Study of Utilizations Coconut Fiber with Kalimantan Local Material on the Concrete Compressive and Flexural Strength

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ABSTRACT
East Kalimantan is an area which rich in natural resources, as a Mahakam sand and local stones. They also have coconut fiber waste to increase the flexural strength of concrete. This material is still underutilized by the people of East Kalimantan. But, they prefer to use materials from Palu, Sulawesi, so the unit price of concrete is Very Expensive. The purpose of this study was to investigate the effect of local Kalimantan material and coconut fiber on the strength of concrete. This research begins with a literature review, then material procurement, and material testing. After that, make a concrete mix design. Made of specimens with a variation of coconut fiber 0%, 0.4%, 0.5% and 0.6%. Then the compression test at the age of 7, 14, 21, and 28 days. The flexural strength testing at the ages of 28 days. From the test results can make analysis and conclusions. From the research results, it indicated that the maximum compressive strength in the addition of coconut fiber 0.6% with the compressive strength 21.74 MPa, and the maximum of flexural strength in the additional of coconut fiber 0.6 % with flexural strength 2.83 MPa.

Keywords: *Local material, Coconut fiber, Compression strength, Flexural strength.*

1. INTRODUCTION

Concrete is one of the construction materials used in buildings, bridges, roads, and others. Concrete consists of a mixture of fine aggregate (sand), coarse aggregate (gravel), water, and cement. The mixture will harden due to a chemical reaction between cement and water. Comparison of the amount of material affects the compressive strength of the concrete tested at the aged standard of 28 days. Based on its compressive strength, concrete is divided into three classifications, namely normal concrete with compressive strength less than 50 MPa, high-performance concrete with a compressive strength between 50 to 90 MPa, very high-performance concrete with compressive strength more than 90 MPa[1]. To get better concrete characteristic, many things can be done. Start from improving the quality of concrete material by adding addictive substances. Addictive substances can be either liquid or fiber.

Coconut coir is the largest part of the coconut fruit, which is about 35% of its weight [2]. Fiber is usually made as waste which is only piled under coconut trees and then left to rot or dry, its use is mostly for firewood. Traditionally, the community processed coir to be used as rope and woven into doormats [3]. Coconut coir is a waste that is easily available in areas along the coast such as most parts of Indonesia. Indonesia is the main coconut producing country in the world with a coconut plantation area of 3.76 million hectares and a total production of 14 billion coconuts [4]. Coconut fiber can't increase the compressive strength and split tensile strength but can increase the flexural strength [5][6]. To increase the strength of concrete can use superplasticizer [7][8][9].

2. METHOD

This research was conducted at the Laboratory of Materials, Department of Civil Engineering, State Polytechnic of Samarinda. The experimental method in this study was carried out by looking for the ratio of added material to concrete using coconut fiber with a predetermined variation. Then the concrete will be tested by compressive strength of the concrete and the flexural strength of the concrete. In the preparation of the research, there are stages carried out begin with literature review, material procurement, material testing, concrete mix design, curing, compressive strength, and flexural strength testing, then data analysis. The compressive

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strength value can be calculated by using equation 1 [10]. Flexural strength use Indonesia standard SNI 4431:2011 [11].

$$f'c = P/A \quad (1)$$

With:

$f'c$ = Compression strength (MPa),

P = Maximum load (N),

A = Section area (mm^2).

The specimen for the present investigation are divided into two specimens. The first specimen is a cube with a size of 150 mm x 150 mm x 150 mm for testing the compressive strength of concrete. The second specimen is beamed with a size of 150 mm x 600 mm x 150 mm for testing the flexural strength of concrete. The number of test specimens is 48 for the compressive test and 12 specimens for the flexural test. The test object will be compressed at the age of 7, 14, 21, and 28 days, while the flexural test will be at the age of 28 days.

3. RESULT AND DISCUSSION

3.1. Material Properties

3.1.1. Cement

This research use Portland composite cement (PCC), it conformed to Indonesian National Standard (SNI) which has been determined. From the test result shown that a specific gravity 3.012, setting time (early binding 47.3 minute, final binding 135 minute) (Table 1).

Table 1. Cement properties

No	Characteristics	Result
1	Specific gravity	3.012
2	Normal consistency	24.1 %
	Setting Time	
3	Early binding	47.3 Minute
	Final binding	135 Minute

3.1.2. Aggregate

The fine aggregate use Mahakam sand. This is a local material. This material has been test use SNI standard. The properties of fine aggregate shown in Table 2. The tests carried out consisted bulk density, specific gravity, absorption, water content and mud content.

Table 2. Fine aggregate properties

No.	Characteristics	Result
1.	bulk density	1.34 gr/cm^3
2.	Specific gravity	2.51
3.	Absorption	0.60%
4.	Water content	1.88%
5.	Mud content	3.09%

The coarse aggregate use local materials from Senoni. The properties of coarse aggregate shown in Table 3. The tests carried out consisted bulk density, specific gravity, absorption, water content, abration and mud content.

Table 3. Coarse aggregate properties

No.	Characteristics	Result
1.	Bulk density	1.59 gr/cm^3
2.	Specific gravity	2,63
3.	Absorption	0.85%
4.	Water content	0.60%
5.	Abrasion	23.21%
6.	Mud content	0.42%

From the test results, it can be concluded that the material can be used for concrete. All aspects meet the Indonesian national standard (SNI).

3.2. Compression Test

The result of compressive strength paver porous at 28 days of all samples are shown in Figure 1. The average of compressive strength at 28 days is 17.26 MPa. The graph showed that the maximum compressive strength is 21.74 MPa with a coconut fiber content of 0.6%. The smallest compressive strength is 13.62 MPa with a coconut fiber content of 0.4%. The addition of coconut fiber will increase the compressive strength of the concrete.

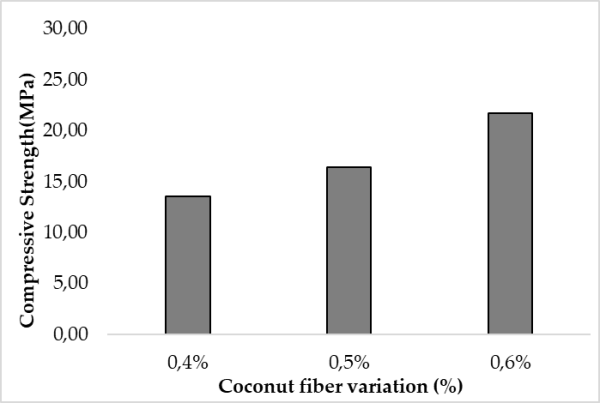

Figure 1 Average compressive strength

3.3. Flexural Test

The optimum flexural strength is 2.62 MPa with coconut fibre 0.4%, and the minimum is 2.36% with coconut fibre 0.6%. From the graph (Figure 2) shown that with additional of coconut fibre will reduce compressive strength of concrete.

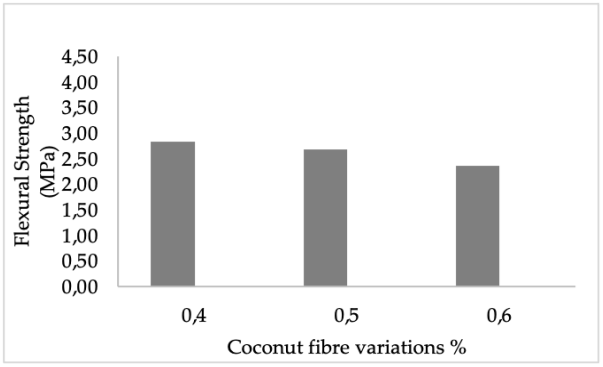

Figure 2 Flexural strength test result

4. CONCLUSION

Based from the result can be concluded that the maximum of compression strength is 21.74 MPa with addition of 0.6% coconut fibre, minimum compression strength 13.62 MPa with addition 0.4%. The addition of abaca fibre can increase compression strength. The maximum of flexural strength is 2.83 MPa with addition of 0.4 % coconut fibre, and the minimum of flexural strength 2.36 MPa with addition 0.6% coconut fibre. The addition of coconut fibre will increase the compressive strength, but will reduce flexural strength.

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REFERENCES

[1] S. Hani and Rini, "Pengaruh Campuran Serat Pisang Terhadap Beton," *Educ. Build.*, vol. 4, no. 1, pp. 40–45, 2018.

[2] Elhusna, F. Supriani, A. Gunawan, and M. Islam, "Pengaruh Serat Sabut Kelapa terhadap Kuat Lentur Beton dengan Faktor Air Semen O,5," vol. 3, no. 1, pp. 39–44, 2011.

[3] A. M. Putra, *Analisa Perbandingan Limbah Serat Serabut Kelapa dan Serat Purun terhadap Kuat Tekan dan Kuat Tarik Belah Beton FC' 18*. Palembang, 2019.

[4] T. Indahyani, "Pemanfaatan Limbah Sabut Kelapa pada Perencanaan Interior dan Furniture yang Berdampak pada Pemberdayaan Masyarakat Miskin," *Humaniora*, vol. 2, no. 1, pp. 15–23, 2011.

[5] M. Ghozi and D. Novianto, "Pengaruh Penambahan Serabut Kelapa dalam Campuran Beton terhadap Kuat Tekan dan Kuat Tarik Beton," *J. Tek. SIPIL*, vol. 2, no. 2, pp. 156–160, 2008.

[6] L. Halim, S. Banjarsanti, and Y. Pranoto, "Perbandingan Serat Abaka (Musa Textillis Nee) dan Serat Sabut Kelapa Sebagai Bahan Tambah Terhadap Campuran Beton," *JUTEKS-JURNAL Tek. SIPIL*, vol. V, no. 2, pp. 115–119, 2020.

[7] A. Hadori and Y. Pranoto, "Pengujian Kuat Tekan Beton dengan Penambahan Fly Ash dan Admixture Superplasticizer," *J. Inersia*, vol. VII, no. 1, pp. 50–55, 2015.

[8] A. Pujianto, "Beton Mutu Tinggi dengan Admixture Superplastisizer dan Aditif Silicafume," *J. Ilm. Semesta Tek.*, vol. 14, no. 2, pp. 177–185, 2011.

[9] S. dan R. K. Krisman Aprieli Zai, "Pengaruh Penambahan Silica Fume Dan Superplasticizer Terhadap Kuat Tekan Beton Mutu Tinggi Dengan Metode Aci (American Concrete Institute)," *Tek. Sipil Univ. Sumatera Utara*, vol. 2, no. 1, pp. 1–9, 2015.

[10] Badan Standardisasi Nasional, "SNI 03-1974-1990 Metode Pengujian Kuat Tekan Beton," *Badan Stand. Nas. Indones.*, 1990.

[11] Badan Standar Nasional Indonesia, *Cara uji kuat lentur beton normal dengan dua titik pembebanan*. 2011.