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FIBER CONCRETE STUDY WITH THE ADDITION OF PALM SIGNS ON THE COMPRESSIVE STRENGTH OF CONCRETE

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ABSTRACT

Concrete is part of a construction formed by a mixture of cement, water, fine aggregate, coarse aggregate either crushed stone or gravel and other mixed materials. Fiber concrete is concrete whose method of manufacture is added with fiber, both man-made fiber and natural fiber such as palm fruit bunches. The addition of palm fruit bunches to the concrete mix is expected to increase the compressive strength of concrete. The percentage of addition of palm marks is 6%, 8% and 11% by weight of cement with FAS 0.35. The test object used was a cube (15 x 15 x 15) cm with a total of 12 test objects for 7 days of age and 12 test objects for 28 days of age. The results of the 7-day average compressive strength test for BTTS were 310.76 kg/cm2, BDTS (6%) were 260.23 kg/cm2, BDTS (8%) were 237.83 kg/cm2 and BDTS (11%) were 244.67 kg/cm2. cm2. Testing the compressive strength at an average age of 28 days obtained results for BTTS of 342.20 kg/cm2, BDTS (6%) of 294/18 kg/cm2, BDTS (8%) of 269.42 kg/cm2 and BDTS (11%) of 279.72 kg/cm2. From the results of the compressive strength test, the average test age of 7 days and 28 days shows that the addition of palm fiber can reduce the compressive strength of concrete in all variations, namely 6%, 8% and 11%.

Keywords: Concrete Compressive Strength, Fiber Concrete, Palm Marks

INTRODUCTION

Fiber concrete is concrete by adding fibers, both natural fibers and man-made fibers with the hope of increasing the compressive strength of concrete.

The relationship between the percentage and type of fiber on the weight and compressive strength of fiber concrete EFB K225 cube aged 3 days; compared to standard concrete K225 cube aged 3 days showed with the addition of fiber (1%) for version C the average weight was 7.37 kg, compared to 7.5 kg standard weight. While the 3K1C1, 3K1C2 and 3K1C3 matrix samples were the best mixtures with the highest average weight of 7.42 kg. However, the average value of compressive strength is still below the permitted conversion value for standard concrete K225 cube aged 3 days; where the compressive strength value of the average EFB fiber concrete is 72.84 kg/cm, compared to 82.8 kg/cm2 - 103.5 kg/cm2 of standard concrete K225 cube aged 3 days.

So it was concluded that the 3K1C1, 3K1C2 and 3K1C3 matrix samples were the best sample matrices (C1%).[1].

The use of coconut coir fiber as a material for forming fiber concrete has an effect on the split tensile strength of concrete and the flexural strength of concrete with samples used cylinders (15 x 30) and beams (10 x 10 x 50) cm with the addition of 0.15% fiber from the total volume of concrete. Concrete mixing is carried out dry and wet. Planned f'c 20 MPa with the DOE method and concrete mechanical testing carried out at the age of 28 days by curing the specimen in the bath.[2].

Variations in the addition of fiber from the mortar to the concrete mixture, namely 0.5%, 1%, 1.5% and 2% by weight of cement and 3 cm length of cement can increase the compressive strength of concrete, with the highest increase in compressive strength achieved by the addition of 1%, which is 21.87 MPa compared to with normal concrete 21.40 MPa.[3].

The effect of using thorn shoulder pandanus fiber with variations of 0.25%, 0.5%, and 0.75% of the volume of the test object can reduce the split tensile strength of concrete. The age of 41 days decreased less than the age of 34 days. The lowest and highest percentage reduction in split tensile strength of normal concrete was 9.249% (0.25% variation, 41 days old) and 14.518% (0.75% variation, 34 days old).[4].

Utilization of empty oil palm fruit bunches (EFB) as biomass PLT, fertilizer and bioethanol For oil palm shells it can be used as carbon/activated charcoal, making potassium sulfate liquid fertilizer, natural tofu preservative, fuel (biomass), briquettes. For oil palm coir, it can be used as a material for strengthening the mechanical properties of composites, fiber glass, wastewater treatment, pulping, alternative plant media, an alternative to diesel and coal as fuel for power plants.[5].

Coconut coir fiber is one of the wastes that has not been fully utilized in Indonesia. The addition of coconut coir fiber (cocofiber) can affect/add a better absorption value. The value of the sound absorption coefficient shows a graph that increases with each addition of coconut fiber variations. The lowest sound absorption coefficient value is 0.0324, at a frequency of 500 Hz while the highest sound absorption coefficient value is 0.93411 at a frequency of 2000 Hz. The value of the lowest sound wave velocity is 16.2 m/s, at a frequency of 500 Hz while the sound wave velocity is 1868.22 m/s at a frequency of 2000Hz.[6].

The use of a mixture of palm fiber for the compressive strength of concrete produces the optimum proportion of palm fiber to obtain the compressive strength value is the use of 2.5% palm fiber with a volume weight of 125 gr palm fiber, the dimensions of the palm fiber are 0.5 mm with a length of 15 cm. The change in the weight of the concrete

occurs in palm fiber concrete becomes lighter, namely 2,243 gr/cm. The strength of the concrete produced after being compressed through the conversion of 28 days to 21 days is 226 kg/cm2.[7].

The addition of glass shards (15%) produces a compressive strength value of 24.94 Mpa with a modulus of elasticity of 23471.8 MPa and an addition of 20% yields a compressive strength of 25.48 Mpa with a modulus of elasticity of 23724.5 MPa, whereas with the addition of 25% glass shards a compressive strength of 25.77 MPa with a modulus of elasticity of 23859.2 MPa. The addition of glass shards to fiber concrete can increase the compressive strength of concrete. The value of the compressive strength of concrete on the addition of 15% broken glass; 20% and 25% respectively of 24.94 MPa, 25.48 MPa and 25.77 MPa. The percentage increase in compressive strength in the addition of glass 15% to 20% was 2.17% while the addition of broken glass 20% to 25% experienced an increase in compressive strength of 1.14%.[8].

Fiber from oil palm plantation waste that has undergone processing on a fiber press, the fiber is dried and cut to a length of ± 2 cm. Variation of the percentage of fiber to the volume weight of sand in the mixture is 0.5%, 1% and 1.5%. Variation of the percentage of fiber can increase the flexural strength and the greatest increase in the 1.5% variation is 90.63% of the normal flexural strength.[9].

The addition of palm frond fiber which is a local material, is expected to improve the weakness of the concrete. Variations in the content or percentage of palm fiber added to the concrete mixture are 1%, 1.5% and 2% of the total weight of concrete cement. The results of the addition of palm frond fiber, namely the greater l/d of palm frond fiber, did not have a significant effect on increasing compressive strength, the highest compressive strength was obtained at a ratio of l/d = 50 with a fiber content of 1% with a compressive strength value of 14.33 MPa.[10].

Compressive strength with the addition of empty palm fruit bunch fiber to the aggregate of 5%, 10%, 15% and the effect of the ratio of the addition of empty palm fruit fiber to ACWC using a mixture (5%, 10% and 15%) and normal. Compressive strength results obtained with the addition of empty palm fiber bunches for each content only one that meets the specifications. For the 5% content the stability value is 995 kg, for the 10% content the value is 660 kg and at the 15% content the value is 545 kg. Each addition of fiber, the strength decreases and cannot meet specifications. Comparison of the use of empty palm fruit fiber waste as an aggregate additive in the AC-WC asphalt mixture, it turns out that the content of 5% 10% and 15% cannot achieve strength,[11].

Variations in the addition of palm shell ash and normal aggregate are 15%, 20 and 25%. From the addition of palm shell ash, it showed that the addition of palm shell ash and silica gel increased the slump value and the split tensile strength of concrete. The results of the analysis show strong
The optimum splitting tensile strength of concrete with a composition containing palm shell ash and 25% silica gel is 4.88 MPa.[12].

RESEARCH METHODS

2.1 Research design

The dimensions of the specimens in this study were cubes (15 x 15 x 15) cm with the number of specimens being 3 specimens for each variation in the percentage of palm marks. For FAS used 0.35 with a test age of 7 days and 28 days. The additional percentage of palm marks is 0%, 6%, 8% and 11% by weight of cement.

2.1.1 Data source

Data sources include examining the physical properties of the aggregate, namely specific gravity, aggregate absorption, volume weight, grain arrangement, as well as organic matter content. Examination of the slump test data obtained from the concrete after mixing the concrete. For the manufacture of obsobsorption test specimens taken from cube test specimens (15 x 15 x 15) cm then cut into cubes (5 x 5 x 5) cm to obtain concrete absorption data.

2.1.2 Equipment used

The equipment in this study included electric mixers for mixing concrete, Abrams cones for measuring slump values, cube molds (15 x 15 x 15) cm, ovens, concrete curing stations, compressive strength testing machines, thermometers, data loggers, and transducers.

2.1.3 Material

The materials used include portland cement, coarse aggregate, fine aggregate, namely fine sand and coarse sand, palm oil and water.

2.2 Concrete mix design

The design of the concrete mix is calculated based on the ACI 211.1-91 method for normal concrete with mixed aggregate grain gradations. The calculation of the concrete mix plan with this method is taken based on the existing tables. The amount of water needed for 1 m3 of concrete is based on the design slump height (75-100) mm with a FAS of 0.35. The maximum aggregate diameter used is 25.4 mm. To obtain a comparison between fine sand and coarse sand as fine aggregate.

2.3 Manufacture of Test Objects

Table 2.1 Design variations and number of specimens for 7 days of testing

Variables	Percentage Palm Bunches (%)	Testing Age	Cube (15 x 15 x 15) cm			Number of Test Objects
BTTS	0%	7 days	BTTS1	BTTS2	BTTS3	3
	6%	7 days	BDTS1A	BDTS1B	BDTS1C	3
BDTS	8%	7 days	BDTS2A	BDTS2B	BDTS2C	3
	11%	7 days	BDTS3A	BDTS3B	BDTS3C	3
					Total Test Items	12

Table 2.2 Design variations and number of specimens for the 28-day age test

Variables	Percentage Palm Bunches (%)	Testing Age	Cube (15 x 15 x 15) cm			Number of Test Objects
BTTS	0%	28 days	BTTS11	BTTS22	BTTS33	3
	6%	28 days	BDTS11A	BDTS11B	BDTS11C	3
BDTS	8%	28 days	BDTS22A	BDTS22B	BDTS22C	3
	11%	28 days	BDTS33A	BDTS33B	BDTS33C	3
					Total Test Items	12

Information:

BTTS = test object without using palm marks (0%);

BDTS = specimens with the addition of palm fruit bunches (6%, 8% and 11%);

Figure 2.1 Cube test object (15 x 15 x 15) cm

2.4 Treatment of test objects

Treatment of the test object is carried out by inserting the test object into a treatment tub which has been filled with fresh water until the time of testing. three hours before the test, the specimen is removed in the treatment bath and dried so that the specimen is surface dry.

Figure 2.2 Treatment of test objects

2.5 Concrete compressive strength test

The compressive strength test at the age of 7 days was carried out by 24 specimens as well as for the 28-day age test by 24 specimens. The test is carried out using a compressive strength testing machine. Before testing, the test object is weighed first to determine the weight of the test object and its dimensions are measured. The compressive strength loading is carried out slowly with a load of 2 to 4 N/mm2/second until the test object is destroyed. The magnitude of the load that causes the specimen to be crushed is the data that will be used to obtain the compressive strength of the concrete.

Figure 2.3 the scales of the test object

Figure 2.4 testing of test objects

RESULTS AND DISCUSSION

3.1 Aggregate Physical Properties

The results of examining the physical properties of the aggregates indicated that the aggregates used met the requirements as concrete forming materials.

3.1.1 Volume Weight

Calculation of the average unit weight obtained for each type of aggregate is shown in table 3.1.

Table 3.1 results of volume weight calculation examination.

No	Aggregate Type	Volume Weight (kg/l)	Reference	
			Orchard (1979)	Somayaji (2001)
1.	Gravel (Coarse Aggregate)	1675	>1.445	1.52 - 1.68
2.	Coarse Sand (Coarse Sand)	1632		
3.	Fine Sand (Fine Sand)	1611		

Based on the results of the unit weight examination, the aggregate used is in accordance with that recommended by Orchard (1979) and Somayaji (2001).

3.1.2 Specific gravity and absorption

The calculation results for aggregate specific gravity and absorption obtained for each type of aggregate are shown in Table 3.2 and Table 3.3.

Table 3.2 results of checking the calculation of aggregate specific gravity

No	Aggregate Type	Specific Gravity (SSD)		Reference	
		SG (SSD)	SG (OD)	Orchard (1979)	Somayaji (2001)
1.	Gravel (Coarse Aggregate)	2,650	2,602	2.6 - 2.7	
2.	Coarse sand (Coarse Sand)	2,641	2,552	>2,6	2.6 - 2.65
3.	Fine sand (Fine Sand)	2,688	2,552		

Table 3.2 shows the specific gravity of surface dry water-saturated aggregate (SSD), which has met the conditions suggested byOrchard (1979), while the specific gravity of oven dry aggregate (OD) for gravel complied with that suggested byOrchard (1979)while the sand is smaller than suggestedOrchard (1979).

Table 3.3 results of inspection of aggregate absorption calculations

No	Aggregate Type	Absorption (%)	Reference
			Orchard (1979)
1.	Gravel (Coarse Aggregate)	4,048	
2.	Coarse sand (Coarse Sand)	3,447	0.4 – 1.9
3.	Fine sand (Fine Sand)	5.311	

Table 3.3 shows the absorption values of gravel, coarse sand, and fine sand obtained which are higher than the absorption values suggested by Orchard (1979).

3.1.3 Arrangement of aggregate grains

Table 3.4 Aggregate fineness modulus (FM) values.

No	**Aggregate Type**	**Fineness Modulus (FM)**	**Reference**	
			ASTM (2004)	**Mulyono (2005)**
1.	Gravel	6,801	5.5 – 8.0	5.0 – 8.0
2.	Rough sands	3.135	2.9 – 3.2	1.5 – 3.8
3.	Fine sand	2,424	2.2 – 2.6	
4.	Mixed aggregate	5,288	4.0 – 7.0	5.0 – 6.0

Table 3.4 shows that the fineness modulus of the mixed aggregate is 5,288 which meets the requirements of ASTM (2004) and Mulyono (2005). For gravel, coarse sand and fine sand are also in accordance with the provisions of ASTM (2004).

3.2 Concrete Mix Design.

Table 3.5 Material composition for 1 m3 of concrete

FAS	Use of Palm Marks (%)	Water (kg)	Cement (kg)	Coarse Aggregate (kg)	Rough sands (kg)	Fine Sand (kg)	Number of Palm Bunches	Total (kg)

							(kg)	
0.35	0%	192.62	550.33	1112.04	429.73	96.23	0	2380.96
	6%	192.62	550.33	1112.04	429.73	96.23	33.02	2413.98
	8%	192.62	550.33	1112.04	429.73	96.23	44.03	2424.99
	11%	192.62	550.33	1112.04	429.73	96.23	60.54	2441.50

3.3 Mixing of concrete and manufacture of test specimens.

1373 results of the slump collection carried out are shown in table 3.6 and graph 3.1 below:

Table 3.6 slump value for FAS 0.35

Casting Variations	***temperature***		***Air Content (%)***	***Slumps (cm)***
	Room	***Mortars***		
BTTS	30.0	30.0	1.1	8.6
BDTS (6%)	29.0	30.0	1.2	8.5
BDTS (8%)	29.0	30.0	1.2	8.4
BDTS (11%)	28.0	29.0	1.2	8.4
Average	29.00	29.75	1.18	8.48
Standard Deviation	0.82	0.50	0.05	0.10
Covariance (%)	2.82	1.68	4.26	1.13
Category	***Very good***	***Very good***	***Very good***	***Very good***

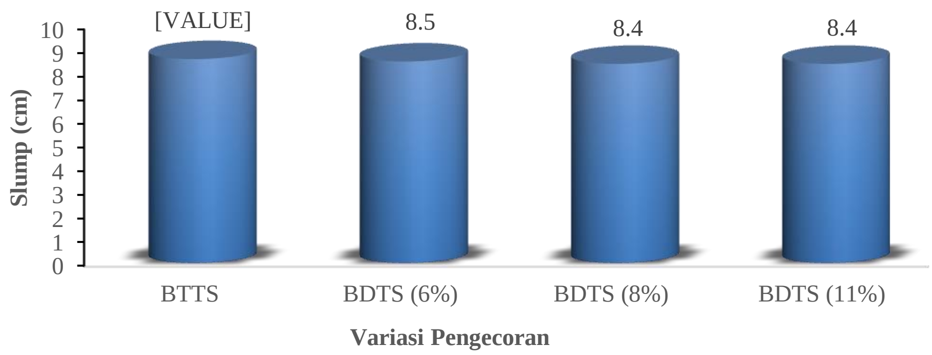


Figure 3.1 Graph of slump values

Table 3.6. showing that the temperature of the concrete mix has met the required conditions, which is less than 32°C, the average air content in the mortar obtained is 1.18% which also meets the requirements, which is between 0.5% - 1.75%. For the slump value, there is a variation in the percentage of added palm fruit bunches in the casting, but it still meets the slump value limit for normal concrete, which is 75-100 mm.

3.4 Test result.

3.4.1 Concrete Compressive Strength Testing.

The results of the concrete compressive strength test at the age of 7 and 28 days are shown in table 3.7 below.

Table 3.7 The results of the compressive strength test with a cube test object (15 x 15 x 15) cm

Testing	FAS	Concrete Compressive Strength (kg/cm2)

Age		BTTS	BDTS (6%)	BDTS (8%)	BDTS (11%)
		309.11	259.16	236.47	243.33
7 days	0.35	304.67	255.10	232.86	240.11
		318.5	266.43	244.16	250.56
Average		***310.76***	***260.23***	***237.83***	***244.67***
		340.22	292.39	267.86	278.47
28 days	0.35	343.67	295.52	270.67	280.61
		342.70	294.62	269.74	280.09
Average		***342.20***	***294.18***	***269.42***	***279.72***

Table 3.7 above can be described in a graphical average concrete compressive strength as shown in Figure 3.2 below.

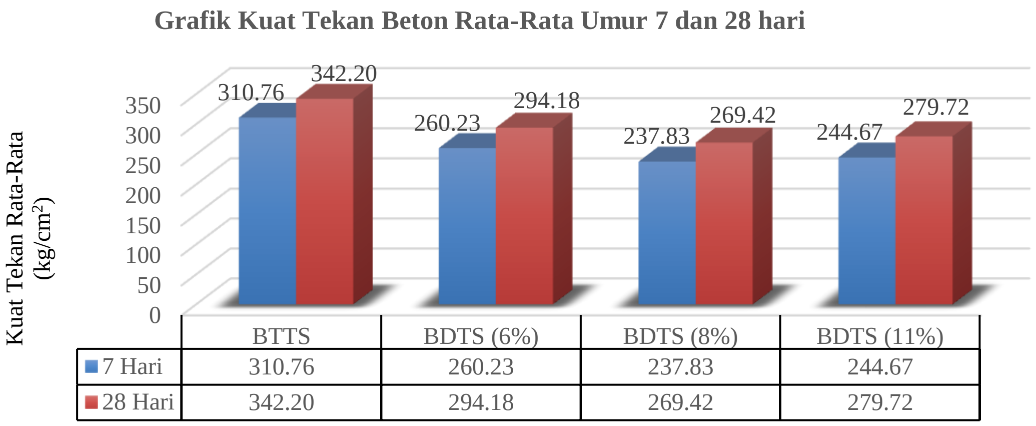


Table 3.8 Data comparison/ratio of the compressive strength test results of concrete aged 7 days to the compressive strength of concrete aged 28 days.

Casting Variations	FAS	Average Compressive Strength (f'c) 7 Days Testing Age (kg/cm2)	Average Compressive Strength (f'c) 28 Days Testing Age (kg/cm2)	Comparison/Ratio of Average Compressive Strength (f'c) 7 Days Testing Age to Average Compressive Strength (f'c) 28 Days Testing Age (kg/cm2)
BTTS	0.35	310.76	342.20	0.908
BDTS (6%)		260.23	294.18	0.885
BDTS (8%)		237.83	269.42	0.883
BDTS (11%)		244.67	279.72	0.875

Table 3.8 shows the average compressive strength of the 28-day test, an increase in the quality of the concrete compared to the 7-day test. The results of the comparison/ratio for BBTS are 0.908, BDTS (6%) are 0.885, BDTS (8%) are 0.883 and BDTS (11%) are 0.875.

Table 3.9 Comparison of the average compressive strength of BTTS and BDTS

Casting Variations	Testing Age (day)	Average Compressive Strength (f'c) (kg/cm2)	Comparison with BTTS	Information

BTTS	7 days	310.76	100%	-
BDTS (6%)		260.23	83.74%	Reduction in compressive strength
BDTS (8%)		237.83	76.53%	Reduction in compressive strength
BDTS (11%)		244.67	78.73%	Reduction in compressive strength
BTTS	28 days	342.20	100%	-
1375		294.18	85.97%	Reduction in compressive strength
BDTS (8%)		269.42	78.73%	Reduction in compressive strength
BDTS (11%)		279.72	81.74%	Reduction in compressive strength

The results of table 3.9 show that the use of palm marks in concrete decreased the compressive strength of the concrete both for the addition of palm marks of 6%, 8%, 11% compared to concrete without the use of palm bunches.

3.5 Concrete Absorption Test

Concrete Absorption Test with a value of W ≤ 3% indicated good concrete quality and 3% ≥ W ≤ 5% indicated moderate concrete quality and a value of W ≥ 5% indicated poor concrete quality. The following results of the average concrete absorption test are shown in table 3.10 below.

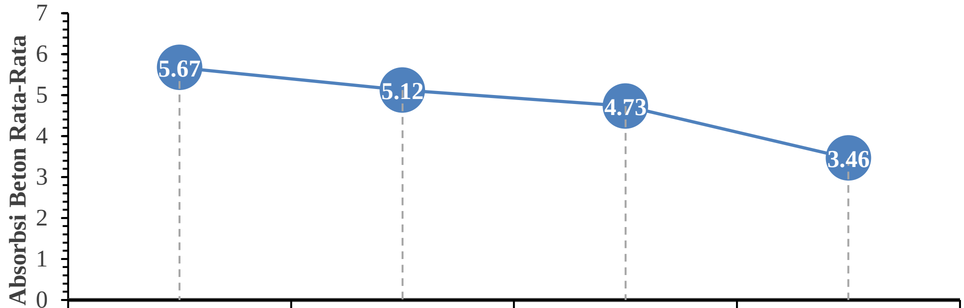
Table 3.10 Data of Concrete Absorption Test Results

FAS	Casting Variations	Average Concrete Absorption	Information
0.35	BTTS	3.46	Currently
	BDTS (6%)	4.73	Currently
	BDTS (8%)	5.12	Not good
	BDTS (11%)	5.67	Not good

Table 3.10 shows that BTTS and BDTS (6%) of medium quality concrete, for BDTS (8%) and BDTS (11%) the quality of concrete is not good, this is due to the use of more palm marks which causes ductility to decrease.

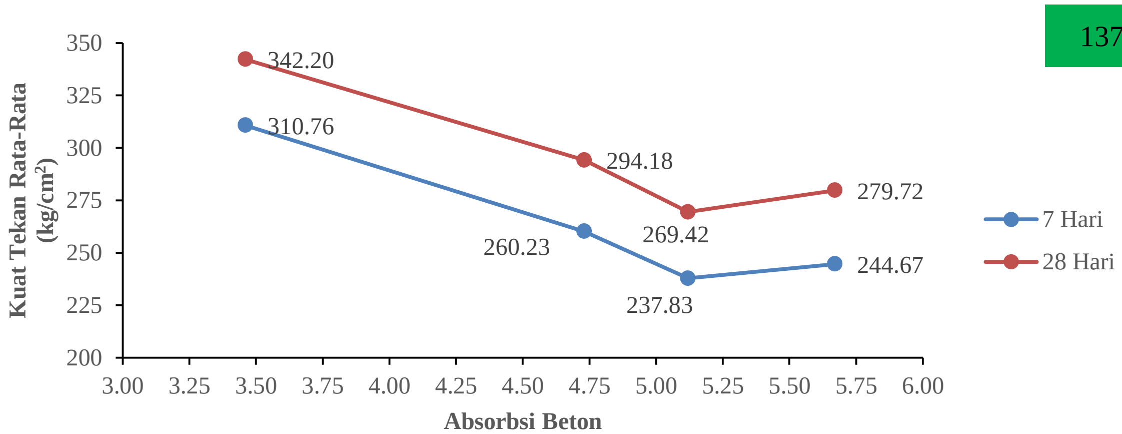
The values from Table 3.10 above can be depicted in the graph in Figure 3.3 below.

Grafik Hubungan Absorbsi Beton dengan Variasi Pengecoran



	BDTS (11%)	BDTS (8%)	BDTS (6%)	BTTS
Variasi Pengecoran	5.67	5.12	4.73	3.46

Graph 3.4 shows the relationship between the average compressive strength (kg/cm^2) of concrete and concrete absorption.



CONCLUSIONS

The conclusions from the results of this study include the following:

1. The average compressive strength of concrete aged 7 days with the addition of 6% palm fruit bunches was 260.23 kg/cm^2, the addition of 8% palm fruit bunches was 237.83 kg/cm^2 and the addition of 11% palm fruit bunches was 244.67 kg/cm^2.
2. The average compressive strength of concrete aged 28 days with the addition of 6% palm fruit bunches was 294.18 kg/cm^2, the addition of 8% palm fruit bunches was 269.42 kg/ cm^2, and the addition of 11% palm fruit bunches was 279.72 kg/cm^2.
3. The effect of adding palm fruit bunches to concrete can reduce the compressive strength of concrete, both the addition of 6%, 8% and 11%.

1377

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