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EFFECT OF VARIATION OF CEMENT WATER FACTOR IN CONCRETE MIXTURE WITH THE ADDITION OF PALM SHELL ON THE PRESSIVE STRENGTH OF NORMAL CONCRETE

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Abstract

Palm shell is a waste from palm oil production which is shaped like a shell with a hard layer character that aims to protect the palm kernels. The addition of palm shells to concrete is an innovation and breakthrough in the more productive use of palm oil waste. In this study, the percentage of addition of palm shells was used, among others, 0%, 7% and 14% by weight of cement with variations in the cement water factor (FAS) of 0.35, 0.45 and 0.50. The test object used was a cube (15 x 15 x 15) cm with a total of 9 test objects for each FAS with a test time of 28 days. The results of the concrete compressive strength test obtained data for FAS 0.35, the average compressive strength for BTCS was 348.15 kg/cm2, BDCSA (7%) was 363.07 kg/cm2 and BDCSB (14%) was 302.90 kg/cm2. FAS 0. 45 the average compressive strength for BTCS was 292.59 kg/cm2, BDCSA (7%) was 303.20 kg/cm2 and BDCSB (14%) was 249.27 kg/cm2. FAS 0.50 average compressive strength for BTCS was 273.09 kg/cm2, BDCSA (7%) was 271.53 kg/cm2 and BDCSB (14%) was 219.47 kg/cm2. The test results show that the average concrete compressive strength is influenced by the cement water factor (FAS) and the percentage of addition of palm shells in the concrete mix.

Keywords: ***Aggregates, FAS, Palm Shells, Concrete Compressive Strength.***

1. INTRODUCTION

The compressive strength of concrete is the value of the load per unit area that causes damage to the concrete specimen when given a certain pressure generated by the press machine. The compressive strength of concrete is influenced by many factors, including the suitability of the proportions of the concrete constituents, the water-cement factor (FAS), the design method, the curing of concrete, the addition of additives or admixtures and the conditions at the time of casting.

Calculation of statistical analysis with the F test, obtained the value of Fcount = 0.53 when compared with the value of F for F 0.01 table = 7.59 and F 0.05 table = 4.07. So it can be concluded that there is no significant interaction or influence between the compressive strength of concrete and the addition of palm shells on the compressive strength of concrete f'c 25 MPa.

The average compressive strength of normal concrete for fourteen days is 18.7 MPa, and the variation of each palm shell concrete is 25% (10.1 MPa), 50% (7.3 MPa), 75% (5.9 MPa), and 100% (3.1 MPa), meanwhile the average compressive strength of ordinary concrete after twenty eight days is 23.86 MPa, and the variations for coconut shell concrete are 25% (10.3 MPa), 50% (7.0 MPa), 75% (4.9 MPa), and % (2.9 MPa).

The compressive strength value of normal concrete characteristics aged 56 days, 37.23 MPa, normal +5% palm shells obtained 32.51 MPa, normal +10% palm shells obtained 28.30 MPa, normal +15% palm shells obtained 27.86 MPa. The average elastic modulus of normal concrete aged 28 days yielded 21684.974 MPa, normal +5% palm shell yielded 21938.735 MPa, normal +10% palm shell yielded 19366.810 MPa, normal +15% palm shell yielded 16946.708 MPa, Values This value shows that the longer the life of the concrete, the compressive strength of the concrete also increases, even though the concrete with the addition of palm shells is lower than normal concrete.

The resulting normal shear capacity of the beam is 2,285. The maximum deflection for additive variations was obtained at additive palm shell BMT (CSA) with a percentage of the normal BMT of 146,310% with a maximum load of 227,002 kN, with a percentage of 143,511% deflection with a load of 233,378 KN. The ratio of the ductility of the coarse aggregate (CSAK) palm shell BMT beam to the normal BMT beam is 115.544%. It can be concluded that variations in aggregate additives and substitution can increase the deflection and ductility values of high strength concrete. Palm shells have the best value and are very effective to use.

Concrete with palm shell (CKS) is an innovation as an alternative material to normal concrete which is increasingly expensive. Variation of oil palm shells with a percentage of 10% is the optimum compressive strength value obtained. Compressive strength will decrease in concrete with a percentage above 10%. This happens because the increasing number of CKS compositions causes the low workability of the concrete mix so that the compressive strength of the concrete becomes lower.

The compressive strength of mortar at 28 days of testing for mortar mixes using beach sand washed with plain fresh water and substitution of palm fruit shells 0%, 5%, 10%, 15% and 20% respectively are 5.2 MPa, 5.13 MPa, 3.73 MPa, 3.67 MPa, 2.87 MPa. And the results of the compressive strength of the mortar at the age of 28 days for the mortar mix using beach sand washed with hot fresh water and substitution of palm fruit shells 0%, 5%, 10%, 15% and 20% respectively are 5.27 MPa, 3.33 MPa, 3.2 MPa, 3.87 MPa, 3.87 MPa. It can be concluded that the maximum compressive strength that can be achieved from the planned mixture is 5.27 MPa. This compressive strength is produced from a mixture with the use of beach sand washed with hot fresh water and the use of palm fruit shells of 0%.

Testing at 28 days for non-sand concrete with a volume ratio of cement and gravel of 1:3 obtained a compressive strength of 8.71 MPa, while for non-sand concrete with a volume ratio of cement and palm shell respectively 1:3, 1:6, and 1 :8 obtained compressive strength of 4.64 MPa, 3.62 MPa, and 3.06 MPa. Furthermore, for the volume ratio of cement and palm shell respectively 1:10 and 1:12, the compressive strength is below 3 MPa. These results show that non-sand concrete with palm shell aggregate in a ratio of 1:3, 1:6, and 1:8 meets the criteria for compressive strength of non-sand concrete, which is between 2.8 MPa to 10 MPa. Thus, non-sand concrete from palm shell aggregates can be applied as non-structural lightweight concrete which is environmentally friendly due to its water-permeability.

Evaluation of the results of the compressive strength test, that is, on a normal concrete mix with 28 days of age, the compressive strength of concrete is 231.73 kg/cm2, on a concrete mixture with 5% coarse aggregate replacement of palm shell waste, with 28 days of age, the compressive strength of concrete is 217.39 kg/cm2. cm2, in the concrete mixture with replacement of 10% coarse aggregate waste palm shell waste, with an age of 28 days the compressive strength of concrete was obtained at 164.55 kg/cm2 and in concrete mixtures with replacement of coarse aggregate 15% waste palm shell waste, with an age of 28 days obtained strong compressed concrete of 153.98 kg/cm2. From the results of the evaluation of the compressive strength of concrete using 5%, 10% and 15% coarse aggregate replacement, palm shell waste does not have a compressive strength that exceeds that of normal concrete.

Laboratory test examination states that the characteristics for fine aggregate and coarse aggregate can be used because they meet SNI standards. Likewise with palm oil waste, it was found that for sieve analysis, specific gravity, absorption met SNI standards so that it could be used as an aggregate substitute in an amount of not more than 10% for palm oil boiler ash and not more than 30% for palm oil shells. The results of the average compressive strength of concrete on the 7th and 28th day were obtained at 21 MPa, not meeting the initial estimate of the desired compressive strength of 25 MPa.

The highest concrete compressive strength was in concrete using 5% coconut shell mixture, which was 16.5 tons or 73.33 kg/cm2 with a projected compressive strength at 28 days of 112.82 kg/cm2 while the lowest compressive strength was found in concrete using a 15% mixture, namely 4.5 tons or 20kg/cm2. The addition of coconut shell to the concrete mixture increases the compressive strength of the concrete for the addition of 5% coconut shell by weight of coarse aggregate.

The results of the analysis of the compressive strength of the mortar obtained an optimum mix of 15% for the manufacture of concrete which will be compared with normal concrete. The compressive strength of concrete with the optimum mixture at 28 days of age is 24.44 MPa, exceeding the design compressive strength of 23 MPa. The concrete with the highest compressive strength occurred at the age of 56 days was the normal mix concrete with a compressive strength of 34.44 MPa higher than the compressive strength of concrete with an optimum mixture of 15% boiler slag ash, which was 28.51 MPa.

At 28 days of testing, the compressive strength of concrete without the addition of palm shells (0%) was 254.19 kg/cm2, while the compressive strength of concrete added with palm shells increased in the 5% mixture of 269.96 kg/cm2, 15% of 211.98 kg/cm2 and 25 % of 173.71 kg/cm2. It can be concluded that the composition of the mixture in this analysis refers to the 2013 AHSP for Cipta Karya from the Ministry of Public Works for K-250 quality using local Kotabaru materials (Cement Tiga Roda, sand from Sungup Village, gravel from Sarang Tiung Village and palm shells from the Palm Oil Mill). Cantung), meaning that the addition of palm shells of 5% of the concrete has increased while the addition of palm shells of 15% and 25% to the concrete mixture cannot increase the compressive strength of concrete but reduces the compressive strength of concrete to the design compressive strength.

Testing the compressive strength of concrete at each temperature variation of the test specimens showed that at 28 days of age Normal Concrete (BN) = 19.6 Mpa, Concrete Without Combustion (BS0) = 26.4 Mpa, Concrete Temperature 6000C = 11.4 Mpa, Concrete Temperature 7000C = 13.4 Mpa and Temperature Concrete 8000C = 18.2MPa.

The addition of palm shell ash with variations of 0%, 5%, 7.5%, 10%, 12.5%, 15% and 20% by testing the average compressive strength of concrete at 3 days of age is 46.48 MPa, 49.45 MPa, 50.26 MPa, 50.64 MPa, 52.70 MPa, 48.26 MPa and 44.42 MPa. At the age of 14 days it was 55.62 MPa, 58.71 MPa, 60.03 MPa, 59.47 MPa, 63.13 MPa, 57.53 MPa and 52.23 MPa. Whereas at the age of 28 days it was 58.60 MPa, 60.07 MPa, 61.42 MPa, 62.02 MPa, 64.72 MPa, 60.83 MPa and 55.81 MPa. With the same addition variation, the results of the slump flow test were 63 cm, 60 cm, 60 cm, 59 cm, 58 cm, 57 cm and 55 cm.

The addition of oven-baked and un-baked palm shell ash on the red bricks increased the compressive strength of the red bricks. The addition of unbaked palm shell ash to the red bricks reduces the water absorption capacity of the red bricks and makes the red bricks lighter. The lightest weight occurs in 8.6% of unbaked palm shell ash, which is 12.96% of normal red brick. The greatest compressive strength occurs in 4.3% of oven-baked palm shell ash, which is 112.82% of normal red brick. The smallest water absorption capacity occurred in 8.6% of unbaked palm shell ash, which was 18.7% of normal red brick.

2. IMPLEMENTATION METHOD

2.1. Research Design

The specimens used were cubes (15 x 15 x 15) cm with a total of 27 specimens for all variations of concrete mixing, for each variation of concrete mixing 3 specimens were made. The variations in the cement water factor (FAS) used were 0.35, 045 and 0.50 with a test age of 28 days. The additional percentage of palm shells is 0%, 7% and 14% by weight of cement.

Data source

Data acquisition was obtained from the measurement results of the concrete slump test value, examination of the physical properties of the material (aggregate) including specific gravity, absorption, volume weight, grain arrangement and organic matter content. Obtaining concrete absorption data was taken by cutting the specimen into cubes (5 x 5 x 5) cm from the cube specimen (15 x 15 x 15) cm.

Equipment

The tools used include mixers for mixing concrete, abrams cones for measuring concrete slump test values, cube molds (15 x 15 x 15) cm, test object treatment tanks, ovens, compressive strength testing machines, thermometers, data loggers and transducers.

Material

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

2.2. Concrete mix design

Planning concrete mix using ACI 211.1-91 method. Calculation of water requirement in 1 m3 of concrete is based on the design slump height (75-100) mm with FAS 0.35, 0.45 and 0.50. The maximum aggregate diameter size used is 25.4 mm to obtain the ratio between fine sand and coarse sand as fine aggregate.

2.3. Making Test Objects

Table 2.1 Design of concrete mixing variations with FAS 0.35

Concrete Mixing Method	Palm shells (%)	Testing Age	Cube (15 x 15 x 15) cm			Amount Test Objects
BTCS	0%	28 days	BTCS1A	BTCS2A	BTCS1A	3
BDCSA	7%	28 days	BDCSA1A	BDCSA2A	BDCSA3A	3
BDCSB	14%	28 days	BDCSB1A	BDCSB2A	BDCSB3A	3
					Total Test Items	9

Table 2.2 Design of concrete mixing variations with FAS 0.45

Concrete Mixing Method	Palm shells (%)	Testing Age	Cube (15 x 15 x 15) cm			Amount Test Objects
BTCS	0%	28 days	BTCS1B	BTCS2B	BTCS1B	3
BDCSA	7%	28 days	BDCSA1B	BDCSA2B	BDCSA3B	3
BDCSB	14%	28 days	BDCSB1B	BDCSB2B	BDCSB3B	3
					Total Test Items	9

Table 2.3 Design of concrete mixing variations with FAS 0.50

Concrete Mixing Method	Palm shells (%)	Testing Age	Cube (15 x 15 x 15) cm			Amount Test Objects
BTCS	0%	28 days	BTCS1C	BTCS2C	BTCS1C	3
BDCSA	7%	28 days	BDCSA1C	BDCSA2C	BDCSA3C	3
BDCSB	14%	28 days	BDCSB1C	BDCSB2C	BDCSB3C	3

Total Test Items	9

Information:
BTCS = Test objectwithout the addition of palm shells (0%);
BDCSA = Test objectwith the addition of palm shells (7%);
BDCSB = Test objectwith the addition of palm shells (14%);

Figure 2.1 Oven for drying palm shells

Figure 2.2 Palm shells before baking

Figure 2.3 Palm shells after baking

2.4. Treatment of test objects

Treatment of the cube test object (15 x 15 x 15) cm is carried out by placing the cube test object (15 x 15 x 15) cm into the concrete curing tub, where the tub is filled with water first. The length of time the concrete was cured until the time of testing was 28 days. Three hours before testing, cubes (15 x 15 x 15) cm were removed in a treatment bath and dried so that cubes (15 x 15 x 15) cm were surface dry.

Figure 2.4 Treatment of cube specimens (15 x 15 x 15) cm

2.5. Testing the compressive strength of concrete

The compressive strength test was carried out at 28 days of concrete age with a total of 9 specimens for each FAS, namely 0.35, 0.45 and 0.50. Before testing the compressive strength of concrete, its dimensions are first measured and after that, each specimen is weighed to determine its weight. Next, the transducer is installed on the test object and connected to the data logger for reading, after which it is slowly loaded 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 2.5 Compressive strength testing machine

Figure 2.6 Testing the compressive strength of cubic concrete (15 x 15 x 15) cm

Figure 2.7 After testing the cube (15 x 15 x 15) cm

3. RESULTS AND DISCUSSION

3.1. Concrete Mix Design.

Table 3.1 Material composition for 1 m3 of concrete

Method Concrete Mixing	FAS	Water (kg)	Cement (kg)	Coarse Aggregate (kg)	Rough sands (kg)	Fine Sand (kg)	Number of Palm Shells (kg)	Total (kg)
BTCS		192.62	550.33	1168.00	386.66	83.35	0.00	2380.96
BDCSA (7%)	0.35	192.62	550.33	1168.00	386.66	83.35	38.52	2419.48
BDCSB (14%)		192.62	550.33	1168.00	386.66	83.35	77.05	2458.01
BTCS		192.62	428.04	1168.00	487.27	105.04	0.00	2380.97
BDCSA (7%)	0.45	192.62	428.04	1168.00	487.27	105.04	29.96	2410.93
BDCSB (14%)		192.62	428.04	1168.00	487.27	105.04	59.93	2440.90
BTCS		192.62	385.23	1168.00	522.48	112.63	0.00	2380.96
BDCSA (7%)	0.50	192.62	385.23	1168.00	522.48	112.63	26.97	2407.93
BDCSB (14%)		192.62	385.23	1168.00	522.48	112.63	53.93	2434.89

3.2. Mixing of concrete and manufacture of specimens.

After mixing/mixing the concrete forming material with the mixer, then measuring the slump test value using the Abrams cone for each FAS 0.35, 0.45 and 0.50, the results of measuring the slump test value are shown in table 3.2 below:

Table 3.2 Slump test value for FAS 0.35

Method Concrete Mixing	temperature		Air Content (%)	Slump (cm)
	Room	Mortars		
BTCS	31	29	1.10	9.20
BDCSA (7%)	30	30	1.20	10.80
BDCSB (14%)	30	31	1.30	11.00
Average	30.33	30.00	1.20	10.33
Standard Deviation	0.58	1.00	0.10	0.99
Covariance (%)	1.90	3.33	8.33	9.55
Category	Very good	Very good	Currently	Currently

Table 3.2. shows that the temperature data of the concrete mixture (room and mortal) with FAS 0.35 has fulfilled the requirements, namely ≤ 32°C in the Very Good category, the average air content obtained is 1.20% and also meets the requirements, namely 0.5% - 1.75% in the Moderate category. The slump test values obtained varied for each concrete mixing method, for the average slump value it was still within the limits of 10.33 cm in the Medium category. The following is shown in graph 3.1. The slump test value for FAS is 0.35.

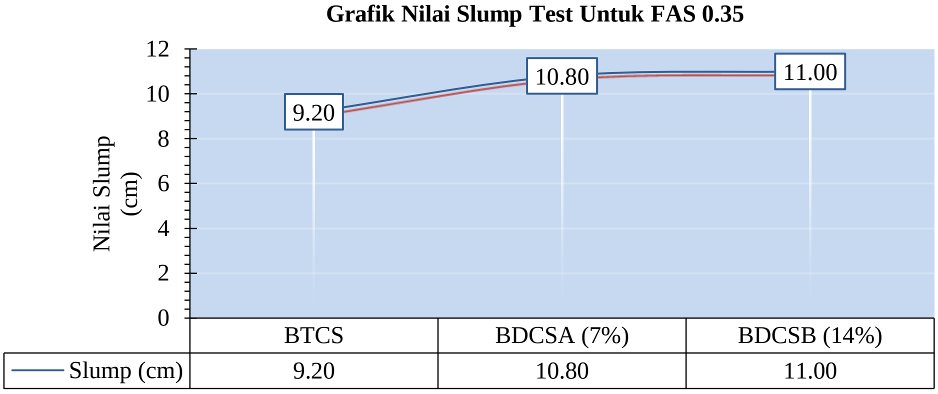


Figure 3.1 Graph of slump test values for FAS 0.35

Table 3.3 Slump test value for FAS 0.45

Method Concrete Mixing	temperature Room	Mortars	Air Content (%)	Slump (cm)
BTCS	30	30	1.20	10.00
BDCSA (8%)	29	30	1.30	11.50
BDCSB (14%)	28	31	1.30	11.80
Average	29.00	30.33	1.27	11.10
Standard Deviation	1.00	0.58	0.06	0.96
Covariance (%)	3.45	1.90	4.56	8.69
Category	Very good	Very good	Very good	Currently

Table 3.3. showed that the temperature of the concrete mixture (room and mortal) for FAS 0.45 met the requirements, namely ≤ 32°C, the average air content was obtained at 1.27% and also met the requirements, namely between 0.5% - 1.75% with the Very Good category. The slump test values obtained varied for each concrete mixing method, for the average slump value it was still within the limits of 11.10 cm in the Moderate category. The following is shown in graph 3.2. The slump test value for FAS is 0.45.

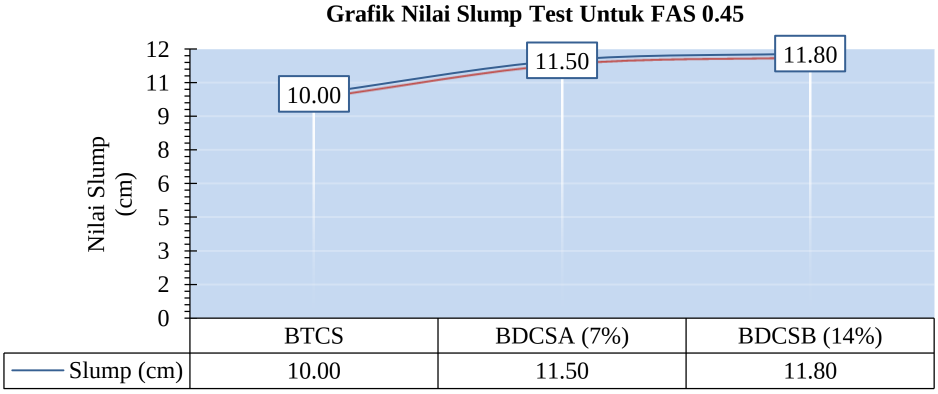


Figure 3.2 Graph of slump test values for FAS 0.45

Table 3.4 Slump test value for FAS 0.50

Method Concrete Mixing	**temperature**		**Air Content (%)**	**Slump (cm)**
	Room	**Mortars**		
BTCS	29	30	1.20	10.40
BDCSA (7%)	28	31	1.30	12.00
BDCSB (14%)	28	31	1.30	12.40
Average	28.33	30.67	1.27	11.60
Standard Deviation	0.58	0.58	0.06	1.06
Covariance (%)	2.04	1.88	4.56	9.12
Category	Very good	Very good	Very good	Currently

Table 3.4. showed that the temperature of the concrete mixture (room and mortal) with FAS 0.50 fulfilled the requirements, namely ≤ 32°C, the average air content was obtained at 1.27% also met the requirements, namely 0.5% - 1.75% with the Very Good category. The acquisition of the slump test varies according to the concrete mixing method, the average slump value is 11.60 cm in the Medium category. The following is shown in graph 3.3 the slump test value for FAS 0.50

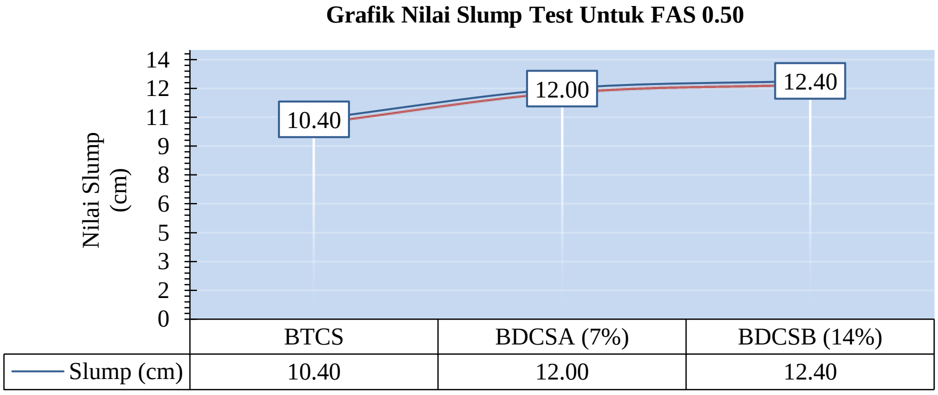


Figure 3.3 Graph of slump test values for FAS 0.50

3.3. Test Results.

Concrete Compressive Strength Testing.

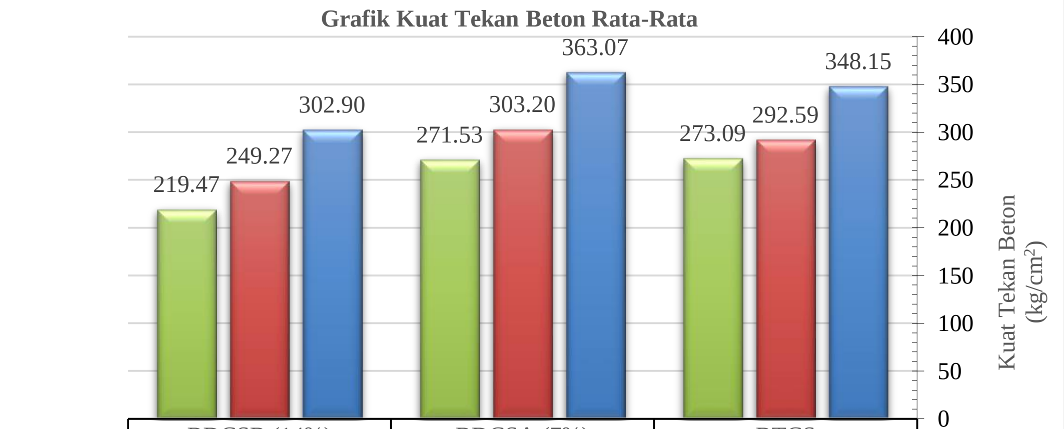
The results of the compressive strength test of cube concrete (15 x 15 x 15) cm at 28 days old with FAS 0.35, 0.45 and 0.50 are shown in table 3.5 below.

Table 3.5 Results of concrete compressive strength testing with cube specimens (15 x 15 x 15) cm

FAS	**Testing Age**	**Concrete Compressive Strength (kg/cm2)**		
		BTCS	**BDCSA (7%)**	**BDCSB (14%)**
0.35	28 days	342.22	358.20	299.20
		346.67	361.40	301.30
		355.56	369.60	308.20
Average Concrete Compressive Strength		348.15	363.07	302.90
0.45	28 days	297.78	300.60	254.80
		293.33	319.60	249.80
		286.67	289.40	243.20
Average Concrete		292.59	303.20	249.27

Compressive Strength				
0.50	28 days	268.44 271.93 278.90	267.20 270.80 276.60	215.80 220.20 222.40
Average Concrete Compressive Strength		273.09	271.53	219.47

From the results of table 3.5 it can be described in a graph of the average concrete compressive strength as shown in Figure 3.4 below.



	BDCSB (14%)	BDCSA (7%)	BTCS
FAS 0.35	302.90	363.07	348.15
FAS 0.45	249.27	303.20	292.59
FAS 0.50	219.47	271.53	273.09

Figure 3.4 Graph of average concrete compressive strength for FAS 0.35, 0.45 and 0.50

Table 3.6 Comparison of the compressive strength of concrete FAS 0.35 with FAS 0.45.

Method Concrete Mixing	**Average Compressive Strength (kg/cm2) For FAS 0.35**	**Average Compressive Strength (kg/cm2) For FAS 0.45**	**Comparison of Average Compressive Strength (kg/cm2) FAS 0.35 with FAS 0.45**	**Information**
BTCS	348.15	292.59	15.96 %	Decrease in compressive strength of concrete
BDCSA (7%)	363.07	303.20	16.49 %	Decrease in compressive strength of concrete
BDCSB (14%)	302.90	249.27	17.71 %	Decrease in compressive strength of concrete

Table 3.6 shows that the average compressive strength value for BTCS has decreased by an average compressive strength of 15.96%, BDCSA (7%) has decreased in average compressive

strength by 16.49% and BDCSB (14%) has decreased in value. average compressive strength of 17.71%. The largest decrease in the average compressive strength occurred in BDCSB (14%), namely 17.71%, and the smallest average decrease in compressive strength was in BTCS of 15.96%. The results of the comparison of the average compressive strength of FAS 0.35 with FAS 0.45 are shown in Graph 3.5 below.

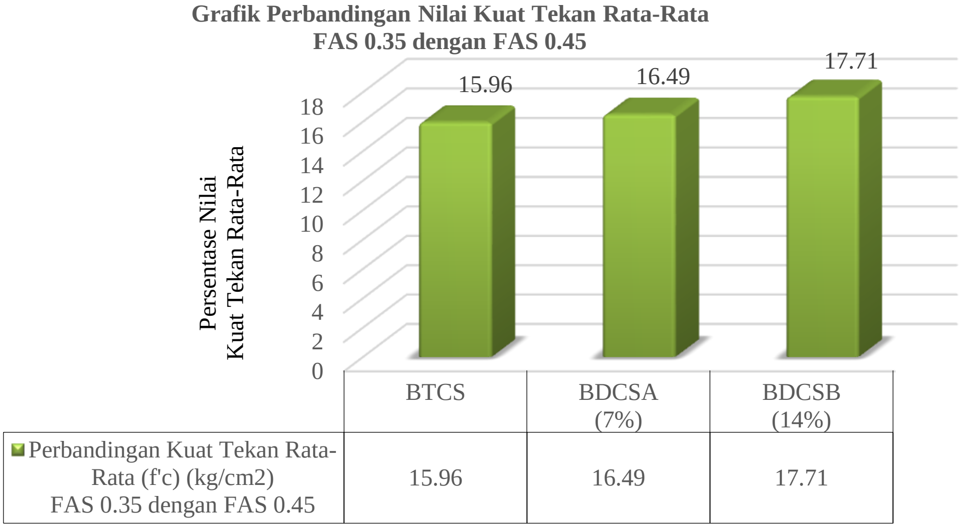


Figure 3.5 Graph of comparison of the average compressive strength value of FAS 0.35 with FAS 0.45

Table 3.7 Comparison of the compressive strength values of FAS 0.35 and FAS 0.50.

Method Concrete Mixing	Average Compressive Strength (kg/cm2) For FAS 0.35	Average Compressive Strength (kg/cm2) For FAS 0.50	Comparison of Average Compressive Strength (kg/cm2) FAS 0.35 with FAS 0.50	Information
BTCS	348.15	273.09	9:56 p.m	Decrease in compressive strength of concrete
BDCSA (7%)	363.07	271.53	25.21	Decrease in compressive strength of concrete
BDCSB (14%)	302.90	219.47	27.54	Decrease in compressive strength of concrete

Table 3.7 shows that the average compressive strength value for BTCS has decreased by an average compressive strength of 21.56%, BDCSA (7%) has decreased in average compressive strength by 25.21% and BDCSB (14%) has decreased in value. average compressive strength of 27.54%. The largest decrease in the average compressive strength occurred in BDCSB (14%), namely 27.54%, and the smallest average decrease in compressive strength was in BTCS, which was 21.56%. The results of the comparison of the average compressive strength of FAS 0.35 with FAS 0.50 are shown in the following graph 3.6.

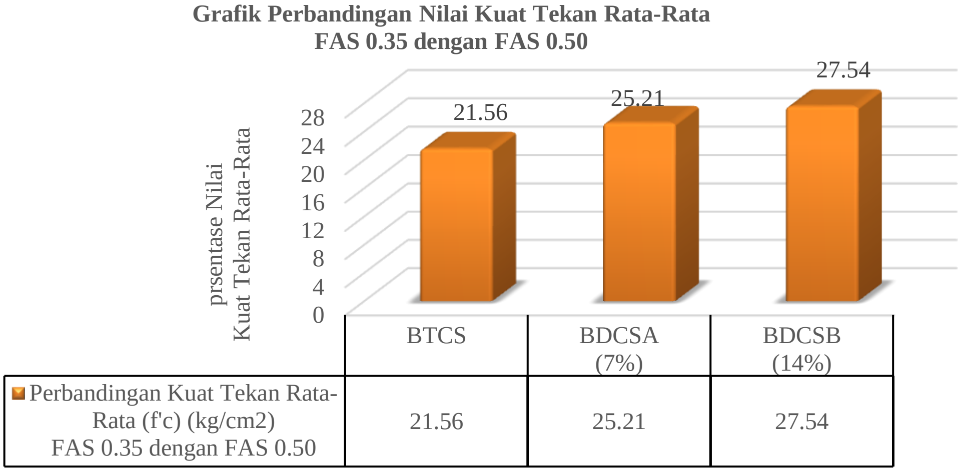


Figure 3.6 Graph of comparison of the average compressive strength value of FAS 0.35 with FAS 0.50

Table 3.8 Comparison of the compressive strength values of FAS 0.45 and FAS 0.50.

Method Concrete Mixing	**Average Compressive Strength (kg/cm2) For FAS 0.45**	**Average Compressive Strength (kg/cm2) For FAS 0.50**	**Comparison of Average Compressive Strength (kg/cm2) FAS 0.45 with FAS 0.50**	**Information**
BTCS	292.59	273.09	6.67	Decrease in compressive strength of concrete
BDCSA (7%)	303.20	271.53	10.44	Decrease in compressive strength of concrete
BDCSB (14%)	249.27	219.47	11.96	Decrease in compressive strength of concrete

Table 3.8 shows that the average compressive strength value for BTCS has decreased by an average compressive strength of 6.67%, BDCSA (7%) has decreased in average compressive strength by 10.44% and BDCSB (14%) has decreased in value. average compressive strength of 11.96%. The largest decrease in the average compressive strength occurred in BDCSB (14%), namely 11.96% and the smallest average decrease in compressive strength was in BTCS of 6.67%. The results of the comparison of the average compressive strength of FAS 0.45 with FAS 0.50 are shown in the following graph 3.7.

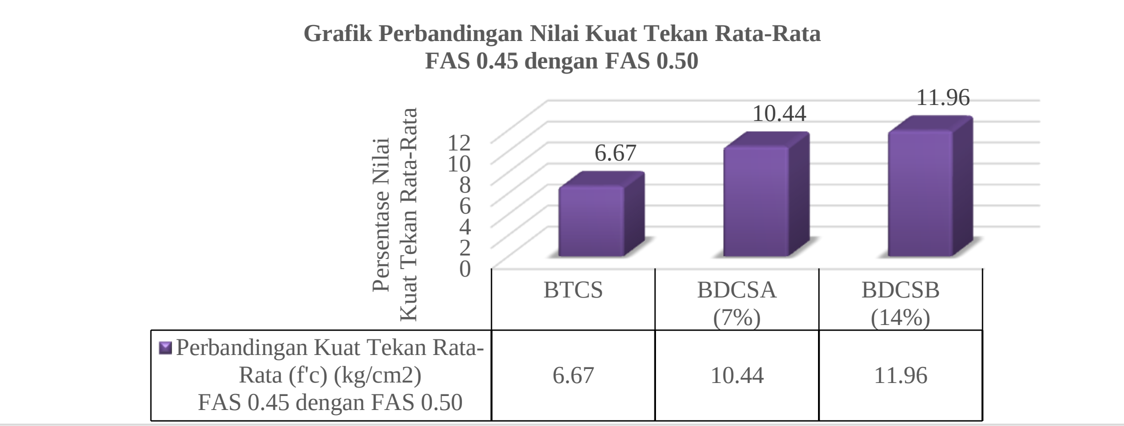


Figure 3.7 Graph of comparison of the average compressive strength value of FAS 0.40 with FAS 0.50

3.4. Concrete Absorption Test

Concrete absorption test if W ≤ 3% then the concrete is of good quality and 3% ≥ W ≤ 5% then the concrete is of medium quality and if W ≥ 5% the quality of the concrete is not good. The following results of the average concrete absorption test are shown in table 3.9 below.

Table 3.9 The results of the concrete absorption test

Method Concrete Mixing	FAS	Average Concrete Absorption	Information
BTCS		3.85	Medium quality concrete
BDCSA (7%)	0.35	4.85	Medium quality concrete
BDCSB (14%)		4.91	Medium quality concrete
BTCS		5.82	Poor quality concrete
BDCSA (7%)	0.45	6.85	Poor quality concrete
BDCSB (14%)		7.06	Poor quality concrete
BTCS		6.92	Poor quality concrete
BDCSA (7%)	0.50	7.22	Poor quality concrete
BDCSB (14%)		7.74	Poor quality concrete

Table 3.9 displays the average absorption value of concrete, for FAS 0.35 all concrete mixing methods are categorized as moderate concrete quality. For FAS 0.45 and FAS 0.50 all methods of mixing concrete are of poor quality, this is influenced by the cement water factor (FAS) and also due to the use of palm shells which causes poor concrete ductility.

4. CONCLUSION

From the results of the research that has been carried out, there are several conclusions that can be concluded, among others:

1. The influence of variations in the water-cement factor (FAS), namely 0.35, 0.45 and 0.50 can affect the compressive strength of concrete with the addition of palm shells.
2. For FAS 0.35 the average concrete compressive strength for BTCS was 348.15 kg/cm2, BDCSA (7%) was 363.07 kg/cm2 and BDCSA (14%) was 302.90 kg/cm2.
3. FAS 0.45 average concrete compressive strength for BTCS is 292.59 kg/cm2, BDCSA (7%) is 303.20 kg/cm2 and BDCSA (14%) is 249.27 kg/cm2.
4. FAS 0.50 average concrete compressive strength for BTCS is 273.09 kg/cm2, BDCSA (7%) is 271.53 kg/cm2 and BDCSA (14%) is 219.47 kg/cm2.

5. Comparison of the average compressive strength value between FAS 0.35 and FAS 0.45 resulted in a decrease in the average compressive strength for BTCS of 15.96%, BDCSA (7%) of 16.49% and BDCSB (14%) of 17.71%.
6. Comparison of the average compressive strength value between FAS 0.35 and FAS 0.50 resulted in a decrease in the average compressive strength for BTCS of 21.56%, BDCSA (7%) of 25.21% and BDCSB (14%) of 27.54%.
7. Comparison of the average compressive strength value between FAS 0.45 and FAS 0.50 resulted in a decrease in the average compressive strength for BTCS of 6.67%, BDCSA (7%) of 10.44% and BDCSB (14%) of 11.96%.

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