ARCN International Journal of Sustainable Development
ISSN: 2384-5341. Volume 13, Issue 6, (March, 2023) pages 92 - 98
DOI: 2726457311368
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An Overview of Natural Fibre Composite in Formwork in Nigeria

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Abstract: *Conventional construction methods are not able to cope with the demand of infrastructural facilities with a high degree of quality control and assurance. Formwork which constitutes getting 50% of the building construction contract cost. The successful completion of reinforced concrete (RC) building construction projects depends, in part, on selecting the appropriate formwork system (FWS) since it may significantly affect the project's cost, time, and quality performance factors. The study concluded that implementing alternative formwork material from natural fibre-reinforced polymer composite will improve the quality of work in construction when compared to traditional formwork by nearly 25-30 %. The duration of the project gets reduced to 15-20% when applying this alternative formwork on the construction site. By using this alternative formwork cost gets reduced to nearly 20- 25 %. The safety and efficiency of the work get improved by 10-15%. But getting alternative formwork material in the construction site is far from satisfying due to the lack of established technology to produce the composite.*

Keywords: *Formwork, Mould, Cost, quality control, quality assurance.*

Introduction

Formwork is the term used to denote a temporary mould in the construction industry into which concrete is poured and formed (Holbery and Houston, 2006). Traditional formwork for concrete especially in developing countries is usually made from wood normally requiring skilled carpenters to come up with. This type of formwork often has poor safety features and takes time to construct and with huge levels of waste also being generated which invariably affects the environment.

The total expenditure of construction work includes the cost of formwork among others. Construction of formwork involves considerable cost in terms of material cost, labour cost including fabrication, erection and removal, and time element. In case of buildings, the cost of formwork may range between 30 to 40% of the cost of concrete work. In case of special structures like bridges, tall buildings, dams, etc., the cost of formwork may range between 50 to 100% of the cost of concrete work, or even more. Since formwork contributes nothing towards the stability of the finished structures, its cost should be kept barest minimum consistent with safety and environmental concerns.

The compelling environmental issues, the increasing global awareness of the depletion of natural resources have therefore generated particular interest in bio-composite materials and the need to explore their use in structural applications. Rethinam and Sivaraman (2012) investigated the

mechanical properties of natural fibres reinforced epoxy polymer concrete. Coconut, sugar cane bagasse, and banana fibres were used as they come without any kind of preparation. Of the three types of fibres, chopped coconut fibres were found to be an excellent reinforcement for polymer concrete increasing the fracture and flexural properties. Abdellaui *et al*. (2015) have replaced natural sand with by-products from the timber and wood processing industries to produce light mortars, which were characterised by means of compression and bending tests, drying shrinkage, resistance to water vapour permeability, water capillary absorption, and thermal conductivity measurements.

Bio-sourced materials combined with a cementitious matrix offer an interesting alternative to traditional construction materials. They constitute an interesting economic and ecological solution. Biomaterials such as wood fibres can be sourced from recycled timber or from sustainably managed forests. They are inexpensive to produce, and environmentally friendly. They can sequester carbon in the construction. They are generally highly porous with a low apparent density and a complex architecture marked by a multi-scale porosity. These geometrical characteristics result in a high capacity to absorb sounds and have hygro-thermal transfer ability (Mallick 2010; Saravana Bavan and Mohan Kumar 2010). Their thermal conductivity is close to that of expanded polystyrene and glass wool. The use of natural resources offers therefore real possibilities of improving the thermal and acoustic comfort of the built environment as well as developing new construction techniques. In addition, they lend themselves to modular construction. They are well suited in warm and humid environments where termites and decay pose a serious problem.

Methodology

The paper discusses different types of fiber which can use as part of composite for making formwork materials. The properties of different types of fiber will also be discussed here. From the compares' and brief description, one can get a concept that how, and which type of fiber works better to form a good quality formwork material. The steps are;

A. Description of work

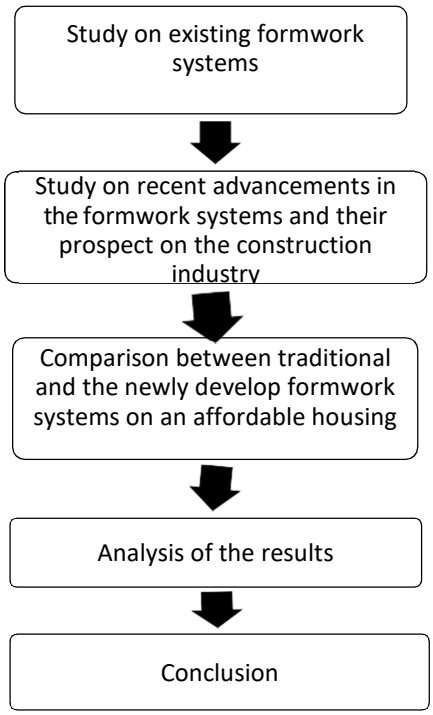


Fig.1 Detailed methodology of project

B. Present Scenario of Formwork in Nigeria

- Low technology
- Labour intensive.
- Labour-unskilled, moving, traditional and family oriented
- Lack of monitoring body generally for quality construction.

C. Nigeria Construction using Formwork

Formwork may be defined as the temporary structure that helps to mould the concrete into shape we required and holds it in the exact size, shape and place till it is hardened sufficiently to bear the loads imposed on it. In the Nigerian scenario, there are different types of formwork some are mentioned below:

a) Timber Formwork

b) Plywood Formwork

c) Iron Formwork

d) Aluminum Formwork

Timber Formwork: For minor construction works, timber (wood) is the best suitable type and commonly usable type formwork materials but will warp, swell and shrink.

Plywood Formwork: Usually for one-time use.

Iron Formwork: For repetitive works.

Aluminum Formwork: Aluminum forms are lighter and can be used repetitively, thus enhance the productivity.

D. *Removal of Formwork (As Per IS 456)*

In normal conditions where convenient type of temperature does not decrease below 10 degree, Celsius and where normal cement are used and sustainable curing is done. Following by the removal period of formwork might consider satisfying. Table I shows different types of removal of form works.

Table I: Different types of removal of form works

S.NO	TYPES	PERIOD
1	Components in Which Formwork Is Used	18-24 hours
2	Soffit formwork to slabs (props to be re-fixed Immediately after removal of formwork)	7 days
3	Soffit formwork to beams	14 days
4	Props to slabs:	
	a) slab spanning up to 4.5mb)	7 days
	b) slab spanning up to 4.5m	14 days
5	Props to beams and arches	
	a) spanning up to 6m	14days
	b) spanning up to 6m	21 days

E. *Impacts of Formwork*

Formwork takes more than 50% of RC construction time. The cost of formwork varies between 15 to 25% of the reinforcement concrete structure cost. Proper engineered system formwork should be specified upon in the tender to attain good formwork practice, safe working conditions and to get quality and durable concrete structure Otherwise it will not only lead. Too poor-quality structures but also wasting resources like materials, manpower, and time.

Which in turn affects construction delays and cost leaps of projects. That affects the balance between safe and unsafe conditions. However, once a failure has occurred investigators will certainly check whether the code was followed or not.

F. Alternative Formwork Systems

As a result of the efforts to improve the formwork for achieving construction project efficiencies, the following new systems of formwork have been made possible to best suit each type of the project, as detailed below

i. Re-Usable Plastic/PVC/Aluminum Formwork Systems

ii. Table form/Flying Formwork Systems

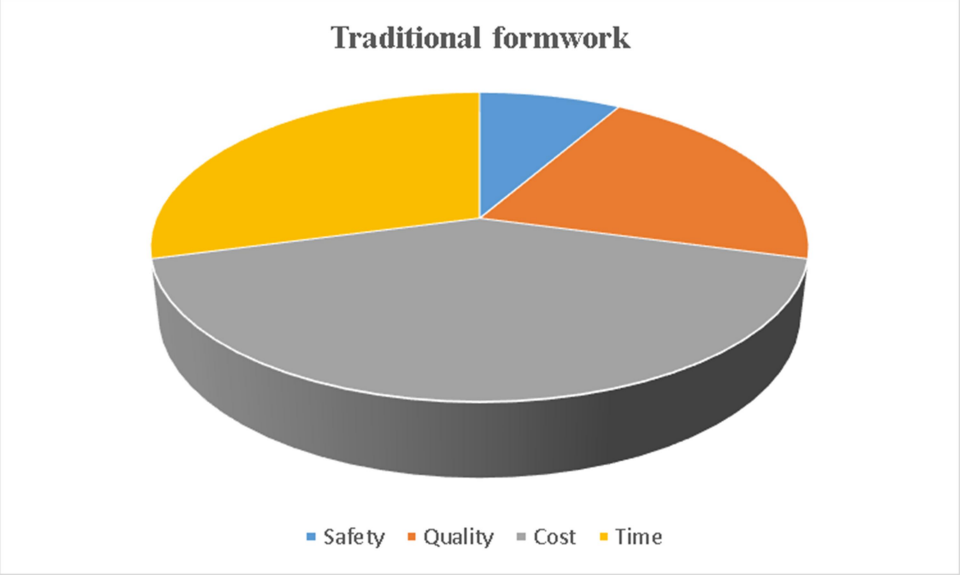
iii. Jump Formwork Systems

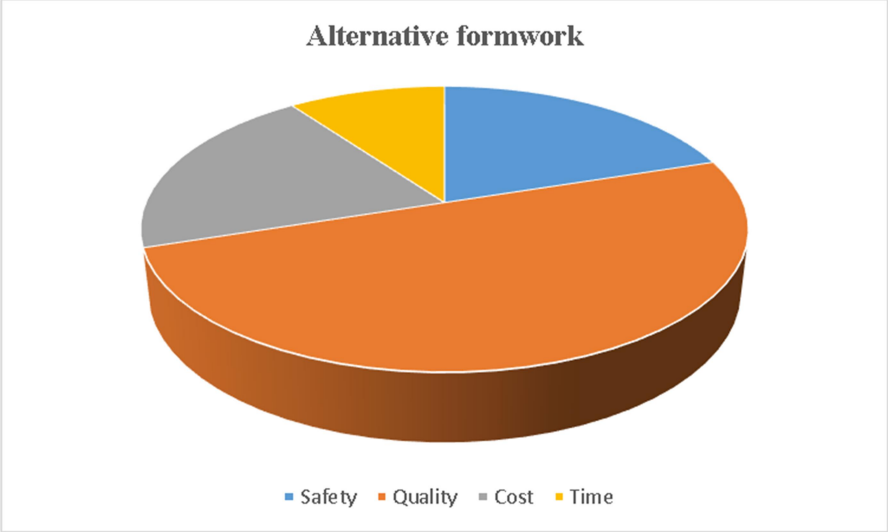
iv. Slip Formwork Systems

v. Permanent Insulated Formwork Systems (ICF)

Discussion and results

The below pie charts showing the cost, quality, time and safety of the traditional formwork systems with the natural composite formwork systems in construction site.





Conclusion

The above results (study) concluded that by this implementing advancement formwork will improve the quality of work in construction when compared to traditional formwork by nearly 25-30 %. The duration of the project gets reduced to 15-20% when applying this advancement formwork in the construction site. By using this advancement formwork cost gets reduced to nearly 20- 25 %. The safety and efficiency of the work get improved to 10-15%. But implementing this advancement formwork in the construction site is far from satisfying due to lack of knowledge and due to lack of skilled labor.

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