

ANALYSIS OF CONCRETE COMPRESSIVE STRENGTH WITH COCONUT FIBER WASTE AS A PARTIAL REPLACEMENT OF FINE AGGREGATE

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ABSTRACT

Although concrete is less strong in resisting tensile loads, the addition of fibers makes it a more resilient construction material, especially fiber concrete which is abrasion resistant and has better tensile, flexural and compressive strengths. In Indonesia, coconut fibers, which have been used since prehistory as a building material, are now being utilized as an additive in cement, thanks to their advantages in absorbing water and having good tensile strength. The use of coconut fibers not only increases the flexibility and strength of concrete, but also utilizes household waste that is difficult to recycle to create high-quality construction materials that are more durable and less prone to cracking. The results of testing the compressive strength of normal concrete at 28 days showed that without coconut fiber waste, the compressive strength was 440 kN (f'_c 24.91 Mpa). With the addition of 5% coconut fibers, the compressive strength dropped to 318 kN (f'_c 18 Mpa), and with 10% coconut fibers, to 292 kN (f'_c 16.53 Mpa), showing the effect of fibers on the mechanical properties of concrete.

Keywords: concrete, compressive strength, waste, coconut fiber.

INTRODUCTION

Although concrete is less strong in resisting tensile loads, it remains an important construction material. The addition of fibers to concrete increases its tensile, flexural, and compressive strengths, as well as its resistance to abrasion and impact. In Indonesia, coconut fiber, which has long been used as a building material, is now used as an additive in cement because of its water absorption capacity and tensile strength. The use of coconut fiber not only increases the flexibility and strength of concrete, but also utilizes household waste that is difficult to recycle to create high-quality construction materials that are durable and resistant to cracking.

METHODS

This study uses an experimental method with a series of laboratory tests to evaluate and compare the results. The testing process in the study includes material analysis, preparation of a concrete mix plan, concrete viscosity testing through slump tests, making test samples, concrete curing, and concrete compressive strength testing. The implementation of the study is divided into several stages of implementation, including:

- 1) At this stage, the equipment and materials used in the research are provided;
- 2) At this stage, testing is carried out on the concrete components such as:
 - a. Specific gravity testing on aggregates;
 - b. Testing to pass through the sieve.

- 3) Called the concrete mix planning stage (mix design) based on the SK SNI 03-2834-2000 method.
- 4) Slump testing refers to SNI 1972-2008;
- 5) Concrete curing is carried out by immersion in water;
- 6) Concrete compressive strength testing is carried out after the concrete is 7 days, 14 days, and 28 days old;
- 7) At this stage, the data obtained from the test results will be analyzed to obtain the relationship between the variables studied;
- 8) The last stage is drawing conclusions, at this stage the data that has been analyzed must be drawn into a conclusion related to the research objectives.

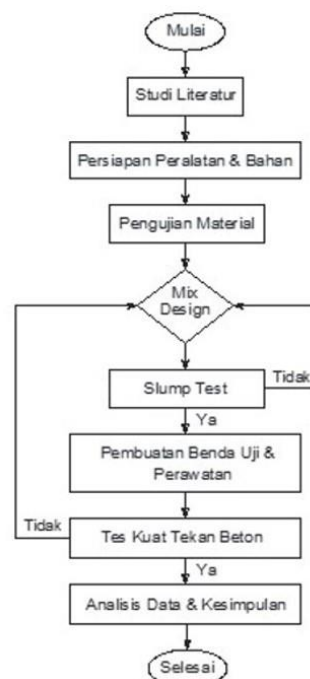


Figure 1. Research Flowchart

Before starting the research, it is important to prepare the tools and materials needed so that the process runs smoothly. Tools such as concrete cylinders, scales, ovens, and mixers must be cleaned of dust and dirt, and lubricated if necessary, to avoid problems during use. Materials such as sand, crushed stone, water, and cement must be available in full and stored in a protected place to maintain their quality during the research. Slump testing on concrete is a measurement of the decrease in the height of the concrete that occurs immediately after the slump mold is lifted, according to SNI 1972-2008.

- 1) The concrete molding process is in accordance with SNI 2493-2011 which describes the method of making and maintaining concrete test objects in the laboratory.
- 2) The concrete molding process is in accordance with SNI 2493-2011 which describes the method of making and maintaining concrete test objects in the laboratory.

RESULTS AND DISCUSSION

For the use of fine aggregate substitute materials using coconut fiber waste of 5% and 10%. The specific gravity of coconut fiber waste can be seen below:

- 1) The specific gravity of coconut fiber waste needed as a substitute for fine aggregate is 5%

$$= \frac{5\% \text{ coconut fiber waste}}{\text{weight of fine aggregate} \cdot \text{cylinder volume}}$$

= 0.17 kg

- 2) The specific gravity of coconut fiber waste needed as a substitute for fine aggregate is 10%

= 10% coconut fiber waste. weight of fine aggregate. cylinder volume

= 0.34 kg

Table 1. Concrete Slump Test Result Data

Variasi Campuran	Nilai Slump	Satuan
Beton f'c 25 Mpa.	8	cm
Beton f'c 25 Mpa variasi 5% limbah sabut kelapa sebagai substitusi sebagian agregat halus	9	cm
Beton f'c 25 Mpa variasi 10% limbah sabut kelapa sebagai substitusi sebagian agregat halus	11	cm
Rata-rata	9,3	cm

Concrete was tested for compression using test specimens aged 7, 14, and 28 days. The concrete compression testing equipment has a computerized display and a reader that uses kN units. Tables 2 to 4 below show the results of concrete compressive strength testing

Table 2. Results of Cylinder Concrete Compression Test at 7 Days

No	Benda Uji	Tanggal Pembuatan	Tanggal Pengujian	Umur Benda Uji (hari)	Berat Benda Uji (kg)	Aktual Kuat Tekan kN	Rata-rata Kuat Tekan kN	Rata-rata Kuat Tekan kN
1	fc'25	27 Mei 2024	3 Juni 2024	7	11,85	265		
2	fc'25	27 Mei 2024	3 Juni 2024	7	12,1	274	266	60,18%
3	fc'25	27 Mei 2024	3 Juni 2024	7	11,7	260		
1	5% SK	6 Juni 2024	13 Juni 2024	7	11,8	195		
2	5% SK	6 Juni 2024	13 Juni 2024	7	11,8	192	199	45,02%
3	5% SK	6 Juni 2024	13 Juni 2024	7	11,7	209		
1	10% SK	15 Juni 2024	22 Juni 2024	7	11,6	183		
2	10% SK	15 Juni 2024	22 Juni 2024	7	11,6	176	177	40,05%
3	10% SK	15 Juni 2024	22 Juni 2024	7	11,5	171		

Table 3. Results of Cylinder Concrete Compression Test at 14 Days

No	Benda Uji	Tanggal Pembuatan	Tanggal Pengujian	Umur Benda Uji (hari)	Berat Benda Uji (kg)	Aktual Kuat Tekan kN	Rata-rata Kuat Tekan kN	Rata-rata Kuat Tekan kN
1	fc'25	27 Mei 2024	10 Juni 2024	14	11,95	367		
2	fc'25	27 Mei 2024	10 Juni 2024	14	12,16	372	372	84,16%
3	fc'25	27 Mei 2024	10 Juni 2024	14	11,9	377		
1	5% SK	6 Juni 2024	20 Juni 2024	14	11,6	261		
2	5% SK	6 Juni 2024	20 Juni 2024	14	11,85	283	274	61,99%
3	5% SK	6 Juni 2024	20 Juni 2024	14	11,7	279		
1	10% SK	15 Juni 2024	29 Juni 2024	14	11,5	224		
2	10% SK	15 Juni 2024	29 Juni 2024	14	11,8	231	223	50,45%
3	10% SK	15 Juni 2024	29 Juni 2024	14	11,4	213		

Table 4. Results of Cylinder Concrete Compression Test at 28 Days

No	Benda Uji	Tanggal Pembuatan	Tanggal Pengujian	Umur Benda Uji (hari)	Berat Benda Uji (kg)	Aktual Kuat Tekan kN	Rata-rata Kuat Tekan kN	Rata-rata Kuat Tekan kN
1	fc'25	27 Mei 2024	24 Juni 2024	28	11,85	445		
2	fc'25	27 Mei 2024	24 Juni 2024	28	12,1	439	440	99,55%
3	fc'25	27 Mei 2024	24 Juni 2024	28	11,7	436		
1	5% SK	6 Juni 2024	4 Juli 2024	28	11,8	349		
2	5% SK	6 Juni 2024	4 Juli 2024	28	11,5	284	318	71,95%
3	5% SK	6 Juni 2024	4 Juli 2024	28	11,7	321		
1	10% SK	15 Juni 2024	13 Juli 2024	28	11,4	284		
2	10% SK	15 Juni 2024	13 Juli 2024	28	11,6	297	292	66,06%
3	10% SK	15 Juni 2024	13 Juli 2024	28	11,5	296		

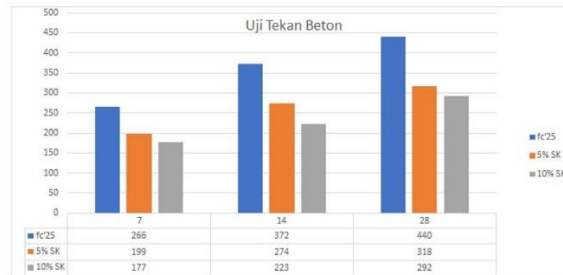


Figure 2. Normal Concrete Compression Test Diagram, Variation 1 and Variation 2

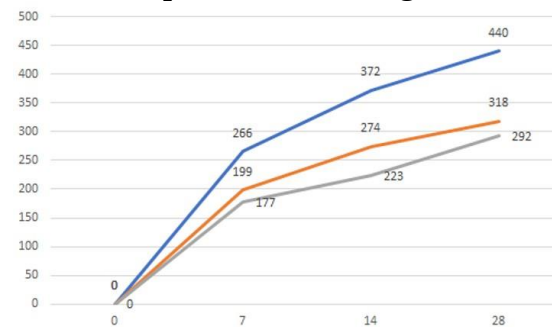


Figure 3. Normal Concrete Compression Test Graph, Variation 1 and Variation 2

CONCLUSIONS

The results of the compressive strength test on normal concrete at the age of 28 days were obtained based on data analysis and discussion that have been presented in the previous chapter regarding the use of coconut fiber waste with variations of 0%, 5%, and 10%, namely 440 kN (f'_c 24.91 MPa), while variation 1 of 5% coconut fiber waste reached 318 kN (f'_c 18 MPa), and variation 2 of 10% coconut fiber waste reached 292 kN (f'_c 16.53 MPa).

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