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OVERVIEW OF THE MECHANICAL PROPERTIES OF *HIGH FLOWABILITY CONCRETE* USING LADUNG ANDESITE STONE WITH *SUPERPLASTICIZER*

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ABSTRACT

In the construction world, there are often problems with theof concrete in special constructions where normal concrete cannot be applied. Another obstacle that often occurs is waiting for the concrete to reach its optimum strength at the age of 28 days so that the next structural work can then be continued. Therefore, flow concrete with increased initial strength was developed. The process of making flow concrete in this study aims to use local aggregate of South Kalimantan andesite stone with an abrasion value of 13.8% as one of the new coarse aggregates with *superplasticizer Viscocrete 1050 HE* and *Plastiment VZ.*
This research is an experimental test in a laboratory with a cylindrical specimen with a diameter of 11 cm and a height of 22 cm. The levels of *Viscocrete 1050 HE* were 0%, 1%, 1.55% and 1.75% by weight of cement, while the levels of *Plastiment VZ were* 0.15% and 0.2%, respectively. Concrete mix planning refers to SNI-2834-2000 with fresh concrete tests including *slump test*, *slump flow test* and T_{500}. Testing of hard concrete is a test of compressive strength, tensile strength, and flexural strength of concrete. Parameters reviewed were paste setting time, concrete flowability, compressive strength, tensile strength, and flexural strength of concrete.
The results showed that the binding time increased with increasing levels ofusage *superplasticizer*. Fresh concrete testing all variations meet the requirements of flow concrete except normal concrete variations. The optimum levels for the test requirements of fresh concrete and hard concrete were found in the variation of *Viscocrete 1050 HE* 1.75% with a slump value of 23 cm, *slump flow* 650 mm, T_{500} 3 seconds, compressive strength 39.66 MPa, andtensile strength 2.51 MPa.

Keywords: Flow Concrete, Initial Strength Improvement, Andesite Stone, *Superplasticizer*

1. INTRODUCTION

In the construction world, problems are often encountered in theof concrete. In the implementation of construction, the flowability of concrete must meet the requirements and must also facilitate implementation. If during construction with tight reinforcement, normal concrete will not be able to enter the reinforcement cavities. This will cause problems such as segregation of concrete results in concrete strength will be reduced. Usually the general concept is that the higher the quality of the concrete,the *water ratio* the lower, so that the flowability of concrete to achieve high quality is difficult to achieve. So that the type of concrete was developed in the form of flow concrete.

In addition to the problem of the flowability of concrete, another obstacle in the field that often occurs is waiting for the concrete to reach its optimum strength at the age of 28 days so that only the next structural work can be continued. Then also as in the manufacture ofprestressed concrete *post tension*, where the withdrawal of reinforcement is carried out after the concrete reaches its optimum strength. Therefore, if this problem is not followed up, it will cause the construction project to run longer and be inefficient. As is the case withconstruction problems *rigid pavement* where the road is made of cast concrete. The road is a transportation access that must be used at all times, so the casting of concrete requires fast time, so that concrete is needed that quickly reaches the optimum strength so that the casting of the road can run sustainably. One of the modifications of concrete is concrete with an increase in strength at an early age (*early strength concrete*).

One of the coarse aggregate materials that can be used for making concrete is andesite stone. Andesite rock is a type of volcanic igneous rock, extrusive, intermediate composition, with an aphanitic to porphyritic texture. In a general sense, andesite is a transitional type betweenbasalt and dacite, with a range of silicon dioxide (SiO_2) is 57-63%

so that it can be classified as a*mineral admixture*and is pozzolanic which can improve the quality of the mixture (Wikimedia, 2006). . Currently andesite rock is used as an aggregate material for the construction sector, especially infrastructure such as roads, bridges, buildings, irrigation, as well as housing and other public facilities. The andesite that will be used comes from Kotabaru Regency, South Kalimantan Province.

Based on the exposure and the potential use of the material aggregate locally in south Kalimantan as a mixture of concrete and the ability of the flow of concrete it is necessary to do further research focused on the use of coarse aggregate in the form of andesite and *superplasticizer* to be concrete to achieve the requirements of *high flowability* and *early strength concrete* (ESC) for *flowing concrete*.

2. LITERATURE REVIEW

Flow

Concrete Flow concrete is concrete with a slump value of more than 19 cm (ASTM-C1017). Flow concrete is produced with a *superplasticizer* which is needed to spread cement particles evenly and separate them into fine particles. The composition of coarse aggregate and fine aggregate must also be considered in the flow concrete production process, considering that the greater the proportion of fine aggregate can increase the flowability of fresh concrete but if too much fine aggregate is used, it can reduce the compressive strength of the resulting concrete, on the contrary if there is too much aggregate. Coarse can increase the risk of segregation in concrete, while the use of filler is needed to increase the viscosity of the concrete in order to avoid *bleeding* and *segregation* (Sebayang *et al*., 2012)**.**

Early Strength Concrete Early Strength Concrete

Early strength concrete (ESC) is concrete that can reach structural concrete strength (compressive strength > 21 Mpa) within 24 hours after casting on site. Concrete can be said to beESC when the concrete is able to reach 50% of the design compressive strength at the age of 24 hours with a water-cement ratio ranging from 0.3 to 0.4. Generally, it takes 7 to 14 days for the concrete to fully harden and reach a minimum compressive strength of 0.7 to 0.85 fc' (Yasin et al., 2017)

Superplasticizers

Superplasticizers in concrete are chemical additives that are specifically used to improve the quality of concrete. by reducing the use of water (*water reducing*) (Indoprecast, 2020). *Superplasticizer* is an added material that is inserted into fresh concrete which can increase the slump value to facilitate the workability of the concrete. *Superplasticizer* can also improve the quality of concrete due to water reduction so that the cement water factor becomes lower with an increased slump (Umiati *et al*., 2019)

AndesiteAndesite

Rockrock is a type of volcanic igneous rock, extrusive, medium composition, with an aphanitictexture to porphyritic. In general, andesite is a kind of intermediate between basalt and dacite with a range of silicon dioxide (SiO_2)is 57-63% so that it can be classified as additional material mineral *(mineral admixture)* and is capable of improving the quality pozzolan mix (Wikimedia,2006).

Concrete Test

1) Fresh Concrete Test

(1) Slump Test

It is a test to determine the decrease in height at the center of the top surface of the concrete which is measured immediately after the slump test mold is lifted. The test equipment must be a mold made of metal material that is not sticky and does not react with cement paste. The thickness of the metal must not be less than 1.5 mm and when formed by a spinning process, there must be no point in the mold that is less than 1.15 mm thick. The test method is to addfresh concrete with 3 parts as much as 1/3 slump tool. Each stage is compacted with an iron puncture of 25 punctures. After doing as many as 3 stages, remove the concrete mixture vertically with a slump tool so that there will be a decrease in the mix. After the concrete shows a settlement on the surface, immediately measure the slump by determining the vertical difference between the top of the mold and the center of the top surface of the concrete (SNI 1972-2008, 2008).

(2) Slump Flow and T_{500}

Is a test to assess *flowability* in the absence of obstructions. The result is also an indication of the *filling ability* of the concrete. *Filling ability* is the ability of fresh concrete to flow and fill all spaces in the formwork, under its own weight (EFNARC, 2005). The working principle of fresh concrete is poured into a cone that has been placed on amold *slump flow*. Then the cone is pulled up, the time from the start of the upward movement of the cone until when the concrete has flowed to a diameter of 500 mm is measured, this is the time T_{500} . The Trequirement is$_{500}$ met if the concrete that comes out can reach a diameter of 500 mm in 3-6 seconds after the slump is pulled. Then thevalue is *slump flow* obtained until the concrete has flowed until it stops. The *slump flow value* forconcrete *high workability* is at least 550-850 mm with a tolerance of ±50 mm

2) Hard Concrete Testing

(1) Compressive Strength Test

The procedure for carrying out the compressive strength test is based on SNI 03-1974-1990, where the test object is placed in a press machine. uniform or centric. Strength stress is definedby the maximum axial load that can be accepted until failure occurs . The formulation of the compressive strength is calculated by dividing the load per unit area in Equation 2.1, namely:

$$fc' = \frac{P}{A} \quad \text{..........} \quad 2.1$$

Where :

f_c' = compressive strength of concrete (MPa)

P = maximum load (N)

A = cross-sectional area of the test object (mm^2)

(2) Tensile Strength Test The

Procedure for performing the tensile strength test is based on ASTM C496-90. Where theconcrete is given an indirect tensile stress, where the concrete cylinder is laid down and pressure is applied to give rise to a tensile stress in the concrete, this test is also called the indirect tensile strength test. The formulation of tensile strength can be seen in Equation 2.2 below:

$$fct = \frac{2P}{\pi l d} \quad \text{..........} \quad 2.2$$

Where:

f_{ct} = tensile strength (MPa)

P = maximum load (N)

l = length of test object (mm)

d = diameter of test object (mm)

3. RESEARCH METHODOLOGY

1) Literature study on flow concrete, concrete with an increase in initial strength, and the effect of using andesite coarse aggregate.
2) Inspection of basic materials of coarse aggregate, fine aggregate and cement.
3) Planning mix design with SNI 2834 2000 and determining the variation of casting samples
4) Penetration testing and *setting time for* each variation.
5) Casting of concrete for each variation
6) Testing of fresh concrete consisting of *slump test, slump flow test*, and T_{500} for each variation. Casting of concrete into formwork
7) Curing of concrete to the specified age
8) Testing of hard concrete which consists of compressive testing of concrete and split tensile test of concrete.
9) Data analysis and drawing conclusions.

Research Design

1) The concrete quality target is set at *fc*' = 40 MPa,
2) Coarse aggregate used is andesite stone from Kotabaru Regency, South Kalimantan.
3) The fine aggregate used is sand from the Barito River, South Kalimantan. 4) The cement used is Three Wheel Cement which is a composite portland cement (PCC).
4) The *superplasticizer* used is *Viscocrete 1050 HE* and *Plastiment VZ*. 6) The size of the cylindrical test object used is a PVC pipe with a diameter of 11 cm and a length of 22 cm.
5) Testing the compressive strength of the study using the ages of 1 day, 3 days, 7 days, 14 days, and 28 days where each day will use 3 samples for each variation.
6) The tensile strength test was carried out at the age of 28 days, where each variation will use 3 samples.
7) The tests carried out aretesting of *high flowability* concrete, namely the s*lump test* and *slump flow test* as well as testing the mechanical properties, namely the compressive strength, and tensile strength

Nomenklatur

Nomenclature that will be used in working on each variation to make it easier to check the name on each sample of the test object can be seen in Table 3.1

.Table 3.1 Variation Nomenclature

No.	Code	Explanation
1	HF-V0-VZ0	Andesite Stone Concrete without the Addition of *Superplasticizer*
2	HF-V1-VZ0	Andesite Stone Concrete with the Addition of *Viscocrete 1050 HE* of 1.0%
3	HF-V1,55-VZ0	Andesite Stone Concrete with the Addition of *Viscocrete 1050 HE* of 1.55%
4	HF-V1,75-VZ0	Andesite Stone Concrete with Addition of *Viscocrete 1050 HE* by 1.75%
5	HF-V1,55-VZ0,15	Andesite Concrete with Addition of *Viscocrete 1050 HE* by 1.55% + *Plastiment VZ* 0.15%
6	HF-V1,55-VZ0,2	Andesite Concrete with Addition of *Viscocrete 1050 HE* of 1.55% + *Plastiment VZ* 0.20%

Mix Design

Calculation of the *mix design* of concrete refers to SNI 03-2834-2000 with some adjustments to flow concrete requirements with an increase in initial strength. Material requirement per m^3can be seen in Table 3.2.

Table 3.2 Concrete Mixture Material Requirement for Each Variation per m^3

Variation of	Casting Material per m3					
	Aggregate Fine (kg)	Aggregate Rough (kg)	Cement (kg)	Water (liter)	*Viscocrete 1050* (liter)	*Plastiment VZ* (liter)
HF-V0-VZ0	826,40	1051,79	485,26	146,55	0	0
HF-V1.0-VZ0	826,40	1051,79	485,26	98,95	4,85	0
HF-V1.55-VZ0	826,40	1051,79	485,26	96,95	7,52	0
HF-V1.75-VZ0	826,40	1051,79	485,26	96,22	8,49	0
HF-V1.55-VZ0.15	826,40	1051,79	485,26	96,35	7,52	0,73
HF-V1.55-VZ0.2	826,40	1051,79	485,26	96,15	7,52	0,97

4. RESULT AND DISCUSSION

Results of Examination of Coarse Aggregates

Aggregates used in the form of rock originating from Batu Ladung, Kotabaru Regency, the results of the inspection can be seen in Table 4.1

Table 4.1 Coarse Aggregate

ExaminationTesting	Results	Unit
Moisture Content	1,25	%
Mud Content	3,63	%
Aggregate Wear	13,8	%
Weight Loss Volume	1,39	gr/cm^3
Weight Volume Shake	1,53	gr/cm^3
Weight Volume Solids	1,55	gr/cm^3
Apparent Specific Gravity	2,77	
Bulk Specific Gravity on dry basic	2,67	
Bulk Specific Gravity SSD Basic	2,71	
Aggregate Zone	2	
Fine-Grain Modulus (MHB)	7,20	

Fine Aggregate Inspection Results

Aggregate used in the form of sand from the Barito River. The results of the examination can be seen in Table 4.2.

Table 4.2 Fine Aggregate

ExaminationTesting	Results	Unit
Moisture Content	2,28	%
Sludge Content	3,10	%
Organic Content	No.2	
Weight Loss Volume	1,52	gr/cm^3
Weight Volume Shake	1,58	gr/cm^3
Weight Volume Solids	1,63	gr/cm^3
Apparent Specific Gravity	2,57	
Bulk Specific Gravity on dry basic	2,42	
Bulk Specific Gravity SSD BasicGravity	2,48	
Aggregate Zone	1	
Fine Modulus	2,89	

Cement Inspection Results

Used is three-wheel composite Portland cement the results of the examination can be seen in Table 4.3.

Table 4.3 Cement Inspection Results

ExaminationTesting	Results	Unit
Specific Gravity	3.16	
Release Volume Weight	1.00	gr/cm^3
Shaking Volume Weight	1.05	gr/cm^3
Solid Volume Weight	1.20	gr/cm^3

Checks The *Setting Time*

Cement time is carried out by the weight of cement 500 grams for each variation. The table of test results can be seen in Table 4.4.

Table 4.4 Setting Time Inspection Results

Variation	*Viscocrete 1050 HE* (gram)	*Plastiment VZ* (gram)	Water (ml)	Initial Time (Minutes)	Final Time (Minutes)
HF-V0-VZ0	0	0	130	101	180
HF-V1.0-VZ0	5	0	90	114	240
HF-V1.55-VZ0	7.75	0	90	247	450
HF-V1.75-VZ0	8.75	0	90	256	570
HF-V1.55-VZ0.15	7.75	0.75	90	600	3330
HF-V1.55-VZ0.2	7.75	1	90	900	5190

In Table 4.4, it can be seen that there are differences in the use of water for normal concrete and concrete with the addition of *superplasticizer*. This is because if you use the same water as normal concrete paste, the concrete paste with the addition of a *superplasticizer* will be very runny and cannot be printed on the binding container. The test was carried out again by reducing the water to 100 ml or about 23% water reduction from the use of pasta water variations HF-V0-VZ0, but the results also showed the paste was in a watery state and could not be printed on the binding container. Therefore, it is necessary to reduce water by 30% from the use of normal concrete water so that the printing of concrete paste with the addition of a *superplasticizer* can be carried out.

The graph of the penetration results and the increase in setting time between variations of normal concrete and concrete with the addition of *Viscocrete 1050 HE* can be seen in Figure 4.1 and Figure 4.2.

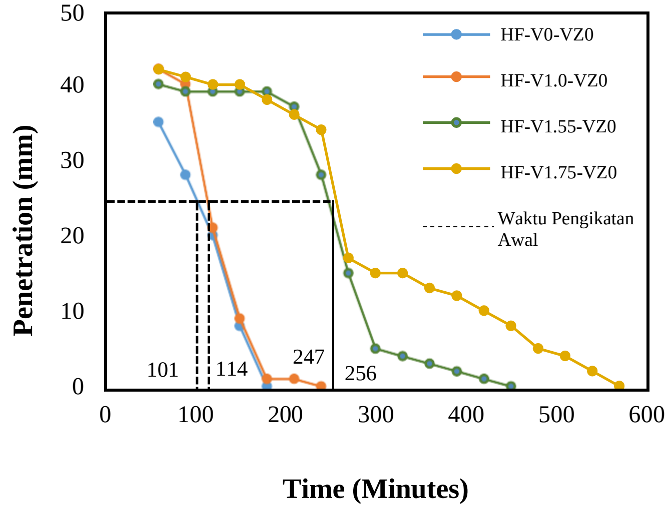
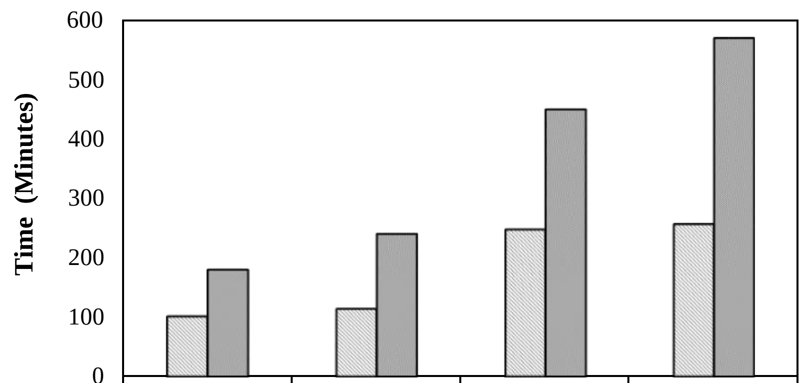


Figure 4.1 Graph of Penetration Results Between Normal Concrete and Concrete with the Addition of *Viscocrete 1050 HE*



	HF-V0-VZ0	HF-V1.0-VZ0	HF-V1.55-VZ0	HF-V1.75-VZ0
Pengikatan Awal (Menit)	101	114	247	256
Pengikatan Akhir (Menit)	180	240	450	570

Figure 4.2 Initial and FinalTime of Concrete Normal with Concrete Addition of *1050 HE Viscocrete*

In the test results of the HF-V0-VZ0 binding time, the fastest initial and final setting times were 101 minutes and 180 minutes, respectively. In the HF-V1.75-VZ0 variation, the initial and final setting times were increased. the longest with an initial setting time of 256 minutes and a final setting time of 570 minutes.The

results of penetration and concrete setting time with the addition of *Viscocrete 1050 HE* and *Plastiment VZ* can be seen in Figure 4.3 d Figure 4.4.

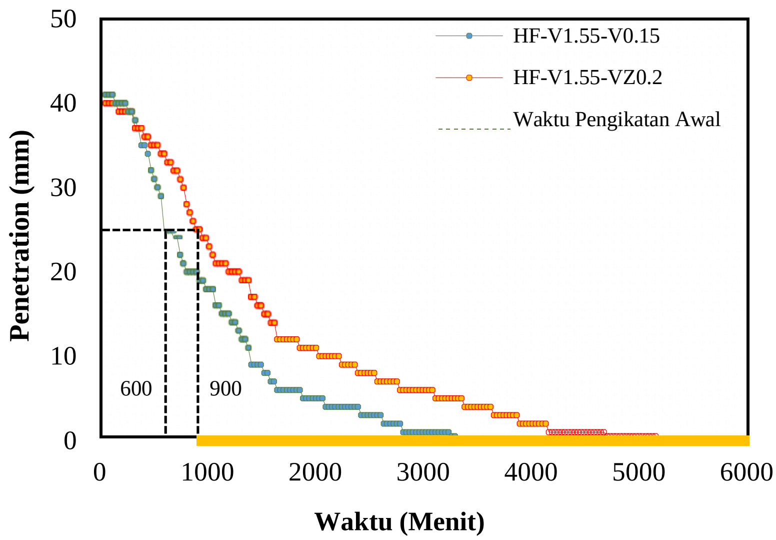
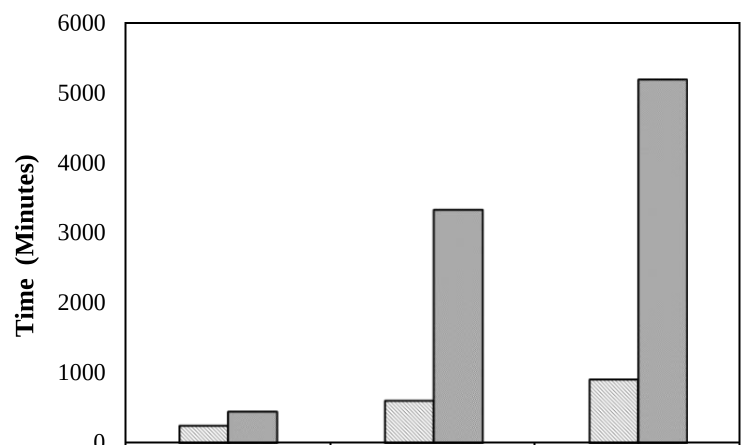


Figure 4.3 Graph of Concrete Penetration Results with Addition of *Viscocrete 1050 HE* and *Plastiment VZ*



	HF-V1.55-VZ0	HF-V1.55-VZ0.15	HF-V1.55-VZ0.2
Pengikatan Awal (Menit)	247	600	900
Pengikatan Akhir (Menit)	450	3330	5190

Figure 4.4 Initial and Final Time of Concrete Addition of *Viscocrete 1050 HE* and *Plastiment VZ*

on variation HF-V1.55-VZ0 (without *Plastiment VZ*) obtained the initial setting time of 247 minutes and the final binding time of 450 minutes. In the HF-V1.55-VZ0.15 variation, the initial setting time was 600 minutes and the final setting time was 3330 minutes.While the variation HF-V1.55-VZ0 .2 obtained a longer bonding time, obtained the initial bonding time of 900 minutes and the final bonding for 5190 minutes. the increasing usage percentage increase *VZPlastiment* the bonding time will be slowed down.

Results Slump Test

Test results *slumptest* each variation can seen in Table 4.5.

Table 4.5 Results Slump Test

Code	Variation	Decrease Slump (mm)
HF-V0-VZ0	Control	30
HF-V1.0-VZ0	Visco 1%	195
HF-V1.55-VZ0	Visco 1,55%	210
HF-V1.75-VZ0	Visco 1,75%	230
HF-V1.55-VZ0.15	Visco 1,55% + Plastiment 0,15%	220
HF-V1.55-VZ0.2	Visco 1,55% + Plastiment 0,2%	230

In the HF-V0-VZ0 variation, the slump test results obtained by 30 mm. These results indicate that HF-V0-VZ0 cannot meet the slump reduction specifications for flow concrete. This is due to the absence ofeffect *superplasticizer* which is useful for increasing the flowability of concrete. Meanwhile, in the concrete with the addition of *Viscocrete 1050 HE* , there was an increase in the decrease in slump. In variations of HF-V1.0-VZ0, HF-V1.55-VZ0, and HF- V1.75-VZ0 the slump values are 195 mm, 210 mm, and 230 mm, respectively, so that they meet the requirements of flow concrete.

In the variation of concrete with the addition of *Viscocrete 1050 HE* a constant content of 1.55% with *Plastiment VZ* also resulted in an increased slump decrease. In the HF V1.55-VZ0 variation (without *Plastiment VZ*) the slump value is 210 mm, the HF-V1.55-VZ0.15 variation has a slump value of 220 mm, while HF-V1.55-VZ0.2 produces a slump value of 230 mm that meets the requirements of flow concrete. Besides being influenced by the use of *Viscocrete 1050 HE, the* use of *Plastiment VZ* can also have an effect on decreasing the slump value.

Results *Slump Flow Test*

Results *slump flow test* are shown in Table 4.6.

Table 4.6 Results Slump Flow Test

Code	Variation	*Filling Ability* *Slump Flow* (mm)		
HF-V0-VZ0	Control	300	260	280 -
HF-V1.0-VZ0	Visco 1%	560	590	575 SF1
HF-V1.55-VZ0	Visco 1,55%	630	620	625 SF1
HF-V1.75-VZ0	Visco 1,75%	650	650	650 SF1
HF-V1.55-VZ0.15	Visco 1,55% + Plastiment 0,15%	640	620	630 SF1
HF-V1.55-VZ0.2	Visco 1,55% + Plastiment 0,2%	650	640	645 SF1

In the HF-V0-VZ0 variation, theresult is *slump flow* 280 mm. These results indicate that HF-V0-VZ0 cannot meet the specifications of thetest *slump flow*. This is due to the absence of the influence of *superplasticizer* which is useful for increasing the *filling ability of* concrete. Meanwhile, in concrete with the addition of *Viscocrete 1050 HE*, an increase in thevalue was seen *slump flow*. In variations of HF-V1.0-VZ0, HF-V1.55-VZ0, and HF V1.75-VZ0 the slump values are 575 mm, 625 mm, and 650 cm respectively so that they meet therequirements *slump flow* and enter the SF1 class. Which can be applied to slab and foundation structures.

In the variation of concrete with the addition of *Viscocrete 1050 HE* a constant content of 1.55% with *Plastiment VZ* also resulted in a decrease in thevalue *slump flow* which increased. In the HF-V1.55-VZ0thevalue is *slump flow* variation,625 mm, the HF-V1.55-VZ0.15 variation has avalue of *slump flow* 630 cm, while the HF-V1.55-VZ0.2 variation produces a value of *slump flow* 645 cm so that it meets the specifications for thetest *slump flow* with class SF1.

Results T_{500}

Measurement of T_{500} $_{is}$ carried out when carrying out thetest *slump flow* by measuring the time of spreading the concrete when it reaches a diameter of 500 mm. Measurement T_{500} used to measure the viscosity of concrete. The results of the Tmeasurement$_{500}$ can be seen in Table 4.7.

Table 4.7 Results T500

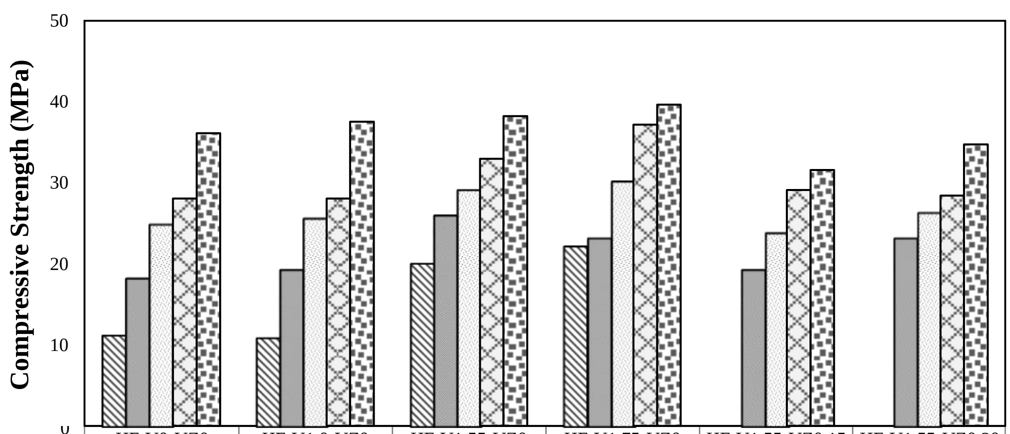
Code	Variation	T_{500} (second)
HF-V0-VZ0	Kontrol	-
HF-V1.0-VZ0	Visco 1%	5
HF-V1.55-VZ0	Visco 1,55%	4
HF-V1.75-VZ0	Visco 1,75%	3
HF-V1.55-VZ0.15	Visco 1,55% + Plastiment 0,15%	4
HF-V1.55-VZ0.2	Visco 1,55% + Plastiment 0,2%	3

In the variation HF-V0-VZ0 can not be obtained $T_{500.}$ In concrete with the addition of *Viscocrete 1050 HE, the* value of Tobtained$_{500}$ iswhich is getting faster. In the variation of HF V1.0-VZ0, HF-V1.55-VZ0, and HF-V1.75-VZ0 obtained T_{500} successively 5 seconds, 4 seconds, and 3 seconds so that it meets the requirements of the $T_{500.}$

In the variation of concrete with the addition of *Viscocrete 1050 HE* a constant content of 1.55% with *Plastiment VZ* also produces T_{500} which increases faster. Although the variation of concrete HF-V1.55-VZ0 (without *Plastiment VZ*) and HF-V1.55-VZ0.15, the T_{500} value is which is the same for 4 seconds, but the variation of HF-V1.55-VZ0.2 produces a T_{500} for 3 seconds.

Concrete Compressive Strength Test Results

Average compressive strength test results for each variation can be seen in Figure 4.5.



	HF-V0-VZ0	HF-V1.0-VZ0	HF-V1.55-VZ0	HF-V1.75-VZ0	HF-V1.55-VZ0.15	HF-V1.55-VZ0.20
Rerata 1 Hari	11,23	10,88	20,00	22,11		
Rerata 3 Hari	18,25	19,30	25,97	23,16	19,30	23,16
Rerata 7 Hari	24,92	25,62	29,13	30,18	23,86	26,32
Rerata 14 Hari	28,07	28,07	32,99	37,20	29,13	28,43
Rerata 28 Hari	36,15	37,55	38,25	39,66	31,58	34,74

Figure 4.5 Test Results of Average Compressive Strength of Concrete for Each Variation

From Table 4.5 it can be seen that as age increases, the average compressive strength also increases.In normal variations of concrete, compressive strength is obtained. 28 days average of 36.15 MPa. Variations of concrete with the addition of Viscocrete 1050 HE increased compressive strength with increasing levels of Viscocrete 1050 HE. Variations HF-V1.0-VZ0 got an average compressive strength of 28 days of 37.55 MPa, HF-V1 .55-VZ0 of 38.25 MPa, and HF-V1.75-VZ0 of 39.66 MPa.

The specimens of variation HF-V1.55-VZ0.15 and HF-V1.55-VZ0.2 cannot be tested at one day old because of ada yes *Plastiment VZ* which is a retarder or inhibits the setting time so that the binding of concrete is hampered for more than 1 day. Therefore, this variation was testedstarting at the age of 3 days. Variations HF-V1.55-VZ0.15 get a 28-day average compressive strength of 31.58 MPa, and variations of HF-V1.55-VZ0.2 of 34.74 MPa.

Addition of Superplasticizer to Increase Early Strength

In four variations, namely HF-V0-VZ0, HF-V1.0-VZ0, HF-V1.55-VZ0, and HF-V1.75-VZ0 the percentage of the design compressive strength at the age of 1 day . In two variations, namely HF V1.55-VZ0.15 and HF-V1.55-VZ0.2, a percentage of the design compressive strength was carried out at the age of 3 days. The results of the average compressive strength in the study of adding *superplasticizer* to the initial strength increase can be seen in Table 4.8.

Table 4.8 Compressive Strength Results Mean to See Effects of Addition *of superplasticizer* Against Early Strength Increasing

Variation	Average Compressive Strength1 Day (MPa)	Average Compressive Strength 3 Day (MPa)	Percentage Of Compressive Strength
HF-V0-VZ0	11,23	18,25	28,08%
HF-V1.0-VZ0	10,88	19,30	27,20%
HF-V1.55-VZ0	20	25,97	50,00%
HF-V1.75-VZ0	22,11	23,16	55,28%
HF-V1.55-VZ0.15	-	19,30	48,25%
HF-V1.55-VZ0.20	-	23,16	57,90%

It was found that the variation of HF-V0-VZ0 did not meet the requirements for increasing the initial strength. The HF-V1.0-VZ0 concrete showed a decrease in compressive strength at the age of 1 day against normal concrete. Therefore, the HF-V1.0-VZ0 does not meet the initial strength increase requirements. The initial strength increase was found in the concrete variations

HF-V1.55-VZ0 and HF-V1.75-VZ0 which obtained compressive strength values of 50.01% and 55.27% of the design compressive strength, respectively.

At the age of 3 days, it is required for concrete with an initial strength increase of up to 70% of the design compressive strength according to SHRP Miller *et al.*, (1993). In Table 4.16 itcan be seen that 2 variations of concrete with the addition of *Viscocrete 1050 HE* and *Plastiment VZ* have not met the requirements for increasing initial strength concrete because they only get a compressive strength of 48.25% in HF-V1.55-VZ0.15 and 57.90% in the concrete HF-V1.55-VZ0.2 at the age of 3 days.

Analysis of Compressive Strength on Conditions for Flow Concrete

In sub-chapter 3.1.1 Table 1 ASTM-C1017 requires that the minimum compressive strength of flow concrete that can be achieved at the age of 28 days is 90% of the design compressive strength. This means that with a design compressive strength of 40 MPa, if the concrete reaches a compressive strength of 36 MPa, it can be said to have reached the minimum compressive strength required for flow concrete. Variations HF-V0-VZ0 can not be analyzed using the terms of the compressive strength of flow concrete, so it is analyzed using the requirements of SNI-2847-2013. The results of the average compressive strength at 28 days can be seen in Table 4.9.

Table 4.9 Percentage of 28 Days Average Compressive Strength

Variasi	Average Compressive Strength 28 Day (MPa)	Percentage Of Compressive Strength
HF-V0-VZ0	36,15	90,38%
HF-V1.0-VZ0	37,55	93,88%
HF-V1.55-VZ0	38,25	95,63%
HF-V1.75-VZ0	39,66	99,15%
HF-V1.55-VZ0.15	31,58	78,95%
HF-V1.55-VZ0.2	34,74	86,85%

Graph percentage compression test results of 28 days can be seen in Figure 4.6 .

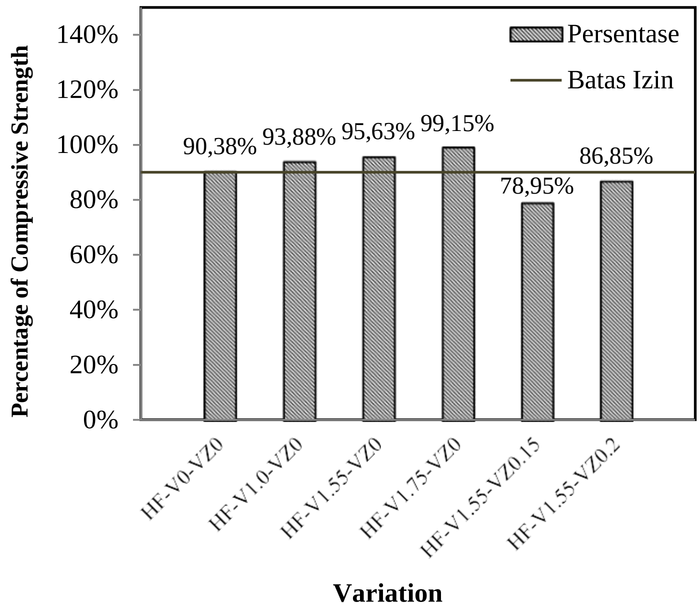


Figure 4.6 Graph Percentage Compression Test Results Of 28 Days

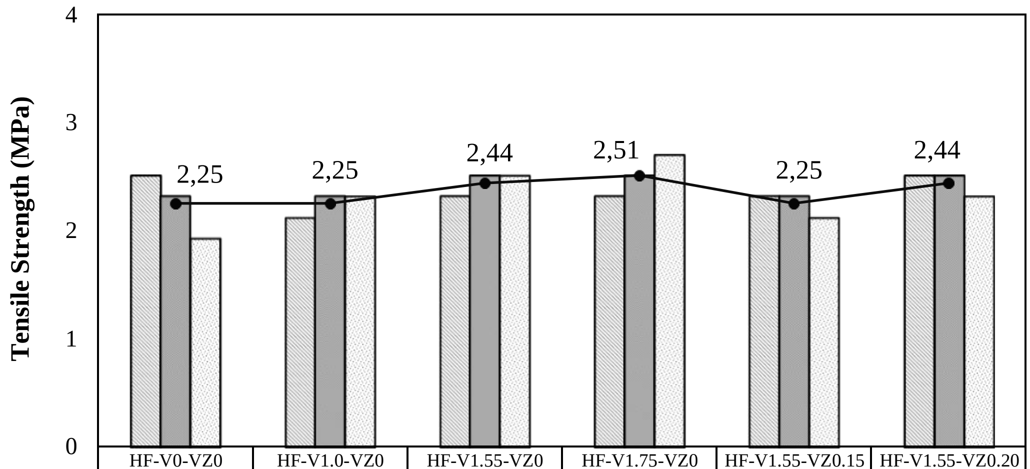
In the HF-V0-VZ0 variation, the average compressive strength is 36.15 MPa. The analysis of SNI-2847-2013 states that the strength of the concrete quality can be said to meet the requirements if the average value of three consecutive samples is fc' and the average value of two consecutive samples with no value below fc'-3.5 MPa. After being analyzed using the analysis of SNI-2847-2013, it was found that the variation of HF-V0-VZ0 met the average value of two consecutive samples with no value below fc'-3,5MPa.

In the concrete variation HF-V1.0-VZ0, HF-V1.55-VZ0, and HF-V1.75-VZ0 the compressive strength is 93.87%, 95.63%, and 99.14% of the strength of the concrete hit plan. These results indicate that the concrete HF-V1.0-VZ0, HF-V1.55-VZ0, and HF-V1.75-VZ0 meet the requirements of the minimum compressive strength of flow-through concrete with the optimum content at 1.75% with compressive strength. of 99.14% This shows that the addition of *Viscocrete 1050 HE* can increase the compressive strength of flow concrete.

In the variation of concrete HF-V1.55-VZ0.15 obtained a compressive strength of 78.96% of the design compressive strength, while the concrete HF-V1.55-VZ0.2 obtained a compressive strength of 86.86% of the planned compressive strength. shows that the addition of *Viscocrete 1050 HE* and *Plastiment VZ concreteflowable* has not met the requirements of the minimum compressive strength of concrete.

Tensile Strength Test Results

Results of the tensile strength test for each variation in this study can be seen in Figure 4.7.



	HF-V0-VZ0	HF-V1.0-VZ0	HF-V1.55-VZ0	HF-V1.75-VZ0	HF-V1.55-VZ0.15	HF-V1.55-VZ0.20
Sampel 1	2,51	2,12	2,32	2,32	2,32	2,51
Sampel 2	2,32	2,32	2,51	2,51	2,32	2,51
Sampel 3	1,93	2,32	2,51	2,7	2,12	2,32
Rata-rata	2,25	2,25	2,44	2,51	2,25	2,44

Figure 4.7 Graph of Split Tensile Strength Testing of Concrete

Pada variasi HF-V0-VZ0 didapatkan kuat tarik belah rata-rata sebesar 2,25 MPa. Pada In the HF-V0-VZ0 variation, the average split tensile strength is obtained an average of 2.25 MPa. In the variation of HF-V1.0-VZ0 also get the same tensile strength as HF-V0-VZ0 which is 2.25 MPa. However, in the variations of HF-V1.55-VZ0 and HF-V1.75.VZ0, the average split tensile strength was 2.44 MP and 2.51 MPa, respectively. These results indicate that the addition of *Viscocrete 1050 HE* can increase the split tensile strength of the concrete as the percentage of the use ofincreases *Viscocrete 1050 HE.* This is in accordance with Dwicahyo's research (2019) which states that the higher the level of use of *viscocrete, the* tensile strength of splitting increases.

In the variation of HF-V1.55-VZ0.15, the average split tensile strength is 2.25 MPa, while the HF-V1.55-VZ0.2 concrete has a split tensile strength of 2.44 MPa. These results indicate that the addition ofconcrete *Plastiment VZ* can also increase the split tensile strength of the concrete as the percentage ofusage *Plastiment VZ* increases.

Relationship between Compressive Strength and Tensile Strength of Concrete

An analysis of the relationship between the compressive strength of concrete and the splitting tensile strength of concrete can be seen in Table 4.10.

Table 4.10 Analysis of the Relationship between Compressive Strength of Concrete and Tensile Strength of Concrete

Variation	fc' (MPa)	fct (MPa)	$fct/\sqrt{fc'}$	fct/fc' (%)
HF-V0-VZ0	36,15	2,25	0,374	6,22%
HF-V1.0-VZ0	37,55	2,25	0,367	5,99%
HF-V1.55-VZ0	38,25	2,44	0,395	6,38%
HF-V1.75-VZ0	39,66	2,51	0,399	6,33%
HF-V1.55-VZ0.15	31,58	2,25	0,400	7,12%
HF-V1.55-VZ0.2	34,74	2,44	0,414	7,02%

Based on the book W.Day (2005), the relationship between concrete compressive strength and tensile strength of normal concrete sides can be calculated by the formula $fct = \sqrt{0.6}$. In Table4.21, the range of K values for all variations is 0.374-0.414 f'c. The value of K obtained is below the value of K from the normal concrete based on W.Day (2005). This result also occurred in the research Wulandari (2008) where the K value of tensile strength to compressive strength is below the value of K normal concrete required. Obtained a range of values of K that, 0.35 to 0.55 √f'c. The percentage of split tensile strength to compressive strength for normal concrete is usually 10% to 15% of the compressive strength (ACI-318-99), obtained from the study is the percentage of split tensile strength of 5,99% to 7,12%.

5. CONCLUSION

1. The binding time paste (setting time) will increase with increasing levels of use of superplasticizer. On the variation of the normal concrete or HF-V0-VZ0 obtained the binding time of the end the fastest for 180 minutes. On the variation of the HF-V1.55- VZ0.2 obtained time fastening the end of the longest during 5190 minutes. The binding time is also influenced by the addition of Plastiment VZ is the retarder.
2. Increasing levels of use of superplasticizer, the results of fresh concrete concrete is also increased and the meet of the requirements of the flowabilty concrete flow. The obtained variations of the eligible testing fresh concrete optimum on the variation of the HF-V1,75-

VZ0 values Obtained decrease in slump by 23 cm, slump flow of 650 mm with a T500 for 3 seconds.

3. Coarse aggregate local andesite Ladung can be categorized as a new material for the manufacture of concrete with good quality because it has the level of a small abrasion by 13.8%.
4. Increased early strength is achieved by the variation of the HF-V1.55-VZ0 and HF-V1.75-VZ0 that reaches the compressive strength of ≥ 50% of the compressive plans
5. On a review of the mechanical properties of concrete flow consisting of compressive strength, split tensile, and flexural strength obtained increased with increasing levels of use of superplasticizer. Although on the variation of the HF-V1.55-VZ0.15 and HF-V1.55-VZ0.2 do not meet the terms of the compressive strength of the concrete flow, but still showed an increase on the mechanical properties of the concrete flow. Therefore, the obtained variation of the HF-V1.75-VZ0 as a variation of the optimum in this research is to review the mechanical properties of concrete flow with strong press 39,66 MPa, and tensile strength 2,51 MPa

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