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ADDING CALCIUM INFLUENCE ON COMPRESSIVE STRENGTH OF MORTAR WITH DIFFERENT CEMENT VARIATIONS

Khairil Yanuar, Abdul Hafizh Ihsani, Faryanto Effendi, Muhammad Suhaimi, Ruspiansyah
Politeknik Negeri Banjarmasin, Indonesia
Email: khairil@poliban.ac.id, abdulhafizhihsani@gmail.com, ferindi196402@poliban.ac.id, muhsuhaimi60@gmail.com, ruspipoliban@poliban.ac.id

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Abstract

Mortar is a mixture of binder and sand in a certain ratio, the binder is cement and lime. This test aims to determine the results of the compressive strength of mortar aged 3,7,14, and 28 days on variations of cement and lime mixture. The fine aggregate used in this test is Barito Sand which is included in zone 2. With the composition of the mixture used is 1 pc : 5 ps for cement and sand, the mixture used for cement, lime and sand is 1 pc : 1_4^1kp : 5 ps. From the results of this study with the same mixture proportions, the compressive strength for the variation of cement conch (PCC) = 7.40 MPa, the variation of cement gresik (PPC) = 10.41 MPa, the variation of cement conch with a mixture of lime = 4.54 MPa and strong Press the mortar for the variation of Gresik cement with a mixture of lime = 7.90 MPa. It can be concluded that the compressive strength of mortar for cement conch with a mixture of lime is higher than the variation of cement conch, gresik and conch with a mixture of lime.

Introduction

Mortar is a mortar consisting of fine aggregate (sand), binder (clay, lime, portland cement) and water. The function of mortar is as a binding matrix for the constituent parts of a construction, both structural and non-structural. The use of mortar for construction of a structural nature, such as masonry mortar for foundation structures, while non-structural ones, such as masonry mortar for infill walls.

Considering the importance of mortar as part of the load-bearing construction, the use of mortar must comply with the standard specification of SNI-03-6825-2002. The mortar specification standard refers to its compressive strength, namely the mortar's ability to accept loads. Similar to concrete, the compressive strength of mortar is influenced by several factors, including water-cement and density factors, type of cement, amount of cement, aggregate properties and also the age of the mortar. , because usually the mortar will be loaded with a construction on it before reaching the age of 28 days. Therefore, compressive strength tests at the stages of mortar hardening age, namely, 3, 7, 14, and 28 days need to be carried out to

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control the quality of the compressive strength to be as expected, which is not less than the compressive strength required in the bestek. The evaluation results are used to determine whether the compressive strength of the mortar meets the requirements or not. So a value that can be used to express the relationship between the compressive strength at the beginning of the mortar age and the compressive strength of the mortar characteristics is needed.

Method

1. Making Test Items

The manufacture of mortar specimens with variations to obtain appropriate results, respectively in each mortar composition and the proportion of mortar mixture in each manufacture of test specimens is made based on SNI 03-6882-2002.

Table 1
Number of Test Objects For Mortar (Cube 5 cm x 5 cm)

No	Sample Name And Composition	Mortar Age				Number of Test Items
		3 Days	7 Days	14 Days	28 Days	
1	Semen Conch 1Sp : 5 Ps	3	3	3	6	15
2	Semen Gresik 1 Sp : 5 Ps	3	3	3	6	15
3	Semen Conch + Kapur 1 Sp : $1\frac{1}{4}$ Kp : 5 Ps	3	3	3	6	15
4	Semen Gresik + Kapur 1 Sp : $1\frac{1}{4}$ Kp : 5 Ps	3	3	3	6	15
Total						60

1. Flowchart

In this study, several work steps were carried out as listed in the flow chart of the research stages in Figure 1.

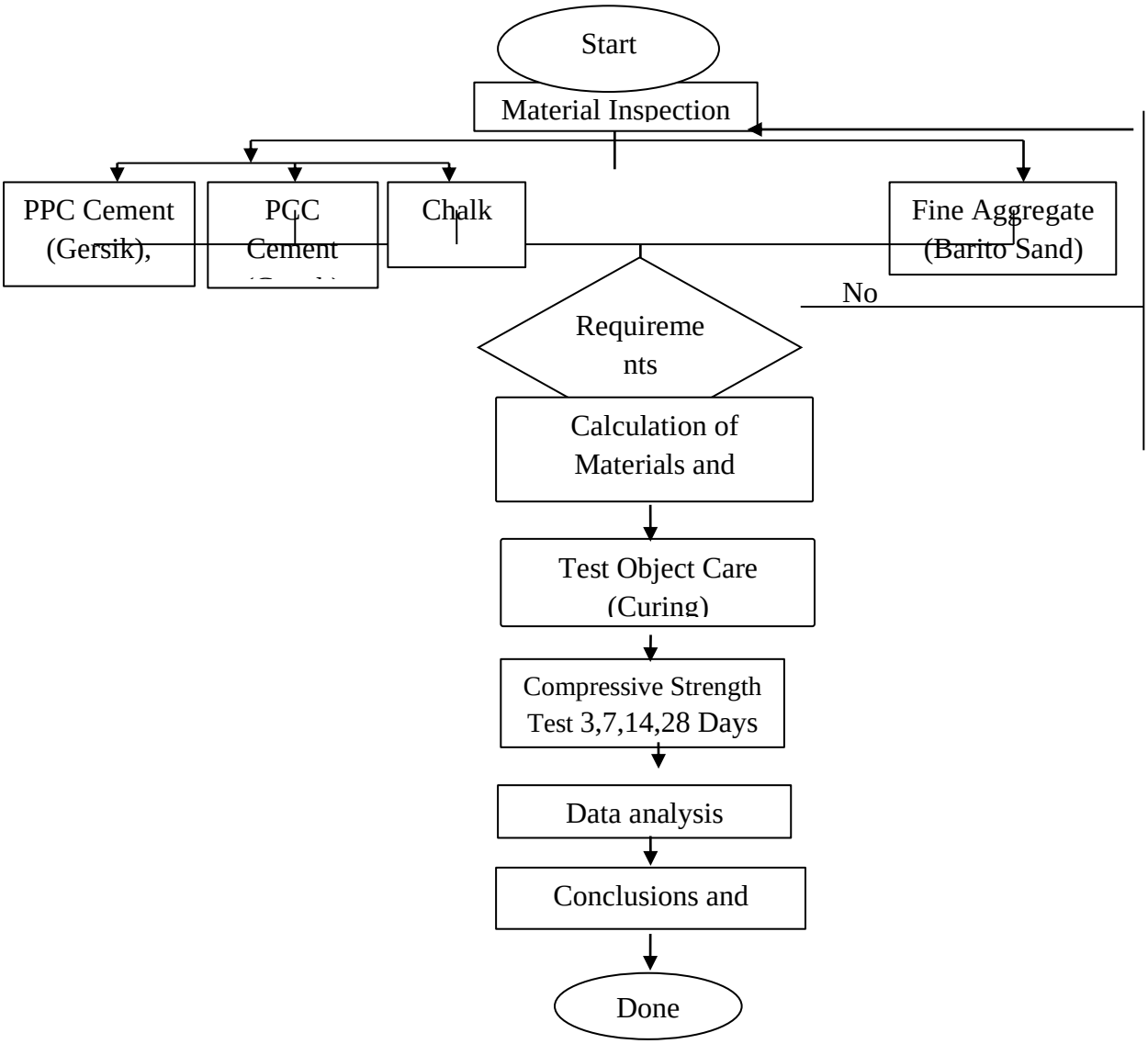


Figure 1
Research Method Flowchart

Results and Discussion

1. Fine Aggregate Test Results (Barito Sand)

The fine aggregate used is barito sand, by testing the mud content, organic matter content, specific gravity, absorption, bulk density, water content, sieve analysis, the results of the fine aggregate test (barito sand) can be seen in table 2.

Table 2
Fine Aggregate Test Results (Barito Sand)

No	Kinds of Inspection	Barito Sand		Specification
		Standard/Reference	Result	SII 0052-80
1	Sludge levels %	SNI 03-4142-1996	0,91%	Max. 5%
2	Organic Substance	SNI 03-2816-1992	No. 4	Color Standard No. 2

	Level				
3	SSD Specific Gravity		SNI 03-1870-1990	2.66 gr	Min. 2.5
4	Absorption	%	SNI 03-1870-1990	0,45%	Max. 3%
5	Water content	%	SNI 03-1971-1990	2,98%	
6	Grading Arrangement Aggregate :				Zona II
	No.4		SNI 03-1968-	100	90-100
	No.8		1990	87,66	85-100
	No.16			80,42	75-100
	No.30			52,20	60-79
	No.50			16,31	12-40
	No.100			1,69	0-10

From the test results it can be concluded that fine aggregate (barito sand) is included in SII 0052-80 and can be used for mortar mixtures.

1. Cement Test Results

In the cement testing carried out, there were 2 types of 3 types of cement, namely Gresik cement (PPC), Tonasa cement and Tiga Roda (PCC). The test results of the three cements can be seen in table 2. to table 3.

Table 3
Semen Gresik (PPC) Test Results

No	Kinds of Inspection	Granulated Cement (PPC)		Specification
		Reference Standard	Result	
1	Specific gravity	AASHTO T-133-74	3,07	-
2	Subtlety			
	- stuck filter No.100	AASHTO T-128-76	0,12%	-
	- stuck filter No.200		15,44%	-
3	Consistency	AASHTO T.19-74	24,67%	-
4	Binding Time	AASTHO-13174		SNI 15-0302-2004
	- Beginning of Bonding		125 Minutes	Min. 45 Minutes
	- End of Binding		195 Minutes	Maks. 7 O'clock

Table 4
Cement Conch Test Results (PCC)

No	Kinds of Inspection	Granulated Cement (PPC)		Specification
		Reference Standard	Result	
1	Specific gravity	AASHTO T-133-74	3,23	-
2	Subtlety			
	- stuck filter No.100	AASHTO T-128-76	0%	-
	- stuck filter No.200		1,76%	-
3	Consistency	AASHTO T.19-74	25,67%	-
4	Binding Time	AASTHO-13174		SNI 15-7064-2004
	- Beginning of Bonding		129 Minutes	Min. 45 Minutes
	- End of Binding		210 Minutes	Maks. 375 Minutes

Table 5
Chalk Test Results

No	Kinds of Inspection	Three Wheel Cement (PCC)	
		Reference Standard	Result
1	Specific gravity	AASHTO T-133-74	3,03
2	Subtlety		
	- retained filterNo.100	AASHTO T-128-76	3,72
	- stuck filter No.200		22,7

Table 6
Cement Conch Fastening Time (PCC) Judging

Decrease Observation Number	Drop Time (Minutes)	Decrease (mm)
1	30	41
2	45	41
3	60	39
4	75	39
5	90	35
6	105	33
7	120	31
8	135	21
9	150	12
10	165	4
11	180	2
12	195	1
13	210	0

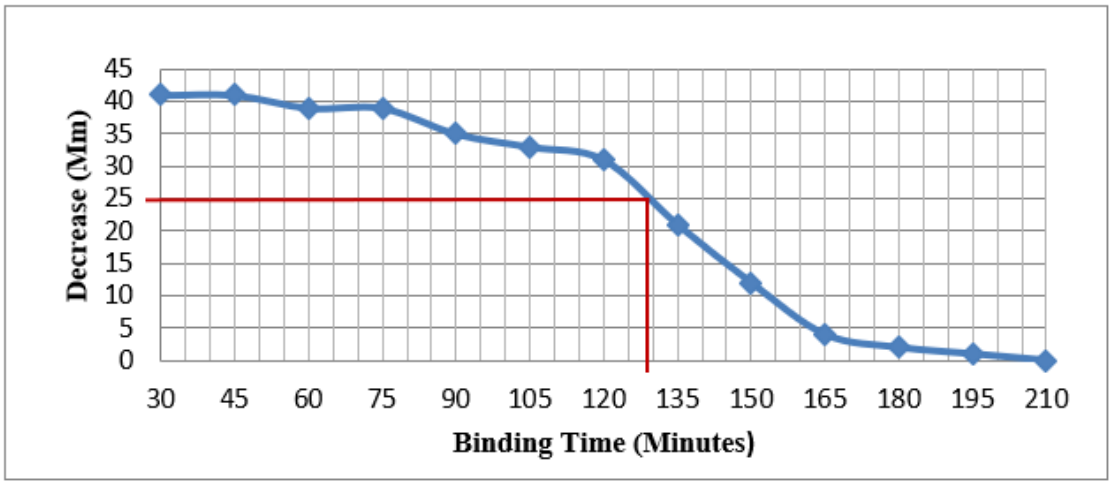
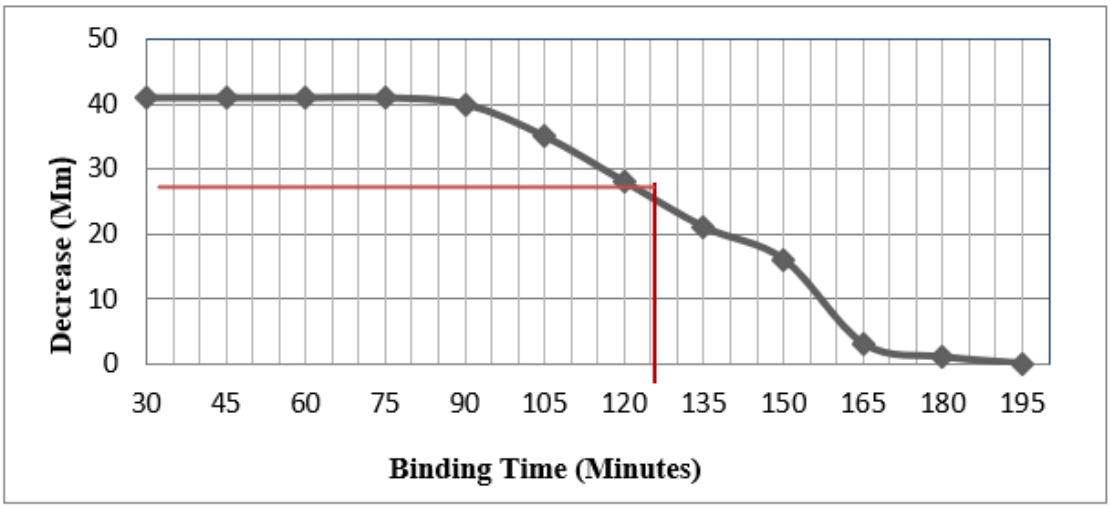


Table 7
Semen Gresik (PPC) Bonding Time Judgment

Decrease Observation Number	Drop Time (Minutes)	Decrease (mm)
1	30	41
2	45	41
3	60	41
4	75	41
5	90	40
6	105	35

7	120	28
8	135	21
9	150	16
10	165	3
11	180	1
12	195	0



From the results of cement testing, it can be concluded that:

1) The specific gravity of greek cement and lime is smaller than that of conch cement.
2) Of the two types of cement, conch cement is smoother than gresik cement.
3) Semen Gresik has a smaller consistency.
4) The initial setting time of Gresik cement is faster.

1. Calculation of Mortar Mixed Materials (Mix Design)

For the calculation of the planning of the mortar mix (mix design) according to SNI 03-6882-2002 the materials used such as water, fine aggregate of barito sand, lime and cement used are greek cement and conch, the proportions of the mixture of the 2 types of cement, fine aggregate, lime and water is all the same.

The calculation of mixed materials is in tables 7 to 8.

Table 8
Proportion of Gresik Cement Mixture (PPC) And Cement Conch (PCC)

Mixed Proportion	Portland Cement	Fine Aggregate (Sand)
Volume Proportion	1	5
Filling Weight (g/m³)	1250	1530
Modifying Factor	0,392	0,392
Material Weight (g)	490	2998,8

Mortar with a mixture composition of 1 part portland cement and 5 parts sand based on a volume ratio. Conversion of volume ratio to weight ratio is calculated as follows:

For 1 x Mixing, 3000 grams of sand is recommended.

Mixed one-time modifier	= 3000/(1530 x 5)	= 0,392
(Based on Sand Material)		
Portland cement weight	= 1 x 1250 x 0,392	= 490 g
Sand Weight	= 5x 1530 x 0,392	= 2998,8 g.
Water	= 425 ML	
Water Cement Factor	= 0.87	

One-mix modifier factor is the volume of material for one part in the volume ratio for one mix.

Table 9
Cement Mixture Proportion
Gresik+Lime and Cement Conch+Lime

Mixed Proportion	Portland Cement	Fine Aggregate (Sand)	Chalk
Volume Proportion	1	5	$1\frac{1}{4}$
Filling Weight (g/m³)	1250	1530	806
Modifying Factor	0,392	0,392	0,392
Material Weight (g)	490	2998,8	394,94

Mortar with a mixture composition of 1 part portland cement, lime and 5 parts sand should be tested. Based on the comparison for the conversion from the volume ratio to the weight ratio is calculated as follows:

Mixed one-time modifier	= 3000/(1530 x 5) = 0,392
Portland cement weight	= 1 x 1250 x 0,392 = 490 g
Chalk Weight	$=1\frac{1}{4}$x 806 x 0,392 = 394,94 g
Sand Weight	= 5x 1530 x 0,392 = 2998,8 g.
Water	= 410 ML
Water Cement Factor	= 0,84

One-mix modifier factor is the volume of material for one part in the volume ratio for one mix.

1. **Mortar Compressive Strength Test Results**

The results of the compressive strength test of mortar according to SNI – 03-6825-2002 For variations in the type of cement there are 15 test objects and are divided into 4 mortar ages, namely 3, 7, 14 and 28 days. From the mortar compressive strength test, the following results were obtained:

The results of the compressive strength test of a mixture of cement mortar (PPC) and conch (PCC) mortar Table 4.9. For more details, see Appendix 2.

Table 10
Mortar Strength Test Results

No	Test Objects And Composition	Strong Press			
		Age 3 Days	Age 7 Days	Age 14 Days	Age 28 Days
1	Mortar (Cement Conch) 1 Sp : 5 Ps	2.31	4.50	8.74	7.07
2		2.31	5.27	5.91	5.52
3		3.98	3.73	5.91	7.45
4					9.76
5					7.19
Average		**2.87**	**4.50**	**6.85**	**7.40**
1	Mortar (Semen Gresik)	1.80	3.34	11.05	9.25

2	1 Sp : 5 Ps	2.70	6.04	6.94	9.76
3		2.44	2.96	9.25	12.21
	Average	**2.31**	**4.11**	**9.08**	**10.41**
1	Mortar (Cement Conch+Lime) 1 Sp : $1\frac{1}{4}$ Kp : 5 Ps	6.94	10.92	6.42	3.85
2		3.85	4.63	5.14	3.34
3		5.14	3.34	11.05	3.60
4					5.40
5					2.83
6					8.22
	Average	**5.31**	**6.30**	**7.54**	**4.54**
1	Mortar (Semen Gresik+Lime) 1 Sp : $1\frac{1}{4}$ Kp : 5 Ps	5.01	6.17	6.42	11.05
2		5.14	6.17	6.04	6.94
3		4.63	6.81	6.94	6.42
4					7.19
	Average	**4.93**	**6.38**	**6.47**	**7.90**

From the results of mortar testing at the age of 3, 7, 14 and 28 days, there are several samples of test objects that must be removed because the results obtained are not in accordance with SNI due to non-technical errors so they must be removed.

The average compressive strength value shows that the average compressive strength of Gresik cement increases at the age of 28 days.

5. Graph of Mortar Test Results

Graph of Average Compressive Strength Against Mortar Age

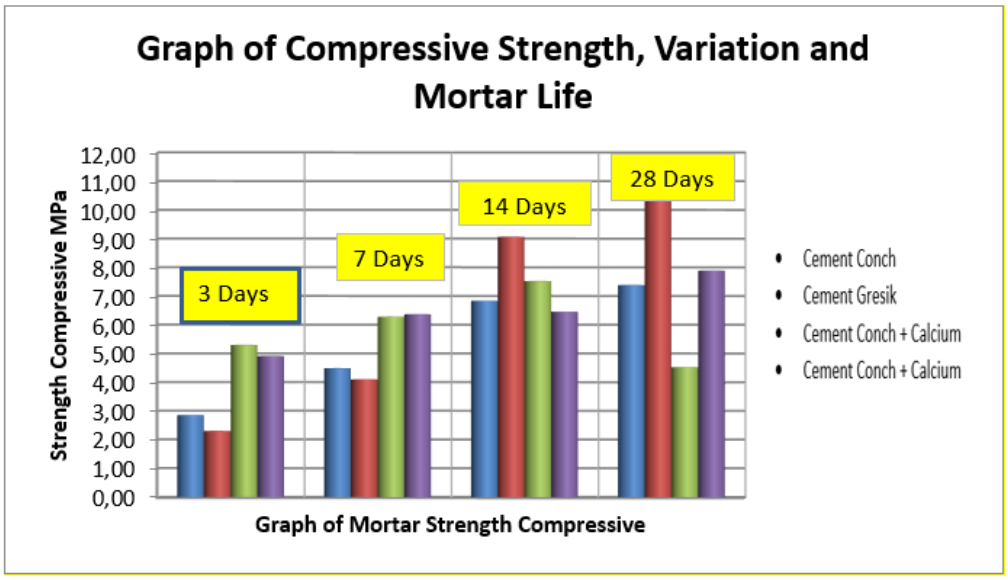


Figure 2
Comparison Graph of Compressive Strength with Mortar Age

The compressive strength of mortar for the use of Semen Gresik and Semen Conch from the age of 3 days to 28 days there was an increase in the compressive strength, compared to Cement Conch with the addition of lime at the age of 3 days to 14 days an increase in the age of 28 days decreased the average compressive strength, while For mortars that use the addition of lime, Semen Gresik with a mixture of lime, the results of the average

compressive strength of the age always increase and the normal without lime, Semen Gresik, the results increase as the age of the mortar increases.

6. Graph of Compressive Strength Against Mortar Age

The results of the compressive strength of mortar for each age, mortar can be seen in the graph of the results of the compressive strength.

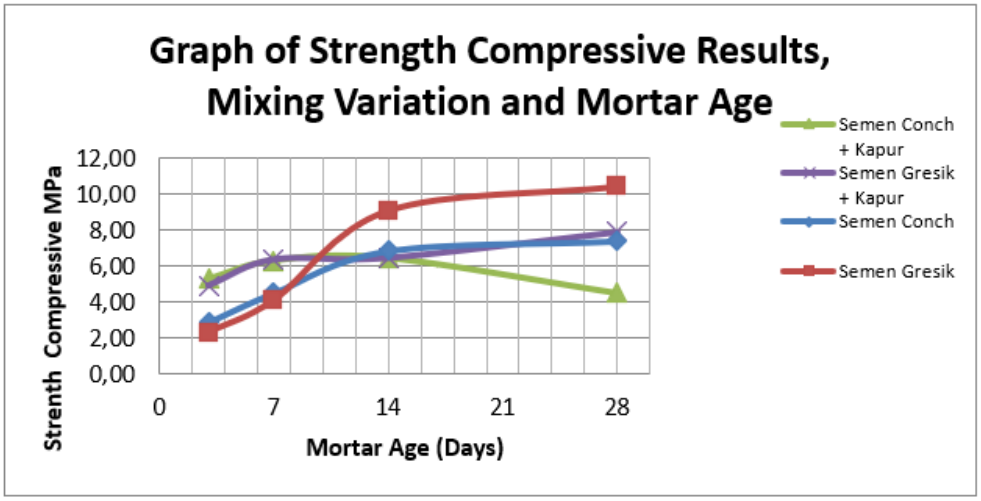


Figure 3
Graph of Compressive Strength Against Mortar Age

Mortar compressive strength value:

1. Aged 3 Days
   Conch cement with lime mixture yields 5.31 Mpa
2. 7 Days Old
   Cement Gresik with a mixture of lime yields 6.38 Mpa
3. Aged 14 Days
   Cement Gresik with a mixture of lime yields 9.08 MPa, and
4. Aged 28 Days
   Cement Gresik with a mixture of lime yields 10.41 M

Conclusion

From the results of research and discussion, it can be concluded as follows: 1. From all variations of the results of the compressive strength tested, it meets the requirements of type N Mortar, because Mortar type N is a mortar that has a strength of 5.2 MPa, for example, the test specimen of Gresik cement the result is 10.41 MPa, Semen Conch yields 7.40 MPa, and Semen Gresik with the addition of lime yields 7.90 MPa and those whose yield is below 5.2 MPa enter the requirements for type O mortar because it has a strength of 2.4 MPa for example Cement Conch with the addition of lime yield below mortar type N with a yield of 4.54 MPa at an average age of 28 days. 2. From the results of the average compressive strength value produced at the age of 3 days for the Cement Conch test with the addition of lime the results are higher than the cement conch test without mixed materials which results are lower than the average

existing test specimens, and for the age of 7 days of using Gresik cement with additional lime the results are also higher than 3 test objects, while at the age of 14 days there is a significant increase for Gresik cement without lime mixture, the results are better than the 3 existing variations, and at 28 days conch cement using lime mixture shows a lower compressive strength value compared to mortar using gresik cement with the addition of lime the results are higher in each predetermined age test.

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