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TAPPING THE STRENGHT OF CONCRETE WASTE: ENHANCING COMPRESSIVE AND FLEXURAL STRENGHT THROUGH COARSE AGGREGATE SUBSTITUTION IN NORMAL CONCRETE

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ABSTRAK

Sangat diperlukan suatu teknologi konstruksi yang dapat mengurangi eksploitasi alam dan dapat memanfaatkan limbah beton. Salah satu contoh upaya untuk mengurangi dampak tersebut adalah dengan memanfaatkan kembali limbah beton menjadi beton baru. Penelitian ini bertujuan untuk mengetahui seberapa besar pengaruh limbah beton sebagai pengganti agregat kasar terhadap kuat tekan dan kuat lentur. Penelitian ini merencanakan beton normal dengan target kuat tekan 20 MPa dan menggunakan slump 60-180 mm serta menggunakan Semen Portland Pozzolan (PPC). Proporsi agregat sampah yang digunakan pada penelitian ini adalah 0%, 5%, 7,5%, 10% dan 12,5% dari total berat agregat alam dengan umur pengujian 7 hari, 14 hari dan 28 hari. Jumlah benda uji sebanyak 60 buah. Hasil kuat tekan dan kuat lentur akan dibandingkan dengan variasi 0%. Hasil penelitian ini menunjukkan bahwa semakin besar persentase limbah beton maka kuat tekan dan kuat lentur beton semakin menurun. Kuat tekan beton dan kuat lentur beton dengan variasi substitusi limbah beton diperoleh persentase optimum pada uji kuat tekan yaitu pada substitusi limbah beton 5% dengan nilai 18,18 MPa, dan pada uji kuat lentur beton. persentase optimum terdapat pada variasi substitusi 5% dengan nilai 3,385 Mpa

Kata Kunci : Beton Normal, Kuat Tekan, Kuat Lentur.

ABSTRACT

It is urgently needed a construction technology that can reduce natural exploitation and can utilize concrete wastes. One example of an effort to reduce this impact is to reuse waste concrete for new concrete. This study aims to determine how much influence concrete waste as a substitute for coarse aggregate has on compressive strength and flexural strength. This study plans normal concrete with a targeted compressive strength of 20 MPa and uses 60-180 mm slump and uses Portland Pozzolan Cement (PPC). The proportion of waste aggregate used in this study was 0%, 5%, 7.5%, 10% and 12.5% of the total weight of natural aggregate with a test age of 7 days, 14 days and 28 days. The number of test objects is 60 pieces. The compressive strength and flexural strength results will be compared with the 0% variation. The results of this study indicate that the greater the percentage of concrete waste, the compressive strength and flexural strength of concrete decreases. The compressive strength of concrete and the flexural strength of concrete with variations of concrete waste substitution obtained the optimum percentage in the compressive strength test, namely in the 5% waste concrete substitution with a value of 18.18 MPa, and in the flexural strength test of concrete the optimum percentage is found in the 5% substitution variation with a value of 3.385 Mpa

***Keywords** : Normal Concrete, Compressive Strength, Flexural Strength*

1. INTRODUCTION

With the advancements in structural engineering technology, the utilization of concrete remains prevalent in construction works such as high-rise buildings, roads, dams, etc. Concrete is a relatively inexpensive material compared to others. In addition to possessing high compressive strength, concrete is easy to work with and can be shaped as desired. In this research, the author aims to investigate the extent of the influence of using concrete waste from compressive strength testing residue as a partial substitute on the compressive strength of concrete. Normal concrete is concrete with a density of 2200 - 2500 kg/m3 using natural crushed aggregates (Fatah Sidik, 2016). Medium-strength concrete is defined as concrete with compressive strength ranging from 21 - 40 MPa (SNI 03 6468, 2000). The targeted compressive strength of normal concrete is 20 MPa. The selection of this compressive strength is intended for the results of the study to be applicable in the production of concrete for road shoulders and drainage systems that use medium-strength concrete. The proportions of recycled aggregates used in this study were 5%, 7.5%, 10%, and 12.5% of the total weight of natural aggregates, with testing ages of 7, 14, and 28 days.

2. METHOD

The object of this research is normal concrete that utilizes coarse aggregate (Batu Palu) and fine aggregate (Pasir Palu), as well as waste concrete from testing at the Construction Laboratory Unit of the Public Works and Spatial Planning Office of Kutai Timur Regency, East Kalimantan, Indonesia. The specimens used are cylinders with a diameter of 10 cm and a height of 20 cm for compressive strength testing, and beams measuring 15 cm x 15 cm x 60 cm for concrete flexural strength testing. Compressive Strength Test Equipment in this research is for testing concrete compressive and flexural strength.

Image 3.11. Compressive and flexural Strength Test Equipment

Tools: a) Vicat, b)Digital scales and Manual Scales, c) One set of filters, d) Siever Machine, e) Oven, f) Cylinder Mold and Compactor Stick, g) Abrasion Machine, h) Slump Test and Compaction Stick, i) Cube Mold

3. RESULT AND ANALISYS

Testing of the cement, coarse aggregate, and fine aggregate components of concrete is done at this stage in order to see if they meet the specifications provided by the Indonesian National Standards. These materials can be used in the manufacturing of the concrete for this research if their testing results fulfill the requirements.

Table 3.1. List of Tests and Reference Standards for Testing Materials according to Indonesian National Standards (SNI)

No.	Materials	Testing	Testing Reference Standards (SNI)
1.	Cement	a. Consistency Normal	SNI 03-6826-2002
		b. Setting Time	SNI 03-6827-2002
		c. Specific Gravity	SNI 15-2531-1991
2.	Coarse Aggregate	a. Sieve Analysis	SNI 03-1968-1990
		b. Content Weight	SNI 03-4804-1998
		c. Mud Content	SNI 03-4141-1996
		d. Water Content	SNI 1971-2011
		e. Specific Gravity and Absorption	SNI 1969-2008
		f. Abrasion	SNI 2417-2008
3	Fine Aggregate	a. Sieve Analysis	SNI 03-1968-1990
		b. Content Weight	SNI 03-4804-1998
		c. Mud Content	SNI 03-4141-1996
		d. Water Content	SNI 1971-2011
		e. Specific Gravity and Absorption	SNI 1970-2008

RESEARCH PHASE II

At this stage, a standard concrete mix design with a target compressive strength of fc' 20 MPa is prepared using SNI 03-2834-2000. Determining the material composition for regular concrete is the aim of this mix design creation. Variations are made to the mix design, notably in the coarse aggregate that is replaced with waste concrete.

RESEARCH PHASE III

After the concrete constituents have been tested and the mix design has been prepared, the next stage involves the fabrication of test specimens for compressive and flexural strength testing. This stage involves:

a. Testing the concrete slump

The slump test is utilized to determine the workability level of concrete suitable for the type of work intended. This testing follows the reference from SNI 1972-2008 regarding the procedure for conducting the concrete slump test.

b. Fabrication of test specimens

The test specimen for concrete compressive strength testing is a cylinder with dimensions of 10 cm in diameter and 20 cm in height, while the test specimen for concrete flexural strength testing is a beam with dimensions of 15 cm x 15 cm x 60 cm.

c. Maintenance of Test Specimens

Concrete curing is intended to ensure that the hydration process proceeds smoothly and the hardening process occurs perfectly, thereby preventing cracks in the concrete and ensuring the quality of the concrete. This maintenance is carried out by immersing the test specimens that have been removed from the mold for the specified duration, followed by drying for 1 day before testing the specimens

Table 3.2. Test Specimens plan

Variations in Coarse Aggregate Substitution	Age of Concrete Compressive Strength Test Specimens			Flexural Strength Test Specimens	Total of Test Specimens (Pieces)
	7 Day	14 Day	28 Day	28 Day	
0%	3	3	3	3	12
5%	3	3	3	3	12
7,5%	3	3	3	3	12
10%	3	3	3	3	12
12,5%	3	3	3	3	12
Total			60		

RESEARCH PHASE IV (COMPRESSIVE AND FLEXURAL STRENGHT TESTING)

At this stage, testing is conducted on the prepared test specimens, namely:

a. Concrete Compressive Strength Testing

Concrete compressive strength testing is conducted on cylindrical test specimens following the guidelines outlined in SNI 03-1974-1990.

Image 3.17. Concrete Compressive Strength Testing

b. . Concrete Flexural Strength Testing

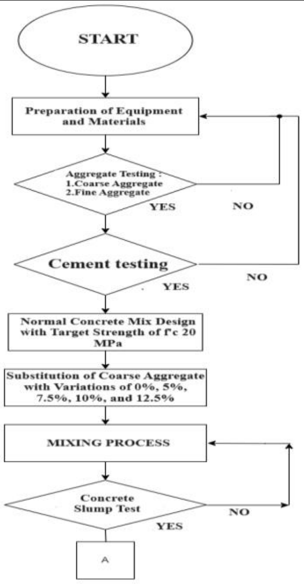
Flexural Strength Testing of Concrete is conducted on beam test specimens following the guidelines outlined in SNI 4431:2011.

Image 3.18. Concrete Flexural Strength Testing

RESEARCH PHASE V (DATA PROCESSING)

In this stage, the data obtained from the conducted tests are processed by the author, followed by drawing conclusions.

Figure 3.1. Flowchart



4.5. RESULT AND ANALYSIS OF COARSE AGGREGATE TESTING

1. Specific gravity and water absorption of coarse aggregates (SNI 03-1969-2008)

Table 4.1. Test Results of Specific Weight and Water Absorption of Coarse Aggregate (Batu Palu)

No	Weight of Test Objects	Symbol	Value		Unit
			Stone (1/2)	Stone (2/3)	
1	Dry Surface Saturated (SSD)	A	1250	1250	gram
2	Oven Dried	B	1244	1234	gram
3	In the Water	C	792	792.4	gram
Calculation					Mean
4	Bulk Specific Weight	$\frac{B}{(A-C)}$	2.498	2.63	2.59
5	Saturated Surface Specific gravity	$\frac{A}{(A-C)}$	2.586	2.724	2.655
6	Apparent Specific gravity	$\frac{B}{(B-C)}$	2.739	2.798	2.768,5
7	Absorption	$\frac{A-B}{(B)}X100$	0,482	1,297	0,889

Based on the results of testing the specific gravity of Batu Palu coarse aggregate above, the SSD density of 1/2 stone was ***2,586*** and 2/3 stone was ***2,724*** and the water absorption of 1/2 stone coarse aggregate was ***0.482*** and 2/3 stone was ***1.297***.

2. Bulk Weight of Coarse Aggregate (SNI 03-4804-1998)

Table 4.3. Results of Coarse Aggregate Content Weight Testing (Batu Palu)

No	Weight of Test Objects	Value		Unit
		I (1/2)	II (2/3)	
1	Mold Weight (W1)	2156	2156	gram
2	Mold Weight + Water (W2)	5247	5247	gram
3	Water Weight (V = W2 - W1)	3091	3091	cm^3
Loose Method				
4	Mold Weight + Sample (W3)	6720	6642	gram
5	Sample Weight (W4 = W3 - W1)	4564	4486	gram
6	Sample Content Weight (g = W4/W1)	1.477	1.451	gr/cm^3
Shake Method				
7	Mold Weight + Sample (W3)	7320	7207	gram
8	Sample Weight (W4 = W3 - W1)	5164	5051	gram
9	Sample Content Weight (g = W4/W1)	2.395	2.343	gr/cm^3

4. CONCLUSION

From the results of the research that has been done, the author can draw the following conclusions:

1. The effect of concrete waste substitution on the compressive strength of concrete, tends to decrease as the percentage of concrete waste increases compared to concrete that does not use a mixture of concrete waste.
2. From the results of testing the compressive strength of concrete and flexural strength of concrete with variations in concrete waste substitution, the optimum percentage in the compressive strength test is obtained at 5% concrete waste substitution with a value of 17.186 MPa, and in testing the flexural strength of concrete the optimum percentage is in the 5% substitution variation with a value of 3.385 MPa.

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