Journal of Physics: Conference Series **1477** (2020) 052015 doi:10.1088/1742-6596/1477/5/052015

The Use of Rattan Processed Waste as A Complement in Fiber Concrete

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Abstract. In this research, the fiber is natural fiber from rattan. Considering, Central Kalimantan Province is home for the commodity of rattan handicraft. Then, the rattan processed waste is used as fiber in concrete. The percentages were 0.1%; 0.3%; and 0.5%, based on the cement needs. The particular study aimed to provide information about rattan fibers if used in concrete mixtures, find out the compression strength after the addition of rattan processed waste fibers, and the ratio occurs after the addition of rattan processed waste fibers. The research stages were material preparation and checking, making the specimens, immersion of test specimens, compression strength test and analysis, and conclusion. The results found out the mean of compression strength in concrete with a mixture type without fiber of 391.378 kg cm^{-2}, while in the mixture type 0.1% at 371.734 kg cm^{-2}, mixed type 0.3% at 308.267 kg cm^{-2}, and mixture type of 0.5% at 297.689 kg cm^{-2}. There was a decrease for each mixed type of 5.02%; 21.24%; and 23.94%, respectively. The more fibers added, the more the compression strength decreases, but the more fiber used, the greater the strength of the concrete in holding cracks.

1. Introduction

One of the causes the collapse of a building is the damage on reinforced concrete due to corrosion on reinforcement. The factor is caused by the release or cracking of a concrete cover that serves to protect the reinforcement [1][2]. Increasing the resistance of spalling and cracking on concrete covers will help to prevent corrosion of reinforcement iron from potentially corrosive environmental conditions [3].

Various concepts have been proposed to solve the problem. One of them is by providing fiber in concrete. Fibers are randomly distributed into concrete volumes with relatively close distances. Fiber concrete is a mixture of concrete that is added with fiber generally in the form of threads with a size of 5-500 mm and a length of 25-100 mm [4][5]. The examples of fiber materials are asbestos fibers, plastic fibers, natural fibers or steel wire strips [6]. The advantages of fiber concrete are randomly distributed into concrete volumes with relatively close distances. This will provide balanced protection in all directions and provide structural material gains that are prepared to withstand earthquake and wind. Aside from that, fiber concrete also improved the deformation behavior such as resistance to impact, large ductility, good flexural strength, good torque capacity, increases the concrete resistance to the formation of cracking, and increasing the resistance of spalling and cracking on concrete covers will help to prevent corrosion of reinforcement iron from potentially corrosive environmental conditions [7][8].

In this research, the fiber is natural fiber from rattan. Rattan is a non-timber forest product, included in the type of palm that has stems, in the middle is compact and have not hollow like bamboo. The shape, diameter size, and length of the section vary depending on the type. The elasticity of rattan is greatly influenced by the moisture content, age, and the position of the rod [9]. After harvested, the rattan is processed as a raw material for crafts. In rattan woven craft, it results in the waste from the sharpener. This sharpener waste is used for concrete fiber in this research. Considering, Central Kalimantan is home for the commodity of rattan handicraft [10]. Then, the rattan processed waste is used as fiber in concrete [11]. The percentages were 0.1%; 0.3%; and 0.5%, based on the cement needs. The focus of the research was the crack caused by compression strength.

The aims of this study were to provide information about rattan fibers if used in concrete mixtures, find out the compression strength after the addition of rattan processed waste fibers, as well as the ratio occurs after the addition of rattan processed waste fibers. The limitation of this study is the fiber is the waste from rattan parts for woven mats with a length of between 8 to 10 cm. Sand is obtained from Tangkiling, Central Kalimantan. Coarse aggregate with a maximum size of 20 mm was obtained from Pelaihari, South Kalimantan. The cement used is branded Semen Gresik, with the strring process carried out with an electric concrete mixer.

2. Methodology

The particular research was conducted at the Laboratory of Structural of Faculty of Engineering at the University of Muhammadiyah Palangkaraya. The research was an experiment which aimed to solve problems to obtain satisfactory results. The number of concrete cube test specimens was 12 samples. The Rattan obtained from rattan craftsmen in the village of Kalaringan, Kapuas Regency, Central Kalimantan province. The fine aggregate was taken from Tangkiling, Palangka Raya. Moreover, the coarse aggregate material was from Banjarmasin, South Kalimantan and obtained in Palangka Raya.

As a scientific researcher, this research carried out systematically and clears, so that obtained satisfactory results and justified. The research conducted into several stages, consisting of:

2.1. Materials and equipment preparation and inspection

All equipment and materials needed are prepared. Examination of the material based on Indonesian National Standards (SNI) 03-2834-2000 including of moisture content check from aggregate, filter analysis, specific gravity and water absorption check, and wear resistance test of coarse aggregate [12].

2.2. Production of specimen

Several steps carried out at this stage, including determination of the concrete mix design based on data at the checking material stage, production of the concrete mortar, the value of the slump examination, and specimen production. Test specimens were made in a 15×15×15 cm cube. Comparison of mixtures for each test specimen is presented in Table 1.

Table 1. Comparison of fiber content in test specimens

Specimen group	Fiber level (%)	Number of specimens needed
1	0	
2	0.1	3
3	0.3	
4	0.5	

2.3. Immersion of test specimens

At this stage, the specimen is then treated with immersion until the compressive strength test, which is about 28 days.

2.4. Compression strength test

Compression strength test is done using a concrete testing machine with a capacity of 200 tons manually as regulated in SNI 03-2847-2002 [13]. The day before the test, the specimen is removed from the immersion and measured by weighing.

3. Results and discussion

The compression strength test is carried out on cube specimens of 15×15×15 cm at the age of 28 days. In the concrete compressive strength test, it obtained the maximum load data when the specimen collapses and continue to analyze the specimen. Based on the results, the addition of rattan fiber to the concrete causes a decrease in the compression strength of the concrete. Considering the fiber is obtained from the processed woven material that the diameter of the fiber is randomly taken so that it affects the fiber and compression strength of the concrete [14]. The results of the test for each type of mixture are presented in Table 2.

Table 2. Results of concrete compression strength test

Type of concrete	Type of mixture	Weight (kg)	Max load (kN)	Compression strength (kg cm^{-2})	Mean of compression strength (kg cm^{-2})
K-300	Normal	8.115	830	376.267	391.378
		7.992	880	398.933	
		8.208	880	398.933	
	0,1%	8.153	740	335.467	371.733
		8.037	830	376.267	
		8.233	890	403.467	
	0,3%	8.276	660	299.200	308.267
		8.072	710	321.867	
		8.053	670	303.733	
	0,5%	8.033	680	308.267	297.689
		8.164	670	303.733	
		7.965	620	281.067	

The decrease also influences by the characteristic of rattan fiber, which cannot be adequately bonded with other materials. The addition of rattan fiber can reduce the compression strength of the concrete [15]. The mean of compression strength score in concrete with a mixture type without fiber is 391.378 kg cm^{-2}; in the mixture type 0.1% is 371.734 kg cm^{-2}; mixture type of 0.3% is 308.267 kg cm^{-2}; and a mixture type of 0.5 % is 297.689 kg cm-2. Respectively for mixture types, there was a decrease of 5.02%; 21.24%; and 23.94%. Based on the compression strength test, a comparison graph is presented in Figure 1.

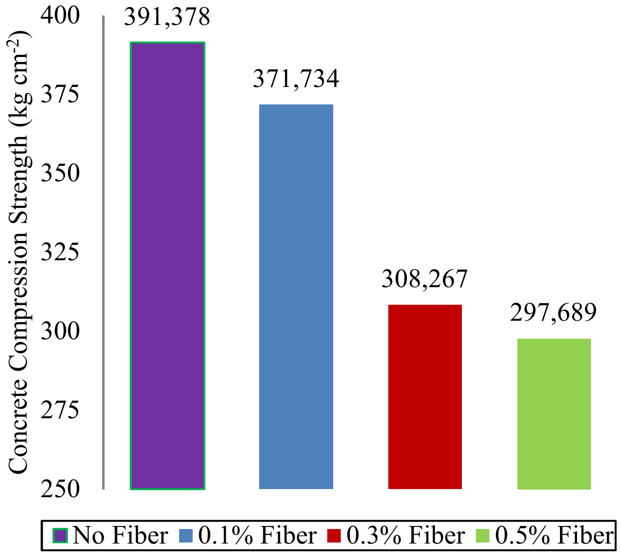

Figure 1. Comparison of concrete compression strength

The results of the collapse caused by the compression load. Figure 2 describes the collapse directly in the crack area caused by compression loads. Also, figures 3, 4 and 5 describe that the higher the fiber at the crack area will also increase the resistance given by the fiber to resist the crack [16]. Crack failure on concrete after a compression strength test is presented in Figures 2 until 5.

Figure 2. Common concrete after compression strength test

Figure 3. Concrete Mixture of 0.1% Fiber after Compression Strength Test

Figure 4. Concrete Mixture of 0.3% Fiber after Compression Strength Test

Figure 5. Concrete Mixture of 0.5% Fiber after Compression Strength Test

4. Conclusion
This research shows that rattan fiber concrete can be used in structural concrete work, but it is more recommended that rattan fiber concrete be used for sidewalks. The mean scores of compressions strength in concrete with normal mix type; 0.1%; 0.3%; and 0.5% are 391.378; 371.734; 308.267 and 297.689 kg cm^{-2}, respectively. Concrete compression strength decreases with the addition of rattan fiber. Comparison of compression strength between normal mix type concrete with 0.1%; 0.3% and 0.5% are 0.95; 0.79 and 0.76, respectively. Further research is needed with more samples, different materials and a long period of observations.

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