The Effect Of Substitution And Admixture Materials On Self-Compacting Concrete (SCC) Characteristics

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Abstract: The admixture modification by adding foaming agent can overcome the problem of high SCC viscosity. The use of foaming agent has double effects on the concrete admixture in which, to meet the characteristic of concrete admixture flow, foaming agent takes a role in increasing the concrete admixture viscosity, and the use of foaming agent can affect the value of concrete compressive strength. However, it is necessary to control the use of foaming agent on the concrete admixture. The decrease of concrete compressive strength using foaming agent from 50 MPa job mix design towards the concrete designed without pozzolan has 42.51 MPa of concrete compressive strength value causing decline to 7.49 MPa. Therefore, to overcome the decrease of concrete compressive strength value used, powder materials in a form of silica fume and foaming agent are added. To determine the ratio of adding additional substances, variations of using silica fume and foaming agent with the percentage of 5%, 10%, and 15% is used. Then, one of the ways to overcome the bad impact of the foaming agent use is by substituting half of the cement with pozzolan in the form of fly-ash and silica fume. The fine grains of these pozzolans can increase the cohesion on the fresh concrete and decrease bleeding. However, the portion of both pozzolans should be in a proper ratio so that it will not decrease the concrete viscosity towards the characteristic of SCC due to the fact that pozzolan can absorb water easily. In this case, the maximum value of concrete compressive strength on silica fume admixture is 58.97 MPa and on fly-ash is 54.90 MPa. However, the pozzolan addition of fly-ash or silica fume admixture has maximal limitation use on concrete admixture. The maximal ratio of pozzolan addition is 10% of the cement weight. Pozzolan addition which is more than 10% can affect the compressive strength and the characteristics of SCC.

Index Terms: self-compacting concrete, foaming agent, fly-ash, silica fume

1 INTRODUCTION

Concrete is the most dominant material used on building construction. In the process of production and application in the field, concrete admixture frequently faces any challenges, both in terms of working on concrete and compaction process while casting. Because of challenges in stirring and casting during process of concrete production, adding water without proper ratio frequently is done which causes bleeding and segregation [1]. However, the current technological advances in construction have successfully made easy-stirred, poured, and compacted concrete without causing segregation and bleeding. It is Self-Compacting Concrete (SCC) which is a type of concrete that can consolidate itself without the process of compaction or vibration. This concrete admixture can be easily poured and flowed, fill the concrete molding chamber using its weight of concrete admixture. The fresh concrete of self-compacting concrete is cohesive in which it is made by the aggregate regulation method, the amount of aggregate, and the admixture modification of concrete admixture [2]. From some methods of the results of studies conducted in Europe and Japan, the mixed designs of SCC are developed towards the modification of materials used. From these methods, concrete admixture of SCC fulfilling SCC standard test is found.

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The design of high quality concrete which is above 45 MPa is commonly accompanied by water cement ratio factor (W/C) which is ≤ 0.35 in which it is difficult to be worked [3]. In order to achieve the absolute flow, admixture is used on the concrete admixture with low W/C. The effect of using admixture on concrete admixture makes the concrete easily to be worked, but it does not guarantee that the concrete admixture included in the SCC concrete standard. The diameter of distribution of SCC is above 50 cm, while the slump flow test with admixture addition which is ≤ 50cm produce admixture which has not fulfilled the available SCC characteristic standards yet. Then, it is necessary to modify the concrete admixture so that the concrete produced is more flowing. Therefore, to meet SCC characteristics, concrete admixture made should not be settled when it is in the fresh concrete condition even though it has met the characteristics of SCC flow [4]. In this case, a way to overcome the aggregate sedimentation on the concrete admixture is by adding foaming agent on the concrete admixture [5]. Based on some previous studies, it shows a good improvement on SCC characteristic standards. The addition of foam on the concrete admixture results high diameter distribution of the slump flow which passes over 80%. The use of foaming agent on SCC mix can be added to increase the viscosity of concrete admixture [6]. However, foaming agent has a bad impact on the decline of concrete compressive strength in which the weight of concrete which has been added by foaming agent will decrease and the pores on the concrete increases [7]. Therefore, it is necessary to conduct further study to overcome the bad impact of foaming agent use in order to produce compressive strength as it is planned. In this case, the use of materials, such as fly ash and silica fume with a certain amount, can affect the characteristics of fresh concrete and the compressive strength of SCC. Moreover, the use of additional materials, such as pozzolan or foam, should be studied further in the process of making SCC admixture.

2 Research Problems

In this study, the research problems are:

a) How does foaming agent affect the characteristics of SCC?
b) How does foaming agent mixture affect the physical characteristics of SCC?
c) How does silica fume and fly-ash addition affect the flow velocity of SCC?
d) How does silica fume and fly-ash addition affect the slump flow of SCC?
e) How does silica fume and fly-ash addition affect the fresh concrete segregation of SCC?
f) How does silica fume and fly-ash addition affect the percentage of escaping hitch of fresh concrete SCC?
g) How does silica fume and fly-ash addition affect the compressive strength value of SCC?
h) How is the ideal composition of SCC admixture with fly-ash, silica fume, and foaming agent addition?

3 Research Objective

This study is aimed at:

a) Determining the composition of optimal SCC admixture using fly-ash, silica fume, and foaming agent addition.
b) Analyzing the effects of fly-ash, silica fume, and foaming agent on the physical and mechanical characteristics of SCC.

4 Scope of the Research

The scope of this research involves:

a) The experimental study is conducted in the laboratory of Civil Engineering of Sriwijaya University.
b) The SCC test object is in a form of cylinder (15 cm for the diameter and 30 cm for the height) with 5%, 10% and 15% variations of fly-ash as well as silica fume.
c) The concrete compressive strength test is conducted when the concrete age is on 3, 7, 14, and 56 days.
d) This study is limited only to examining the effect of silica fume, fly-ash, and admixture use which are added to SCC with certain percentage on the compressive strength of concrete.
e) The planning of mixture uses American Concrete Institute (ACI) method and fresh concrete SSC test with the standard of The European Federation of Specialist Construction Chemicals and Concrete Systems (EFNARC).

5 Theoretical Framework

The theoretical framework consists of relevant theories which can be used to explain variables that will be studied and to answer the hypothesis of the research problems and to design research instruments [8]. Self-Compacting Concrete (SCC) is the latest innovation concrete which does not need vibration and compaction on the process of concrete admixture placement on the cast. SCC can flow with its weight, fill the gaps in the cast perfectly, and it has high density [9]. The concrete admixture is expected to be able to improve the characteristic of concrete which is difficult to be compacted as it can be found on the conventional concrete. Moreover, SCC has additional standard test to determine the characteristics by testing the freshness of the concrete admixture. Some methods implemented to obtain SCC admixture is by limiting the amount of aggregation, using low water concentration (W/C), and using superplasticizer additive [10]. The effect of this admixture can overcome any SCC problems having viscosity, the concrete admixture which is quite high [11]. Moreover, SCC has a basic component of concrete composition, such as normal concrete consisting of cement as the bounding material, fine and rough aggregates as the filling material, and water which interacts mechanically and chemically. Those materials also have the same standards as the ASTM criteria. In this case, the modification of concrete admixture is not only the achievement of workability, but also the fulfillment of the requirements of its SCC quality. In some studies, viscosity modifying admixture is needed to meet the characteristics of SCC. Therefore, the additional materials that should be modified with surfactant or air bubble is superplacticizer so that the water content within the concrete admixture will not be directly absorbed by the materials. As a result, the admixture having low water ratio can be separated equally within the concrete admixture. In this study, superplacticizer is used to produce greater concrete strength with a little amount of water and high workability of its use based on the standard of ASTMC.494 type F. The effect of cement water factor to improve the pore structure of concrete can decrease concrete permeability and add mechanical or durability characteristic of the concrete. Moreover, 55% foaming agent use on the production of precasting concrete produces fresh concrete which is expected to be able to fill the area of the concrete casting chamber. Another effect of foaming agent addition on the concrete admixture is that it can decrease the value of concrete compressive strength and decrease the weight of concrete. The higher the foaming agent used the lower the strength of the concrete [12]. To meet the concrete compressive strength, some substances are added to the modification of SCC admixture. For instance, to meet the fresh concrete, foaming agent and glineum which can affect the value of concrete compressive strength is added. However, it is important to overcome the bad impacts of the decline of the concrete compressive strength value. The addition of fly-ash and silica fume with certain various percentages is assumed to be able to increase the value of concrete compressive strength. The flow velocity of SCC admixture test can be conducted using flow table with diameter 50 cm-85 cm and using slump with 150 mm X 300 mm. The value of slump flow describes the ability to flow of the concrete admixture in the free flowing condition. The test is essential as the basis of observing SCC to know the consistency of the concrete admixture whether it has met the specifications. The visual observation done during observation or with 5-second measurement can give additional information about the quality of concrete segregation and the uniformity of concrete pasta whenever it is stirred.

5 Research Method

This experimental study is conducted in the laboratory of Civil Engineering of Sriwijaya University. In this study, the admixture planning is based on ACI 211.4R-08, SCC ACI 237R-07, and EFNARC 2005 with the target of compressive strength is 50 MPa of the Job Mix Formula standard. Besides, 8-time Trial Mix is done until the concrete admixture made can meet the SCC standard. From the result of the concrete test obtained from the trials mix in the laboratory, it is used as the primary test to see the characteristics of fresh concrete. Because the primary test is needed as the composition to make SCC, 8-time trial mix was conducted by treating different treatment in each stirring. The test object used in this study is a cylinder which size is 15 X 30 cm with fly-ash and silica fume mixture; 5%, 10%, 15% admixture ratio with different variations of test object age in 3, 7, 14, 28, 56 days; addition of 0%, .5%, .25%, .15% foaming agent and 0%, 1%, 1.5% superplasticizer of the cement weight. Besides, the fine aggregate used is sand from Tanjung Raja village in Ogan Ilir South Sumatera regency, while the rough aggregate used is 10 mm broken stone from Merak Banten. The construction of aggregate gradation for concrete filling uses ASTM C33 and some supporting materials, such as water is from PDAM laboratory of Sriwijaya University.

5.1 Research Material

Portland cement is used for general use which does not need certain requirements as it is required for other types. This kind of cement is the most produced product in the market. For instance, OPC (Ordinary Portland Cement) produced by Semen Baturaja Ltd. has fulfilled the available standard. Before using the river sand from Tanjung Raja village in Ogan Ilir regency as the fine aggregate, a test is conducted. Besides, before using the broken stone from local industry in Merak Banten regency as the rough aggregate, material testing is conducted based on the used standard. Moreover, foaming agent used in this study is a product from Fosroc Indonesia Ltd. The foaming agent used is Conplast F294 type. In this case, the use of foaming agent should follow the ratio suggested by the company and fulfill the requirements of ASTM-C-494 and SNI-03-0349-1989. In addition, the fly-ash used in this study is the fly-ash of the combustion residue of Coal-Fired Power Plant (PLTU) produced by Bukit Asam Ltd. In this study, the fly-ash use is based on ACI Manual of Concrete Practice 1993 Part I 226.3R-3, fly-ash type F containing CaO which is less than 10% produced from anthracite combustion or coal bitumen. Fly-ash type F has a compound content which ratio of SiO_2 + Al_2O_3 + Fe_2O_3 is more than 70%, while the ratio of CaO of fly-ash type F is less than 5%. Then, in the concrete admixture, the amount of fly-ash used is 5%-15% of the cement weight. In addition, silica fume used in this study is a product from Sika Indonesia Ltd. named Sika Fume. In this study, the sika fume used is 5%-15% of the cement weight. The standard used in the use of sika fume is ASTM C 1240-00 about the use of silica fume and the ratio of $Si0_2$ is 90%. In this case, the water used on the concrete admixture should be clean and free from destructive materials containing oil, acid, alkaline, salt, organic materials, or other materials which can affect concrete or reinforced quality. To get clean water, the water used is water from PDAM Ogan Ilir laboratory of Sriwijaya University.

TABLE 1

PROPORTION OF CONCRETE MIXED SCC IN M³ TRIAL MIX 1 AND 2

No	Material	Mixed (Kg/m^3)	*Trial Mix 1 (Kg/m^3)*	*Trial Mix* 2 (Kg/m^3)
1	SikaViscocrete 3115 ID		1%	1%
2	W/Cm	0,35	0,45	0,35
3	Cement	545,87	545,87	545,87
4	Fine aggregate	627,60	627,60	1088,85
5	Coarse aggregate	922,50	922,50	461,25
6	Water	191,05	247,65	191,05
7	Foam Agent	-	-	-
8	Fly Ash (-berat semen)	-	-	-

5.2 SCC Mixture Design

The SCC mixture design uses ACI 211.4R-08 as the proportion or ratio to determine the material weight used. After concrete job mix is made based on the standard of ACI 211.4R-08, trial mix is done for many times to know whether the characteristics of concrete admixture have fulfilled the SCC standard. Decreasing and adding some concrete constituent materials are done during the trial mix. The principles of trial mix are done along with series of mix 1-mix 8 studies.

5.3 The Plan of Concrete SCC Mixture Design and Amount of Test object

From the series of trial mix done, adding fly-ash and silica fume to the composition of concrete admixture is made. The ratio of fly-ash and silica fume is varied from 5%, 10%, and 15% which is based on the cement weight. The test involves the test object age of 3, 7, 14, 28, and 56 days.

5.4 Concrete Stirring Process

The concrete stirring has to use a mixer machine because it can produce homogeneous mixture. The mixing using hands (conventional technique) should be avoided unless it is used for small amount of concrete mixing. In fact, mixing using hands (conventional) will not produce homogeneous concrete admixture. Besides, the concrete produced will be bad because of improper technique of mixing. In other words, the most important thing while mixing is the casting-ready homogeneous concrete admixture which is seen from the unseen concrete sand used and the water is not out after the stirring process.

5.5 Fresh Concrete Test

Basically, the fresh concrete test is conducted to see the consistency of the admixture as the basic of work easiness. The rules of fresh concrete test are stated in SK-SNI.T-28-1991-03 which involves slump, bleeding, and content weight test. On the other hand, SCC fresh concrete test involves distribution power of concrete admixture, concrete flow velocity, segregation and the concrete admixture acceleration or retardation in passing through the tools.

5.6 Slump Flow Test

The flow of concrete test uses EFNARC 2005 standard as it can be seen in Figure 2.1 about Slump Flow Test. Slump flow test can be used to determine the filling ability both in laboratory and in the field. By using this tool, concrete workability can be obtained based on the ability of fresh concrete distribution which is stated in the diameter of 50-75 cm. In this case, the need of slump flow value for vertical construction casting is different from the horizontal one. Then, it can be stated that the general rule used to determine the primary workability of SCC is based on the construction types, i.e. 65-70 cm slump flow is suggested for the vertical construction and 60-65 cm slump flow is suggested for the horizontal construction. The tools used are decapitated cone, flow test board, roll meter, and stopwatch. The ready concrete admixture is then poured onto the decapitated cone until it is full and it spreads equally. After that, lift the cone, measure the time and the quantity of concrete distribution.

5.7 L-Shaped Box Test

L-Shaped box or known as Swedish box is an L-shaped tool made from metal. This tool is used to examine the passing ability of self-compacting concrete. In this tool, the direction between horizontal and vertical is separated by bulkhead cover made from metal which can be opened by pulling it up. In front of the bulkhead cover, there is a hitch in the form of reinforced steel which function is to test the ability of the concrete admixture in passing through the reinforced which is the same as in the field condition. Then, from the L-shaped box test, blocking ratio value which is obtained from the comparison of H2/H1 can be obtained.

5.8 V-Funnel Test

V-Funnel test is conducted to know the stability of concrete admixture while flowing. Good concrete admixture will flow continuously until the mixture is run out within certain time. On the other hand, bad concrete admixture will have fast flowing velocity at the beginning, but it will need a long time to make the mixture in the V-Funnel test is run out.

5.9 Solid Concrete Test

The solid concrete test is conducted to estimate the potential strength of test object based on the strength measured in early 24-hour or more age. The result of the test in early age provides information about the diversity of concrete production process which is used in the process of controlling (SNI 03-6805-2002).

6 FINDINGS AND DISCUSSION

6.1 Material Testing

Before doing the concrete casting, it is important to test the materials in the form of fine aggregate which is from Tanjung Raja of South Sumatera and rough aggregate which is from Merak Banten. The material testing is aimed at the reference in the test to determine the bulk density, dry saturated surface density (SSD), pseudo-density, and water absorption level in the fine or sand aggregate. Another purpose of this test is to make students understand the condition and the classification of aggregates, and how to find data in order to obtain a number of sand and broken stone density, saturated surface density (SSD), pseudo-density, and water absorption level in fine or sand aggregate.

TABLE 1

THE TEST RESULTS OF AGGREGATE PHYSICAL PROPERTIES OF COARSE AND FINE

Type of Testing	Weigh and Percentage	Aggregate	
		Fine	Coarse
Organic levels		No. 3	-
Sludge levels	(%)	1,94	-
Solid volume weight	(kg/1)	1,61	1,51
Weight volume of loose	(kg/1)	1,45	1,42
Modulus of fineness		2,80	-
Water content	(%)	2,29	1,15
Apparent specific grafity	(kg/1)	2,62	2,75
Bulk specific gravity (Dry)	(kg/1)	2,51	2,63
Bulk specific grafity (SSD)	(kg/1)	2,55	2,68
Percentage of water absorption	(%)	1,73	1,57

6.2 The Result of Trial Mix Test

The trial mix is conducted to obtain the optimal composition of SCC mixture which has fresh concrete and compressive strength test as it is planned.

6.3 Trial Mix 1

Trial mix test 1 is aimed at seeing the early characteristic of concrete with ACI job mix formula standard. In the early test, the characteristics of SCC admixture have not appeared yet. The water cement ratio used in job mix formula for high quality concrete design is quite low; as a result, workability on trial mix 1 cannot be reached and the SCC test cannot be conducted. On the trial mix 1, modification is done through adding 300 ml water on the concrete admixture. However, adding water to it does not give good impact on the concrete admixture because the concrete flow characteristic remains the same or has not reached the SCC standard. Moreover, segregation on the modified concrete admixture occurs.

6.4 Trial Mix 2 and 3

Trial mix 2 and 3 test are based on some findings on literature studies and the result of trial mix 1 which mixes concrete admixture with low water cement ratio which is difficult to conduct the SCC concrete admixture test. The modification of trial mix 2 and 3 is done though reducing 50% of the rough aggregate ratio. The reduction of this aggregate is aimed at making the stability of concrete admixture so that fine aggregate and cement on the concrete admixture can cover the whole rough aggregates.

6.5 Trial Mix 4

From the result of trial mix 4, the characteristics of concrete admixture flow begins to appear; therefore, slump flow test can be done. However, the characteristics of flow have not met the available SCC standard. SCC standard states that minimal distribution area of concrete admixture is 500 mm. Besides, the effect of adding superplasticizer without reducing water can increase the easiness of stirring. Then, it can be stated that water cement ratio takes an important role in determining the characteristics of concrete admixture.

6.6 Trial Mix 5

On the trial mix 5, foaming agent addition is done. It shows a good trend when foaming agent is on the concrete paste. Then, workability, flow ability, passing ability of SCC test can be conducted. However, the amount of foam ratio should be controlled again because the concrete admixture declines a lot as it can be seen on the result of slump flow test showing 820 mm, L-Box shape test showing 95.97%, V-Funnel test showing 4.5 second. SCC characteristics might appear, but the effect of foaming agent on the concrete admixture can decrease the strength of concrete planed. Therefore, foaming agent addition should be controlled.

6.7 Trial Mix 6, 7, 8

From the result of concrete test, it can be concluded that decreasing the foaming agent ratio and making variations of pozzolan ratio in order to increase the value of concrete compressive strength variations are needed.

6.8 SCC Characteristics Test

SCC concrete in the FNARC 2005 standard has four kinds of fresh concrete tests i.e. slump flow, L-shaped box, V-funnel, and sieve segregation. The tests of the fresh concrete are conducted whenever stirring the concrete. From the tests, it is expected that SCC has standard quality on the concrete softness and control on the segregation. If the early tests can be reached, concrete rough characteristic test can be conducted.

6.9 Slump Flow Test

Slump flow test can be used to determine filling ability both in the laboratory and in the field. From this test, concrete workability condition can be obtained based on the ability of fresh concrete distribution. The result of slump flow can be seen in Table 4.3 for SCCN concrete. SCCF5% is on the SF2 class, while other variations are on the SFI. From the available data which can be seen in Table 4.3, the value of slump flow obtained shows that the concrete admixture of SFI is good to be used for floor casting plate and long injection pomp casting.

6.10 L-Shaped Box Test

The result of test is on the passing ability requirement which is on the range of 80-100% of escaped hitch. This test can be the primary sample after the slump flow determines that the dough is included in SCC category. The maximal value of passing ability is on 90.15% on SCCFA5% concrete admixture and 90.03% on SCCSF5% admixture. On the L-shaped box test in which the concrete dough has not been added with silica fume and fly-ash, the highest value of the admixture additional material variations is 92.97% having high passing ability value. The 5% percentage is better than concrete admixture which is added by other additional substances as it can be seen from the flowing velocity and flow distribution power.

6.11 The Result of V-Funnel Test

The concrete with SCCFA5%, SCCSF5%, and SCCN variations involved in the VFI criteria is 7.00, 7.44, and 7.20 which is below 8 second. For the variation of adding fly-ash and silica fume more than 5% requires longer time because the dough absorbs water faster as it can be seen in Figure 4.12. In other words, the higher the percentage of silica fume and fly-ash admixture is the longer time it needs to flow the V-Funnel.

6.12 The Result of Sieve Segregation Test

From the result of sieve segregation test, it shows that concrete admixture obtained is on SR2 with segregation criteria under 15%. The result also shows that the concrete obtained is very good. For the concrete dough with segregation more than 20%, SCC standard does not suggest the concrete to be used in the field. From the result, adding pozzolan to the concrete admixture can decrease the effect of segregation. Each of the addition of pozzolan percentage on the concrete admixture shows greater number of decline of segregation or gives good trend on the concrete admixture. Then, it can be concluded that the more fly-ash and silica fume are added the better the dough will be because of the decline of segregation on the concrete admixture. In this case, concrete with 5% fly-ash admixture has resistant value towards 10.41% higher segregation. Besides, for the silica fume mixture, the value of the highest point of segregated resistant is 10.34% on the 5% variation. In addition, for the admixture of fly-ash and silica fume can decrease the segregation factors if pozzolan addition is more than 5%.

6.13 The Result of Concrete Density Test

The result of concrete test density can be seen in Table 4.7. The data collection of density was done before conducting the concrete compressive strength test. Moreover, measuring the weight of the test object is done using digital scales during the data collection. From the concrete density test, information about uniformity of concrete weight or stirring made has been well-mixed which is divided into each sample with proper portion of aggregate. Therefore, the weight of the concrete obtained will not be different enough from other samples weight.

6.14 The Result of Concrete Compressive Strength Test

The result of compressive strength of concrete test is based on the age and concrete admixture of the result of concrete compressive strength test which based on the concrete admixture composition. The highest value of silica fume concrete admixture compressive strength is on 60.66 MPa which is the SCCSF10% composition. On the other hand, fly-ash admixture is on 55.78 MPa which is SCCFA10% composition. For the SCCN concrete compressive strength, 42.77 MPa is the lowest value of all available admixture proportions. The compressive strength of 5% fly-ash and silica fume admixture proportions are 44.70 MPa and 46.47 MPa. On the other hand, the compressive strength of 15% fly-ash and silica fume admixture proportions are 43.19 MPa and 48.80 MPa. It shows that SCC design using foaming agent decreases the compressive strength of the early concrete plan which decreasing to 50 MPa. The amount of concrete compressive strength decline from the early plan design is that SCCN decreases 15%, SCCFA5% decreases 12%, SCCFA15% decreases14%, and SCCSF5% decreases 8%, and SCCSF15% decreases 3%. On the other hand, concrete with SCCSF10% increases up to 18% and ASSFA10% increases up to 10%. From, the result of concrete test and concrete admixture that can be seen in the graphic, the highest value can be seen on the silica fume10% admixture, and then fly-ash10% admixture. Then, the effect of fly-ash and silica fume addition takes a very important role in overcoming the decline of concrete compressive strength value. On the other hand, the lowest value of concrete strength is on the SCCN test object. The variations of pozzolan addition between 5%-10% increase the value of concrete compressive strength. However, the decrease of compressive strength of concrete value occurs to the mixture of 10%-15%. In this case, pozzolan addition to the concrete admixture has two effects on the concrete. If the composition is proper, it will increase the quality of the concrete. On the other hand, if the dose of pozzolan addition is too much, it can decrease the quality of the concrete.

6.15 The Analysis of Concrete Pressure Strength Test Regression

The regression function of concrete compressive strength is the result of the variations of test object age test by combining the points on the result of compressive strength test which becomes the equation which is close to compressive strength value of the test result on some variations of fly-ash and silica fume admixture percentage. From the result of concrete compressive strength arranged in the form of regression function from Table 4.8, the highest point of regression value is close to 1. On the variation of SCCFA5%, the value is .99 with .01 difference which is close to 1. On the other hand, the result of the lowest regression value is .95% or the regression difference is .05% which is close to 1 consisting of 3 mixture variations i.e. SCCFA15%, SCCSF5%, and SCCSF10%. For other variations, the range is between .99% - .95%, close to 1. If the regression is equal to 0, there will no effect contribution percentage given by independent variable towards dependent variable. In other words, the variations of independent variable used in the model do not explain anything about the variations of dependent variable. On the other hand, if the regression value is equal or close to 1, the effect contribution percentage given by independent variable towards the dependent variable is nearly perfect or close to the value of the real compressive strength. However, the value is unlikely to obtain 1 because the equation of ACI used is equation approach.

7 CONCLUSION

From the study, it can be concluded that:

a) The result of tests show that the effect of using foaming agent increase the flow of the concrete in which from the trial mix 8, adding .15% of foaming agent is able to produce SCC fresh concrete which can fulfill the standard of EFNARC 2005. However, the use of foaming agent has a bad impact because it can decrease the target of concrete strength plan. The target of concrete strength plan is 50 MPa, then by adding .15% foaming agent the compressive strength produced is 42.77 MPa in which 7.23 MPa differences occurs or 14.46% of the target plan.
b) The combination of .15% foaming agent, silica fume, or fly-ash use up to 15% on the SCC admixture can decrease bleeding and increase the strength concrete compressive strength. However, another impact of using little fly-ash and silica fume can decrease the speed of concrete flow (slump flow test) and decrease the ability of concrete admixture through the L-box test. The concrete admixture produced becomes thicker. However, the SCC admixture with silica fume and fly-ash addition still fulfills the standard of EFNARC 2005.
c) The composition of foaming agent use is .15 by adding 10% fly-ash or silica fume produces optimal composition in which maximal compressive strength can reach 54.90 MPa for fly-ash and 58.97 MPa for silica fume within 56-day test.

8 SUGGESTION

a) It is important to use standard for SCC concrete admixture design based on Standard National of Indonesia (SNI) for more intensive and comprehensive study.
b) The use of other pozzolan materials, except fly-ash, silica fume and other foaming agent materials, for the application on the SCC needs to be further studied.

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