VOLUME 3 | NUMBER 1 | JANUARY 2021
Available online at http://proceedings.worldconference.id.
ISSN: 2656-1174 (online)

The Effect of The Use of Limestone As a Cement Subtitution and Ceramic Waste or Tile As a Coarse Aggregate Subtitution in Concrete Mixtures to The Strength of Concrete Press

Acep Hidayat, Ahmad Faham
Faculty of Engineering
Civil Engineering Education Program
Mercubuana University
Jl. Raya Kranggan No 6 Jatisampurna Bekasi 17433, Indonesia
fahamdg@gmail.com, acephidayat1975@gmail.com

Abstract

Concrete is the result of the preparation of materials consisting of cement, aggregate and water. All the constituent materials of concrete are obtained from natural resources, which, if exploited continuously will be increasingly depleted. The use of waste as an added material or as a substitute material is a good alternative for mixing the building blocks of concrete. Extinguished lime is one of the materials for making cement where quenched lime is made without a fabrication process such as cement which produces waste during the fabrication period. As for ceramic or tile waste, it is one of the building wastes that cannot be used anymore so that ceramic waste can be used as a substitute for coarse aggregate in the concrete mixture. This study aims to determine the effect of using extinguished lime as a substitute for cement and ceramic or tile waste as a substitute for coarse aggregate in the concrete mixture on the compressive strength of concrete. This study used a cylindrical specimen measuring 15x30 cm as many as 40 samples from 4 mixed variations and added with 4 normal concrete samples which serve as benchmarks. This study used a mixture of lime substitute as much as 15%, and 25% by weight of cement, as well as ceramic or tile waste as much as 30%, and 60% of the weight of coarse aggregate. Where the concrete compressive strength test was carried out on day 28. The results of this study were that the resulting slump value was still in accordance with the mix design with a range between 60-180 mm with the highest slump value found in the variation of 15% lime + 60% ceramic waste, namely 15 cm.

Keywords:
Ceramic Waste, Concrete Compressive Strength, Limestone, Substitution, Tile Waste.

1. Introduction

1.1. Background

Technological developments in the building construction continue to experience developments not only in Indonesia but also in various parts of the world. The majority of buildings are designed using concrete with high quality including strength, durability (durability), and efficiency. Concrete is a construction material composed of water, sand, gravel, and cement mixed into one unit. Of the many existing constructions, concrete is a component that is almost always used as an architectural combination, foundations, beams, slabs, dams, and drainage channels, so the demands for the use of concrete are getting higher.

Reducing air pollution and environmental damage caused by cement factory waste by reducing the amount of cement used, by reducing the use of cement is expected to reduce cement production so as to reduce air pollution and environmental damage due to cement factory waste.

Damage to the ecosystem in the river and the environment around the river due to illegal rock mining will have an impact in the future, one of which is the increase in river flow which results in landslides around the river, and damages the ecosystem in the river, so this illegal mining needs to be stopped.

So that an alternative is needed to at least reduce the use of cement by using other materials such as lime, so that the use of cement can be reduced in number, Likewise the use of coarse aggregate which must also be reduced by replacing it with other materials, The use of ceramic or tile waste as a mixture of concrete is one of the alternatives to reduce the use of cement and coarse aggregate which is usually used in making concrete mixtures.

1.2. Formulation of the problem

1. How is the effect of quenched lime as a substitute for cement and ceramic waste substituted in coarse aggregate in the concrete mixture on the slump value?
2. How is the effect of quenched lime as a substitute for cement and ceramic waste which is substituted in coarse aggregate in the concrete mixture on the value of the compressive strength of concrete?

2. Literature Review

Concrete complies (Nawy, Edward G., Suryoatmono, Bambang 2001) Indicates that simple concrete is formed by hardening a mixture of cement, water, fine aggregate, coarse aggregate (crushed stone or gravel), air and sometimes other additional mixtures.

2.1. Materials - Concrete Composer Materials

Nearly 60% of the meterial used in construction work is concrete, which is generally combined with steel (composite), or other types (Mulyono 2019). According to Mulyono (2019) Concrete is a function of its constituent materials consisting of hydraulic cement (Portland cement), coarse aggregate, fine aggregate, water and additives (admixture or additive).

2.2. Limestone

Limestone (limestone) is a type of carbonate rock that occurs in nature, also called limestone. The main mineral of limestone is calcite (CaCO3), other minerals are impurity minerals, usually consisting of quartz (SiO2), carbonates associated with iron and clay minerals, and organic plant residue (Aziz 2010). Limestone resources owned by Indonesia are very large (Anonymous. 2003), which is ± 2.156 billion tons, which are scattered in several regions in Indonesia, namely: N. Aceh Darussalam (131.12 billion tons (Mt)), North Sumatra (3, 24 Mt), West Sumatra (68.1 Mt), Riau (53.2 million tonnes (M)), Bengkulu (137.1 Mt), Jambi (157 M), South Sumatra (294 M), Lampung (2 M), Banten (61.6 M), West Java (660.3 M), Central Java (6 Mt), DI Yogyakarta (10 Mt), East Java (3,069 Mt), Bali (154.64 Mt), NTB (1.2 Mt), NTT (132.82 Mt), Central Kalimantan (449 Mt), South Kalimantan (8.33), East Kalimantan (57 Mt), North Sulawesi (18.8Mt), Gorontalo (18.5Mt), Central Sulawesi (696 Mt), South Sulawesi (31.33 Mt), Southeast Sulawesi (1,527 Mt), North Maluku (8.87 Mt), and Papua (2.6 Mt). Quicklime and extinguished lime are conventional products of the limestone industry, limestone is burned in a calcination furnace with a combustion temperature of 900 - 1000 ° C where limestone (CaCO3) breaks down, into quicklime (CaO) and CO2 gas, extinguished lime is made by reacting CaO is the result of calcination with water (H_2O) to form calcium hydroxide (Ca (OH) senyawa), this process is also called quicklime hydration (Kibria et al. 2016). Central Sulawesi (696 M), South Sulawesi (31.33 Mt), Southeast Sulawesi (1,527 Mt), North Maluku (8.87 Mt), and Papua (2.6 Mt). Quicklime and extinguished lime are conventional products of the limestone industry, limestone is burned in a calcination furnace with a combustion temperature of 900 - 1000 ° C where limestone (CaCO3) breaks down, into quicklime (CaO) and CO2 gas, extinguished lime is made by reacting CaO is the result of calcination with water (H_2O) to form calcium hydroxide (Ca (OH) senyawa), this process is also called quicklime hydration (Kibria et al. 2016). Central Sulawesi (696 M), South Sulawesi (31.33 Mt), Southeast Sulawesi (1,527 Mt), North Maluku (8.87 Mt), and Papua (2.6 Mt). Quicklime and extinguished lime are conventional products of the limestone industry, limestone is burned in a calcination furnace with a combustion temperature of 900 - 1000 ° C where limestone (CaCO3) breaks down, into quicklime (CaO) and CO2 gas, extinguished lime is made by reacting CaO is the result of calcination with water (H_2O) to form calcium hydroxide (Ca (OH) $_2$), this process is also called quicklime hydration (Kibria et al. 2016).

2.3. Ceramic or Tile Waste

Ceramics are a building element that is used to cover floors or walls which are usually in the form of thin and square plates, which are made of clay and other ceramic raw materials, by burning them to a certain temperature so that they have special physical properties (Suria, A., Neneng, I., & Alamsyah 2017).

3. Research Methods

The research methodology is used to obtain data for research purposes carried out in a systematic and structured manner. In this research, the method used is an experimental method by mixing (substitution) cement with lime and substituting coarse aggregate with ceramic or tile waste in the concrete mixture.

3.1. Research Percentage

In this study, the use of chalk and ceramic waste was varied, as for the presentation itself, 15% and 25% of the weight of cement were used for quenched lime, according to the study (LUAN DALAM Rerc YASA, SMA SATA WERDHAPU RA SnruuR -Elaur, and Jun 2010). The use of ceramic or tile waste used is 30% and

VOLUME 3 | NUMBER 1 | JANUARY 2021
Available online at http://proceedings.worldconference.id.
ISSN: 2656-1174 (online)

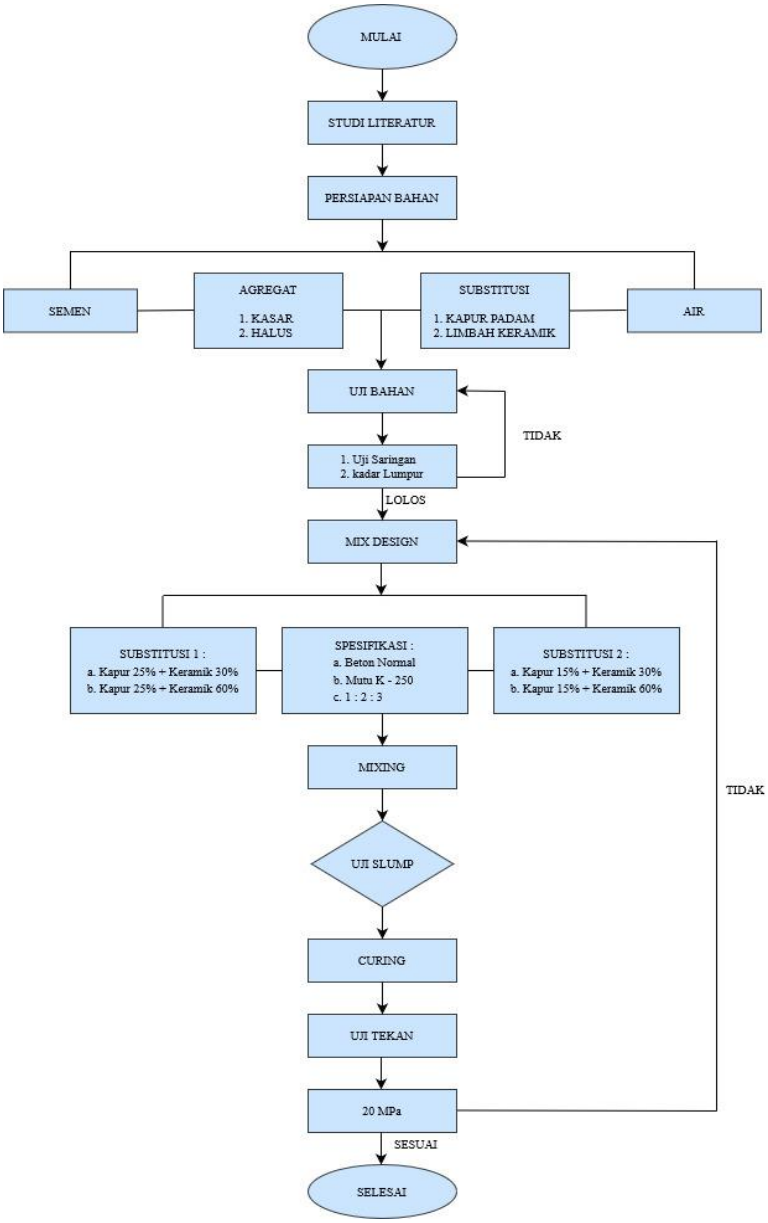
60% of the weight of coarse aggregate (gravel) referring to research (Kurniawan Dwi Wicaksono 2012). The two variations will be combined between extinguished lime and ceramic or tile waste, for concrete compressive strength testing will be carried out at the age of 28 days referring to research (LUAN DALAM Rerc YASA et al. 2010).

Table 3.1 Substitution Percentage

Percentage	
Limestone	Ceramic waste
15%	30%
	60%
25%	30%
	60%

Source: Personal Data

3.2. Research Flowchart

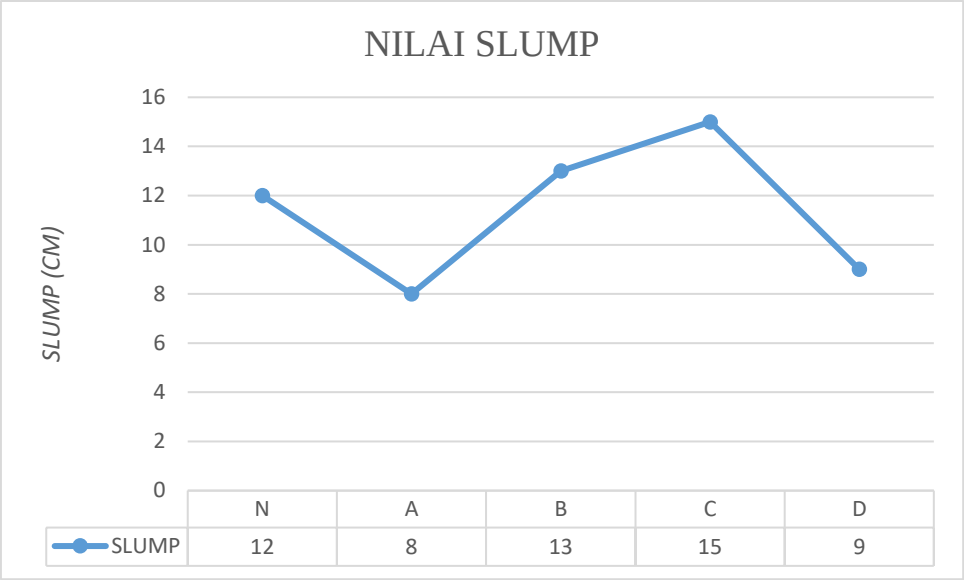


Source: Personal Data
Figure 1. Flowchart

VOLUME 3 | NUMBER 1 | JANUARY 2021
Available online at http://proceedings.worldconference.id.
ISSN: 2656-1174 (online)

4. Research Results and Analysis

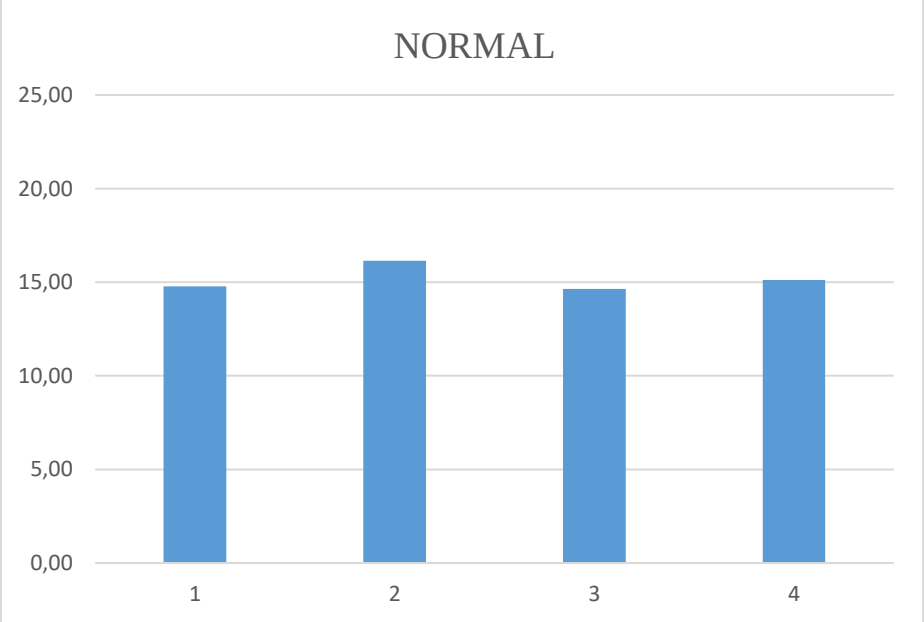
4.1. Slump Value Testing Results



Source: Personal Data

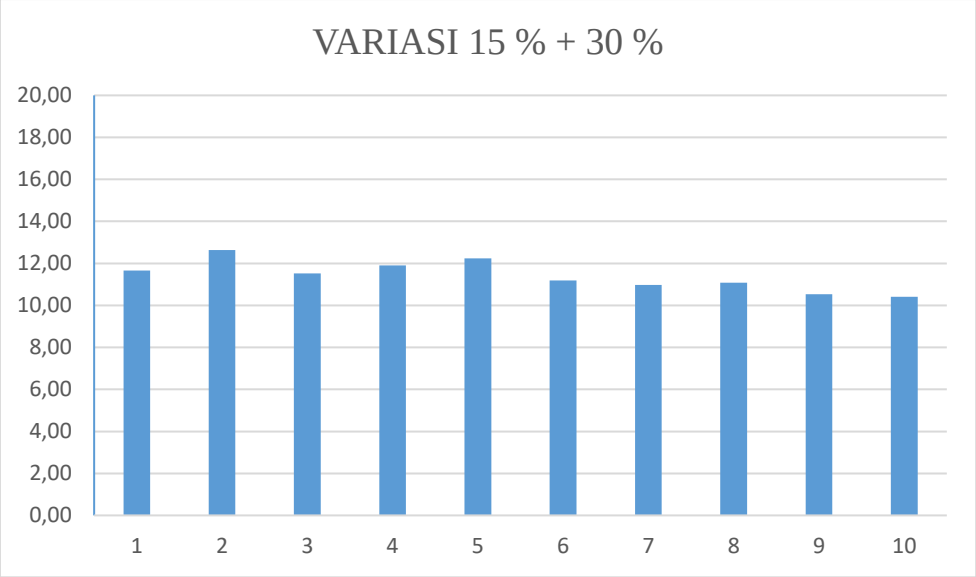
Figure 2. Graph of Slump Value Testing Results

4.2. Concrete Compressive Strength Test Results

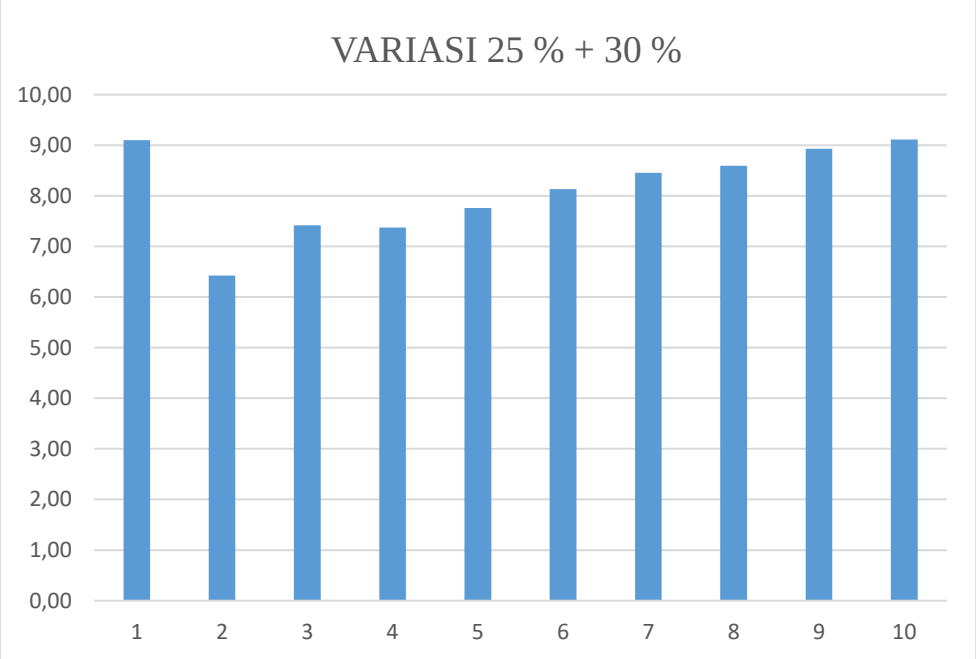


Source: Personal Data

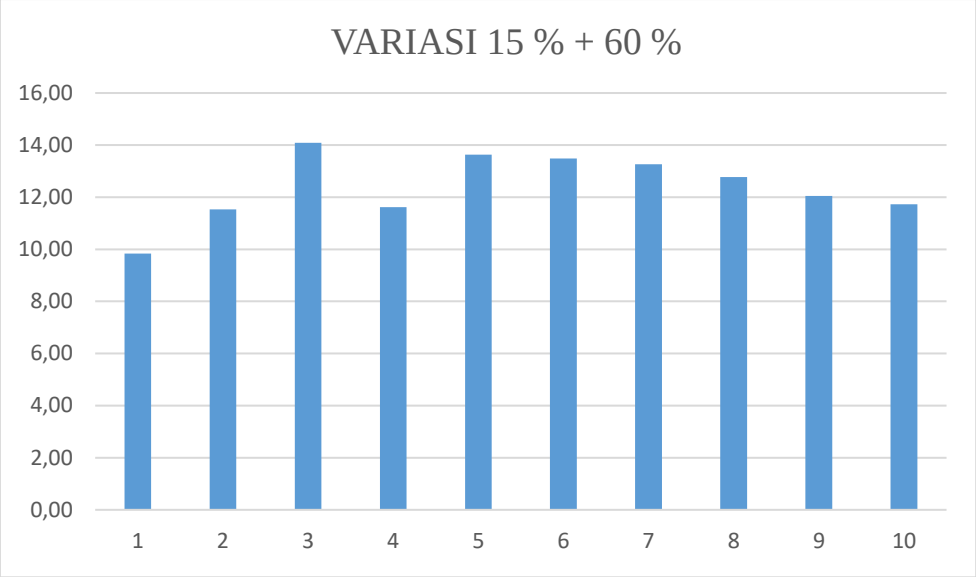
Figure 3. Graph of the Concrete Compressive Test Result



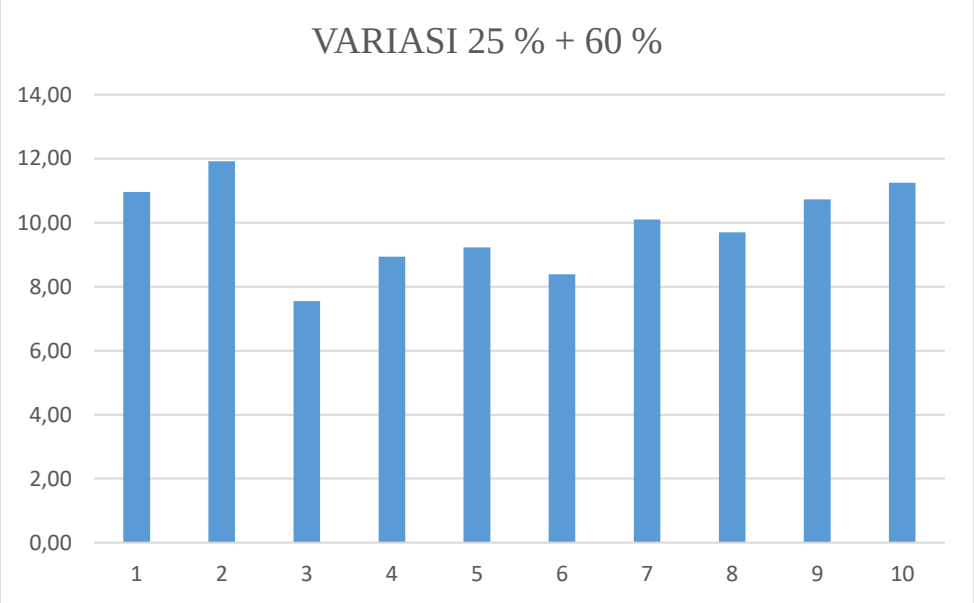
Source: Personal Data
Figure 4. Graph of Concrete Press Test Results A.



Source: Personal Data
Figure 5. Graph of Concrete Press Test Results B.



Source: Personal Data
Figure 6. Graph of Concrete Press Test Results C



Source: Personal Data
Figure 7. Concrete Press Test Results Graph D.

5. Conclusions and Suggestions

5.1. Conclusions

Based on the results of testing and analysis of the effect of extinguished lime as a substitute for cement and ceramic waste as a substitute for coarse aggregate in the concrete mixture on the compressive strength of concrete, the following conclusions are obtained:

1. Based on the results of research, concrete with additional substitution in the form of lime which is substituted into cement and ceramic waste which is substituted for kelad in coarse agrrates tends to experience a decrease in quality or compressive strength when compared to normal concrete without any added substitute materials.
2. Based on the results of the research, the highest compressive strength value of concrete mixed with substitution materials is the mixture or variation of 15% + 60% with the average results of 12.40 MPa.
3. Based on the results of research on concrete mixed with substitution materials, the highest slump value is in the 15% + 60% variation, which is 15 cm, and the lowest slump value is in the 15% + 60% variation, which is 8 cm, where these results are still in accordance with calculation of mix designs, namely between 60 - 180 mm.

4. Based on the results of research, concrete with a substitute material in the form of lime as a substitute for cement and crust waste as a substitute for coarse aggregate is more efficiently used for the manufacture of non-structural concrete.

5.2. Suggestion

Based on the results of observations and research, the suggestions that can be taken from this research are as follows:

1. When the research is carried out, it is necessary to have special accuracy in testing the materials, calculating the mix design, curing control, and testing the compressive strength, in order to get maximum results.
2. At the time of making the test material, it is necessary to pay attention to the good and homogeneous concrete mixing process, which is then followed by the compaction of the molds done carefully so that the resulting concrete does not experience porous in the concrete, if there is porous in the concrete it will affect the results of the compressive strength value. the concrete.

References

Anonymous. 2003. *Hasil Survey SCSI*. Surakarta: PPM FE UNS.

Aziz, M. 2010. "Limestone and Increased Value Added and Specifications for Industry." *Journal of Mineral and Coal Technology* 6(3):116–31.

Kibria, M. A., R. Saidur, F. A. Al-Sulaiman, and Md Maniruzzaman A. Aziz. 2016. "Development of a Thermal Model for a Hybrid Photovoltaic Module and Phase Change Materials Storage Integrated in Buildings." *Solar Energy* 124:114–23. doi: 10.1016/j.solener.2015.11.027.

Kurniawan Dwi Wicaksono, Johanes Januar Sudjati. 2012. "Johanes Januar Sudjati - Google Scholar." *Universitas Atma Jaya*. Retrieved March 8, 2021 (https://scholar.google.co.id/citations?user=LLMGWFIAAAAJ&hl=en#d=gs_md_cita-d&u=%2Fcitations%3Fview_op%3Dview_citation%26hl%3Den%26user%3DLLMGWFIAAAAJ%26citation_for_view%3DLLMGWFIAAAAJ%3A9yKSN-GCB0IC%26tzom%3D-420).

Luan Dalam Rerc YASA, E., Wi WI SMA Sata Werdhapu Ra SnruuR -Elaur, and -b ZE Jun. 2010. *Pnosiding Ipil Dan Linekunean*.

Mulyono, Tri. 2019. *Concrete Technology*. Yogyakarta: Andi.

Nawy, Edward G., Suryoatmono, Bambang, Beton Prategang. 2001. "Suatu Pendekatan Mendasar." *Erlangga*. Retrieved March 8, 2021 (http://repository.unpar.ac.id/bitstream/handle/123456789/1627/Edward_141439-p.pdf?sequence=1&isAllowed=y).

Suria, A., Neneng, I., & Alamsyah, W. 2017. "Utilization of Ceramic Shard Waste as Mixed Coarse Aggregate and Its Effect on Concrete Compressive Strength. Aceh: Ocean University. JURUTERA-General Scientific." *Journal of Applied Engineering* 4(1):16–24.