
EXPERIMENTAL STUDY ON ADDING POLYPROPYLENE FIBER TO COMPRESSIVE STRENGTH AND FLEXURAL STRENGTH OF CONCRETE

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ABSTRACT

Concrete is one of the most frequently used materials in the construction world, concrete is generally composed of a mixture of fine aggregate composition. Coarse aggregate, water and cement. However, concrete has a weakness to the ability to withstand the flexural force, today concrete has experienced a lot of innovations, one of which is fiber concrete. Polypropylene fiber is a type of fiber that can be used as an added material in concrete. This research was conducted to determine the effect of adding polypropylene fiber on compressive strength and flexural strength of concrete. Tests in this study were carried out according to SNI (Indonesian national standard) and ASTM (American standard testing and material), from the results of the experiment of adding polypropylene fiber with variations of 0%, 1%, 1.2%, and 1.4% known to have an effect to the compressive strength and flexural strength of concrete. The highest compressive strength and flexure obtained in concrete variations of 1%. By using cylindrical and beam test specimens.

Keywords: Concrete, Polypropylene Fiber, Compressive Strength, Flexural Strength.

INTRODUCTION

The construction world always experiences development from time to time, since the past until now Concrete is one of the most frequently used materials (commonly) in the construction process of construction other than wood and steel. Concrete is a mixture of cement, coarse aggregate, fine aggregate, and water with or without additives forming a solid mass (SK SNI T-15-1990-03: 01). Good concrete has strong, durable, waterproof, wear-resistant, and small shrinkage properties (Tjokrodimulyo, 1996: 2). Homogeneous mixture will harden as the chemical reaction that occurs between water and cement. Concrete is also known to have the ability to resist corrosion, environmental decay is also able to withstand the compressive force well.

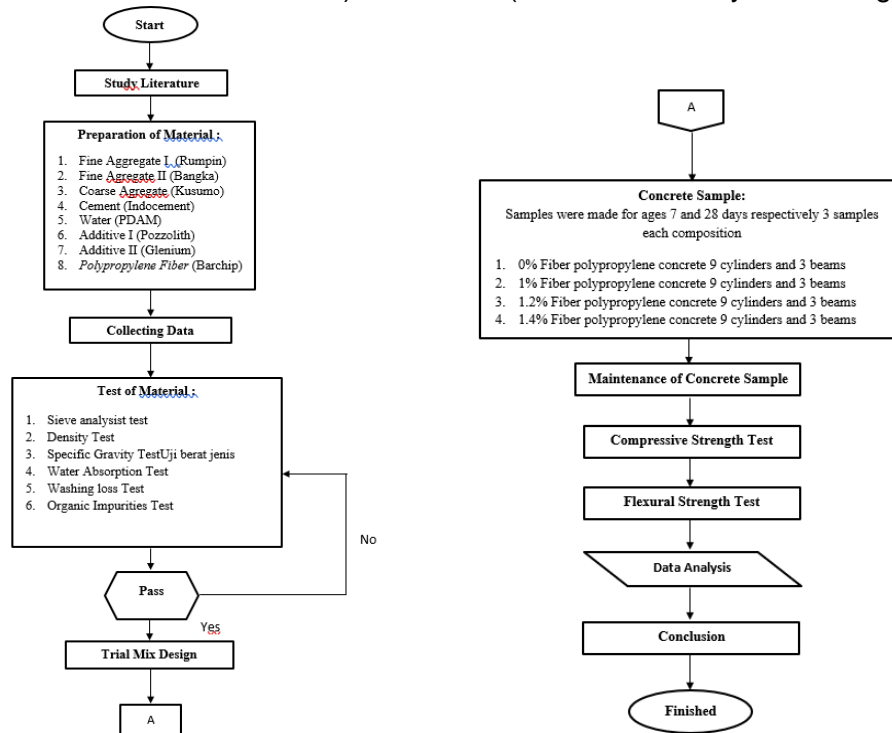
The use of CFRP (Carbon Fiber Reinforced Polymer) and GFRP (Glass Fiber Reinforced Polymer) on beams dimensions of 15 x 20 x 120 cm with reinforcing steel diameters 6 and 10 which results in a flexural strength increase of 31.885% with CFRP and 13.736% with GFRP (Nurlina, et al , 2016). The use of polyerta additive polymers and Fiber Polypropylene as a concrete added material (Hanafi, 2018). The use of Polypropylene Fiber which affects the compressive strength of concrete at a variation of 0.4 kg / m ³ of 35.65 MPa or 18.13% greater than concrete without polypropylene fiber

Polypropylene fiber is one of the added ingredients used in concrete mixtures. The use of Polypropylene fibers in concrete building materials is one of the ways used to improve and improve the structural properties of concrete (ACI Committee 544, 1982), namely ductility

related to the ability of concrete to absorb energy, resistance to shock loads, and resistance to wear and tear, and shrinkage effects.

RESEARCH METHODOLOGY

This research will use an experimental method in a concrete laboratory using a mixture of Fiber Polypropylene which is used as an added material in the preparation of concrete with several variations used. All testing procedures in this study were carried out with reference to SNI (Indonesian National Standard) and ASTM (American Society for Testing and Materials).



Picture 1 Research Flowchart

Source : Research Data

Preparation of tools and materials, as well as material testing that will be used in research. Refers to SNI and ASTM. In this study the constituent materials in the concrete mixture are as follows:

- a) Cement used type 1 – from PT Semen Indonesia
- b) Coarse Aggregate used originates from Kusumo and the fine aggregate used Bangka.
- c) The water used comes from PDAM
- d) Admixture materials used in concrete are Pozzolith and Glenium from BASF
- e) Polypropylene fiber – Barchip48 from Barchip.

Place and Time of Research

Where: This research will be conducted at PT Waskita Beton Precast Laboratory.

Timing: September, 2019-January, 2020

RESULT AND DISCUSSION**Material Inspection Results**

The material used in this study has been through a series of tests in the laboratory to determine the nature and characteristics of the materials used, both fine aggregate and coarse aggregate, including:

Fine Agregate

Testing of fine aggregate material aims to determine the feasibility of the constituent materials that will be used in this study. So that obtained good results. Following testing of fine aggregate material.

a. Sieve Analys Of Fine Agregate

From the results of sieving analysis on the sand of the fart, obtained the results of Fine Modulus 2.59. These results are in accordance with the standard used which refers to

ASTM C-33, which is 2.3 - 3.1. In accordance with the standard table of fine aggregate gradation, it is found that the sand of the fangka enters zone 2 or the sand is rather coarse.

b. Density Of Fine Agregate

The results of weight content testing on fine aggregate get aggregate content weight value of 1.6 gr / cm³. Referring to SNI 03-4804-1998, this value is in accordance with applicable requirements, namely > 1.2 gr / cm³.

c. Specific Gravity (SSD)

The result of specific gravity test on fine aggregate gets saturated surface dry density value of 2.59 gr / cm³. Referring to SNI 03-1750-1990, these values can be classified into normal aggregate, because the values obtained are within the allowable limit of 2.2 - 2.7 gr / cm³.

d. Water Absorbtion

The results of testing the absorption of water in fine aggregate obtained an absorption value of 0.98 gr / cm³.

e. Washing Loss

The results of sludge content testing on fine aggregate obtained sludge value of 2.3%. Referring to SNI S-04-1989-F the value is still within the allowable limit of <5%.

Coarse Agregate

Testing of coarse aggregate material aims to determine the suitability of the constituent materials that will be used in this study. So that obtained good results. Next is the testing of coarse aggregate material.

a. Sieve Analys Of Fine Agregate

From the test results of coarse aggregate sifter analysis, data such as the graph above obtained where the material passed in the 9.5mm sieve was 11.91%, the 12.5mm sieve was 35.74%, the 19.1mm sieve was 91.8, and the sieve was 25 , 4mm equal to 100. The aggregate used has a maximum size of 3cm.

b. Density Of Coarse Agregate

From the testing of coarse aggregate weight we get coarse aggregate values of 1,634 gr.

c. Specific Gravity (SSD)

From the test results obtained the value of specific gravity SSD (saturated surfce dry) of 2,671 grams. Referring to SNI 03-1750-1990, the value obtained is still within the allowable limit of 2.0-2.7 grams.

d. Water Absorbtion

From the absorption test results in the coarse aggregate values of 1.021% were obtained.

e. Roughness Coarse Agregate

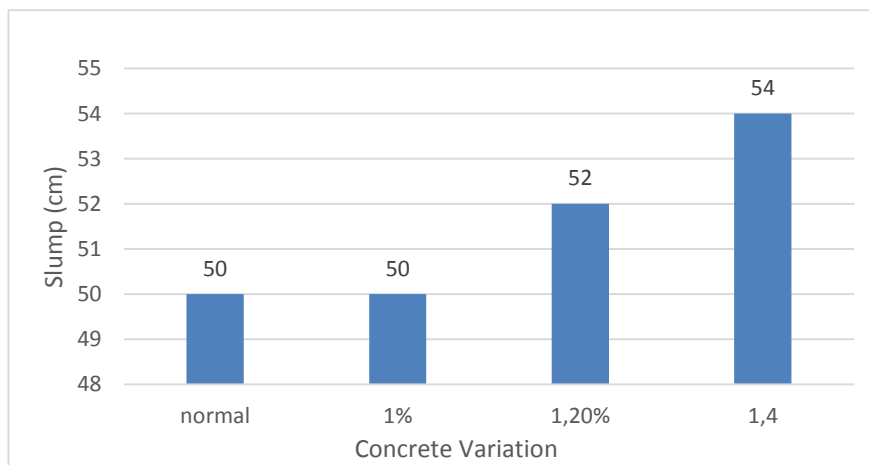
From the results of tests on aggregates performed using Los Angeles machines, the aggregate wear value was 23.45%. Referring to SNI 03-2417-1991, this value is still within the allowable limit because the part that must not be destroyed in the wear test should not be more than 40%.

Table 1. Material requirements for 1 m³

Materials	Unit	Composition	Composition	Composition	Composition
		0%	1%	1,2 %	1,4 %
Water	Ltr	150	150	150	150
Cement	Kg	470	470	470	470
Sand	Kg	820	820	820	820
Split	Kg	940	940	940	940
Additive I	Ltr	1.65	1.65	1.65	1.65
Additive II	Ltr	5.17	5.17	5.17	5.17
Polypropylene Fiber	Kg	0	5	6	7

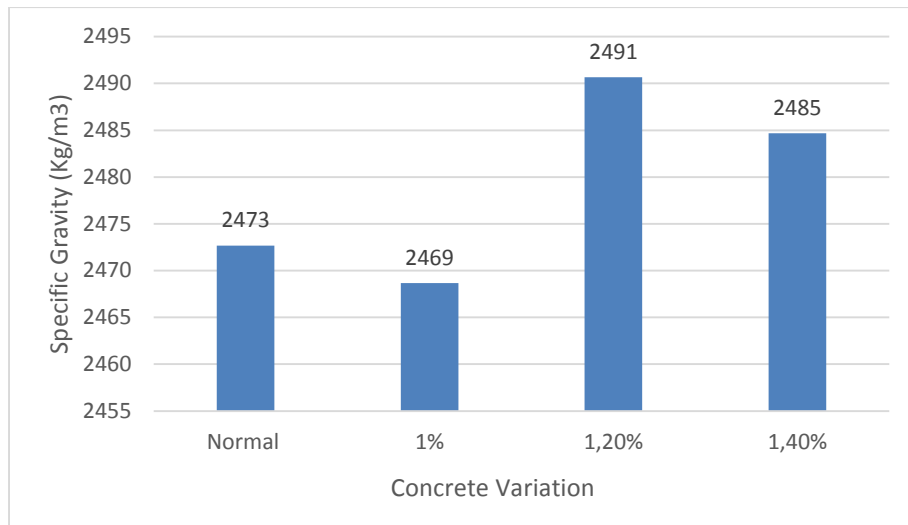
Workability.

Slump testing (workability) is needed to determine the level of fresh concrete permeability. The higher the value of the slump, the concrete is thinner and easier to do, and vice versa. In this study the researchers planned a slump value of 50 ± 2 cm.



Picture 2 Slump Test
Source : Research Data

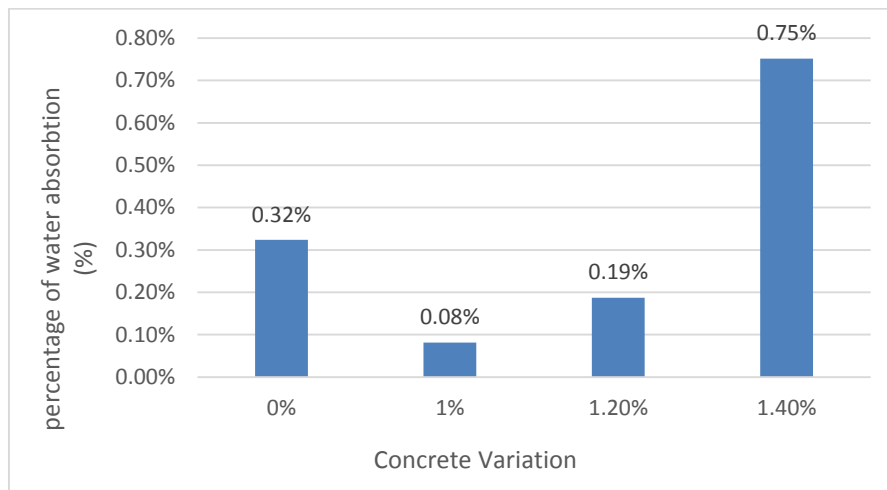
Specific Gravity Test (SSD).



Picture 3 Specific Gravity Test

Source : Research Data

Concrete Water Absorbtion Test.



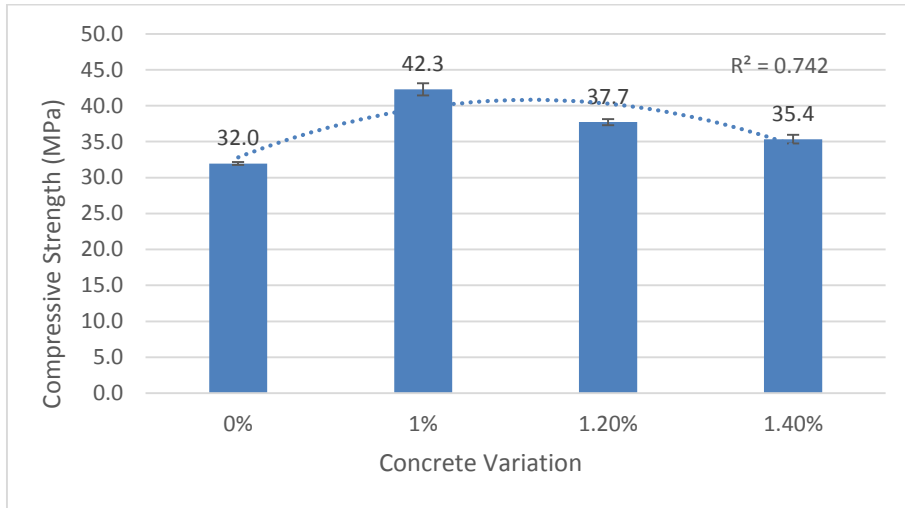
Picture 4 Concrete Water Absorption test

Source : Research Data

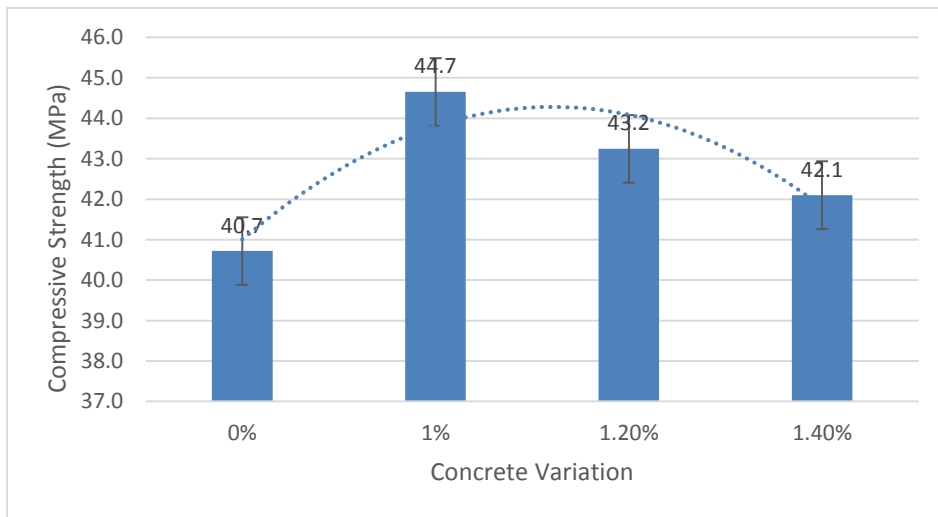
Water Absorption Testing can find out what percentage of concrete can absorb water, for normal concrete conditions a smaller percentage of water absorption is better because the concrete can be waterproof so that if applied to the structure it can prevent water from entering so the reinforcing iron is not exposed to water making the structure durable and strong.

Concrete Compressive Strenght Test

Concrete compressive strength test was carried out on SNI 1974-2011, using cylindrical specimens with a size of 15 x 30 cm. For testing conducted when the sample has reached the age of 7, 28 days. With the following results :

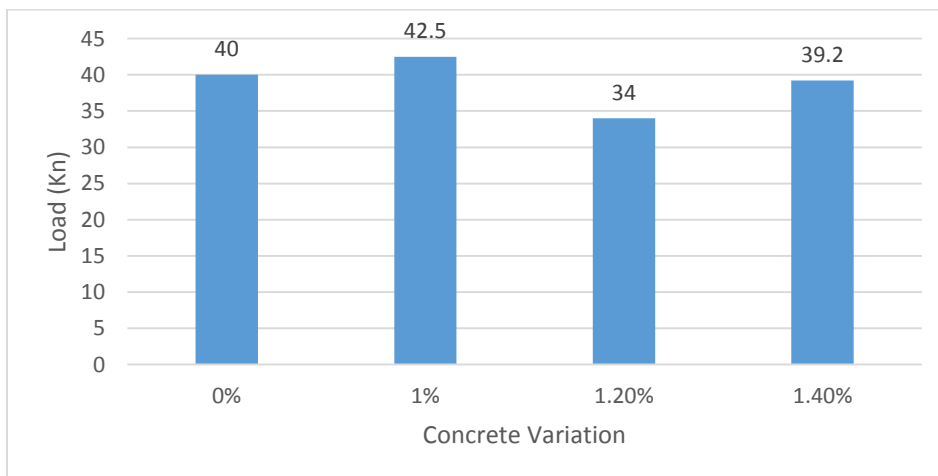


Picture 5 *compressive strength 7 day*
Source: Research Data



Picture 6 *compressive strength 28 day*
Source: Research Data

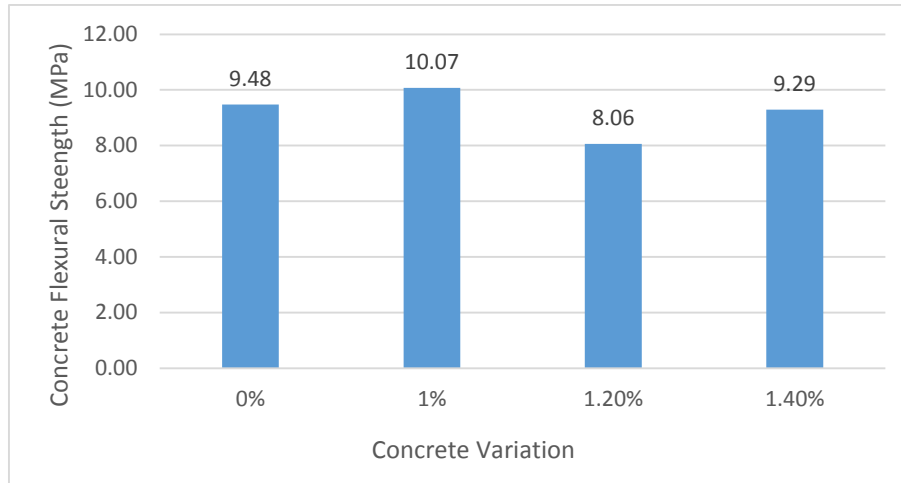
Concrete Flexural Strength Test.



Picture 7 *Flexural strength Test*

Source: Research Data

From the test results obtained loadcell reading values with a value of 40 Kn in normal concrete and 42.5 Kn for concrete variations of 1%, 34 Kn for concrete variations of 1.2%, and 39.2% for concrete variations of 1.4%.

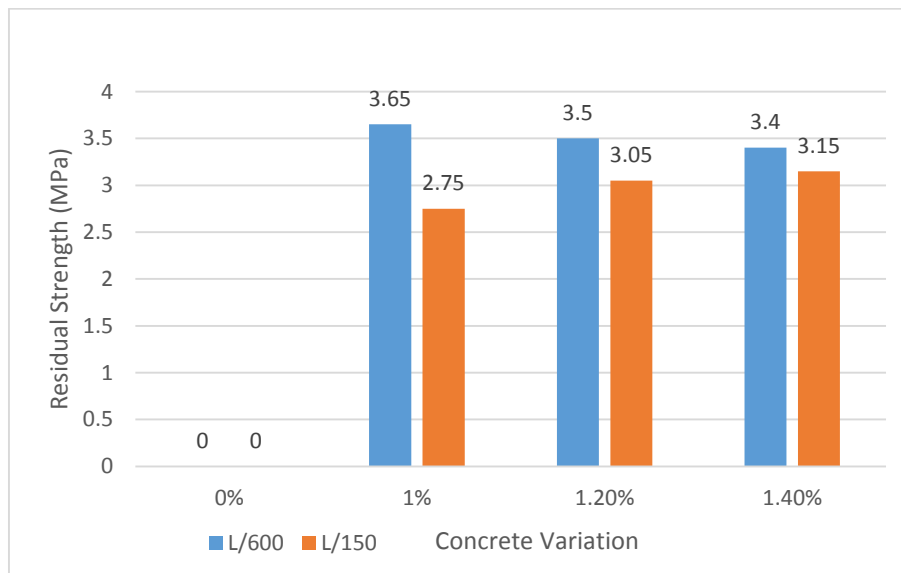


Picture 8 Flexural strength Test

Source: Research Data

Concrete Residual Strength

In this study the concrete residual strength test carried out refers to ASTM C1609 for testing residual strength. The test object used was a beam with a size of 15x15x60 cm with a placement of 45 cm.



Picture 9 Residual strength Test

Source: Research Data

CONCLUSIONS

From the results of the analysis and discussion in the previous chapter and answer from the formulation of the problem, the following conclusions can be drawn:

1. Adding Polypropylene Fiber to concrete gives an increase in the value of concrete workability but it is not significant.
2. Adding Polypropylene Fiber to concrete influences the specific gravity value of the concrete. Concrete with an additional variation of 1% has the lowest specific gravity value of 2469 kg / m³.
3. Absorption of water that occurs varies, the degree of addition of Polypropylene Fiber to concrete affects the value of concrete water absorption.
4. The compressive strength of concrete with the addition of Polypropylene Fiber reaches and exceeds the compressive strength plan at 28 days.
5. Value of flexural strength of concrete using Fiber Polypropylene as an added material has an increase from normal concrete, in this study concrete with a variation of 1% has the highest flexural strength value of 42.5 Kn.
6. Addition of Polypropylene Fiber has an influence on the flexural strength value of concrete residuals, concrete with 1% variation has a value that meets the minimum requirements according to ASTM C1609.

Recommendation

Suggestions that can be delivered at the writing of this thesis after getting the results and solutions provided, the advice that will be given is as follows :

1. Future studies can be carried out as variations in the levels of Fiber Polypropylene as a mixture composition that is even more, making it possible to obtain better concrete data and quality.
2. In this research, concrete with a variation of 1% is a mixture that the author can recommend, because it has the greatest compressive strength, and flexural strength compared to other variations. As well as having residual strength values that meet the requirements of ASTM C1609 / 1609M.
3. Concrete building material used can affect the results of this research.

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Biography / Biographies

Agung Sumarno, ST, MT is a Lecturer in Concrete Structure at Mercu Buana University. He began to join Mercu Buana University in 2015. Mr. Agung Sumarno obtained his Strata-1 (S1) degree at Mulawarman University with the title Thesis Compressive Strength Of Bamboo Fiber Concrete graduated in 2011, then he continued his Masters level in 2012-2015 , at the Bandung Institute of Technology (ITB) with the title Thesis Finite Element Analysis Oh Half Space Strengtening Using Short Pile and graduated in 2015. Besides teaching, he also works as a researcher at Indonesian research institute.

Leonardus Kevin D born in Jakarta on January 14th, 1997, the first child of 3 siblings, having 2 younger siblings, 1 little brothter and 1 little sister. Started lectures at Gadjah Mada University in 2014 in the D3 Civil Engineering program. Graduated in 2017 then continued his studies at the University of Mercubuana in 2018. Has completed his final project, namely, an Experimental Study on Adding Polypropylene Fiber to Compressive Strength and Flexural Strength of Concrete. To fulfill the requirements to get a bachelor's degree. In addition to lecturing he also became an employee at a contractor company in Indonesia.