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Performance Analysis of Self Compacting Concrete (SCC) with Material Add Silica Fume and Viscosity

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A B S T R A C T

Self Compacting Concrete (SCC) is one of the innovations in concrete to make work easier. Self Compacting Concrete (SCC) or self-compacting concrete is concrete that has high liquid properties so that it can fill space and compact itself with little or even without a vibrator. The research method is an experimental method with a mixture composition in this test, namely SCC N 0% without Silica Fume and SCC + SF 3%, SCC + SF 4%, SCC + SF 5% with Silica Fume additives and with Superplasticizer Viscocrete-3115 N 2%. Includes the characteristics of Self Compacting Concrete (SCC) with Slump Flow test, L-Shaped Box test, V-Funnel test and compressive strength test. From the results obtained, the volume weight of SCC concrete has a range between 2.267-2.341 kg/m^3, the highest Slump Flow value is in SCC+SF 4% concrete with a value of 700 mm, the H2/H1 ratio from the L-Box Test ≥ 0.8 indicates the ability of concrete to flow through barriers well, and the best V-Funnel Time value is in SCC+SF 4% which is 7 seconds. The greatest compressive strength is in SCC+SF 5% concrete which is 26.80 Mpa at the age of 28 days compared to SCC N 0% concrete without Silica Fume which is 21.24 Mpa at the age of 28 days

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INTRODUCTION

The process of casting in the field often encounters obstacles faced by the implementer. Normal concrete has a relatively short flow rate so it will be difficult to reach parts far from the spread point. The compaction process which is considered troublesome and slows down the work is also often ignored, even though compaction is very important so that there are no cavities trapped in the concrete. The importance of new methods in casting will be a solution to simplify the implementation and can reduce the Human Error factor during the casting process.

Self Compacting Concrete (SCC) is one of the innovations in concrete to make work easier. Self Compacting Concrete (SCC) or self-compacting concrete is concrete that has high liquid properties so that it can fill space and compact itself with little or even without a vibrator (Siddique, 2011). Self Compacting Concrete (SCC) has the ability to flow and compact into every part of the building that is difficult to reach and is able to flow through iron gaps with resistance to segregation due to restrictions on the content and size of aggregates commonly used in normal concrete, the use of Superplasticizer, and w / p or low Water per Powder . The difference between Self Compacting Concrete (SCC) and normal concrete is also in the mixture used, in SCC powder is used more than concrete besides the mixture in SCC also has Superplasticizer additives and chemical admixture materials that have pozzolan content. The use of SCC as an alternative mixture in concrete that has a small pore volume requires slightly different characteristics from normal concrete, one of which is the use of relatively small coarse aggregate sizes to reduce segregation in concrete (Okamura and Ouchi, 2003).

LITERATURE REVIEW

Self -compacting concrete (SCC) has several slump tests. In general, testing on SCC concrete is carried out to determine Flowability, Filling Ability, Viscosity, Passing Ability and Segregation Resistance. Flowability is the ability of concrete to flow, various tests to determine Flow Ability are Slump-Flow by Abrams Cone, Kajima Box. Viscosity is the thick property of concrete, various tests to determine Viscosity are T50cmSlumpFlow, V-Funnel, O-Funnel and Orimet. Passing Ability is the ability of concrete to reach and pass through obstacles such as installed reinforcement, various tests to determine Passing Ability are J-Ring, L-Box, U-Box, and Kajima Box. Segregation resistance is the resistance of concrete to segregation, various tests to determine Segregation Resistance are V-Funnel at T5minutes, GMT Screen Stability Test, Penetration, Sieve Segregation, and Settlement Column (EFNARC, 2005).

METHODOLOGY

Time and Place of Research

This research is an experimental study conducted at the Material Testing Laboratory of the Civil Engineering Department of Manado State Polytechnic. Where in the implementation of the research begins with the process of making test objects, maintenance, and testing test objects. The stages of the research can be seen, while the implementation of the research was carried out for approximately 4 (four) months.

Research Methods and Types

Research methods are general steps or methods carried out in researching a problem, case, phenomenon, or other thing scientifically to obtain rational results.

Method study Which done on study This that is method experimental conducted at the Material Testing Laboratory, Civil Engineering Department, Manado State Polytechnic. Where writer will do testing to Silica Fume and Viscocrete as material add the Self Compacting Concrete mixture . And from results research conducted will served with method analysis data using program Microsoft Excel. As for testing Which done that is:

a. Testing Characteristics Materials.
b. SCC Characteristics Testing.
c. Compressive strength testing.

Data Types and Data Collection Methods

Method selected experimental requires a set variable Supporter in support implementation proper research target as well as measurable. Form the variable that meant related with tools, materials and data. Correlation from variable the support creation type data, type Which required in study which is conducted is experimental data.

Method collection data Which done namely through testing in laboratory based on standard Which applies, in addition, in matter method Data collection methods are also used observation for get correlation from behavior sample to results test sample based on test parameters in formulation problem. So that information obtained through testing on laboratory, studies library And observation This can made into as reference For strengthen the arguments put forward in analysis results, discussion, conclusion as well as related suggestions study.

RESULTS AND DISCUSSION

Slump Flow

This test aims to measure the ability of concrete to flow and spread without segregation. The following shows the results of the Slump Flow test for each variation of the concrete mixture.

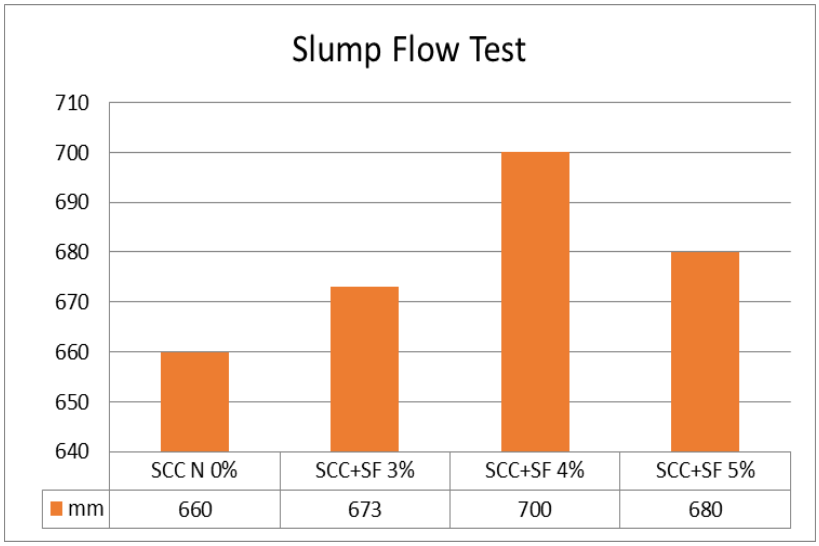

Figure 2. Slump Flow Test Results

Slump Flow test results, the addition of Silica Fume with a content of 3%, 4%, and 5% together with Viscocrete-3115 N 2% significantly increased the workability of SCC, with Slump Flow values in the range (550 mm - 850 mm). SCC N 0%, a mixture without additional Silica Fume got a Slump Flow value of 660 mm, SCC + SF 3% got a value of 673 mm, SCC + SF 4% got a value of 700 mm, and SCC + SF 5% got a value of 680 mm, Silica Fume content of 4% gave the highest Slump Flow results , indicating that SCC has very good flow ability.

L-Shaped Box

This test aims to assess the ability of concrete to flow through narrow gaps and barriers without segregation or separation of aggregates. The following shows the results of the L-Box test for each variation of the concrete mixture.

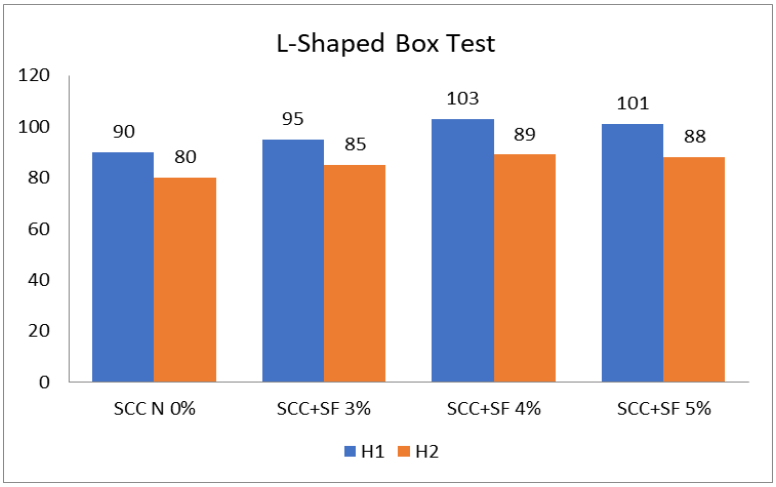

Figure 3. L-Box Test Results

L-Box test results, the H2/H1 ratio of each concrete variation shows the workability and ability of SCC to flow through the barrier. H2/H1 ratio SCC N 0%, without the addition of Silica Fume, obtained a comparative result with a value of 0.89 mm, the H2/H1 ratio of SCC+SF 3% obtained a result of 0.89 mm, the H2/H1 ratio of SCC+SF 4% obtained a result of 0.86 mm, and the H2/H1 ratio of SCC+SF 4% obtained a result of 0.89 mm. SCC+SF 5% got the result with

a value of 0.87 mm. The flow ratio (H2/H1) ≥ 0.8 shows that SCC has good flow capability through narrow gaps and around reinforcement without segregation. This value shows good concrete flow and Formwork filling capability.

V-Funnel

This test aims to assess the flowability and viscosity of the concrete, and to ensure that the concrete has good enough flow properties to fill the mold by itself without segregation or obstruction. The results of the V-Funnel test can be seen in table 4 and graph 3.

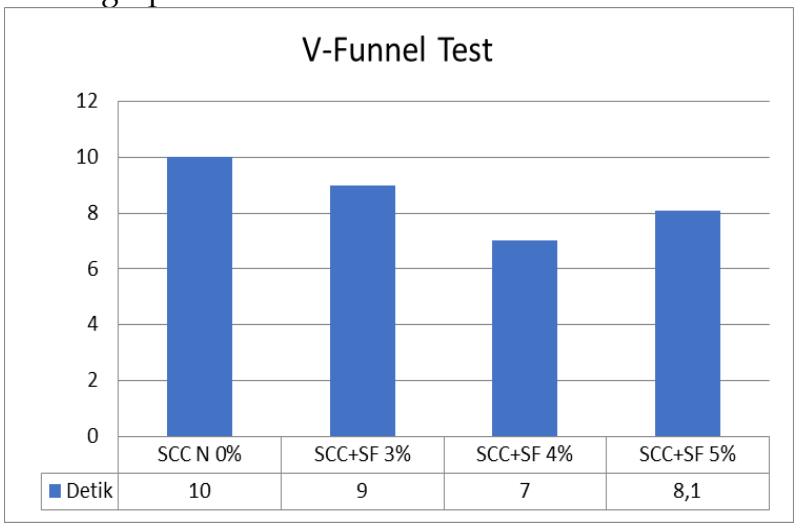

Figure 4. V -Funnel Test Results

The V-Funnel test results, the addition of Silica Fume with a content of 3%, 4%, and 5% with Viscocrete 2% significantly increased the fluidity of SCC, as shown by the reduction in V-Funnel time . A lower V-Funnel Time indicates that SCC has a lower viscosity and better flowability, SCC N 0%, without the addition of Silica Fume shows the results of V-Funnel Time is 10 seconds, SCC+SF 3% shows V-Funnel results Time 9 seconds, SCC+SF 4% shows V-Funnel Time 7 seconds, and SCC+SF 5% shows V-Funnel results Time 8.1 seconds. Mixture with 4% Silica Fume shows V-Funnel The best time is 7 seconds, while the mixture without 0% Silica Fume shows the longest time of 10 seconds. This shows that the addition of Silica Fume up to 4% with 2% Viscocrete effectively increases the flowability of SCC.

CONCLUSION AND RECOMMENDATION

1. The addition of Silica Fume in the Self Compacting Concrete (SCC) mixture significantly increases the compressive strength of concrete aged 7, 14, and 28 days. The higher the percentage of Silica Fume, the higher the compressive strength obtained. The average compressive strength obtained by SCC N 0% without Silica Fume additives is 21.24 Mpa at the age of 28 days, with the addition of Silica Fume content of 3%, 4%, and 5% shows an increase in compressive strength, Silica Fume content of 3% obtains an average compressive strength at the age of 28 days of 23.65 Mpa, Silica Fume content of 4% obtains an average compressive strength at the age of 28 days of 25.24 Mpa, and Silica Fume content of 5% obtains an average compressive

strength at the age of 28 days of 26.80 Mpa, SCC with Silica Fume content of 5% obtains optimal compressive strength results from all SCC variations, exceeding the target concrete quality plan f'c 20 Mpa.

2. Slump Flow, L-Box, and V-Funnel tests show that the use of Viscocrete- 3115 N with a content of 2% is a Superplasticizer that successfully maintains good workability without the addition of water, even with the addition of Silica Fume in all SCC variations . This ensures that the concrete can flow and fill the mold without segregation (separation of aggregates in the concrete mixture).
3. Silica Fume content provides a clear picture of how each additional Silica Fume content impacts the SCC characteristics. The 5% Silica Fume content showed the best performance in terms of compressive strength, but 4% Silica Fume showed the best workability. The decrease in workability occurred at the 5% Silica Fume content because the addition of Silica Fume with a content of more than 4% can reduce the workability of the concrete, but it is still included in the concrete mixture with the SCC category.

FUTHER STUDY

This research still has delays, therefore further research related to the topic of Performance Analysis of Self Compacting Concrete (SCC) with the addition of Silica Fume and Viscosity is needed to enhance this study and provide insights for readers.

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