Precast Concrete Girders, The 14th World Conference on Earthquake Engineering, October 12-17, 2008, Beijing, China, 2008.

[8]Radhika J. Popat and Rajul K. Gajjar, Seismic Evaluation of Beam-Column joints using GFRP Bars in Multi-Storey building using ETABS, Radhika et al, International Journal of Advanced Engineering Research and Studies, E-ISSN2249–8974, 2011:

[9] Patrick Tiong Liq Yee, Azlan Bin Adnan, Abdul Karim Mirasa and Ahmad Baharuddin Abdul Rahman , Performance of IBS Precast Concrete Beam-Column Connections Under Earthquake Effects:A Literature Review, American J. of Engineering and Applied Sciences 4 (1): 93-101, 2011, ISSN 1941-7020, 2010 Science Publications, 2011.

[10]G. Metelli and P. Riva, Behavior of a Beam to Column "DRY" Joint for Precast Concrete Elements, The 14th World Conference on Earthquake Engineering October 12-17, 2008, Beijing, China, 2008