Technological Advancement in Housing Industry

Ganesh P. Phule[1]* A. R. Kolhe[2]

[1]Student M.E (C&M) Civil Department, ICOER, JSPM, Wagholi, Pune, Maharashtra

[2]Assistant Professor, (C&M) Civil Department, ICOER, JSPM, Wagholi, Pune, Maharashtra

Abstract – ***The scenario of housing industry is being changing rapidly, as the urban population is increasing day by day leads to increase the demand for housing. The most efficient factor in completion of construction project in terms of speed, cost, quality, and safety of work by using the technologies adopted in housing. As the contractor has to complete the project in given frame of time by client, as the client wants to use building for the intended purpose as soon as possible. The most efficient way to speed up the work in mass housing construction is by adopting the new technologies .The aim of this paper is to present the technological transformation adopted in housing industries, to achieve project duration , project cost and quality of work. For that a research has been carried out and the results will present in this paper.***

Keywords: Conventional formwork, Precast Technology, Tunnel Formwork Technology, Aluminium Formwork Technology, Mascon Technology.

----------X----------

1. INTRODUCTION

Housing industry is changing day by day, as demand by the customers for housing has been increasing, there is a challenge in front of companies to provide the possession as fast as possible by maintaining quality, cost and safety. For undertaking mass housing works, it is necessary to have innovative technologies which are capable of fast construction and deliver good quality structure in a cost effective manner. Certain system are in vogue and more contractors are trying to being in new technology will reduce the cost of construction , time of construction , wastages and labour requirement which reduces the total cost of construction.

The present scenario in growing the demands for housing makes the contractor to adopt the appropriate technology for speedy construction. As a result of experimentation of innovate construction technology and it is now possible to achieve an overall saving to the extent of 5% - 10% in total cost of housing construction compared to cost of traditional housing . As per todays demand of housing the speed of construction needs to be greater importance especially for large housing projects.

Fortunately some of the advanced technologies catering to faster speed of construction are already available in country.

Example :-

1. Conventional formwork.
2. Precast technology.
3. Aluminium formwork technology.
4. Tunnel formwork technology.
5. Mascon technology.

2. HOUSING AT OLD AGE :

Since the houses are being built from decades according to their need and available material, but from this past years to present, the technology has been change rapidly . Some of the houses where build using the following:

2.1 Earth Houses:

Earth houses built with the use of the earth beneath our feet are a perfect example of sustainable construction. And some of the longest lasting buildings still standing are earthen. These building techniques include cob, rammed earth and earth bag buildings. While the first two are made with a

particular mix of clay, earth bags are a more modern twist on using the earth as a building material.

2.2 Stone Houses:

Stone houses are about as sustainable as it can get. Build with rocks, stone houses have their natural beauty and don't require additional painting. They can be built with the use of local materials and are very comfortable. With the use of a passive house design, stone homes can store heat within its walls. And although stone homes may seem like an idea from the Dark Ages, it is certainly a bright, sustainable idea.

2.3 Bamboo Houses:

Bamboo houses are an even more eco-friendly alternative to building with timber. Bamboo is a very strong material to build with and well-constructed bamboo homes are said to withstand hurricanes and earthquake

2.4 Load Bearing Houses:

A load bearing structure has a load-bearing wall that bears a load resting upon it by conducting its weightto a foundation structure. The materials most often used to construct load-bearing walls in large buildings are concrete, block, or brick.

3. TECHNOLOGICAL ADVANCEMENT IN HOUSING INDUSTRY

3.1 Conventional Formwork

This type of formwork is the oldest method and is still being used in constructing 4 to 5 storey buildings . This type of formwork is a combination of bamboo , plywood sheet , steel planks. Most of the contractors are using the new technology of conventional formwork which includes steel props which can be adjusted according to the floor to floor height instead of bamboo. This takes more time and required skill labour for the erection . The time required for one floor by using conventional formwork is minimum 3-4 weeks and this ultimately results in increasing the time required for completion of project [Pawar and Atterde]

Conventional Formwork

3.2 Precast Technology

The precast technology involves the manufacturing of different components of construction in a controlled environment such as factory and delivering them to site for erection and assembly. For a building, theprecast components can include elements such as columns and beams, floor slabs, in-filled walls, bathrooms, and staircases, etc. These building components are manufactured under a controlled environment in a specific factory setting and subsequently transported and installed at the project site. Precast elements can be manufactured at offsite as well as onsite.

Use of precast technology in construction has numerous advantages. As the precast elements are produced in a factory, better quality of concrete can be achieved because of the controlled environment. Precast mode of construction has a lesser dependency on labour force compared to conventional technique which helps in minimizing the disarray in coordination, scheduling, and sequencing of the project. There is no need for curing on site after assembly of members because the members are cured in a factory for the desired duration. The cost of the formwork is eliminated by using precast which can result in savings. Cost to carry out post concrete repairs can be eliminated by using precast members.

Precast also enhances occupational health and safety as minimum operational risks are involved. Its use can lead to significant wastage reduction at the site because on-site construction activities are minimized. Through effective planning and design, material quantity required for doing the same construction can be reduced by using precast technology. This can be compounded by the fact that it helps in waste reduction making precast a more sustainable and environment-friendly technology for construction. The biggest advantage of precast is that it accelerates the construction process thereby reducing the duration of the project [Nanyam, et. al.]

Precast Technology

3.3 Aluminium Formwork

Aluminium formwork system is a system for forming the cast in place concrete structure of a building.

[Thiyagarajan, et. al.] Contractors are adopting these technologies for mass construction where speed and quality can be achieved at high level. The speed of construction by this system will surpass speed of most of the other construction method and technologies. The labour handles this method effectively to speed up the construction to assure quality control and durability. Adoption of this system reduces overall cost of the structure, using this unique formwork, walls, floor slabs, columns, beams, stairs, balconies together with door and window opening are cast in place in a single site based operation. The resulting building structure is very strong, accurate in dimension and tolerance with a high quality of finished concrete surface. The basic element of Formwork technology is the panel which is a framework of extruded aluminium sections, welded to an aluminium sheet. The panels are made from a high strength aluminium alloy, with the face or contact surface of the panel, from 4mm thick plate, which is welded to a framework of specially designed extruded sections, to form a robust component. It can be reused over 250 times, the initial cost appears high; however the ultimate cost persft of forming area is less when compared to traditional methods.

Aluminium Formwork Technology

3.4 Tunnel Formwork

The tunnel formwork is a box sized steel formwork by which RCC walls and slabs are constructed in continuous pour. This technology is used for a multi-storied building construction in order to reduce cycle time. Once reinforcement is placed concrete for walls and slabs can be poured in a continuous pour. An arrangement of hot air blowers accelerates the setting of the concrete and one slab is achieved in one day i.e. 24 hours slab cycle [Chaudhary] It is normally used for the rooms with span between 2.5m to 6.5m. If span exceeds 11m then the new component called Midspan table is introduced, basic and the main component of the tunnel formwork is half tunnel. When these two tunnel are joined together it forms a tunnel [Hangarge, et. al.]. It is particularly effective in projects suited to repetitive cellular construction involving huge symmetrical work such as residential blocks , hotels , students hostels.

Tunnel Formwork Technology

3.5 Mascon Technology

The buildings are the monolithic structures and constructed by using the MASCON technology in which the aluminium form work are used which is very efficient compared to the method used for the construction of the conventional structures. The monolithic structure constructed by using the MASCON technology are much better in strength than the conventional structures. Also the work of construction can be done faster and there are many advantages except the high initial cost. The Mascon System is unique because it forms all of the concrete in a building including; walls, floor slabs, columns, beams, stairs, window hoods, balconies and various decorative features in exact accordance with the architect's design The majority of the equipment is comprised of panels while the rest includes vertical and horizontal corner sections, bulkheads and special floor slab beams that can be dismantled without disturbing the props supporting the floor slab concrete. Ninety-nine per cent of the Mascon equipment is made of aluminium while the remaining one per cent is steel. The need for cranes or other heavy handling equipment is eliminated. All of the individual pieces of equipment are joined by simple steel pins and wedges and the only tool required in assembly is a hammer. This also eliminates the need for skilled workers. Each floor of the multi-storey buildings is broken into four sections and all of the concrete in each floor section (walls, columns, beams, floor slabs, staircases, lift shafts etc.) is concreted in a single working day. The Mascon formwork can be used to form both concrete structural designs – i.e. traditional RCC frame design or load-bearing wall design. The Mascon aluminium forms can be used over 250 times and are 100% recyclable unlike wooden forms and steel panels [Solanki, et. al.]

4. COMPARATIVE STUDY OF MODERN CONSTRUCTION TECHNIQUES

From the table we can study or have an idea about the present technology adopted by the contractors by which we can know there importance or when to adopt the particular technology, speed of construction of respective technology, skilled labour required or not required, cost required, etc. can be study from the following table.

	CONVENTIONAL FORMWORK TECHNOLOGY	PRECAST TECHNOLOGY	ALUMINIUM FORMWORK TECHNOLOGY	TUNNEL FORMWORK TECHNOLOGY	MASCON TECHNOLOGY
CAPITAL COST	Rs. 800 per sq.m.	-	Rs.10000 per sq.m.	Rs.22000 per sq.m.	Rs.10000 per sq.m.
CASTING SYSTEM	RCC framed structure. Cast-in-situ	Prefabricated. Factory made products.	Monolithic structure of walls and ceiling casted together	Monolithic structure of walls and ceiling casted together. Internal portion of walls build afterwords.	Monolithic structure of walls and ceiling casted together.
ACCURACY	Low accuracy	High accuracy	High accuracy	Very High accuracy	High accuracy
SPECIAL MACHINERY	Not required	Tower crane	Not required	Tower crane	Not required
LABOUR COST	Rs.80 to 100 per sq. ft.	Rs.80 to 100 per sq. ft.	Rs.175 to 200 per sq. ft.	Rs.175 to 200 per sq. ft.	Rs 175 to 200 per sq. ft.
STAFF ON SITE	Required more	Required more	Required more	Required less	Required more
QUALITY	Normal	Superior	Superior	Superior	Superior
SPEED OF CONSTRUCTION	Slow	High	High	Very High	High
SLAB CYCLE	21 days	5 – 7 days	7 – 10 days	1 – 3 days	7 – 10 days
TYPE OF LABOUR	No skilled labour required	Skilled labour required	Skilled labour required	Skilled labour required	No skilled labour required
NO. OF REUSES	15 – 25 times	-	100 to 150 times	500 + times	250 + times
WASTE DISPOSAL	High waste generated	Low waste generated	No waste generated	No waste generated	No waste generated

5. CONCLUSION

From this we can conclude that, technology has been changed rapidly and has been adopted by the contractors as per the demand of housing. Precast technology is adopted where component parts can be made in a continuous process in a nearby factory by which progress of work is being achieved simultaneously. Also tunnel formwork is being adopted by most of the contractor where floor cycle is about 1-3 days only for fast completion of the project. Also the new technology gives superior quality, has high speed of construction, can be used repeatedly and generates low waste.

6. REFERENCES

Divyang Solanki, Rinni Shah and Noopur Shah "Benefits of mascon construction system in economic area" Ahmedabad. ISSN : 2321-0613.

Injal M. Parekh, Bhupendra M Marvadi, Umang Patel "Comparative Studies of Construction Techniques" L.D.R.P. institute of technology and research, Gandhinagar, Gujarat. ISSN: 0975–6744

Miss. Jyoti Suresh Magdum, Prof. Madhav Bhalchandra Kumthekar and Prof. Gayatri Dhananjay Jadhav "Comparative study of various types of aluminium formworks" Kolhapur, India, ISSN0974-3154

Miss. Renuka Hangarge, Mr. Ashish Waghmare and Mr. Shridhar Patil "Comparison of Conventional, Aluminium and Tunnel Formwork" Dr. D Y Patil SOET, Lohgaon, Pune. ISSN 2250-3153

Mr. Manas A. Shalgar and Mr. Tejas D. Aradhye "Introduction to advanced TUNNEL Formwork system: Case study of Rohan - Abhilasha" Pune. e-ISSN: 2395 -0056.

Mrs. Neetu B. Yadav and Mr. Rushabh A. Shah "Pre-Cast Technology: An Initial Step to Sustainable Development" Bardoli, India. ISSN (online): 2321-0613.

Ms. Aakanksha Dilip Chaudhary "Study of Tunnel Formwork System & Comparative Analysis with Conventional Formwork". ISSN 2229-5518

Prof. Ashish P. Waghmare and Renuka S. Hangarge "Cost and Time estimation for Conventional, Aluminium &Tunnel Formwork" Pune . e-ISSN: 2395-0056.

R. Thiyagarajan, V. Panneerselvam and K. Nagamai "Aluminium formwork system using inhighrise buildings construction "College of Engineering Guindy, Tamil Nadu . ISSN Online: 0976-6499

Sandip P. Pawar and P. M. Atterde "Comparative analysis of formwork in multi-storey building" SSGBCOET Bhusawal Maharashtra .ISSN: 2319-1163.

Tejas D. Aradhye and Emeritus M. R. Apte "Study of advanced tunnel formwork system in high-rise building" Pune. ISSN: 2319-1163

VPS Nihar Nanyam, Riddha Basu, Anil Sawhney, Harsh Vikram, Gourav Lodha "Implementation of Precast Technology in India Opportunities and Challenges"

Procedia Engineering 196 (2017) pp. 144–151.

Corresponding Author

Ganesh P. Phule*

Student M.E (C&M) Civil Department, ICOER, JSPM, Wagholi, Pune, Maharashtra