Study of Precast Construction And Its Benefits Over Cast-In-Situ Construction

Roshan G. Maheshwari[1] , Dr. G. A. Hinge[2]
[2] Principal
[1, 2] TSSM's Bhivrabai Sawant College of Engineering And Research. Pune, India

Abstract- *Urbanization in India has generated huge demand for housing which neither the cities nor the housing sector is prepared for. The number of urban agglomerations has increased from 384 in 2001 to 475 in 2011, a decadal increase of 23.7%. As per the twelfth five year plan (2012-17) the total housing shortage in rural areas is 43.66 million units. In order to cater the issue surrounds the shortage of affordable and low cost mass housing at a much competitive cost and on time schedule, it is imperative to adopt alternative construction system. The Indian construction industry led by traditional mode of construction as characterized by challenges such as low productivity, lack of skilled labor, time and cost overruns etc. Precast Concrete Construction, the so called unconventional method in Indian Construction Industry can cater the above needs by offering both speed and quality of the construction. The research and applications of precast concrete structural systems are intended to support the low cost mass construction at a much accelerated rate. This research aims to critically analyses these above factors and overcome with the guidelines to address the bottlenecks of Implementing PCC technology in India*

Keywords- Precast Construction, Production, Installation

I. INTRODUCTION

As per the 2011 study report conducted by Ernst & Young and the Federation of Indian Chambers of Commerce and Industry, the construction industry in India is grappling with a 30% labour shortage. According to the report "Indian Construction Sector: The Great Leap Forward," released earlier this year by Synergy Property Development Services, the country's labour shortage is "pegged to go up by 65% by the next decade, with more workers and professionals shifting from construction and real estate industries to real estate to services industries. Due to uncertainties and unavailability of the workers, the companies schedules goes out of the window creating huge stress on project schedules, thus compromising on quality to meet the deadlines. The Indian construction industry is characterized by challenges such as low productivity, lack of skilled labour, time and cost overruns etc. [9]. Moreover, The Indian Construction Industry has changed rapidly since 5 to 6 years. The large-scale projects comprising of Townships, Mass Housings, IT/ITES parks, and sezs" are of common occurrence these days and will only grow exponentially in the near future. The Construction industry is facing problems such as shortage of skilled labour, poor workmanship, and low quality of construction. There is a huge shortfall in meeting the demands of affordable housing. The urban population of India is expected to rise to 576 million by 2030 (currently population is 350 million) [8]. Nonetheless housing is an industry that is mainly still hand crafted and majorly depends on manual labour and on-site construction, resulting in to large tons of material wastage, work inefficiency and lag in project deliverance.

II. AIM

1. To study process of precast construction.
2. To study factors such as material wastage, labour, time required for construction of precast construction.
3. To analyze costing of construction by precast method and Cast-in-situ

III. METHODOLOGY

Site visits to precast elements production factory at Precast

1. India Infrastructure Pvt. Ltd Wagholi Pune.,
2. Shapoorji Pallonji's Mercedz Benz project at Chakan Pune
3. Cummins Technical Center India at Kothrud Pune
4. TATA Housing at Bengluru

Actual cost analysis of 1bhk villa with all market rates.

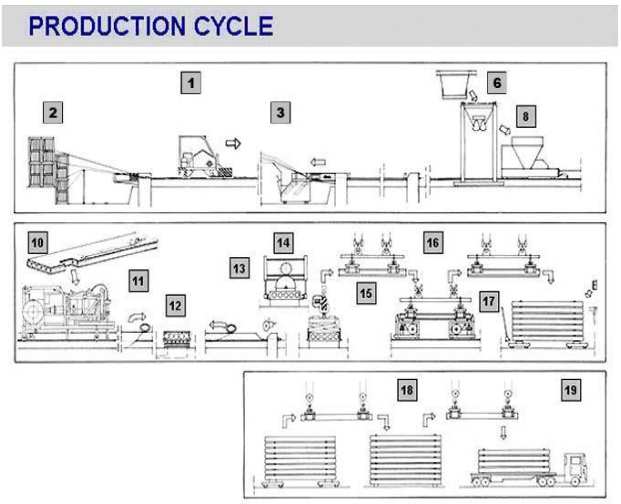
i. Production

A hollow core slab, also known as a voided slab or hollow core plank, is a precast slab of prestressed concrete typically used in the construction of floors in multi-story apartment

Buildings. The slab has been especially popular in countries where the emphasis of home construction has been

on precast concrete. Precast concrete popularity is linked with low-seismic zones and more economical constructions because of fast building assembly lower self-weight (less material), etc. The precast concrete slab has tubular voids extending the full length of the slab, typically with a diameter equal to the 2/3-3/4 of the slab. This makes the slab much lighter than massive floor slabs of equal thickness or strength. Reduced weight is important because of transportation cost and less cost of material (concrete). The slabs are typically 120 cm wide with standard thicknesses between 15 cm and 50 cm. The precast concrete I-beams between the holes contain the steel wire rope that provides bending resistance to bending moment from loads. Slabs are usually produced in lengths of about 120 meters. The process involves extruding wet concrete along with the prestressed steel wire rope from a moving mould. The continuous slab is then cut by big diamond circular saw according to the lengths (and width) required on blueprint. Factory production provides the obvious advantages of reduced time, labour and training. To meet modern standards (both hollow-core and massive slab) of soundproofing the floor needs to be covered with a soft floor covering that is able to dampen the sound of footsteps. An alternative is to use a thin "floating" slab of concrete insulated from the voided slabs.

1. Cleaning and oiling of the bed
2. Strand pulling
3. Tensioning of strands
4. Lifting the extruder on the bed (not shown)
5. Concrete mixing (not shown)
6. Concrete transportation
7. Concrete dosing to extruder (not shown
8. Extruding
9. Draw openings by plotter (not shown)
10. Making openings
11. Covering of slab
12. Curing of slab
13. Recovering of slab
14. Cutting of slab
15. Lifting of slab
16. Drilling of drainage holes
17. Transportation to storage
18. Handling of slabs in storage Transportation to site



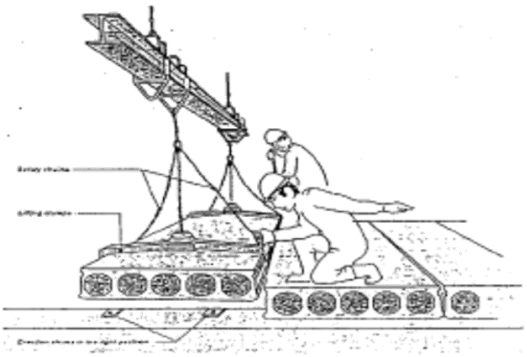
Production cycle of hollow core slab

ii. Installation

Sequence of operation shall be carried out for the erection of precast hollow core slab:

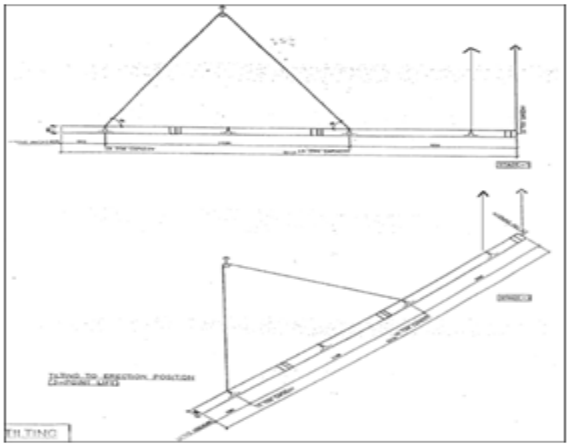
1. An exclusion zone will be erected using Red / White tape around the area where the lift will take place to prevent unauthorized personnel entry. Signage will also be erected to notify operatives of the hazards within the exclusion zone.
2. Transportation of hollow core slabs shall be done by trailers wooden planks shall be used and will be tightened with belt and chain.
3. Ensure proper level of supporting platform on which hollow core slabs unloaded.
4. Mobile crane and trailer will be entering from Gate no. 2/4, with ensuring all prior permission from client.
5. Entry of mobile crane/ trailer from gate no. 2/4 & move towards site & fix position, proper level of crane at erection location.
6. Setting-out and marking is carried out with the help of site grid reference points by surveyor.
7. Care to be taken to avoid damaged during unloading.
8. Hollow core slabs will be delivered with open cores, cores to be closed with plastic core plugs, either before lifting the hollow core slabs or after erection, but before screeding to avoid flow of concrete in the core while screeding.
9. Fix Lifting rods /sling & D-shackle & pulley to the precast Hollow core slabs.
10. Securely fixe guide rope to the precast hollow core slabs to limit the amount of movement during the lift.
11. After the confirmation erection supervisor / Forman the slings and lifting hooks shall be securely fixed only then the lift commencement will start.

12. Hollow core slabs are lifted directly from the trailer and placed in the position one by one with Mobile crane.
13. This sequence will be carried out throughout the duration of the hollow core slab erection.
14. Trailer will move out of the erection area.
15. Longitudinal joints / filling between two hollow core slabs shall be done together with screed.



Installation of Column

1. Lifted precast column, mobile crane boom will move towards erection place, along with guide rope to control movement of precast column.
2. Then the column shall be placed in the dowels coming from CIS footing.
3. The wire ropes will be fixed to the four sides for alignment purpose by using Turn Buckle.
4. Now the column is in place, the final verticality and alignment check will be carried out on both faces of the column, with the help of surveyor by total station.
5. Corbel position & top level of column shall be checked by auto level/ total station..
6. After checking, plumb, level, co-ordinates the activity of erection of precast column grouting will be done.
7. Attached slings & D-shackle of precast column will be released by using of Tower crane/ Man lifting cage after the providing turn buckle supports.



Tilting process of column

Cost comparison between precast concrete and cast in situ

While conducting survey across all the areas in current scenario of precast and considering all the aspects in field work and going through enquiries, following is the cost per square feet of finishing 1BHK Villa by pre casting.

Villa 1BHK including finishing	
Total sqft Area	655.95
Total RCC Cost	1039108
Finishing Items @ 200 per sqft	131190
Total Cost for material	**1170298**
Profit @15%	**175544.7**
Total cost	**1345843**
Total cost per sqft 1BHK villa	**2051.746**

As per current market situation Cost of mould is approximately INR 5,00,000 which can be covered in 5-7 villas, thereafter costing of precast construction will be lower than Cast-in-situ.

In general practice in cast in situ wastage of material is considered to 5%. And out of total cost of construction 70% is material cost. But in precast villa masonry work, plastering work is eliminated; plumbing and electrical work is done at the time of casting so overall wastage is reduced by 60%- 70% i.e. around 3% to 3.5% of material cost.

In precast construction no different labour required for RCC, masonry, plumbing and electrical work. All work is covered at time of production only so overall labour cost and no. of labour get reduced which is very crucial in current scenario of labour shortage.

With good planning production work can be stared parallel with excavation so that as soon as backfilling is done elements are ready to install which saves lot of time.

IV. CONCLUSION

1. Production and installation process of precast construction is quite easy. However, in current situation it is essential to bring awareness among people to boost usage of precast technology.
2. In precast construction all the construction process is done in controlled conditions due to which wastage is reduced and optimum utilization of labour is made.
3. In case of mass construction precast construction is more economical than Cast-in-situ construction. In mass production cost is saved upto 6-7 %

V. ACKNOWLEDGEMENT

My sincere gratitude go to the God for giving me the strength and wisdom to be what I am and whose guidance ,protection ,direction remain priceless .A work of this nature would not have been successful without unreserved efforts of numerous persons who in one way or either contribute successfully to its success. To these persons I hereby express my profound gratitude. I would like to acknowledge the support of my parents whose love, prayers, financial aid and their belief has seen me through this life to this stage .I am particularly grateful to my guide Dr. G. A. Hinge for caring, motivating and supporting me for successful accomplishment of my study. I must also express my gratitude and appreciation to my true friend, brother, mentor Mr. Ronak Dhoot for his immense help and unparallel support throughout my entire study which contributed a great deal in my intellectual and moral advancement of the subject. Mention must be made of group of people namely Mr. Amit Sinha , Mr Sanjay Lahoti, Mr. Sandeep Borlikar, and Mr. Shubhankar Bhivalkar who participated enlightening discussions and provided useful responses to my survey and thereby contributed to my knowledge by sharing the actual insights and happenings, challenges faced by the Indian precast Industry . Finally to all my colleagues Hemant Patil, Mahesh Patil, Jeetendra Dangat for supporting me in completing my project work in a given stipulated time

REFERENCES

[1] Brian Ó Murchú ."PRECAST GUIDE" published by Irish Precast concrete association
[2] National Precast concrete Association & British Precast "A LITTLE BOOK OF CONCRETE "Copyright 2006 by NCPA
[3] Abraham Warszawski , Moshe Avrahamand, David Carmel (1990) "Utilization of precast concrete elements in building" London, England, .
[4] Yee, A.A. (2001) 'Social and Environmental benefits of Precast Construction.' PCI Journal
[5] Yee, A. (2001) 'Structural and Economic Benefits of Precast/Prestressed Concrete Construction.' PCI journal
[6] Jha, K. Iyer, K. (2006) 'Critical Factors Affecting Quality Performance in Construction Projects.' Total Quality Management 17, (9) 1155-1170
[7] 9The Master Builder (June 2014)
[8] Goyal, C. (2013) 'Casting a Concrete Future.' The Master Builder ,
[9] Ramaswamy, K.P. and Kalidindi, N.S. (2009) 'Waste In Indian Building Construction Projects.