MEASURING THE MECHANICAL STRENGTH PROPERTIES OF BAMBOO FIBRE REINFORCED CONCRETE

[1]OMISANDE, LAWRENCE A. AND [3]ONUGBA, MICHAEL A.
[1]DEPARTMENT OF CIVIL ENGINEERING,
THE FEDERAL POLYTECHNIC, ILARO, OGUN STATE, NIGERIA.
lawrence.omisande@federalpolyilaro.edu.ng

[2] DEPARTMENT OF CIVIL ENGINEERING,
SCHOOL OF ENGINEERING,
THE FEDERAL POLYTECHNIC, IDAH, KOGI STATE, NIGERIA.

ABSTRACT

Concrete is a construction material known for its good compressive strength however high strength concrete are required for special purposes. Construction industries in recent times have resulted to the use of fibers in concrete to improve concrete properties. The study investigates the use of bamboo fiber in improving the properties of concrete. 36 Concrete cubes measuring 225mmx225mmx225mm were cast with bamboo fibre added varying percentages (0%, 0.5%,1.0%,1.5%, and 2.0%) by volume of concrete, cured for 28days and tested for workability and compressive strength. The results revealed that at 2% bamboo fibre addition there was an observed 4.3% gain in strength. Workability decreases with the increase in the percentage of bamboo fibre. Bamboo fibre showed good potential and increased strength as it bears more load as compared to conventional concrete.

KEYWORDS: ***Bamboo Fibre, Compressive Strength, Concrete, Workability***

1.0 INTRODUCTION

The construction industry contributes partly to environmental damage, hence the need to look for more environmental techniques of construction for development (Kumar et al., 2020). A feasible solution is to examine new materials that can be recycled and reused. Consequently, it is necessary investigate naturally available materials such as agricultural product, silica, coconut shell, bamboo, glass, rice husk, ceramic, crump rubber (Kumar et al., 2019; Yildizel et al., 2020; Poongodi et al., 2020; Palanisamy et al., 2020; Ahsan et al., 2018). Bamboo is one of the most abundant and renewable natural resource. With the advance of science and technology, different techniques are applied for treating bamboo to make it durable and more useful construction materials. Concrete is commonly used as the construction worldwide for many years due to its ability to withstand large compressive stresses (Banu et.al, 2019). Its use is limited however because of its low tensile strength (Archana et.al, 2020). Bamboo fiber reinforced concrete is a composite material. It comprises of natural bamboo fibers of different lengths and diameters with different fractions. Bamboo fibers are natural plant

fibers that are environment friendly, sustainable, cost less, have less density. Like glass fiber, it is lightweight, biodegradable, and inexpensive. This research intends to adopt the use of bamboo fibre in concrete to study its strength properties (Awoyera et.al, 2019).

2.0 LITERATURE REVIEW

Moisture content directly affects the strength of bamboo hence, seasoning or other suitable treatment should be given. AjinkyaKaware et. al. (2013) reported that water absorption of bamboo is quite high. It was suggested that bamboo should be treated by epoxy coating, tar coating etc. Shakeel Ahmad et al. (2014) studied that concrete cubes with 1% bamboo fibre by volume and reported that the strength of concrete cubes with fibres doesn't show much development at 28 days but increased significantly after 50 days testing. Jain et. al (2015) observed that bamboo can be used as an alternative to steel in tensile loading applications as the tensile strength of bamboo is very high and can reach 370 N/mm^2. Though bamboo is strong in tension, prior investigations showed little possibility of replacement of steel by bamboo due to its low elastic modulus, poor bond with concrete, high water absorption potential, and low durability (Archana, 2020; Awoyera, 2019; Shyamala, 2020; Poongodi K, 2020). Untreated bamboo absorbs a significant amount of water from wet concrete resulting in swelling, it shrinks as the concrete dries out. This challenge was tackled by Mansur et al. (2015) by use of water sealing agents which could lower the absorption capacity of bamboo. Nowadays, many of the other shortcomings can be significantly improved by subjecting the bamboo to appropriate treatments.

Bamboo is being processed to reinforcement bar sizes that can be used instead of conventional steel bars. Adewuyi et al (2015) assessed the performance and deformation characteristics of concrete reinforced with bamboo. It was concluded that the bamboo bars are suitable rebars for lightweight reinforced concrete flexural structures. In a similar study carried out by Ikponmwosa (2017) on the performance of foamed aerated concrete reinforced with bamboo. The beam decreased with increase in the area of bamboo splints in deflection, moreso, there was a decrease in failure load with increase in area of bamboo at the tension area. However, it was suggested that, bamboo has the potential to be used as substitute for steel as reinforcement in structural members (Ghavami, 2005).

3.0 MATERIALS

Cement: The cement used in the concrete in ordinary Portland cement. Specific gravity of cement is 3.15.

Fine aggregate: The fine aggregate which is taken from river is used to manufacture the concrete Specific gravity of fine aggregate is 2.69, Fine modulus of fine aggregate is 3.28.

Coarse aggregate: Coarse aggregate is used which is passed in 20mm sieve. The water absorption of coarse aggregate is 0.46% and the specific gravity of coarse aggregate is 2.77.

Bamboo fibre: Bamboo fiber was obtained from cutting bamboo into 10 mm wide strips. The strips were soaked in NaOH for 24 hrs and hitting those strips with a mallet to loosen the fibers. The bamboo was dried immediately after for two hours to reduce its moisture content. The dried bamboo was later cut

into shorter lengths of 30mm that were used to manufacture the bamboo fiber reinforced concrete.

3.1 Experimental Procedures

Concrete Mix Design

Machine mixing was used for convenient handling of bamboo fiber. The cubes (225mm x 225mm x 225mm) of both control and fiber reinforced concrete specimens were cast. Samples were cured for 28 days in water after 24 hours of their casting and still 48 hours before testing. Bamboo fiber was added at varying percentages (0%, 0.5%,1%,1.5%, and 2%) of concrete. It was mixed in concrete homogeneously and the fiber of longer size was chosen to reduce the number of fibers per kg to avoid workability problem.

4.0 RESULTS AND DISCUSSIONS

Workability of concrete

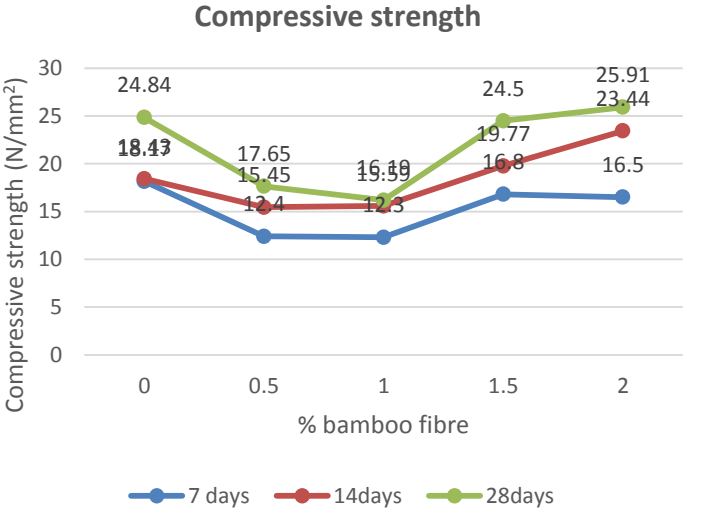
Table 1: Slump values obtained from varying proportions of bamboo fiber in concrete

% Variation of bamboo fibre	Slump value
0	11
0.5	10.5
1	9.8
1.5	9
2	8

From the obtained results, the slump was observed to decrease with increase of bamboo fiber in the mix. This implies that the more fiber content in the concrete, the less workable the concrete. This is due to the reduction in workability when fiber content is increased and absorption of water by the fibers from the concrete mix. Concrete with 2% fiber content was also observed to have taken longer time to set.

Compressive Strength

Concrete strength is formed through hydration; a reaction between cement and water to form a paste and bind all the materials together, incorporation of bamboo fiber does not affect this process.



The compressive strength of concrete with 0.1% addition of bamboo fibre showed 29% decrease at 28days with reference to control, however on further of fibre at 2% there was an observed 4.3% gain in strength. Hence, bamboo fibre showed good potential and increased strength as it bears more load as compared to convectional concrete.

5.0 CONCLUSION

At 2% bamboo fibre addition there was an observed 4.3% gain in strength. Workability decreases with the increase in the percentage of bamboo fibre. Bamboo fibre showed good potential and increased strength as it bears more load as compared to conventional concrete. The fibers acts as a crack resistor, hence take up a lot more load as compared to the conventional concrete. The study concludes that the inclusion of fibers improves the mechanical properties of the concrete which is an innovative low cost material which can be promoted in construction field.

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