

THE EFFECT OF USING SUGAR CANE WASTE ON CONCRETE FLEXURAL STRENGTH

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ABSTRACT

Modern construction technology has developed with the principle of environmental concern, integrating natural materials into construction materials to support environmentally friendly practices. Green construction includes processes that minimize the use of hazardous materials, do not disturb the peace of the population, limit waste production, maintain the balance of nature, and avoid the use of hazardous chemicals. In industry, rapidly developing technology often produces negative waste. Population growth increases the need for construction materials from natural and artificial sources. One solution is the utilization of local resources, including waste and garbage, which not only reduce pollution but also as an alternative to conventional building materials, such as the use of bagasse waste in construction. Based on data analysis and conversations that have been described in the previous chapter regarding the use of bagasse waste with variations of 0%, 10%, and 15%, the results of the flexural test of $f_c'25$ concrete, namely after 28 days, the strength of ordinary concrete is 3.67 MPa, while variation 1 with 10% bagasse reaches 4.06 MPa, while for variation-2 with 15% bagasse reaches 4.49 MPa. The test results appear to meet the minimum requirements of 14% of the planned concrete compression test. The increase with the addition of sugarcane pulp was an average of 10%.

Keywords: Concrete, Concrete Flexural Strength, Sugarcane Bagasse

INTRODUCTION

Modern construction technology has developed with the principle of environmental concern, integrating natural materials into construction materials to support environmentally friendly practices. Green construction includes processes that minimize the use of hazardous materials, do not disturb the peace of the population, limit waste production, maintain the balance of nature, and avoid the use of hazardous chemicals. In industry, rapidly developing technology often produces negative waste. Population growth increases the need for construction materials from natural and artificial sources. One solution is the use of local resources, including waste and garbage, which not only reduce pollution but also serve as an alternative to conventional building materials, such as the use of sugarcane bagasse waste in construction.

METHODS

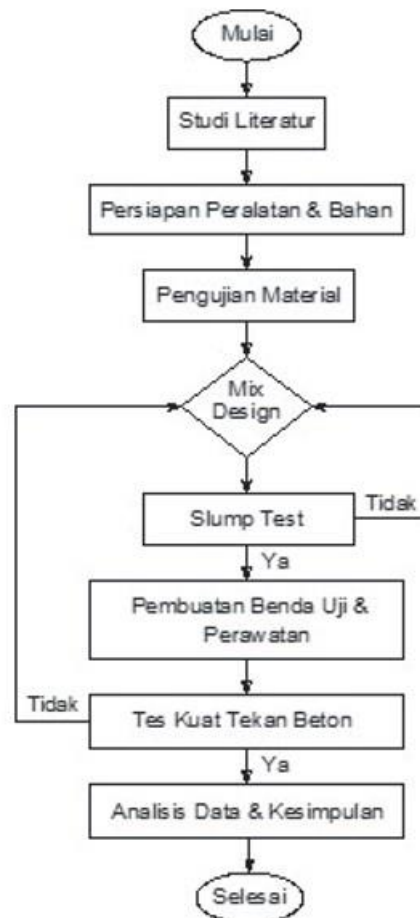


Figure 2. Research Flowchart

Before conducting the research, it is very important to provide and prepare the tools and materials needed for a smooth process. The tools used need to be cleaned from dust and dirt.

For example, the concrete cylinder must be cleaned and lubricated so that the bolts do not jam and the dried concrete does not stick to the walls. Other equipment such as scales, ovens, and mixers also require the same preparation.

Materials such as sand, crushed stone, water, and cement must be available in full from the beginning to the end of the research to avoid shortages. In addition, these materials must be stored in a place protected from the effects of the weather to maintain their quality.

- 1) Slump testing on concrete is a measurement of the difference in concrete height that occurs immediately after the slump mold is lifted, according to SNI 1972-2008. This test assesses the water balance in the concrete mixture, with a target decrease of around $10 \text{ cm} \pm 2$;
- 2) The concrete molding process is in accordance with SNI 2493-2011 which describes how to make and maintain concrete test objects in the laboratory.

RESULTS AND DISCUSSION

The results of the material examination, which include evaluation of aggregate tests, fresh concrete, and hardened concrete, were obtained from the Concrete Technology Laboratory at Krisnadwipayana University, Jakarta. The test and analysis data are then displayed in this chapter using graphs and tables.

Table 1 Results of Sand Gradation Analysis Test

Lolos Ayakan		Berat Tak Lolos	Jumlah Tak Lolos	Jumlah Prosentase		Tidak Lolos Kumulatif
SNI (mm)	ASTM			Tak Lolos	Lolos	
(mm)		(gr)	(gr)	(%)	(%)	(%)
9,52	3/8 in	0	0	0,00	100,00	0,00
4,75	NO.4	30	30	3	97	3
2,36	NO.8	70	100	10	90	10
1,18	NO.16	142	242	24,2	75	24,2
0,6	NO.30	128	370	37	63	37
0,3	NO.50	133	503	50,3	49,7	50,3
0,15	NO.100	277	780	78	22	78
0,075	NO.200	220	1000	100	0	0
Jumlah		1000		100		202,5
Modulus Kehalusan						2.025
Hasil analisis uji modulus Kehalusan = $202.5 / 100 = 2.025$ Sesuai spek SNI-S-04-1989-F nilai modulus pasir 1,50-3,80						

There are two methods to test the content of mud and clay in sand, namely the volume method and the weight method.

Table 2 Sand Mud Analysis Test

No	Uraian	Hasil	
1	Mangkuk	1	2
2	Sebelum dicuci, berat kering (A) gram	500	500
3	Setelah dicuci, berat pasir kering (B) gram	492,3	491,6
4	Kandungan lumpur $((A) - (B) / A) \times 100 \%$	1,54	1,68
	Kandungan lumpur rata-rata (%)	1,61	
Temuan pengujian : 1,61% kandungan lumpur			
Nilai kadar pasir < 5% adalah nilai maksimum yang diperbolehkan oleh spesifikasi SNI-S-04-1989-F			

Table 3 below shows the results of the specific gravity and water absorption tests of the concrete sand used in the concrete mixture.

Table 3 Results of Specific Gravity & Sand Absorption Tests

Berat Jenis dan Penyerapan Pasir Bogor				
No.	Uraian	Satuan	Rumus	Percobaan
1	Bobot pasir kering mutlak (BK)	Gr	-	473,1
2	Bobot partikel pasir (SSD)	Gr	-	500
3	Bobot piknometer ditambah Air ditambah Pasir(BT)	Gr	-	970
4	Bobot Piknometer ditambah Air (B)	Gr	-	667
5	Bobot jenis curah	-	$BK / (B + SSD - BT)$	2,317
6	Bobot jenis SSD	-	$SSD / (B + SSD - BT)$	2,538
7	Bobot jenis semu	-	$BK / (B + BK - BT)$	2,668
8	Daya serap air	%	$(SSD - BK) / BK \times 100$	5,686

Split analysis for split stone with a maximum size of 4 cm used in this test is presented from Table 4 to Table 6.

Table 4 Split Sieve Analysis Results Test

Berat Jenis dan Penyerapan Pasir Bogor				
No.	Uraian	Satuan	Rumus	Percobaan
1	Bobot pasir kering mutlak (BK)	Gr	-	473,1
2	Bobot partikel pasir (SSD)	Gr	-	500
3	Bobot piknometer ditambah Air ditambah Pasir(BT)	Gr	-	970
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5	Bobot jenis curah	-	$BK / (B + SSD - BT)$	2,317
6	Bobot jenis SSD	-	$SSD / (B + SSD - BT)$	2,538
7	Bobot jenis semu	-	$BK / (B + BK - BT)$	2,668
8	Daya serap air	%	$(SSD - BK) / BK * 100$	5,686

Table 5 Results of Specific Gravity and Split Absorption Tests

Uji Analisis Berat Jenis dan Daya Serap Air Split				
No	Keterangan	Satuan	Rumus	Hasil Uji Analisis
1	Bobot agregat kering mutlak (BK)	gr	-	4895,5
2	Bobot split (SSD)	gr	-	5000
3	Bobot split di dalam air (BA)	gr	-	3047
4	Bobot jenis curah	-	$BK / (SSD - BA)$	2,507
5	Bobot jenis SSD	-	$SSD / (SSD - BA)$	2,560
6	Bobot jenis semu	-	$BK / (BK - BA)$	2,648
7	Daya serap air	%	$(SSD - BK) / BK * 100$	2,135

Table 6 Split Wear Test Results

Uji Analisis Berat Jenis dan Daya Serap Air Split				
No	Keterangan	Satuan	Rumus	Hasil Uji Analisis
1	Bobot agregat kering mutlak (BK)	gr	-	4895,5
2	Bobot split (SSD)	gr	-	5000
3	Bobot split di dalam air (BA)	gr	-	3047
4	Bobot jenis curah	-	$BK / (SSD - BA)$	2,507
5	Bobot jenis SSD	-	$SSD / (SSD - BA)$	2,560
6	Bobot jenis semu	-	$BK / (BK - BA)$	2,648
7	Daya serap air	%	$(SSD - BK) / BK * 100$	2,135



Figure 3. Slump Test Making Process

The flexural strength of concrete was tested on beam samples with two samples each at the ages of 7, 14, and 28 days, after the manufacture and curing of the test specimens. Each

study had a total of six test specimens because the size of the beam used was 60 cm x 15 cm x 15 cm. The standard test procedure for the flexural strength of concrete, ASTM C 78-94, was referred to in this flexural strength test.



Figure 4. Beam Flexural Strength Testing Process

Table 7 Flexural Strength Results of 60x15x15 cm Bagasse Reinforcement Beam

Umur Benda Uji hari	Kuat Tekan Mpa	Balok Normal Ampas Tebu 0%	Berat Benda Uji kg	Volume Benda Uji m ³	Berat Volume Benda Uji kg/m ³	Berat Volume Rata-rata kg/m ³	Bacaan Kuat Tekan kN	Kuat Lentur Mpa	Kuat Lentur Rata-rata Mpa
7	25	1	30,58	0,0135	2.265	2.278	13,16	2,34	2,45
		2	30,92	0,0135	2.290		14,37	2,55	
28	25	1	30,58	0,0135	2.265	2.278	20,24	3,60	3,67
		2	30,92	0,0135	2.290		21,08	3,75	

Tabel 8 Hasil Kuat Lentur Balok Variasi I, Ampas Tebu 10%

Umur Benda Uji hari	Kuat Tekan Mpa	Balok Variasi Ampas Tebu 10%	Berat Benda Uji kg	Volume Benda Uji m ³	Berat Volume Benda Uji kg/m ³	Berat Volume Rata-rata kg/m ³	Bacaan Kuat Tekan kN	Kuat Lentur Mpa	Kuat Lentur Rata-rata Mpa
7	25	1	31,80	0,0135	2.356	2.341	15,16	2,70	2,66
		2	31,40	0,0135	2.326		14,74	2,62	
28	25	1	31,80	0,0135	2.356	2.341	23,02	4,09	4,06
		2	31,40	0,0135	2.326		22,61	4,02	

Table 9 Flexural Strength Results of Variation II Beams, Sugarcane Bagasse 15%

Umur Benda Uji hari	Kuat Tekan Mpa	Balok Variasi Ampas Tebu 15%	Berat Benda Uji kg	Volume Benda Uji m ³	Berat Volume Benda Uji kg/m ³	Berat Volume Rata-rata kg/m ³	Bacaan Kuat Tekan kN	Kuat Lentur Mpa	Kuat Lentur Rata-rata Mpa
7	25	1	31,65	0,0135	2.344	2.340	16,22	2,88	2,73
		2	31,54	0,0135	2.336		14,46	2,57	
28	25	1	31,72	0,0135	2.350	2.336	23,62	4,20	4,49
		2	31,36	0,0135	2.323		26,91	4,78	

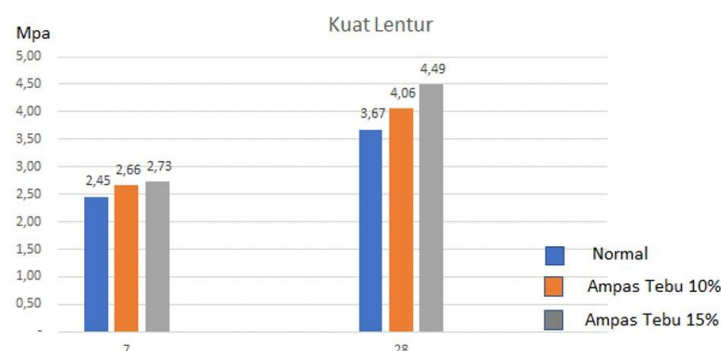


Figure 5. Flexural Strength Graph of Beam

CONCLUSIONS

Based on the data analysis and conversations that have been described in the previous chapter regarding the use of bagasse waste with variations of 0%, 10%, and 15%, the results of

the flexural test of $f_c'25$ concrete, namely after 28 days, the strength of ordinary concrete is 3.67 MPa, while variation 1 with 10% bagasse reaches 4.06 MPa, while for variation-2 with 15% bagasse reaches 4.49 MPa. The test results are seen to meet the minimum requirements of 14% of the planned concrete compression test. There was an increase with the addition of bagasse by an average of 10%.

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