The effectiveness of stone ash and volcanic ash of mount Sinabung as a filler on the initial strength of self-compacting concrete

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Abstract. Self Compacting Concrete is a concrete variant that has a high degree of workability and also has great initial strength, but low water cement factor. It is also self-flowable that can be molded on formwork with a very little or no compacted use of compactors. This concrete, using a variety of aggregate sizes, aggregate portions and superplasticizer admixture to achieve a special viscosity that allows it to flow on its own without the aid of a compactor. Lightweight concrete brick is a type of brick made from cement, sand, water, and developers. Lightweight concrete bricks are divided into 2 based on the developed materials used are AAC (Autoclave Aerated Concrete) using aluminum paste and CLC (Cellular Lightweight Concrete) that use Foaming Agent from BASF as a developer material. In this experiment, the lightweight bricks that will be made are CLC type which uses Foaming Agent as the developer material by mixing the Ash Stone produced by Stone Crusher machine which has the density of 2666 kg / m³ as Partial Pair Substitution. In this study the variation of Ash Stone used is 10%, 15%, and 20% of the planned amount of sand. After doing the testing the result is obtained for 10% variation. Compressive Strength and Absorption Increase will decrease by 25.07% and 39.005% and Variation of 15% compressive strength will decrease by 65.8% and decrease of absorption equal to 17.441% and variation of 20% compressive strength will decreased by 67.4 and absorption increase equal to 17.956%.

1. Introduction

1.1 Background

Present day construction is progressing very rapidly. The increase of development takes place in various fields, such as the construction of buildings, bridges, towers, and so on. Material in the selection of construction depends on several factors such as the relatively cheap price, has good strength and quality, raw materials constituent are easy to find and durable.

Due to the high number of development in the field of construction, the need for construction materials is also increased. One of the most used construction materials in construction is concrete. According to SNI-032847-2002, the concrete notion is a mixture of portland cement or other hydraulic cement, fine aggregate, coarse aggregate, and water, with or without additive that form a solid mass.

Since 1983 in Japan, the problems about the durability of concrete. To get a durable concrete, good quality control is required with the foundry that the experts do. The concrete problem is the need for adequate solidification to produce solid concrete. Air cavities are often trapped inside the concrete thus...
affecting strength and endurance. with a self-compacted concrete mix, it can reduce the work of the experts and obtain a high-quality concrete.

1.2 Problem Formulation
a) What’s the definition of Self Compacting Concrete?
b) How’s the *workability* of SCC (*Self Compacting Concrete*) with the substitution of the volcanic ash of Mount Sinabung and stone ash?
c) How much is the compressive strength of SCC (Self Compacting Concrete) by using volcanic ash of Mount Sinabung and stone ash?
d) How is the price comparison of SCC (Self Compacting Concrete) using volcanic ash of Mount Sinabung and stone ash with normal SCC (Self Compacting Concrete)?

1.3 Purposes and Benefits
Purposes of this paper are:
1. To obtain a concrete mixture of SCC (Self Compacting Concrete) with the substitution of volcanic ash of Mount Sinabung and stone ash.
2. Knowing the comparative price of normal SCC and SCC with stone ash substitution, and volcanic ash of Mount Sinabung.

2. Method
The method used in this study is an experimental study conducted at the Concrete Laboratory Faculty of Engineering Department of Civil Engineering University of Sumatra Utara. In general, the sequence of the study phase includes: a. Provision of porous concrete materials, b. Examination of materials, c. Mix Design, d. Creation of test samples with the addition of superplasticizer, e. Examination of slump flow value, f. Treatment of test samples (Curing), g. 24 hours of compressive strength test.

2.1 Mix Design
Calculation of the mix design can be seen in the attachment fully. From the calculation results of the mix design, 1m³ proportion of the concrete mixture obtained are as follows:

| Annotation          | Cement (kg) | Sand (kg) | Water (kg) | Grevel 1-2 (kg) | Grevel 1-1 (kg) | Stone Ash (kg) | Volcanic Ash (kg) | Siperplasticizer (kg) |
|---------------------|-------------|-----------|------------|-----------------|-----------------|-----------------|-------------------|----------------------|
| Final Innovation    | 510.66      | 715.28    | 155.00     | 291.28          | 416.107         | 416.107         | 71.52             | 6127.01              |

*Figure 1: The Materials*
2.2 Concrete Compressive Strength Test
The test is done on 24 hours old concrete for each concrete day variation as many as 3 pieces. The day before the test according to the age plan, the concrete cylinder is removed from the soaking tub. Before a compressive strength test is performed, the test object is weighed. The concrete compressive strength test is done by using electrical compress machine with 2000 KN capacity.

3. Result and discussion
3.1 Compressive Strength of Cylinder Concrete
The concrete compressive strength test is done at 1 days old, test result can be seen in following graph:

![Concrete Compressive Strength](image)

**Figure 2:** Concrete Compressive Strength
The highest compressive strength is 25.50 MPa.

3.2 Test Documentation

![Test Documentation](image)

**Figure 3:** Test Documentation (a) Sample I (b) Sample II (c) Sample III

3.3 Analysis of the Impacts Inflicted by Concrete Innovation
SCC Concrete is significantly gives positive impacts to the environment by reducing energy consumption and reducing noise pollution generated by the vibrator engine. While the impact on the social is making the job easier and does not require a lot of reliable human resources in in the field processing. The last isthe impact of SCC concrete on the economic side is to directly squeeze the cost of the project on the vibratory and concrete pump processes, due to the nature of the Filling Ability of
SCC concrete that flows by itself throughout the mold surface and solidifies itself, thus reducing the number of workers.

The benefits of added ingredients on SCC Concrete Innovation, one of them is the use of volcanic ash of mount Sinabung:
- Provide a very good impact on the environment because it utilizes waste into something useful and reduce environmental pollution caused by the spread of volcanic ash of Mount Sinabung.
- While the impact on Social and Economy is able to involve the people around Sinabung mountain to build the spirit of gotong royong and of course to support the income of the people because the volcanic ash of mount Sinabung can be utilized as a cement substitution in concrete mixture.

4. Conclusion
From the results of research, analysis, and discussion that has been implemented, it can be concluded that:
1. This research is using Volcanic Ash of Mount Sinabung as a cement substitution of 15%, stone ash as a substitution of coarse aggregate equal to 15%, and superplastisizer MasteGlenium SKY 8614 to improve workability of concrete quality with dose of 1,2%.
2. 1 day old of compressive strength of 25.50 MPa is obtained

5. Suggestion
After seeing the results of the test and being aware of the possible deficiencies in this SCC concrete test, the author can provide suggestions as followst:

1. Need to do an additional test to complete the requirements and characteristics of SCC concrete including:
   - V funnel test = Filling Ability
   - V funnel at 5 minute test = Segregation Test
   - J – ring test = Passing Ability
   - L Shape box = Passing Ability
2. Further research is needed on SCC concrete, especially on waste materials, so that environmental wastes such as volcanic ash of mount Sinabung can be utilized well.

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