

ANALYSIS OF CONCRETE COMPRESSIVE STRENGTH AGAINST BAMBOO FIBER WASTE

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ABSTRACT

Concrete is a primary construction material consisting of a mixture of cement, water, sand, and aggregate, and often includes additives to improve specific properties such as workability, durability, and setting time (McCormac, 2004). Bamboo fibers, which have a compressive strength of 45.4 MPa (Afdal, 2016) and contain hydroxyapatite (HA), are used as an additive in concrete to improve performance. This study tested the compressive strength of normal concrete and concrete with bamboo fiber variations of 2%, 4%, and 6% at ages of 7, 14, and 28 days, each with two samples per variation (total of 24 test specimens). The test results showed that at 7 days, the 6% variation exhibited the highest compressive strength increase (20.42 MPa) compared to normal concrete (16.37 MPa). However, at 14 and 28 days, only the 6% variation again showed an increase in compressive strength (22.64 MPa), while the 2% and 4% variations tended to decrease compared to normal concrete.

Keywords: concrete, waste, bamboo fiber

INTRODUCTION

Various studies and experiments in the field of concrete have been conducted in an effort to improve concrete quality. Concrete quality can be improved by adding additives (Melanira, A., & Rudianto, A. M., 2023). Among the additives, such as silica fume, copper slag, and others, creativity in creating construction designs through simple construction engineering is essential. Therefore, further research is needed on the use of these alternative materials. The researcher will use bamboo fibers as a coarse aggregate mixture, which is expected to improve the properties of concrete and reduce waste. Bamboo fibers have a compressive strength of 45.4 MPa and contain hydroxyapatite, a calcium phosphate derivative that is a bioceramic.

METHODS

Research on the compressive strength of concrete using bamboo fiber was conducted at the Concrete Technology Laboratory of the Civil Engineering Study Program, Faculty of Engineering, Krisnadwipayana University, Jalan Raya Jatiwaringin, RT 03 / RW 04, Jatiwaringin, Pondok Gede, RT. 009 / RW 005, Jaticempaka, Kec. Pondokgede, Bekasi City, West Java.



Figure 1. Research Location

The following explains the number of test samples used in this study.

Table 1. Number of Test Samples

No.	Test Object Sample	7 Day	14 Day	28 Day	Number of Test Items
1.	Compressive strength test of 15 cm x 30 cm cylinders using substitute materials with 0% variation	3	3	3	9
2.	Compressive strength test of 15 cm x 30 cm cylinders using substitute materials with a variation of 2%	3	3	3	9
3.	Compressive strength test of 15 cm x 30 cm cylinders using substitute materials with a variation of 3%	3	3	3	9
Number					27

This study involves several stages in determining the effect of coarse aggregate substitution with concrete mixtures using bamboo fibers. These stages are carried out in a structured, sequential, and systematic manner.

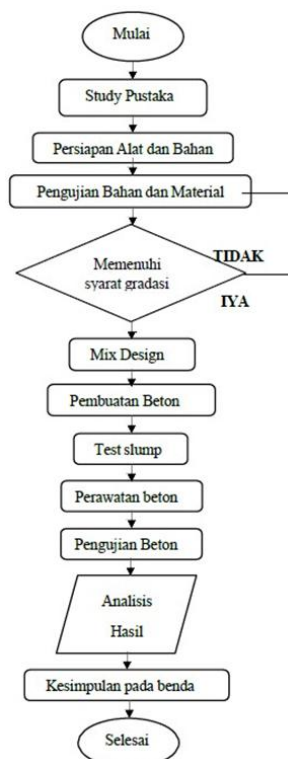


Figure 2. Research Flow Chart

RESULTS AND DISCUSSION

Some results from slump testing on concrete mixtures made in the Krisnadwipayana University laboratory can be seen in the table below:

Table 2. Results of Slump Testing

Adukan ke	Variasi campuran	Tinggi slump test (mm)	Tambahan air	Air 1 x adukan (L)
1	BA 0	100	-	9,28
2		120	-	9,28
1	BA2	100	-	9,28
2		100	-	9,28
1	BA4	100	-	9,28
2		110	-	9,28
1	BA6	100	-	9,28
2		100	-	9,28

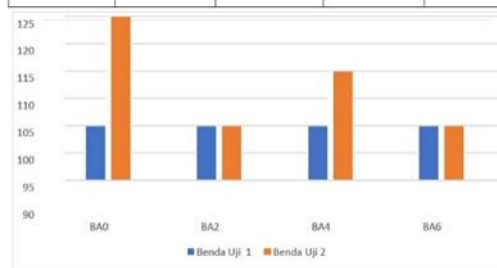


Figure 3. Slump Test Results Graph

Compressive strength tests were conducted after the concrete had aged for 7 days, 14 days, and 28 days. The compressive strength tests were conducted at the Engineering Faculty Laboratory of Krisnadwipayana University. These tests were performed on normal concrete aged for 7 days, and concrete with 2% and 4% variations, each with 2 concrete samples, and for 14 days and 28 days, there were 2 concrete samples each, totaling 27 test specimens. The results of the concrete compressive strength test can be seen in the table and graph below.

Table 3. 7-Day Concrete Compressive Strength Test

No	Tanggal		Benda uji %	Luas benda uji (mm ²)	Volume benda uji (m ³)	Mutu benda uji (Mpa)	Umur benda uji (hari)	Berat benda uji (kg)	Nilai slump test (mm)	Nilai kuat tekan (KN)	Nilai kuat tekan (Mpa)	Rata - rata
	Pembuatan benda uji	Pengujian kuat tekan										
1	16-juni-2023	31-juni-2023	BA0	17,67	0,0053	20,75	28	11,64	100	383	21,15	21,09
2	16-juni-2023	31-juni-2023	BA0	17,67	0,0053	20,75	28	11,6	120	376	21,04	
3	19-juni-2023	20-juli-2023	BA2	17,67	0,0053	20,75	28	11,32	100	220	13,19	13,64
4	19-juni-2023	20-juli-2023	BA2	17,67	0,0053	20,75	28	11,26	100	235	14,09	
5	27-juni-2023	25-juli-2023	BA4	17,67	0,0053	20,75	28	11,1	100	285	15,47	16,73
6	27-juni-2023	25-juli-2023	BA4	17,67	0,0053	20,75	28	11,42	100	300	17,99	
7	27-juni-2023	25-juli-2023	BA6	17,67	0,0053	20,75	28	11,42	100	390	23,39	22,64
8	27-juni-2023	25-juli-2023	BA6	17,67	0,0053	20,75	28	11,14	100	365	21,89	

Table 4. Testing the Compressive Strength of Concrete after 14 Days

No	Tanggal		Benda uji %	Luas benda uji (mm ²)	Volume benda uji (m ³)	Mutu benda uji (Mpa)	Umur benda uji (hari)	Berat benda uji (kg)	Nilai slump test (mm)	Nilai kuat tekan (KN)	Nilai kuat tekan (Mpa)	Rata - rata
	Pembuatan benda uji	Pengujian kuat tekan										
1	16-juni-2023	31-juni-2023	BA0	17,67	0,0053	20,75	28	11,64	100	383	21,15	21,09
2	16-juni-2023	31-juni-2023	BA0	17,67	0,0053	20,75	28	11,6	120	376	21,04	
3	19-juni-2023	20-juli-2023	BA2	17,67	0,0053	20,75	28	11,32	100	220	13,19	13,64
4	19-juni-2023	20-juli-2023	BA2	17,67	0,0053	20,75	28	11,26	100	235	14,09	
5	27-juni-2023	25-juli-2023	BA4	17,67	0,0053	20,75	28	11,1	100	285	15,47	16,73
6	27-juni-2023	25-juli-2023	BA4	17,67	0,0053	20,75	28	11,42	100	300	17,99	
7	27-juni-2023	25-juli-2023	BA6	17,67	0,0053	20,75	28	11,42	100	390	23,39	22,64
8	27-juni-2023	25-juli-2023	BA6	17,67	0,0053	20,75	28	11,14	100	365	21,89	

Table 5. Testing the Compressive Strength of Concrete at 28 Days

No	Tanggal Pembuatan benda uji	Tanggal Pengujian kuat tekan	Benda uji %	Luas benda uji (mm ²)	Volume benda uji (m ³)	Mutu benda uji (Mpa)	Umur benda uji (hari)	Berat benda uji (kg)	Nilai slump test (mm)	Nilai kuat tekan (KJN)	Nilai kuat tekan (Mpa)	Rata-rata
1	16-juni-2024	31-juni-2024	BA0	17,67	0,0053	20,75	28	11,64	100	383	21,15	21,09
2	16-juni-2024	31-juni-2024	BA0	17,67	0,0053	20,75	28	11,60	120	376	21,04	
3	19-juni-2024	20-juli-2024	BA2	17,67	0,0053	20,75	28	11,32	100	220	13,19	13,64
4	19-juni-2024	20-juli-2024	BA2	17,67	0,0053	20,75	28	11,26	100	235	14,09	
5	27-juni-2024	25-juli-2024	BA4	17,67	0,0053	20,75	28	11,10	100	285	15,47	16,73
6	27-juni-2024	25-juli-2024	BA4	17,67	0,0053	20,75	28	11,42	100	300	17,99	
7	27-juni-2024	25-juli-2024	BA6	17,67	0,0053	20,75	28	11,42	100	390	23,39	22,64
8	27-juni-2024	25-juli-2024	BA6	17,67	0,0053	20,75	28	11,14	100	365	21,89	

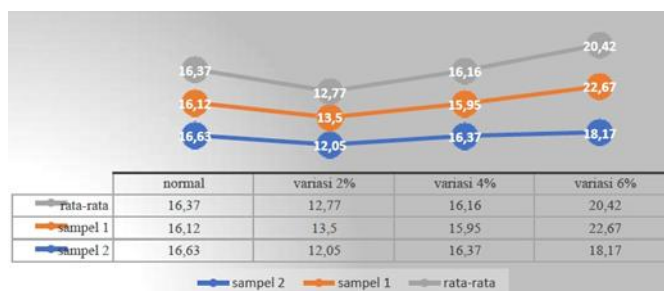


Figure 4. 7-Day Compressive Strength Graph



Figure 5. 14-Day Compressive Strength Graph



Figure 6. 28-Day Compressive Strength Graph

CONCLUSIONS

From the research and discussion described above, the following conclusions can be drawn:

- 1) In this study, the compressive strength of concrete decreased by 12.77 MPa with a deviation of 2% after 7 days, decreased by 16.34 MPa with a deviation of 4% after 14 days, and increased by 22.64 MPa with a deviation of 6% after 28 days.
- 2) The results of the slump test on the bamboo fiber mixture showed stability. Based on the above conclusions, the compressive strength of concrete with bamboo fiber replacement is 20.75 MPa,

higher than planned, and 22.64 MPa after 28 days in the 6-day test. Therefore, bamboo fiber can be used as a replacement for coarse aggregate in concrete, as proven by the research of the authors mentioned above.

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