

Improving Concrete Strength with Bamboo (*Bambuseae*) Fibers

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DOI: <https://doi.org/10.51584/IJRIAS.2023.8423>

Received: 24 March 2023; Accepted: 05 April 2023; Published: 10 May 2023

Abstract: This research study aims to determine the effectiveness of using the Bamboo (*Bambuseae*) Fibers as medium for enhancing the durability and strength of the concrete and compare it to the common ones without fibers. This study utilized the experimental approach in quantitative research to ensure the fairness of the result. The study was conducted in Sto. Tomas National High School last September 2018. To test the effectiveness of the fiber to the concrete, the researchers conducted a 6-foot drop test along with the ones without fibers. The data gathered were analyzed using Chi-square test to determine the significant effect of the bamboo fiber in enhancing the concrete cement. It was found out that the concrete with fiber is more durable than the ones without fibers after the Drop test. This study encourages the use of bamboo fibers to enhance the strength and durability of the concrete.

I. Introduction

These days, the population growth has increased so rapidly it is visible as well to see the rapid growth and development of our economies. Because of that, more structures are built including houses, buildings, bridges and roads that are mostly made up of concretes. But even though with this improvements first thing that we should think about is our safety. So the question is, are these durable enough to reduce the risk of some accidents?

According to Wang (2016), some of the common issues or disadvantages of these concretes are by having low tensile strength, and also the cracking of the concrete because of by drying shrinkage and moisture expansion. Therefore, the researchers came up with the idea of using bamboo fibers for concrete reinforcement. Bamboo grasses are easily be found in some regions in Asia that has a tropical or Sub-tropical climate which the bamboo grass has needed. For most Bamboo species, warm and tropical climates offer optimum condition. (Norton, J. n.d.).

Bamboo plays a major role in wood works, and it is also usable for textiles. The researchers have noticed that we can use bamboo as structural element of construction. so instead of pine trees for making natural fiber reinforced concrete (NFRC), the researchers used bamboo fibers because they are both cellulose fibers. The Chemical components of bamboo fibers have the same chemical components of wood which it consists of cellulose, hemicelluloses, lignin and water. Cellulose $[(C_6H_{10}O_5)_n]$ is a polysaccharide consists of glucose monosaccharide. This glucose has strong binding hydrogen in stabile crystalline form. (Dewi, Wijaya, Remayanti. 2017)

Thus, the researchers conducted this study specially to improve the quality of the concrete and to make it strong enough to withstand any kinds of calamity especially nowadays that it is frequent and our climate has changed.

Research Objective

The main objective of this study is to strengthen the concrete using bamboo fibers.

Hypothesis

The hypothesis that bamboo fibers cannot strengthen the concrete was tested at

0.05 level of significance.

Research Design

This study utilized the quantitative quasi-experimental design. The use of this design is appropriate because according to Dewi, Wijaya, and Remayanti (2017), quasi-experimental design is used to determine the effectiveness of the bamboo fiber to the concrete and compare it to the ones that have no Bamboo fibers.

This study was conducted in Sto. Tomas National High School last September 2018, the test was also conducted in the Sto. Tomas National High school Basketball Court.



II. Materials

The following material and equipments were used in the study:

1. Hammer. It is used to smash the bamboo stem.



2. Bolo. It is used to cut the bamboo stem to get the bamboo fiber.



3. Hand Trowel. It is used for mixing the cement.



4. Bamboo fiber. Extracted from Bamboo stems and to be used for reinforcing the concrete.



5. Water. It is used for mixing the concrete.



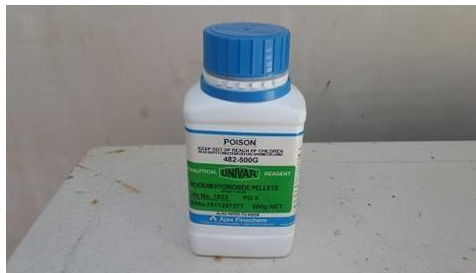
6. Cement. The main ingredient for the concrete.



7. Gravel. It is used for mixing the concrete.



8. Sodium Hydroxide (NaOH). It is used in soaking the bamboo fibers to dissolve the lignin that binds the cellulosic fibers of the bamboo.



Procedures

The following steps were observed in the experiment and in making the concrete with bamboo fibers:

- Step 1: The bamboo stems are peeled using the bolo.
- Step 2: The peeled bamboo stems are chopped into pieces.
- Step 3: Then it subjected to smashing using hammer to extract the fiber.
- Step 4: Then the fiber is soaked for 12 hours in the pot with Sodium Hydroxide (NaOH)
- Step 5: After soaking, it is cut into smaller pieces using shears.
- Step 6: Then the fiber is mixed with the cement.
- Step 7: And the mixture is allowed to dry.

Data Collection

To test the durability of the concrete blocks, the researchers conducted a 6-feet drop test. According to Johnson (2011) a drop test is the simplest way to test the strength of a building block: if the block survives a 6-ft fall, it is strong enough to go into a building. So the researchers conducted it after a 48-hour of concrete drying to define what block is the most durable. The researchers based the durability of the concrete according to the damage or the visible cracks that has been seen after the drop test.

The following steps were observed in the collection of data to be treated: Step 1: After the mixture, the concrete is allowed to dry for 48 hours.

Step 2: Then after it is dried, the concrete is subjected to 6-feet Drop Test

Step 3: After the test, the data was gathered and the result of the bamboo fibers were seen.

Data Analysis

Chi-Square Analysis was used to determine the significant effect of bamboo fibers in enhancing the strength of the concrete cement.

III. Results & Discussion

This portion presents the result and discussion of the study.

The Different Concrete Blocks

The following figure and table show the results of the experiment conducted in making the concrete blocks with different mixtures of bamboo fibers:



Figure 1. The Different Concrete Cement Used in the Experiment.

As shown in figure 1, three different types of blocks were made with 5 samples each with different fiber content.

The Significant Effect of Bamboo Fibers in Enhancing the Strength of the Concrete Blocks

The following table shows the result of the data analysis conducted in testing the data gathered:

Table 1. Effects of Bamboo Fiber Content in the Concrete Blocks.

Fiber Content	Broken	Not Broken	X ² -Value	p-value
No Fiber (n=5)	4	1		
25% Bamboo Fiber	2	3	6.667	0.036
50% Bamboo Fiber	0	5		

$\alpha = 0.05$

Table 1 shows that the blocks have a different durability using drop test. There are 15 blocks. The one that have no bamboo fibers has only, 1 out of 5 has not been broken, blocks that have 25% bamboo fibers have 2 out of 5 has not been broken, blocks that have 50% bamboo fibers have 5 out of 5 has not been broken. Results revealed that there is a significant difference ($X^2\text{-value}=6.667; p\text{-value}<0.05$) on the number of blocks broken from different mixtures of concrete blocks. It shows that blocks with higher content of bamboo fibers were significantly strong than those with less or without content.

A 6-feet drop test is conducted after 48 hours of concrete drying. After the drop, the concrete that has no fiber easily broke; only one out of five is not broken, the block cracked and broke afterwards. And the 25% fiber content concrete was still not durable enough, cracks is still visible and 2 out 5 broke and the 50% fiber content concrete was the most durable, it survived the 6-feet

drop test. Only the edges of the block were slightly scratched but in the center, there no signs of cracking. Among the three subjects, the 25% content was the most successful.

According to Johnson (2011), it is one of the simplest ways to test the strength of the concrete. If the concrete survives the Drop Test, it means that it is good for building. It is a method to determine the capability of a concrete to withstand a sudden force or shock.

Moreover, this test can help to ensure that the concrete was effective to strengthen and improve the durability of the concrete and to withstand calamity especially nowadays that our country often experience many typhoons and earthquakes.

However, there were several limitations and delimitations in the study which require further research to address some issues. First, no laboratory testing was done. Thus, it is suggested that the products made are recommended to be sent to laboratory to check the content and examine durability using high-end technology and appropriate process although there was a citation about 6-feet drop test as a process of testing the durability, it would be better that experts shall check the products. Second, is absorption test, it also recommended to ensure the concrete's water tightness to withstand any ways of water penetration. Third, is the Compressive strength test, to determine its durability and strength. The bamboo fiber reinforced concrete is more durable because the fibers of the bamboo acts as the binding factor inside the concrete that makes it more durable than the ones without bamboo fibers.

References:

1. Dewi, Sri & Wijaya, Ming & Remayanti, Christin. (2017). the use of bamboo fiber in reinforced concrete beam to reduce crack. AIP Conference Proceedings. 1887. 020003. 10.1063/1.5003486. Retrieved on September 24, 2018 from <https://www.researchgate.net/publication/320128561> the use of bamboo fiber in reinforced concrete beam to reduce crack
2. Norton, Joan. (n.d.). rWhich Climate Will Bamboo Grow In? Home Guides | SF Gate.
3. Retrieved on September 28, 2018 from <http://homeguides.sfgate.com/climate-bamboo-grow-in-68358.htm>.
4. S. Wang (2016). Technical Service Engineer at Belzona Inc. / Buildings and Structures Industry. Retrieved on October 3, 2018 from <https://medium.com/@swang.belzona/common-concrete-problems-> retrieved on:
5. K. Johnson. (2011). Drop Test studentsrebuild.org. Retrieved on October 12, 2018 from <https://www.studentsrebuild.org/blog/2011-07-31/drop-test>