Split Ginger Bread (Hyphaene Thebiaca) Truck as a Reinforcement Member in Concrete short Beams

By

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Abstract

It is a fact that the construction industry is the main consumer of energy and materials in most countries. The pursuit of sustainable development, as defined is the "development that meets the needs of the present without compromising the ability of future generations to meet their own needs", has become a major issue when trying to meet the challenges in providing proper housing for the ever-increasing world population. This paper presents the results of some of the recent studies of the microstructure of Ginger Bread (HyphaeneThebiaca) as a functionally gradient material. These studies led to the establishment of Ginger Bread (HyphaeneThebiaca) composite behavior through the rule of mix. A concise summary regarding Ginger Bread (HyphaeneThebiaca) reinforced concrete beams is discussed. Finally, some recommendations for future studies are proposed with the hope that the newly developed material could contribute, on a large scale, to sustainable development without harming our globe.

Keywords: Ginger Bread (HyphaeneThebiaca), Concrete, Beam, Compressive Strength

Introduction

For decades now the needs of individuals and organization to provide adequate and affordable building materials from the usual conventional construction materials have hindered many, especially in the developing country to build a house. Housing being the most energy consuming activity known in the building industries cannot do away with the use of steel, woods, fibers, plastics and glasses as composite materials in constructions. Therefore, either the engineers or other professional in the building industries have a role to play in ensuring that the conventional construction materials are adequate and affordable by avoiding smaller or substandard structures which in turn is absolutely unacceptable or the use cheaper materials and unspecified construction techniques.

With the recent call on the issue of climate change, the production of steel and iron has been a major means in the industries that emit over 2.0 gigatonnes of CO_2 into the atmosphere (Maurina, A. 2015). The need for natural materials cannot be over emphases; therefore, the use of these natural occurring products will decrease the consumption of energy growth and the emission of the CCh into the atmosphere. The Ginger Bread (HyphaeneThebiaca) tree is one of the most common naturally occurring trees found in Sub-Sahara region and in use for centuries mostly for construction purposes such as masonry buildings, Mud House, Bridges and Shelter poles among others.

Many researchers have worked and are still working on the Bamboo as a non- polluting, eco-friendly material and the use of a reinforcement material due to it elastic at serviceability life (Veltkam, M. 2007). But so far the research in regards to Ginger Bread (HyphaeneThebiaca) as a non-polluting, eco-friendly material and stress and strain behaviour in construction industries are not spread both in the academia and in the industry. This study is an experimental research centered on the use of Ginger Bread (HyphaeneThebiaca) as a reinforcing material in cement concrete beam as a partial replacement of steel. Ginger Bread (HyphaeneThebiaca) is another natural occurring tree. It is also seismically resisting material for sustainable environment development without harming our global environment.

The Ginger Bread (HyphaeneThebiaca) also refers to as Doum Palm is a dioecious Palm Tree that grows mostly Sahel Savanna and grows up to 17 m (56 ft) high. The Ginger Bread (HyphaeneThebiaca) trunk had a girth of up to 90 cm (35 in). In recent times, the high cost and general cost of reinforcing steel in many parts of the country has led to increasing interest in the possible use of alternative locally available materials for the reinforcement of concrete (Wegst U Et-al 1986). And also according to K. Ghavani, (2003), especially in the developing Countries where about 80% of the population lives in the villages. This has led to research on several nonferrous reinforcing materials in structural concrete. In Ghana for an instance, a tall straggling shrub known as Babadua (botanical: Thalia Geniculata) also reportedly found in parts of Africa, Asia and South America has been used as a construction material in several rural areas where it is tied into a framework and daubed with mud (Abankwa K, 2003). The local construction method of using

Babadua with mud was improved upon in an experimental Programme by the use of Babadua as reinforcing the material in concrete structural elements. The strength and deformation characteristics of concrete beams reinforced with Babadua bars ranging from 2.87 to 12.13% were tested in bending (Kankam Et-al,1999). The experimental failure loads averaged 1.18 times the theoretical flexural strength of the reinforced concrete (RC) and 1.05 times the theoretical shear strength of the concrete sections taking into consideration the resistance of the tension reinforcement. In the case of one-way concrete slabs reinforced with Babadua bars, the researchers (Kankam Et-al, 2000) found experimental failure loads to average 175% of the theoretically predicted values. However, in Macdonald, A, (2001) state that the experimental failure loads on Bamboo structures is averaged about 67% of the design shear strength of the reinforced concrete section. Research work on two-way concrete slabs reinforced with Babadua bars failed experimentally at loads that averaged 170% of the theoretically predicted loads (Maurina, A. Et-al 2014). A raffia palm (rattan cane) was also used as both bending and shears reinforcement in concrete beams (Kankam, 2000). Fourteen simply supported raffia palm reinforced concrete beams were subjected to four-point bend tests until failure. The collapse occurred mainly through the crushing of concrete and failure loads averaged 1.17 times the theoretically predicted values. In X,Li (2011) it demonstrated that raffia palm fiber improves the compressive and flexural strength of ordinary cement and mortar composites for roofing tiles. Bamboos are tied together to make grid reinforcement and placed in soft clay to solve deformation problems in embankments (Purwito, 2015). It is encouraged that slit Ginger Bread be used as a reinforcement material for construction of walls, beams, column and slab in place of reinforced steel cement concrete structures since they have quite higher strength, and they are environmentally sustainable if being used.

MATERIAL AND METHOD

Materials

Cement: Dangote Cement was used for the purpose of this research, cement as one of the most important building materials, is a binding agent that sets and hardens to adhere to building units such as stones, bricks, tiles etc. Cement generally refers to a very fine powdery substance chiefly made up of limestone (calcium), sand or clay (silicon), bauxite (aluminium) and iron ore, and may include shells, chalk, marl, shale, clay, blast furnace slag, slate.Cement concrete is the most widely used material because of its satisfying performances in strength requirements and its ability to be molded into a variety of shapes and sizes

Aggregates: Aggregates are among the constituent of concrete they include River Sand or Quarry Dust and Crushed Stones and where obtained from a local vendor. Quality of aggregates, its size, shape, texture, flexural strength etc. determines the strength of concrete. The presence of salts (chlorides and sulphates), silt and clay also reduces the strength of concrete.

Water: Frequently the quality of the water is covered by a clause stating "the water should be fit for drinking". Borehole water was used throughout the mixing and curing of the members.

Slit Ginger Bread: The Ginger Bread (HyphaeneThebiaca) tree is one of the most common naturally occurring trees found in Sub-Sahara region it was used to support both the tension and compressive strength, and we obtained it from the local vendor,

Reinforcement rod (12 mm diameters): Reinforcement is strong in Tension, therefore, the Reinforcement is added to support the Tensile Loads from structural members its available at any building material vendor

Methodology

The method in carrying out this research are as follows:

Get the Ginger Bread (HyphaeneThebiaca) truck and mechanically or manually slit them into duferent size by 2inc size, then treat them.

- Construct formwork, fix the reinforcement and then mix the concrete according to specification.
- Casting of the reinforcement concrete and curing for three, seven, fourteen, twenty one and twenty seven days then remove the formwork.
- Subjecting the structural member to temperature of no more than 45° C for twelve hours.
- Subjecting the Beam to compressive strength test.

RESULTS AND DISCUSSION

To achieve a specific property objective using the Ginger Bread as reinforcement in concrete the following test took place

1. Mechanical properties of split Ginger
2. Bread
3. Tensile test
4. Water Absorption test
5. Compressive Strength test

Mechanical Properties of Ginger Bread

The mechanical properties of any material are very important in the field of civil engineering especially in term of structural design. The mechanical property of the split Ginger Bread before the compressive test was taken and the result obtained as observed is presented.

Table 1: Mechanical properties of Split Ginger Bread (HyphaeneThebiaca)

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MECHANICAL PROPERTIES	Symbol	Value (psi)	MECHANICA
Ultimate compressive strength		72	Ultimate com
Allowable compressive strength	A	3.4	Allowable cor
Ultimate tensile strength		15	Ultimate te
Allowable Bond stress	A	3.3	Allowable
Allowable Tensile stress	U	41	Allowable
Modulus of elasticity	E	$Ux10^3$	Modulus

Source: Research Data

Tensile Test

Using the digital UTM ELE model the tensile the test for two different sample of the split Ginger Bread was determined. The two samples are dry split Ginger Bread of estimated age period three month after cutting down from the main tree and a fresh split of estimated two weeks old. The sample required procedure for steel was used so as to relate the result with the samples. From the result in table 2 it was observed that the tensile strength of the dry split Ginger Bread is close to that of bamboo with 125N/mm^2 as recorded.

Sample	Dry samples(N/mm^2)	Fresh samples(N/mm^2)	Bamboo (N/mm^2)	Steel (N/mm^2)
Average value	157	160	125	460

Source: Research Data

Water Absorption

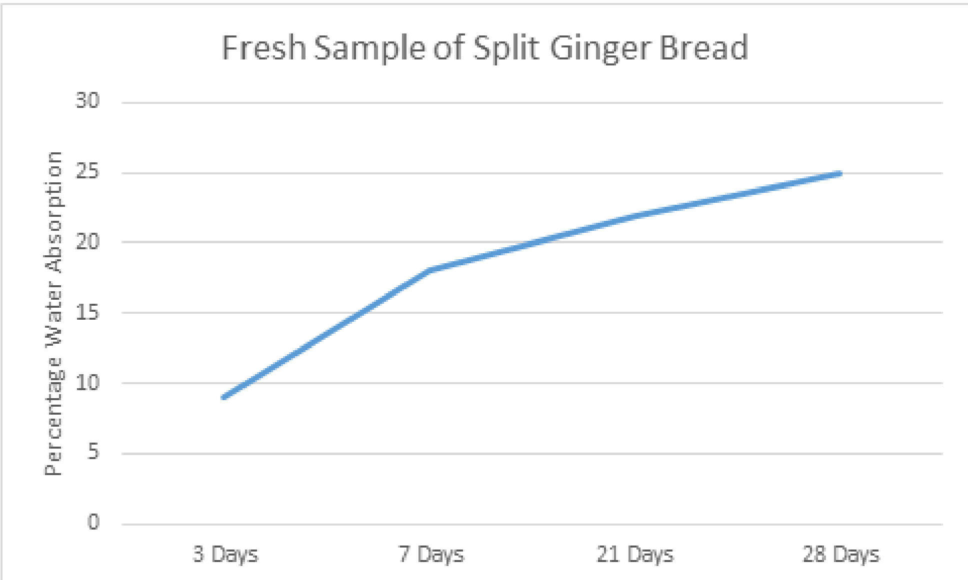
The Ginger Bread from it physical properties or appearance one will not deny it will absorb water. The water absorption rate was conducted for three (3) samples each of the dry and fresh split Ginger bread of the same dimension. The sample is immersed in water for the period of 3days, 7days, 21days and 28days. Their initial weight before immersion was taken and after the stated periods it was observed that there is increase in weight in both dry and fresh samples. The result as shown in table 2a and 2b indicate that the percentage rate of water absorption is high in the fresh samples and lower in the dry samples which nearly correspond to that of bamboo between 22 - 50% rates. As the days increases the absorption rate increases with a negligible percentage

Table 3a: Water Absorption of Split Ginger Bread for Fresh Sample age less than two month

	Initial Weight 974.40g of Fresh Sample		
		Final Weight	% Water Absorption
1	3 Days	1062.10	9
2	7 Days	1091.33	18
3	21 Days	1188.77	22
4	28 Days	1118.00	25

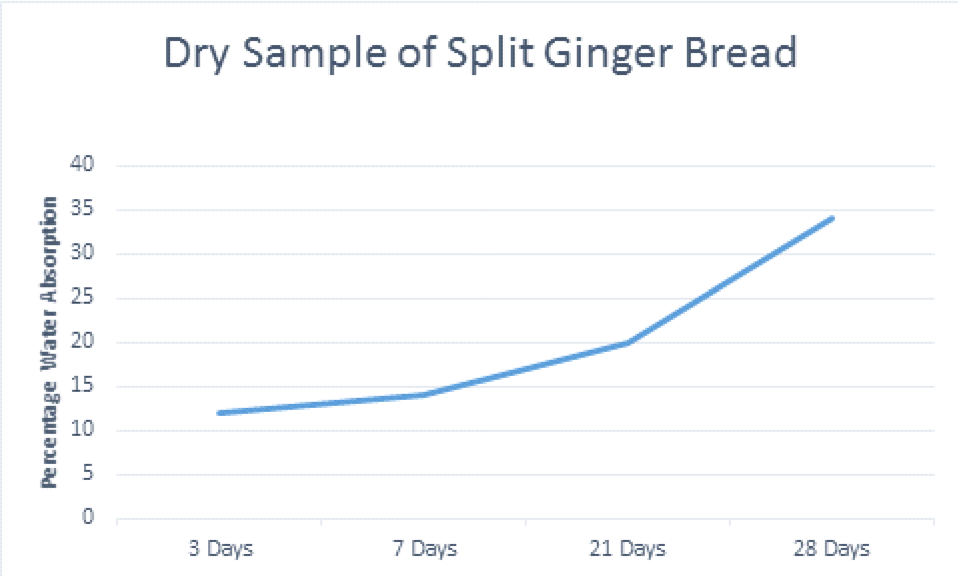
Source: Research Data

Figure 1: Percentage Water Absorption against Days



	Initial Weight 862.90g of Fresh Sample		
		Final Weight	% Water Absorption
1	3 Days	1966.45	12
2	7 Days	983.71	14
3	21 Days	1035.48	20
4	28 Days	1156.29	34

Source: Research Data



Compressive Strength

The Reinforced concrete being a mixture of cement, aggregates and water sometimes admixtures and Steel rod or split Ginger Bread, they weak in tension but strong in compression. The use of reinforcements has balance the phenomenon. Therefore, the split Ginger Bread was used as reinforcement in concrete beam and subjected to UTM.

The beams are designed using the double reinforcement design method with target compressive strength of 55 X10^3 N/mm^2 after 14 days curing and 64 X10^3 N/mm^2 after 28 days curing. The split Ginger Bread was placed at the different zone of the beam structure, that is the split Ginger bread at compressive zone and steel at tension zone, the split Ginger Bread tension zone and steel at the compressive zone, and finally split Ginger Bread the at both compressive and tension zone as shown in figure 4a. and 4b.

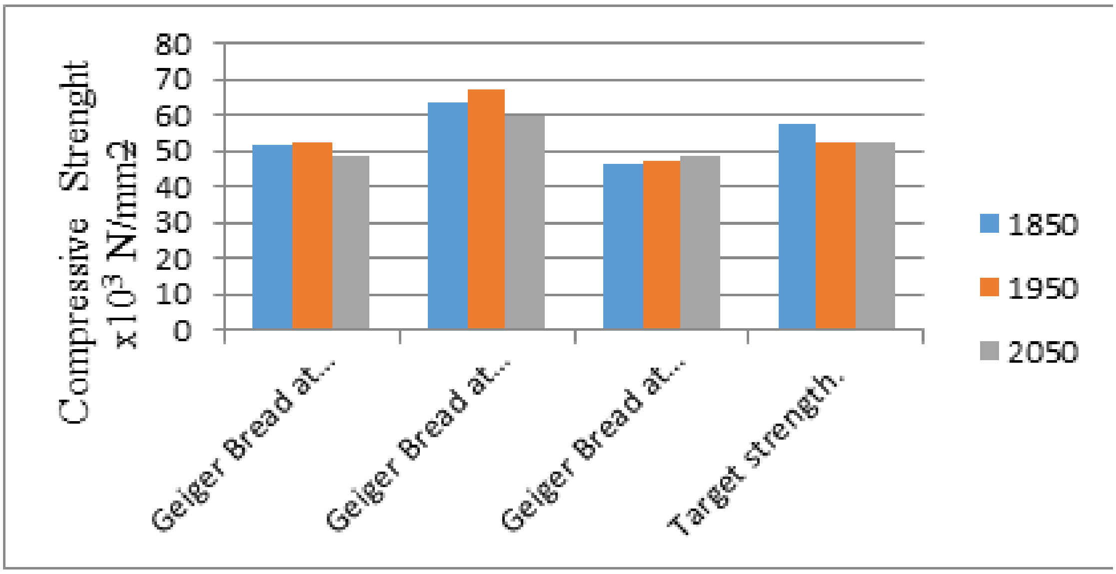
From the result obtained after 14 days the beams with split Ginger bread at compressive zone has the highest compressive strength of 63.3 X10^3 N/mm^2, 67. 6 N/mm^2 and 59. 7N/mm^2 , With the loading rate of 1850kN/sec, 1950kN/sec and 2050kN/sec respectively which is very close to the target compressive strength of double steel reinforcement concrete beam of 55 XI0^3 N/mm2, follow by that with the split Ginger bread at tension zone with compressive strength of 51.6 X10^3 N/mm2, 52.4 X10^3 N/mm^2 and 48.1 X10^3 N/mm^2 with the loading rate of 1850kN/sec, 1950kN/sec and 2050kN/sec respectively, but that which the split Ginger bread is reinforced at both zones (compressive and tension) fall very low below the target compressive strength with the value of 46.3 X10^3 N/mm^2,47.2 X10^3 N/mm^2 and 48.7 X10^3 N/mm^2 With the loading rate of 1850kN/sec, 1950kN/sec and 2050kN/sec respectively.

Table 4a: Compressive Strength after 14days

Loading Rate kN/sec	Geiger Bread at Tension zone **Total Score**	Geiger Bread at compressive zone	Geiger Bread at both zone	Target strength.
1850	51.5 x10^3	63.238 x10^3	46.329 x10^3	57.826 x10^3
1950	52.404 x10^3	6 7 . 5 5 6	47.119	52.806 x10^3
2050	48.603 x10^3	59.72 x10^3	48.711 x10^3	52.707 x10^3

Source: Research Data

Figure 3: compressive strength at different force zone after 14 days



Source: Research Data

It's observed also that From the result obtained after 28 days the beams with split Ginger bread at compressive zone has the highest compressive strength of 54.0 X10^3 N/mm^2, 66.7 N/mm^2 and 73.7N/mm^2 , With the loading rate of 1850kN/sec, 1950kN/sec and 2050kN/sec respectively which is very close to the target compressive strength of double steel reinforcement concrete beam of 64 X10^3 N/mm^2, followed by that with the split ginger bread at tension zone with compressive strength of 47.6 X10^3 N/mm^2, 58.3 X10^3 N/mm^2 and 66.8 X10^3 N/mm^2 with the loading rate of 1850kN/sec, 1950kN/sec and 2050kN/sec respectively, but that which the split ginger bread is reinforced at both zones (compressive and tension) fall very low below the target compressive strength with the value of 43.3 X10^3 N/mm2,53.2 X10^3 N/mm^2 and 456.6 X10^3 N/mm^2 With the loading rate of 1850kN/sec, 1950kN/sec and 2050kN/sec respectively. The result shows that more the curing days and the loading rate the more the compressive strength increases as shown in table 3.

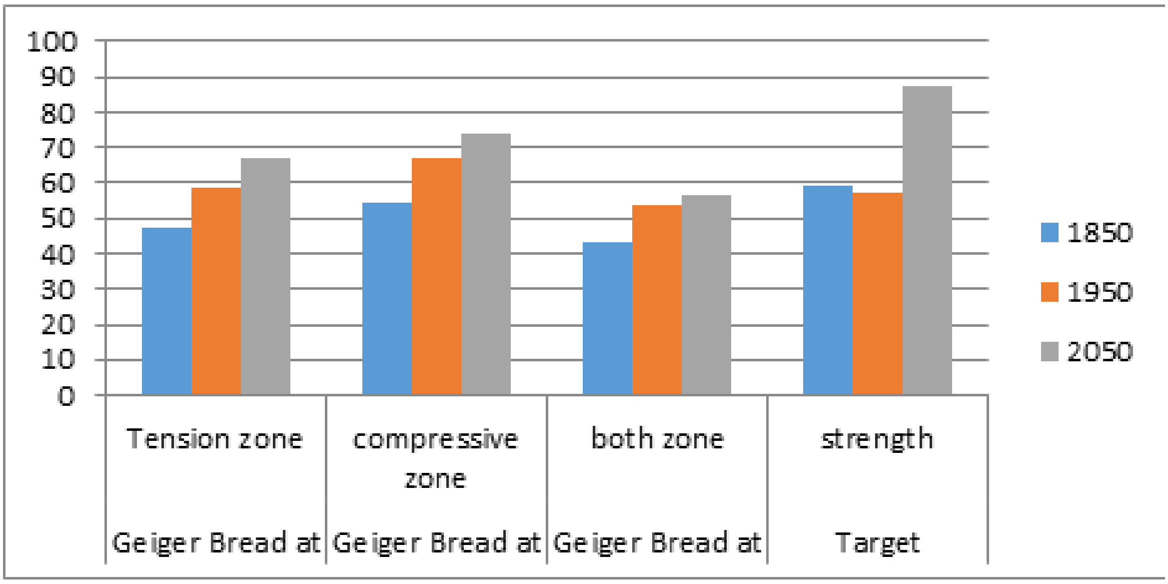
Compressive Strength after 28days

Table 4a: Compressive Strength after 14days

Loading Rate kN/sec	Geiger Bread at Tension zone **Total Score**	Geiger Bread at compressive zone	Geiger Bread at both zone	Target strength.
1850	47.614x10^3	54.081x10^3	43.06x10^3	59.08x10^3
1950	58.3x10^3	66.759x10^3	53.766x10^3	57.191x10^3
2050	66.872x10^3	73.705x10^3	56.568x10^3	86.974x10^3

Source: Research Data

Figure



CONCLUSION AND RECOMMENDATION

The tensile of the two sample of the split Ginger bread is more than average compared to that of steel of 250N/mm2. There is no failure pattern during the test for the two sample (dry and fresh) of the split Ginger bread. The compressive strength of the split Ginger Bread is nearly same as the tensile strength of Bamboo and steel commonly use in concrete as reinforcement. The bond stress in split Ginger bread with concrete is very low compared to HYSD and it's close to the Bamboo that is coated or treated.

The water absorption of split Ginger bread is very high compared to that of Bamboo and therefore waterproofing agent is recommended. From the test so far the split Ginger bread can be used potentially be as a substitute for steel in double reinforcement beam with the split Ginger bread at the compressive zone and the HYSD steel at the tension zone. Due to the present challenges of the environment that result to climatic change the Ginger bread is eco- friendly material it will limit the rate in which steel is used by reducing the carbon dioxide emissions.

Also, the split Ginger bread reinforced concrete is recommended and can be used in green building concept

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