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RESEARCH STUDY OF THE EFFECT OF VARIATION OF CEMENT WATER FACTOR IN BREACH WATER CONCRETE FACTING USING ADMIXTURE ON THE COMPRESSIVE STRENGTH OF CONCRETE

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Abstract

Admixture is an additional ingredient in concrete that is added when mixing concrete takes place in the hope of changing the properties of concrete to make it more suitable for a particular job. In this study, the material used was Sikacrete W with a percentage of 0%, 13% and 16% by weight of cement. The specimens used were cylinders (15 x 30) cm of 12 specimens for each FAS. FAS variations in this study included 0.35, 0.40 and 0.50 with a test age of 28 days. The results of this study, for FAS 0.35 the average concrete compressive strength for STATPLA was 280.24 kg/cm2, STATPDA was 110.38 kg/cm2, SDATPDA (13%) was 244.00 kg/cm2 and SDATPDA (16%) was 256.89 kg/cm2. FAS 0.40 average concrete compressive strength for STATPLA is 272.09 kg/cm2, STATPDA is 94.37 kg/cm2, SDATPDA (13%) was 237.18 kg/cm2 and SDATPDA (16%) was 249.18 kg/cm2. FAS 0.50 average concrete compressive strength for STATPLA was 238.83 kg/cm2, STATPDA was 74.05 kg/cm2, SDATPDA (13%) was 192.22 kg/cm2 and SDATPDA (16%) was 202.23 kg/cm2. These results indicate that there is an influence on FAS variations in concrete casting in brackish water with the addition of admixture.

Keywords: ***Concrete Compressive Strength, Cement Water Factor, Admixture***

1. INTRODUCTION

The water-cement factor (FAS) or water cement ratio (wcr) is an important indicator in the design of concrete mixes because FAS is the ratio of the amount of water to the amount of cement in a concrete mix. The water-cement factor has a very important role in the formation of concrete. Concrete is a construction material that is often used because concrete has several advantages, including easy-to-find basic materials, resistant to various weather conditions and not difficult to implement and maintain.

The addition of Reduced Water and Accelerated Admixture (Bestmittel) of 0.2%, 0.4% and 0.6% by weight of cement and water will increase workability and increase the average compressive strength of normal concrete (0.2% for 25.61 Mpa, 0.4% for 27.66 Mpa, 0.4% for 29.50 Mpa, and 0.6% for 31.44 Mpa).

The proportion of the mixture that provides optimum compressive strength and the influence of variations in the Cement Water Factor (FAS) and the amount of cement on the compressive strength of concrete. The optimum test results for the Water Cement Factor (FAS) are at FAS 0.4 and with a cement quantity of 350 kg, which is 37.05 MPa. The compressive strength meets the requirements of normal quality concrete with a compressive strength value of less than 42MPa at 28 days of age.

The value of the water-cement factor can still be enlarged to exceed the maximum limit according to SNI in accordance with the strength and resistance that can be used in concrete submerged in sea water. This methodology is to collect secondary data about the influence of cement water factor on concrete treated using sea water. Permeability predictions in seawater with variations in the water-cement factor are 0.40, 0.50 and 0.60. The results show that the cement water factor can be increased up to 0.50 if the design life of the building is 50 years.

The relationship between the compressive strength of concrete and FAS using PPC follows Duff Abrams' law, namely the compressive strength decreases exponentially with increasing FAS values. The initial age of concrete compressive strength with PPC is lower than concrete with PC, after 7 days the compressive strength of concrete is higher. Using a FAS value between 0.4-0.9 the difference in compressive strength obtained with PPC and PC is around 1-17% and 3-26% respectively at the age of 28 and 90 days.

The influence of the cement aggregate ratio and the water-cement factor on the compressive strength and porosity of porous concrete where the compressive strength of porous concrete decreases as the aggregate/cement ratio increases. The compressive strength of porous concrete with a water-cement factor (FAS) of 0.25 is lower than FAS of 0.30. The porosity of porous concrete increases with increasing aggregate/cement ratio. Porosity of porous concrete with water-cement factor (FAS) 0.25 is higher than FAS 0.30. The volume weight of porous concrete decreased with increasing aggregate/cement ratio.

The influence of variations in the Water Cement Factor (FAS) on lightweight CLC bricks using white clay with certain variations of 0%, 10%, 70% and 100% The parameters to be measured are compressive strength, water absorption and workability. The results showed that the greatest concrete compressive strength (0.630 MPa) was achieved by samples with white soil variations of 10% and 70% at 21 days of age with an FAS of 0.6. The lowest water absorption was achieved by samples with a white soil variation of 10%. Ease of work in the factory is directly proportional to the use of water and inversely proportional to the use of white soil as a substitute for sand.

The compressive strength of concrete is largely determined by the shape of the specimen, the age of the specimen and the water-cement ratio where it can be concluded that the smaller the w/c ratio, the greater the compressive strength of the concrete produced.

The compressive strength testing of lightweight pumice concrete for FAS 0.5, 0.6, and 0.65 meets the strength limits of lightweight concrete construction for structural purposes. At FAS 0.55, 0.7 and 0.75 did not meet the strength limit of structural lightweight concrete. The higher the FAS value shows a tendency to decrease the compressive strength of the test object, inversely proportional to the slump value. Regression analysis for the relationship between cement water factor and compressive strength gives a correlation value (r) of 0.8052 while for the relationship between cement water factor and slump it gives a correlation value (r) of 0.9878. And these two correlation values show that the stronger the relationship between the FAS variation on the compressive strength and the slump value.

The effect of variation FAS 0.50 (without added material) compressive strength obtained is 38.18 Mpa, in variations FAS 0.50, 0.51 and 0.52 there is an increase and the compressive strength obtained is 39.31 Mpa, 39.50 Mpa and 38.46 Mpa. The results of the compressive strength test carried out obtained that the optimum compressive strength value of all variations was in the FAS 0.51 variation, this was due to the effect of the addition of corncob ash on the FAS 0.51 variation it worked well.

Variations in the cement water factor and the foam agent water factor greatly affect the volume weight and compressive strength produced. The resulting values have different trends in each variation. The smallest unit weight value for each FAF variation is 0.768 gr/cm3 which is found in FAF 1:20 (to FAS 60%). The best quality value of CLC light brick was 2,518 MPa, achieved at 50% FAS variation (to FAF 1:80) for both white and green foam agent. Therefore it is recommended to get the best compressive strength you should use FAS 50% to FAF 1:80 while to get a small density value you can use FAS 60% to FAF 1:20.

2. LITERATURE REVIEW

2.1. Research Design

This study used cylindrical specimens (15 x 30) cm, the number of specimens for each casting method was 3 specimens. FAS variations include 0.35, 040 and 0.50 with a test age of 28 days. Percentage of additional admixture 0%, 13% and 16% by weight of cement.

Data source

Data acquisition was obtained from the results of the slump test after mixing the concrete, examining the physical properties of the aggregate, including specific gravity, aggregate absorption, volume weight, grain arrangement, organic matter content. For concrete absorption data obtained by cutting a cube (5 x 5 x 5) cm from a cylindrical specimen (15 x 30) cm.

Equipment

The equipment used includes mixing concrete using an electric mixer, measuring the slump value using an Abrams cone, 4" pipe, cylindrical mold (15 x 30) cm, oven, concrete curing station, compressive strength testing machine, thermometer, data logger and transducer.

Material

The materials used include cement, coarse aggregate, fine aggregate namely fine sand and coarse sand, Sikacrete W and water.

2.2. Concrete mix design

Designing a concrete mixture using the ACI 211.1-91 method by calculating the concrete mix plan based on the tables in the 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, 0.40 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 Variations	Admixture percentage (%)	Testing Age	Cylinder (15 x 30) cm			Number of Test Objects
STATPLA	0%	28 days	STATPLA1A	STATPLA2A	STATPLA3A	3
STATPDA	0%	28 days	STATPDA1A	STATPDA2A	STATPDA3A	3
SDATPDA	13%	28 days	SDATPDA1A	SDATPDA2A	SDATPDA3A	3
SDATPDA	16%	28 days	SDATPDA1A	SDATPDA2A	SDATPDA3A	3
				Total Test Items		12

Table 2.2 Design of concrete mixing variations with FAS 0.40

Concrete Mixing Variations	Admixture percentage (%)	Testing Age	Cylinder (15 x 30) cm			Number of Test Objects
STATPLA	0%	28 days	STATPLA1B	STATPLA2B	STATPLA3B	3
STATPDA	0%	28 days	STATPDA1B	STATPDA2B	STATPDA3B	3
SDATPDA	13%	28 days	SDATPDA1B	SDATPDA2B	SDATPDA3B	3
SDATPDA	16%	28 days	SDATPDA1B	SDATPDA2B	SDATPDA3B	3
				Total Test Items		12

Table 2.3 Design of concrete mixing variations with FAS 0.50

Concrete Mixing Variations	Admixture percentage (%)	Testing Age	Cylinder (15 x 30) cm			Number of Test Objects
STATPLA	0%	28 days	STATPLA1C	STATPLA2C	STATPLA3C	3
STATPDA	0%	28 days	STATPDA1C	STATPDA2C	STATPDA3C	3
SDATPDA	13%	28 days	SDATPDA1C	SDATPDA2C	SDATPDA3C	3
SDATPDA	16%	28 days	SDATPDA1C	SDATPDA2C	SDATPDA3C	3
				Total Test Items		12

Information:

STATPLA = Test objectwithout the addition of admixture, without being compacted, not cast in brackish water (0%);

STATPDA = Test objectwithout adding admixture without being solidified cast in brackish water (0%);

SDATPDA = Test objectwith the addition of non-compacted admixture cast in brackish water (13% and 16%);

Figure 2.1 Method of casting in brackish water

Figure 2.2 Cylindrical specimen (15 x 30) cm after casting in brackish water

2.4. Treatment of test objects

Treatment of a cylindrical specimen (15 x 30) cm was carried out by inserting a cylinder (15 x 30) cm into a treatment container which was first filled with brackish water until the test time was 28 days. Three hours before the test, the cylinder (15 x 30) cm was removed in the treatment container and dried so that the cylinder (15 x 30) cm was surface dry.

Figure 2.3 Treatment of cylindrical specimens (15 x 30) cm

Figure 2.4 Cylindrical specimen (15 x 30) cm surface dry

2.5. Testing the compressive strength of concrete

The compressive strength test was carried out at the age of 28 days with a total of 12 specimens for FAS, namely 0.35, 0.40 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. then the transducer device is installed on the test object and connected to the data logger for its 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 a cylindrical specimen (15 x 30) cm

Figure 2.7 Cylindrical test object (15 x 30) cm after testing

Figure 2.8 Cylindrical specimen (15 x 30) cm after testing

3. RESULTS AND DISCUSSION

3.1. Concrete Mix Design.

Table 3.1 Material composition for 1 m3 of concrete

Concrete Mixing Variations	FAS	Water (kg)	Cement (kg)	Coarse Aggregate (kg)	Rough sands (kg)	Fine Sand (kg)	Amount of Admixture (kg)	Total (kg)
STATPLA (0%)	0.35	192.62	550.33	1140.02	411.16	86.83	0.00	2380.96
STATPDA (0%)		192.62	550.33	1140.02	411.16	86.83	0.00	2380.96
SDATPDA (13%)		192.62	550.33	1140.02	411.16	86.83	71.54	2452.50
SDATPDA (16%)		192.62	550.33	1140.02	411.16	86.83	88.05	2469.01
STATPLA (0%)	0.40	192.62	481.54	1140.02	467.96	98.83	0.00	2380.97
STATPDA (0%)		192.62	481.54	1140.02	467.96	98.83	0.00	2380.97
SDATPDA (13%)		192.62	481.54	1140.02	467.96	98.83	62.60	2443.57
SDATPDA (16%)		192.62	481.54	1140.02	467.96	98.83	77.05	2458.02
STATPLA (0%)	0.50	192.62	385.23	1140.02	547.47	115.62	0.00	2380.96
STATPDA (0%)		192.62	385.23	1140.02	547.47	115.62	0.00	2380.96
SDATPDA (13%)		192.62	385.23	1140.02	547.47	115.62	50.08	2431.04
SDATPDA (16%)		192.62	385.23	1140.02	547.47	115.62	61.64	2442.60

3.2. Mixing of concrete and manufacture of specimens.

After stirring/mixing with an electric mixer (molen), the next step is to measure the slump value for each FAS 0.35, 0.40 and 0.50, the following is a picture of the measurement of the slump value

Figure 3.1 Slump value measurement

The results of the slump value measurements carried out are shown in table 3.2 below:

Table 3.2 Slump value for FAS 0.35

Concrete Mixing Variations	***temperature***		***Air Content (%)***	***Slump (cm)***
	Room	***Mortars***		
STATPLA (0%)	29	29	1.10	9.50
STATPDA (0%)	28	30	1.20	9.70
SDATPDA (13%)	28	30	1.20	8.90
SDATPDA (16%)	28	30	1.20	8.60
Average	28.25	29.75	1.18	9.18
Standard Deviation	0.50	0.50	0.05	0.51
Covariance (%)	1.77	1.68	4.26	5.58
Category	Very good	Very good	Very good	Good

Table 3.2. showed that the temperature of the concrete mixture met the requirements, namely ≤ 32°C with the very good category, the average air content obtained was 1.18% and also met the requirements, namely 0.5% - 1.75% with the very good category. The slump value obtained varies for each variation of concrete mixing but is still within the limits of 75-100 mm. The following is shown in Graph 3.2. The slump test value for FAS is 0.35.

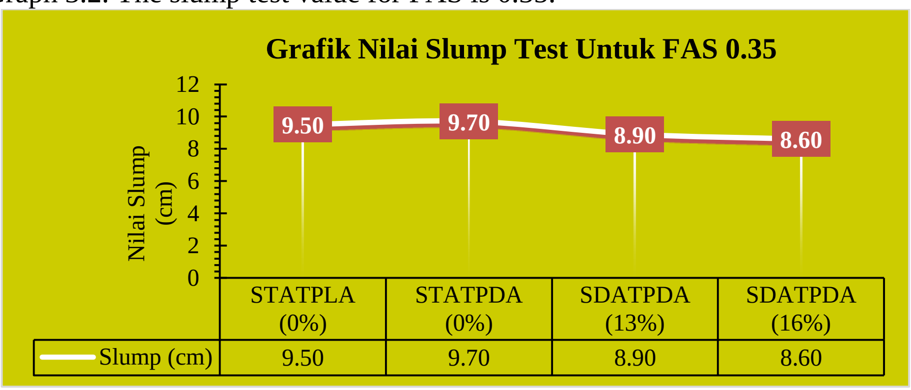

Figure 3.2 Graph of slump value for FAS 0.35

Table 3.3 Slump value for FAS 0.40

Casting Variations	*temperature*		*Air Content (%)*	*Slump (cm)*
	Room	*Mortars*		
STATPLA (0%)	30	31	1.10	9.80
STATPDA (0%)	29	29	1.20	10.20
SDATPDA (13%)	29	30	1.20	9.30
SDATPDA (16%)	29	30	1.30	9.10
Average	29.25	30.00	1.20	9.60
Standard Deviation	0.50	0.82	0.08	0.50
Covariance (%)	1.71	2.72	6.80	5.17
Category	Very good	Very good	Good	Good

Table 3.3. shows that the temperature of the concrete mix meets the requirements, namely ≤ 32°C, the average air content obtained is 1.20% and also meets the requirements, namely between 0.5% - 1.75% in the good category. The slump value obtained has variations for each variation of concrete mixing, for the average slump value it is still within the limits of 9.60 cm with a good category. The following is shown in graph 3.3. The slump test value for FAS is 0.40.

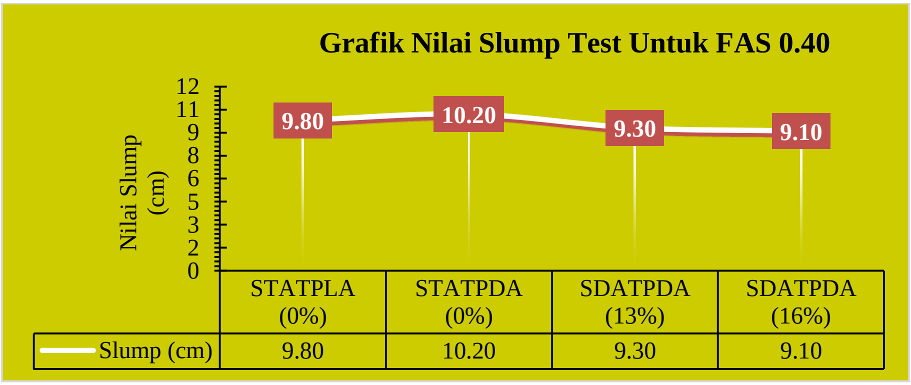

Figure 3.3 Graph of slump value for FAS 0.40

Table 3.4 Slump value for FAS 0.50

Casting Variations	*temperature*		*Air Content (%)*	*Slump (cm)*
	Room	*Mortars*		
STATPLA (0%)	30	31	1.10	11.40
STATPDA (0%)	28	29	1.20	11.70
SDATPDA (13%)	28	29	1.30	10.90
SDATPDA (16%)	29	30	1.30	10.40
Average	28.75	29.75	1.23	11.10
Standard Deviation	0.96	0.96	0.10	0.57
Covariance (%)	3.33	3.22	7.82	5.15
Category	Very good	Very good	Currently	Good

Table 3.4. shows that the temperature of the concrete mix meets the requirements, namely ≤ 32°C, the average air content obtained is 1.23% and also meets the requirements, namely 0.5% - 1.75% in the medium category. The slump value obtained has variations for each variation of mixing concrete, the average slump value is 11.10 cm with a good category. The following is shown in graph 3.4 the slump test value for FAS 0.50

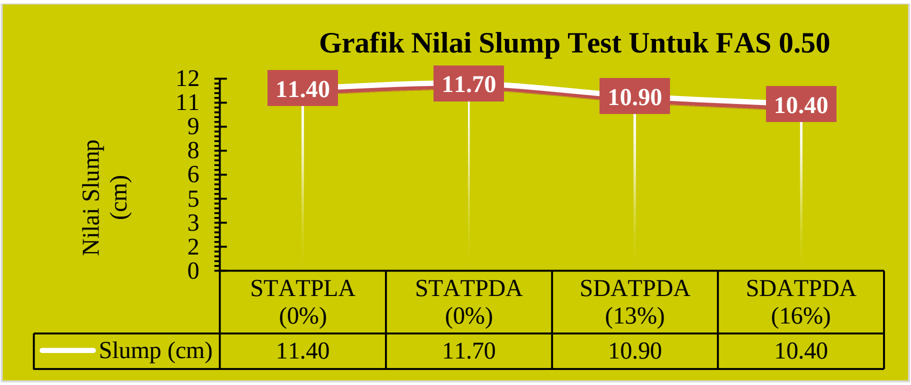

Figure 3.4 Graph of slump value for FAS 0.50

3.3. Test Results.

Concrete Compressive Strength Testing.

The results of the concrete compressive strength test at 28 days of age with FAS 0.35, 0.40 and 0.50 are shown in table 3.5 below.

Table 3.5 Results of concrete compressive strength testing with cylindrical specimens (15 x 30) cm

Testing Age	FAS	Concrete Compressive Strength (kg/cm2)			
		STATPLA	STATPDA	SDATPDA (13%)	SDATPDA (16%)
28 days	0.35	283.20	108.89	238.67	250.67
		285.42	113.25	244.44	257.77
		272.09	108.89	248.89	262.22
Average		***280.24***	***110.34***	***244.00***	***256.89***
28 days	0.40	265.42	91.46	229.78	241.78
		272.09	93.65	236.44	248.44
		278.76	98.00	245.33	257.33
Average		***272.09***	***94.37***	***237.18***	***249.18***
28 days	0.50	233.02	76.22	191.56	200.89
		243.91	71.87	198.22	207.55
		239.56	74.05	186.89	198.24
Average		***238.83***	***74.05***	***192.22***	***202.23***

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

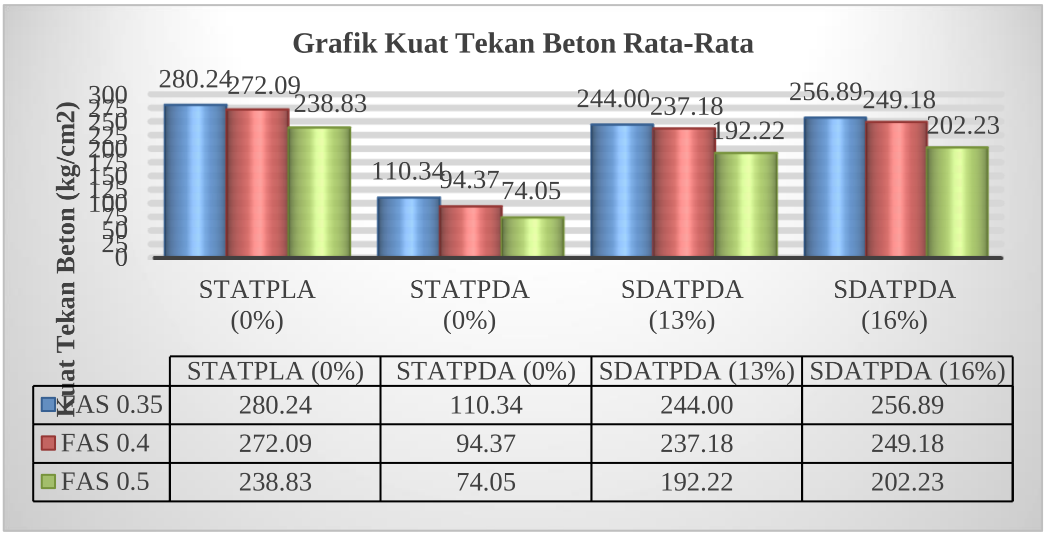

Figure 3.5 Graph of average concrete compressive strength for FAS 0.35, 0.40 and 0.50

Table 3.6 Comparison of the compressive strength of concrete FAS 0.35 with FAS 0.40.

Concrete Mixing Variations	Average Compressive Strength (kg/cm2) For FAS 0.35	Average Compressive Strength (kg/cm2) For FAS 0.40	Comparison of Average Compressive Strength (kg/cm2) FAS 0.35 with FAS 0.40	Information
STATPLA (0%)	280.24	272.09	2.91 %	decrease in the compressive strength of concrete
STATPDA (0%)	110.34	94.37	14.47 %	decrease in the compressive strength of concrete
SDATPDA (13%)	244.00	237.18	2.79 %	decrease in the compressive strength of concrete
SDATPDA (16%)	256.89	249.18	3.00 %	decrease in the compressive strength of concrete

Table 3.6 shows that the average compressive strength value for STATPLA (0%) decreased the average compressive strength by 2.91%, STATPDA (0%) decreased the average compressive strength by 14.47%, SDATPDA (13 %) there was a decrease in the average compressive strength of 2.79% and SDATPDA (16%) there was a decrease in the average compressive strength of 3.00%. The largest decrease in average compressive strength occurred in STATPDA (0%), namely 14.47%, and the smallest average decrease in compressive strength occurred in SDATPDA (13%), which was 2.79%. The results of the comparison of the average compressive strength of FAS 0.35 with FAS 0.40 are shown in the following graph 3.6.

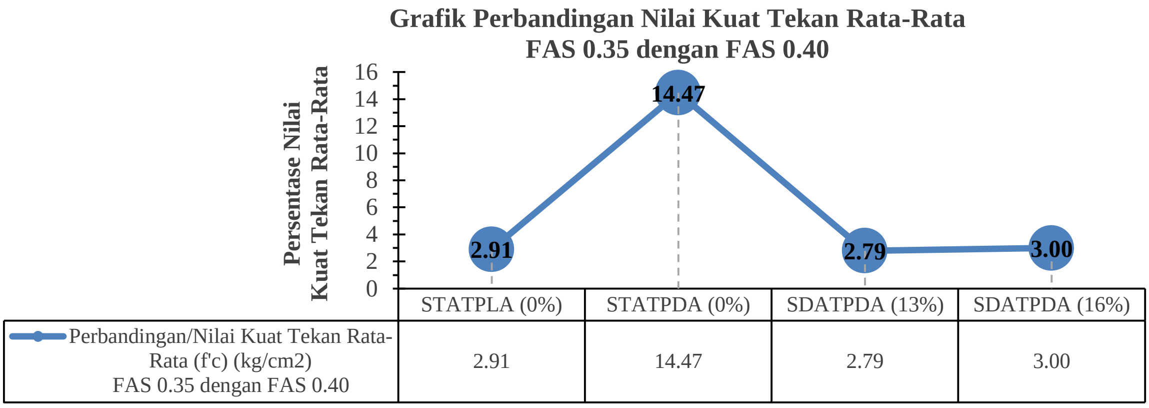

Figure 3.6 Graph of comparison of the average compressive strength value of FAS 0.35 with FAS 0.40

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

Concrete Mixing Variations	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
STATPLA (0%)	280.24	238.83	14.77	decrease in the compressive strength of concrete
STATPDA (0%)	110.34	74.05	32.89	decrease in the compressive strength of concrete
SDATPDA (13%)	244.00	192.22	21.22	decrease in the compressive strength of concrete
SDATPDA (16%)	256.89	202.23	21.28	decrease in the compressive strength of concrete

Table 3.7 shows that the average compressive strength value for STATPLA (0%) decreased the average compressive strength by 14.77%, STATPDA (0%) decreased the average compressive strength by 32.89%, SDATPDA (13 %) there was a decrease in the average compressive strength of 21.22% and SDATPDA (16%) there was a decrease in the average compressive strength of 21.28%. The largest decrease in average compressive strength occurred in STATPDA (0%), namely 32.89%, and the smallest average decrease in compressive strength occurred in SDATPDA (13%), amounting to 21.22%. The results of the comparison of the average compressive strength of FAS 0.35 with FAS 0.50 are shown in the following graph 3.7.

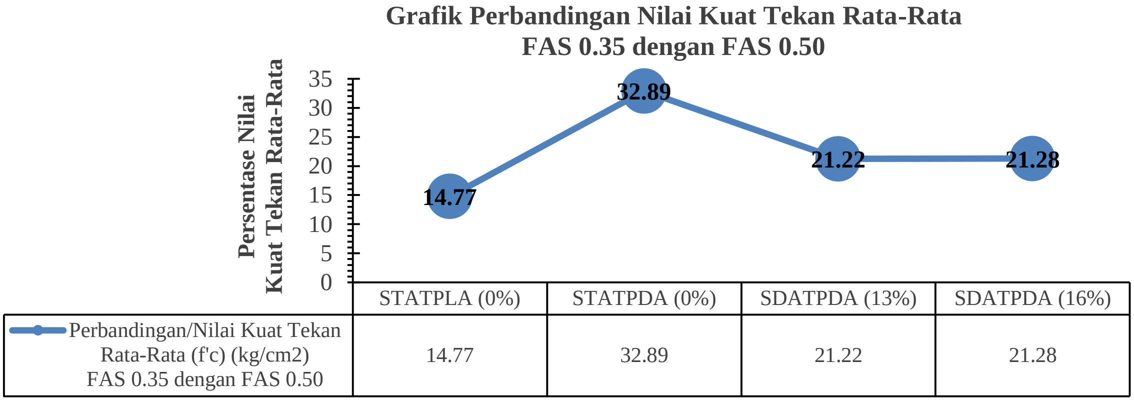

Figure 3.7 Graph of comparison of the average compressive strength value of FAS 0.35 with FAS 0.50

Table 3.8 Comparison of the compressive strength values of FAS 0.40 and FAS 0.50.

Concrete Mixing Variations	**Average Compressive Strength (kg/cm2) For FAS 0.40**	**Average Compressive Strength (kg/cm2) For FAS 0.50**	**Comparison of Average Compressive Strength (kg/cm2) FAS 0.40 with FAS 0.50**	**Information**
STATPLA (0%)	272.09	238.83	12.22	decrease in the compressive strength of concrete
STATPDA (0%)	94.37	74.05	21.53	decrease in the compressive strength of concrete
SDATPDA (13%)	237.18	192.22	18.96	decrease in the compressive strength of concrete
SDATPDA (16%)	249.18	202.23	18.84	decrease in the compressive strength of concrete

Table 3.8 shows that the average compressive strength value for STATPLA (0%) decreased the average compressive strength by 12.22%, STATPDA (0%) decreased the average compressive strength by 21.53%, SDATPDA (13 %) there was a decrease in the average compressive strength of 18.96% and SDATPDA (16%) there was a decrease in the average compressive strength of 18.84%. The biggest decrease in the average compressive strength occurred in STATPDA (0%), namely 21.53%, and the smallest average decrease in compressive strength was in STATPLA (0%), which was 12.22%. The results of the comparison of the average compressive strength of FAS 0.40 with FAS 0.50 are shown in the following graph 3.8.

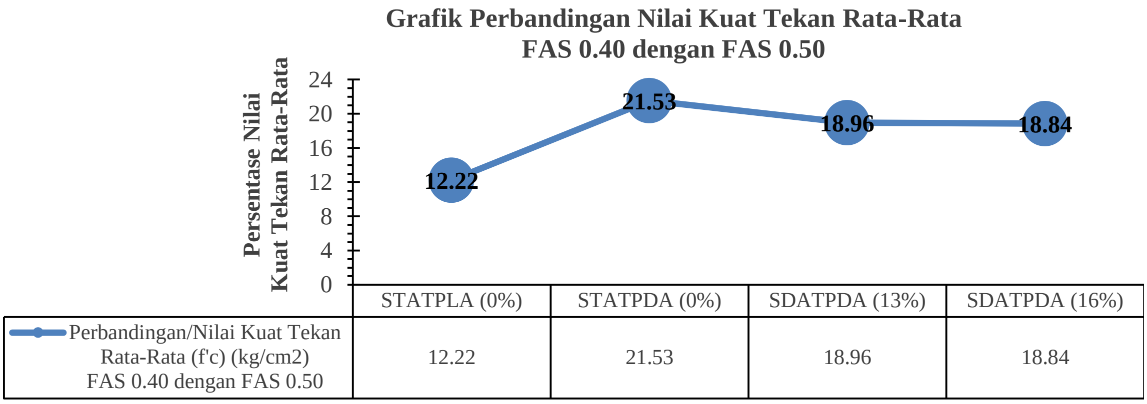

Figure 3.8 Graph of comparison of the average compressive strength value of FAS 0.40 with FAS 0.50

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

Concrete Mixing Variations	FAS	Average Concrete Absorption	Information
STATPLA (0%)	0.35	4.93	Medium quality concrete
STATPDA (0%)		5.91	Poor quality concrete
SDATPDA (13%)		5.20	Poor quality concrete
SDATPDA (16%)		5.14	Poor quality concrete
STATPLA (0%)	0.4	5.94	Poor quality concrete
STATPDA (0%)		6.90	Poor quality concrete
SDATPDA (13%)		6.17	Poor quality concrete
SDATPDA (16%)		6.12	Poor quality concrete
STATPLA (0%)	0.5	7.95	Poor quality concrete
STATPDA (0%)		8.80	Poor quality concrete
SDATPDA (13%)		8.15	Poor quality concrete
SDATPDA (16%)		8.11	Poor quality concrete

From table 3.9 it shows that for FAS 0.35 only STATPLA (0%) has moderate concrete quality, for STATPDA (0%), SDATPDA (13%) and SDATPDA (16%) the concrete quality is not good. For FAS 0.4 and FAS 0.5, all variations of mixed concrete quality were not good, this was caused by the concrete not being compacted, causing poor concrete ductility.

4. CONCLUSION

Some conclusions that can be drawn from this research are as follows:

1. FAS 0.35 average concrete compressive strength for STATPLA is 280.24 kg/cm2, STATPDA is 110.38 kg/cm2, SDATPDA (13%) is 244.00 kg/cm2 and SDATPDA (16%) is 256.89 kg/cm2.
2. FAS 0.40 average concrete compressive strength for STATPLA is 272.09 kg/cm2, STATPDA is 94.37 kg/cm2, SDATPDA (13%) is 237.18 kg/cm2 and SDATPDA (16%) is 249.18 kg/cm2.
3. FAS 0.50 average concrete compressive strength for STATPLA is 238.83 kg/cm2, STATPDA is 74.05 kg/cm2, SDATPDA (13%) is 192.22 kg/cm2 and SDATPDA (16%) is 202.23 kg/cm2.

4. The results of the comparison of the average compressive strength between FAS 0.35 and FAS 0.40 showed that the largest decrease in average compressive strength was in STATPDA (0%) by 14.47% and the smallest decrease was in SDATPDA (13%) by 2.79%.
5. The results of the comparison of the average compressive strength of FAS 0.35 with FAS 0.50 showed that the largest decrease in average compressive strength was in STATPDA (0%) by 32.89% and the smallest decrease was in SDATPDA (13%) by 21.22%.
6. The results of the comparison of the average compressive strength of FAS 0.40 with FAS 0.50 showed that the largest decrease in average compressive strength was in STATPDA (0%) by 21.53% and the smallest decrease was in STATPLA (0%) by 12.22%.

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