

Impact of Plastic Formwork over Conventional Formwork

Imtiyaz Mohi U Din¹, Chitranjan Kumar²

¹Research Scholar, Al-Falah University, Dhauj, Faridabad, Haryana, India

²Assistant Professor Al-Falah University, Dhauj, Faridabad, Haryana, India

Abstract: *Formwork is a major component of any Civil engineering construction. The construction of formwork takes time and involves the expenditure up to 20 to 25% of the cost of the structure or even more. It is envisaged that such a formwork will be more productive and possible to use for more number of cycles. Indian construction industry has grown by leaps and bounds and Thus with the globalization of Indian economy & introduction of multinational companies in India for construction activities, it has become imperative to have precise & speedy construction projects. . In this paper, an attempt is made to have a comparative study of established conventional formwork technology with Plastic formwork which are currently not used much in Indian construction industry. However, in practice, the selection of an appropriate formwork system has depended mainly on the intuitive and subjective opinion of working level employees with restricted experience. Plastic formwork systems have been creating a buzz in recent times with their advantages including flexibility, durability and cost-effectiveness. 'Plastic formwork' is only possible solution to this problem as it is recyclable, reusable and eco-friendly. Plastic formwork is a new innovation in formwork industry and it is famous for its light weight, speedy construction and In with high degree of quality control & assurance in work is obtained. This technology is mostly suitable for projects to be completed in short period of time, where columns, beams, slab sizes are standard. These technologies gives more accurate results and good quality of construction in optimum cost and minimum time and hence suggest this method is superior for the construction project*

Keywords: Plastic formwork, Conventional Formwork, Recyclable Material, Cost Effective, Durability, quality control, quality assurance

1. Introduction

1.1 General

Formwork is a support structure in which concrete is poured .Formwork is a term given to temporary or permanent matrix or a mold comprising of all supporting members, the whole and sole function of which is to give appearance and assist concrete till sufficient strength to carry its own weight is achieved. It should be able to bear all imposed and live loads apart from its own self weight. Formwork serves as a mould to produce concrete elements having a desired size and configuration. There are many types of formwork systems used in construction industry. The selection of type of formwork mainly depends on requirements of particular project. Traditionally formwork systems are made up of wood and steel. Considering the labour problem and the cost of formwork system at Desire Construction Systems thought to develop an alternative formwork system which could help the industry to not only reduce construction cost but also a system that is easy to install, dismantle and handle.. Once the concrete is poured in formwork, it is allow to settle and then formwork is dismantled. The most commonly used type of formwork systems are the conventional system made up of lumber, and formed at site during construction also known as built-in formwork. Currently even for construction of wide variety of structures from small to large size projects the conventional formwork is used. The main objectives of formwork systems are quality safety and economy. Today, with rapidly growing construction industry the needs of industry is also changing. The project should be completion in estimated time, with good quality of construction as well as with utmost safety precautions during the construction phase .As all these needs can't be full filled by conventional formwork system. An alternative formwork system like plastic formwork system can be plausible effective solution to conventional formwork system. Plastic formwork provide

a reputation for durability, aesthetics, easy of handling, high performance and superior corrosion resistance and quickly installed and for strengthening and retrofit of deficient structures Plastic formwork systems are driving innovations for speedy and high quality construction for all income groups of society and cladding or paneling materials are helping to improve aesthetic and increase speed of works. Members of plastics family like polyurethane and expanded polystyrene are helping in energy conservation and are thus indispensable for creation of green built spaces.

1.2 Advantages of plastic form work over conventional formwork

- **Easy Handling:** Light weight so very easy to handle by single labor as well
- **Superior Finish:** Gives a good surface finish of the wall, columns, beams & slabs etc.
- **Reusable:** It can be used 80 to 100 repetitions.
- **Water Resistant:** Can be used in fresh and salt water.
- **Environment Friendly:** Green product (even carbon credits can be earned if applied).
- **Flexibility:** Sizes can be changed very easily as it is modular allowing low inventory.
- **Safety:** Plastic and light weight allows for safer working conditions avoiding fall hazard during both setup and dismantling.
- **Fast Setup:** The simple mechanics of speeds up the assembling at removal operations saving a lot of time.
- **Simplified Logistics:** The need for amount of material is reduced at site as the same panels can be used for wall, slabs, shear wall, columns, foundations, pile caps, rafts etc.
- **Leakage Proof:** No leakage between joints due to its good locking.

- **Easy Cleaning:** No need of using shuttering oil if cleaned with water after each repetition.
- **Storage:** No special storage space is required can be stored even in water areas and in open as well.
- **Plaster Cost Saving:** There is no need to plaster as the finish is good.
- **Labour Cost Saving:** No need of skilled carpenter's normal unskilled people can do the job in supervision and it takes less time labour is saved.
- **Light Weight:** The average weight is around 15 kg persq.mtr .
- **New Applications:** Monolithic applications for high rise buildings using drop head system for faster cycles, can be used in cellular low weight concrete cast in situ walls having density of 1000 to 1200 with installing electrical piping plumbing fitting, door frames, window frames, air conditioner piping etc done in one go saving a lot of labour and time making the project low cost and deliverable on time .

1.3 Details

This system is made from special grade plastic and hence no chemical reaction takes place or the material stick to it. Because of this property you cannot get any patched on the RCC finish. Also the gaps between two plates are so

negligible that no water nor cement gets leaked out at the time of RCC and it gets cured from the bottom of the plate, which also enhance the final quality of RCC casting. Due to easy plugging systems and easy to fit makes this foam shuttering system most labour friendly. By using Desire systems one need not nail or apply oil to the plates before casting RCC. Due to auto leveling of plugging systems the plates are automatically leveled. Hence 30 % time saves in assembling and also while dismantling the same. Desire formwork systems are made from Petroleum waste and its long lasting and gives more than 100 repetitions. After every usage of Desire foam systems once can easily clean the plates with water. In Desire plates if any breakage occurs by mishandling it can be very easily sealed by low voltage hot air gun.

In India "NOVA FORMWORKS" is the first one to introduce the Plastic modular formwork system by "NOVA GROUP" 6 years back and with its continuous research and development is improving its products everyday with many new innovations and observations. The product has excellent resistance, rigidity, impact and lightness which fulfill the requirement of the building industry.

The panels are available in different standard sizes that are

<i>Normal Panels</i>	<i>Inner Corners</i>	<i>Outer Corners</i>	<i>Round Panels</i>
50 mm * 1228mm	155 mm * 614mm*80	38 mm * 614mm	300 mm * 620mm
100 mm * 1228mm	230 mm * 1228mm*80	50 mm * 614mm	
130 mm * 1228mm	308 mm * 614mm*100	100 mm * 614mm	
200 mm * 1228mm		680 mm * 614mm	
230 mm * 1228mm		1085 mm * 614mm	
250 mm * 1228mm		80 mm * 1228mm	
300 mm * 1228mm			
350 mm * 1228mm			
500 mm * 1228mm			
600 mm * 1228mm			
620 mm * 1228mm			

Adjustable panel are also available. With the help of adjustable panel different sizes of column can be achieved. All these panels are made with high accuracy which provides ease in construction work.

Different types of plastic forms are available like glass reinforced plastic, fiber reinforced plastic and thermoplastics etc

These forms have become increasingly popular for casting unique shapes and patterns being designed in concrete because of the excellent finish obtained requiring minimum or no surface treatment and repairs.



2016.09.07

1.4 Objective of Study

- To compare the cost of building by using conventional formwork technique & by using Plastic formwork technique.
- To compare the Cost of building by using conventional formwork technique & by using Plastic formwork technique.
- To carry out which formwork is best for construction of building.
- To understand the concept of Plastic formwork

All above mention points will have been studied on a live case study.

2. Literature Review

With the introduction of advanced techniques for formwork there has been much comparison of the conventional techniques and advanced techniques of formwork system we can achieve cost & time reduction. They have proved that, such techniques reduce cycle time as compared to conventional methods, and hence overall cost saving can be achieved

Different authors give definitions of formwork differently **Belden** (1998), examined some issues involved in formwork at the construction site. His study identified the factors that control the quality, performance and safety of formwork and the methods used to optimize them to reach the economy. Finally his works identified some of the new formwork innovations that aim at improving the cost and performance of formwork. Improved formwork method initially increases 5% of cost but will result in savings of 15% of total cost from improved labour productivity. Cost of project can be reduced by designing the structure as uniform size, choosing the innovative formwork systems, safety, using lightweight materials as formwork.

For instance according to **Dr Anthony Nkem Ede** (March 2015) The research studied the extent of application of plastic materials for structural elements in Nigerian building industry. It was discovered that plastic materials are applied in only minor parts of structural components of building construction in Nigeria compared to many advanced countries such as the United States of America, China and Japan. Cost effectiveness and light weight have been the highest driving factor for the acceptance of plastic formwork materials in Nigerian construction industry.

As deforestation is a major issue worldwide, these days use of ABS plastic as a alternative material for formwork purpose might be possible solution against deforestation. So **Rahul Shinde, TanayKulkarni, NiranjanMahamuni, AbhishekMhetre, Rohit Mehendale and Rohit** (Apr-2016) have carried an experimental study and gave an "Introduction of abs plastic formwork as an alternative option to traditional formwork system".

Thus it can be concluded that the ABS plastic formwork technology is economical when used on large projects. Increases Speed of construction. It enhanced labour productivity. Repetitions are much more than traditional formwork techniques giving more than 100 repetitions and also ecofriendly alternative to wooden formwork system as it is recyclable and also Due to its light weight ABS plastic formwork is easy to handle and easy to transport on site, which increases labour productivity.

Raju Prajapati, Prof. Jayeshkumar Pitroda, Prof.J.J.Bhavsar (29th March, 2014) published;

Plastic formwork: New era for construction sector and observed that this system gives more than 100 repetitions; hence running cost is low. The final RCC work will get a smooth finish with minor joint line which does not require plaster. One can do putty and paint it. If you don't do plaster and hence it is cost effective. Hence it is very easy to install, dismantle, transport from one place to another. Its replace plywood's which consumes trees and M.S. which consumes iron ore from our planet earth. Our products help in preventing this precious metal from our earth.

KaziArbaz Mubarak, Fauwaz Parkar (Dec 2015) concluded the study project on **Comparative study and**

decision making for a Formwork technique to be adopted on a construction Site in Mumbai and On the basis of results obtained it can be concluded that for the study project, Plastech formwork seems to be the best feasible solution for the project.

3. Methodology

- 1) Data collection
- 2) Conduct the survey and analysis the data based on cost, time duration and installation and dismantling time duration.
- 3) Feature comparison chart
- 4) Conclusion.

a) Data Collection

The project undertaken for the study is construction of Multi storied Group Housing Project "PRATEEK GRAND CITY" being constructed in Siddhartha Vihar, Ghaziabad (UP). The project is proposed to have spacious 2, 3 and 4 BHK homes, along with podium car parking, refreshing surroundings and other luxurious amenities. The whole project at ground level is designed for parks, playgrounds, recreation, circulations etc

Name of the Project: PRATEEK GRAND CITY

Type of Project: RESIDENTIAL

Structure Details: 2B + G+ 28 STOREYS.

Name of Client: M/S PRATEEK REALTORS INDIA PVT LTD.

Name of Architect: HAFEEZ CONTRACTOR.

Name of Contractor: M/S AHLUWALIA CONTRACTS INDIA LTD.



In addition to this, survey was carried out on 5 different projects in and around DELHI NCR, with all the factors leading to the cost of various types of formworks, like cost

of materials, labours, props, accessories etc., based on which a comparative statement is prepared. Some of these projects are Apex Golf Avenue, Prateek Fedora Noida

S. No.	Parameters	Conventional		Fast Track
		Timber	Steel	Plastic
1.	Cost			
	Initial Investment	Low	High	High
	Average Cost (Rs.) / m2	600	1600	4150
	Props & Accessories Cost(Rs.) / m2	4	4	Included in formwork cost
	Labour Cost (Rs.) / m2	75	80	110
2.	Repetition Cycle	8	30	130
	Repetition Cost /sq.m	80	45	9
3.	Cycle time for casting at least 100 sq.m (days)	7	7	3
4.	Strength (Permissible Fresh Concrete Pressure) in KN/sq.m	35	-----	110
5.	Durability	Low	Low	High
6.	Surface Finishing	Rough	Average	Smooth
7.	Wastage of materials	High	Average	Nil
8.	Planning of System	Not Required	Not Required	Required
9.	Accuracy in Construction	Very Less	Very Less	Superior
10.	Aesthetics	Not superior	Not superior	Superior
11.	Manpower requirement (including supervisors and engineers)	Medium	Medium	High
12.	Training Programs	Not Provided	Not Provided	Required

Calculations

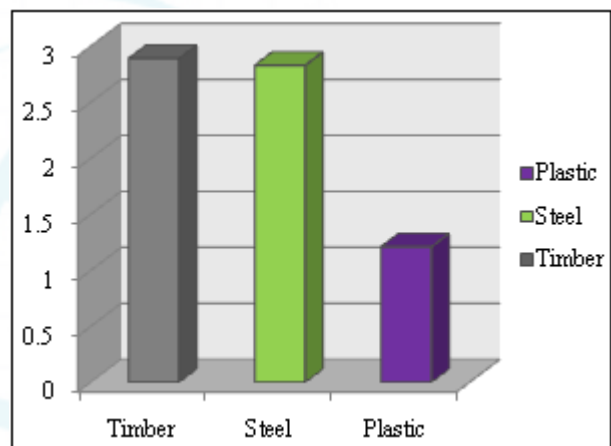
Total area of formwork work done so far = 14750 m2

Cost

Overall cost of conventional timber=
 $14750 \times 80 + 14750 \times 4 + 14750 \times 75 = \text{Rs. } 23,45,250/-$

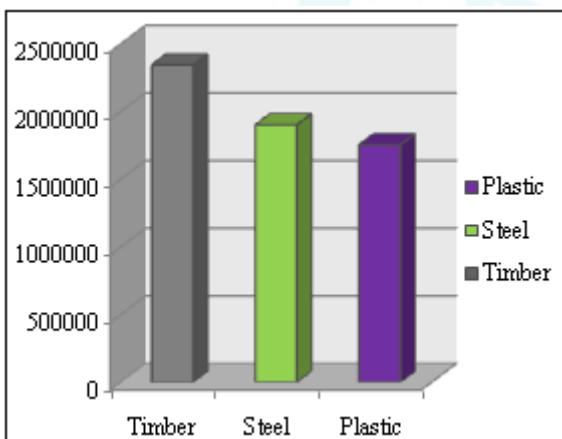
Overall cost of conventional steel=
 $14750 \times 45 + 14750 \times 4 + 14750 \times 80 = \text{Rs. } 19,02,750/-$

Overall cost of Plastic Formwork = $14750 \times 80 + 14750 \times 110 = \text{Rs. } 17,55,250/-$



Time Comparison of various formworks

The installment and dismantling time is specified as under as well:



Cost Comparison of various formworks

Probable Time

It is calculated on the basis of cycle time showed in comparative statement

Duration with Conventional Timber= $(14750 \times 7 / 100) / 365 = 2.89 \text{ yrs.}$

Duration with Conventional Steel= $(14750 \times 7 / 100) / 365 = 2.83 \text{ yrs.}$

Duration with Plastic formwork= $(14750 \times 3 / 100) / 365 = 1.21 \text{ yrs.}$



Feature comparison chart

Features	Wood	Metal	Aluminum	Plastic
Repetitions	50 To 10 Usage	10 To 40 Usage	100 Usage	75 To 100 Usage
Surface	Good	Good	Excellent	Excellent
Handling	Average	Heavy	Average	Light Weight
Chance For Theft	High	High	High	Low
Maintenance	N/A	High	Average	Low
Storage	Warehouse	Warehouse	Warehouse	Not Required
Recycle Eco Friendly	No	Yes	Yes	Yes
Load Per Sq. Mtr.	4 Tonnes	4 Tonnes	4 Tonnes	6 Tonnes

Shuttring Oil	Yes	Yes	Yes	No
Cost	Low	Moderate	Expensive	Economy

4. Conclusion

In traditional formwork system mainly wood and steel are being used as a material for formwork system. In wooden formwork system, time delay and less accuracy are main constrained. Installation and dismantling period is very high in wooden system. In steel formwork system accuracy in work can be achieved but due to its heavy weight it requires crane for lifting purpose as a result it proves to be time consuming. Also the repetitions for wood and steel formwork have 10 and 60 repetitions respectively, while ABS plastic can be used over 100 times. Due to its light weight ABS plastic formwork is easy to handle and easy to transport on site, which increases labour productivity. As deforestation is a major issue worldwide, these days use of ABS plastic as an alternative material for formwork purpose might be possible solution against deforestation. . The next is durability and sustainability

Thus it can conclude that the plastic formwork technology is economical when used on large projects. Increases Speed of construction. It enhanced labour productivity. Repetitions are much more than traditional formwork techniques giving more than 100 repetitions and also ecofriendly alternative to wooden formwork system as it is recyclable. Cost effectiveness and light weight have been the highest driving factor for the acceptance of plastic materials in Indian construction industry

References

- [1] Formwork method selection model based on boosted decision trees in tall building construction. Yoonseok Shin, Taehoon Kim, Hunhee Cho. Automation in Construction, Vol. 23, 01.05.2012.
- [2] Constructability Assessment of Climbing Formwork Systems Using Building Information Modelling. Ramesh Kannan. M, Helen Santhi. M. International Conference On DESIGN AND MANUFACTURING, IConDM 2013
- [3] H.G.VIVEK PRASAD, H.N.RAJENDRA PRASAD "Case Study on Conventional and Fast Track Construction Techniques", International Journal of Science, Engineering & Technology, Vol.3 Issue 5, 2015.
- [4] Ganar A.S, Patil S.D "Comparative analysis on cost and duration of formwork building and Conventional Formwork building", International Journal on Recent and Innovation Trends in Computing and Communication, Vol.3 Issue 12
- [5] Ketan Shah, (2005) "Modular formwork for faster, economical and quality Construction", Indian Concrete
- [6] Journal, Vol-79, pg. 6-23.
- [7] Akovali, G. F. (2005). *The Use of Plastics in Building Construction*. Retrieved November 6, 2012, from GlobalSpecWeb site:
<http://www.globalspec.com/reference/50526/203279/chapter-3-the-use-of-plastics-in-building-construction>

- [8] Ndububa C. O. (2013). "The Use of Plastic Materials in Building Construction in Nigeria", Unpublished final year student project, Department of Civil Engineering, Covenant University, Ota, Nigeria.
- [9] Sparkonix (India) Pvt. Ltd., Pune. - www.sparkonix.com
- [10] Geoplast S.p.A.- www.geoplast.it
- [11] <http://www.concretecentre.com>
- [12] <http://www.concretecentre.com/Building-Elements/Formwork/Jump-Form.aspx>
- [13]– <https://www.bofufarm.com/2015/02/10/advantages-of-using-plastic-formwork-system-specifically-for-walls-and-slabs/>