

BAB VI

KESIMPULAN DAN SARAN

6.1. Kesimpulan

Hasil dari penelitian dan data yang telah di olah, dapat disimplkan sebagai berikut:

1. Hasil pemeriksaan kadar limbah keramik memiliki sifat *pozzolan* kelas C.
2. Klasifikasi tanah asli berdasarkan AASHTO adalah tanah berlempung dengan total lolos saringan no. 200 sebesar 36,21% > 35%, nilai batas cair (*LL*) sebesar 42,45% dan nilai indeks plastisitas sebesar 17,01%. Dari hasil data, tanah dikelompok kan A-7.
3. Klasifikasi berdasarkan USCS adalah lempung anorganik dengan simbol CL (lempung anorganik dari plastisitas rendah sampai sedang, lempung kerikil, lempung pasir, lempung berlumpur, lempung tanpa lemak)
4. Kadar air optimum (OMC) pada pengujian pemadatan tanah sebesar 11,79%
5. Hasil pengujian kuat tekan bebas campuran tanah semen campuran 5% semen pada pemeraman 3, 7 dan 28 hari berturut sebesar 12,11 kg/cm², 18,07 kg/cm² dan 24,545 kg/cm². Sedangkan pada campuran semen 6% pemeraman 3, 7 dan 28 hari berturut sebesar 13,736 kg/cm², 19,874 kg/cm² dan 25,993 kg/cm². Didapatkan hasil kadar optimum paling tinggi adalah campuran tanah semen 6%

6. Pada hasil batas *atterberg* campuran semen 6% nilai batas cair sebesar 37,41%, nilai batas plastis sebesar 22,8% dan nilai indeks plastisitas sebesar 15,33%. Pada campuran tanah semen dapat menurun kan nilai batas cair, batas plastis dan indeks plastisitas.
7. Hasil pengujian kuat tekan bebas limbah keramik sebagai bahan pengganti semen mengalami penurunan dibandingkan campuran tanah semen pada pemeraman 28 hari campuran tanah + 6% semen (25% limbah keramik + 75% semen) dengan q_u 3,892 kg/cm² penurunan sebesar -85,027%, tanah + 6% semen (50% limbah keramik + 50% semen) dengan q_u 3,538 kg/cm² penurunan sebesar -86,389%, tanah + 6% semen (75% limbah keramik + 25% semen) dengan q_u 3,484 kg/cm² penurunan sebesar -86,596% dan tanah + 6% semen (100% limbah keramik + 0% semen) dengan q_u 3,440 kg/cm² penurunan sebesar -86,766%. Dari hasil didapatkan semakin bertambah bahan pengganti semen dengan limbah keramik, semakin menurun nilai kuat tekan bebas.
8. Hasil pengujian CBR pada campuran bahan pengganti semen dengan limbah keramik, mengalami peningkatan dibandingkan nilai CBR tanah asli dengan pemeraman 7 hari campuran tanah + 6% semen (25% limbah keramik + 75% semen) dengan P1 117,64% dan P2 191,66% tanah + 6% semen (50% limbah keramik + 50% semen) dengan P1 142,37% dan P2 142,92%, tanah + 6% semen (75% limbah keramik + 25% semen) dengan P1 50,02% dan P2 50,94%, dan tanah + 6% semen (100% limbah keramik + 0% semen) dengan P1 23,09% dan P2 23,09%. Hasil masuk dalam

persyaratan konstruksi dengan persyaratan nilai CBR diatas 50% memiliki sifat tanah sangat bagus untuk konstruksi *sub base* dan *base* jalan.

6.2. Saran

Berikut merupakan saran untuk penelitian selanjutnya.

1. Perlu dilakukan pengujian parameter lain untuk mengecek apakah masuk pada persyaratan sesuai peraturan yang ada
2. Perlu diteliti penggunaan bahan pengganti atau bahan tambahan lain pada stabilisasi tanah untuk meningkatkan kuat tekan tanah campuran semen
3. Perlu dilakukan pengujian menggunakan metode dilapangan dengan tujuan dapat merealisasikan penelitian yang dilakukan

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LAMPIRAN

Lampiran 1. Pengujian Kadar Air



UNIVERSITAS ATMA JAYA YOGYAKARTA

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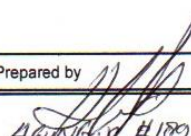
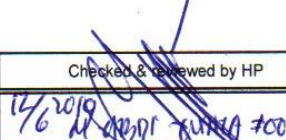
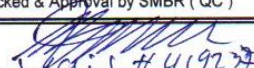
Telp. +62-274-487711 (hunting) Fax. +62-274-487748

PENGUJIAN KADAR AIR




Pengujian Sampel	: Kadar Air Tanah	MDD	:
Tanggal Pengujian	: 13 Agustus 2019	Diameter	: -
Waktu Pengujian	: 07.30	Tinggi	: -
OMC	: 11,79 %	Air yang ditambahkan	: -

Tanah asli		TA	
		1	2
Kode Cawan	W_1 gram		
Berat Cawan Kosong	W_2 gram	10,28	11,09
Berat Cawan + Tanah Basah	W_3 gram	89,31	77,88
Berat Cawan + Tanah Kering	$W_w = W_2 - W_3$	76,01	66,70
Berat Air	$W_s = W_3 - W_1$	13,30	11,18
Berat Tanah Kering		65,73	55,61
Kadar Air	$\frac{W_2 - W_3}{W_3 - W_1} \times 100\%$	20,23	20,10
Kadar Air Rata-Rata		20,17	

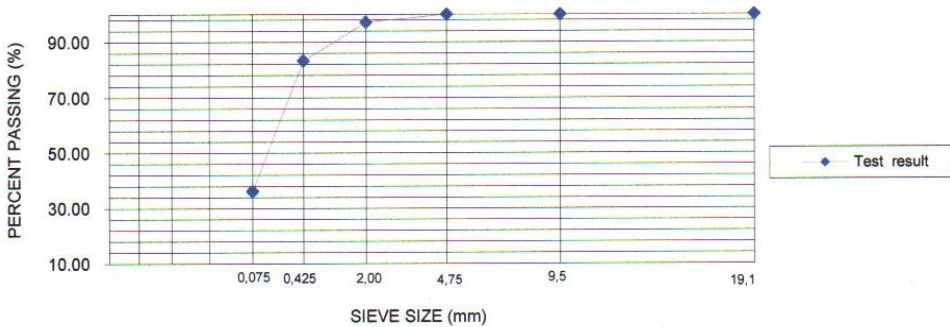
Lampiran 2. Specific Gravity

His Infrastructure Improvement Contract C 1583266																																
 CHEVRON PACIFIC INDONESIA	 A Larger Make - Better & Test Company	SPECIFIC GRAVITY																														
		LABORATORIUM JALAN PT. HARAP PANJANG Branch Office- Duri Phone (+62765) 596389, Fax (+62765) 596399																														
<p>Road section : Infrastructure Improvement South Segment 5E - 99</p> <p>Spl 1 Date 12-Jun-19 Existing soil</p>																																
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 5%;">No.</th> <th style="width: 85%;">Piknometer</th> <th style="width: 10%;"></th> </tr> </thead> <tbody> <tr> <td>A</td> <td>Weight picnometer + Sampel</td> <td style="text-align: center;">771.6</td> </tr> <tr> <td>B</td> <td>Weight picnometer</td> <td style="text-align: center;">271.6</td> </tr> <tr> <td>C</td> <td>Weight Sampel</td> <td style="text-align: center;">500</td> </tr> <tr> <td>D</td> <td>Temperature</td> <td style="text-align: center;">#</td> </tr> <tr> <td>E</td> <td>Weigh picnometer + Water + Sampel</td> <td style="text-align: center;">1562.0</td> </tr> <tr> <td>F</td> <td>Weight picnometer + Water</td> <td style="text-align: center;">1255.8</td> </tr> <tr> <td>G</td> <td>F + C</td> <td style="text-align: center;">1755.8</td> </tr> <tr> <td>H</td> <td>G - E</td> <td style="text-align: center;">193.8</td> </tr> <tr> <td>I</td> <td>Specipic graity C / H</td> <td style="text-align: center;">2.580</td> </tr> </tbody> </table>			No.	Piknometer		A	Weight picnometer + Sampel	771.6	B	Weight picnometer	271.6	C	Weight Sampel	500	D	Temperature	#	E	Weigh picnometer + Water + Sampel	1562.0	F	Weight picnometer + Water	1255.8	G	F + C	1755.8	H	G - E	193.8	I	Specipic graity C / H	2.580
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17/6/19  #189	12/6/2019  #009#	 #4192#																														

Lampiran 3. Sieve Analysis Test

His Infrastructure Improvement Contract C 1583266						
 CHEVRON PACIFIC INDONESIA		 A Geiger, M&E - Brown & Root Company		SIEVE ANALYSIS TEST ASTM D - 136		 LABORATORIUM JALAN PT. HARAP PANJANG Branch Office- Duri Phone (+62765) 596389, Fax (+62765) 596399
Road section : Infrastructure Improvement South Segment 5E - 99						
Date : 12-Jun-19 Material Type : Existing soil Sampling : Spl 1 Total of Weight : 750 Grams						
SIEVE SIZE		CUMULATIVE RETAINED (Gram)	PERCENT RETAINED (%)	PERCENT PASSING (%)	SPEC	
Inch	Mm					
3/4 "	19.1	0.0	0.0	100.00		
1/2 "	12.5					
3/8 "	9.5	0.0	0.0	100.00		
# 4	4.75	0.0	0.0	100.00		
# 8	2.38					
# 10	2.00	21.5	2.87	97.13		
# 16	1.19					
# 30	0.600					
# 40	0.425	125.3	16.71	83.29		
# 50	0.300					
# 70	0.215					
#100	0.150					
# 200	0.075	478.4	63.79	36.21		

GRADATION CURVE OF SOIL






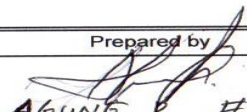


PERCENT PASSING (%)

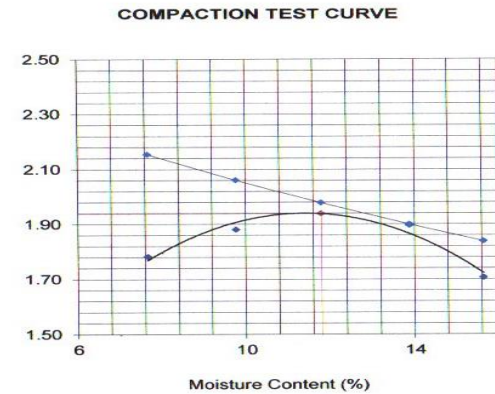
SIEVE SIZE (mm)

◆ Test result




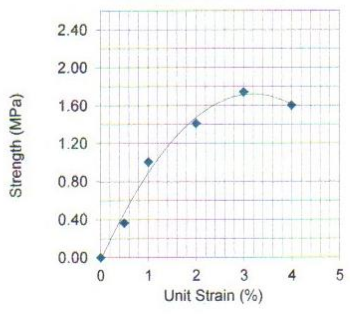
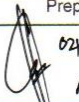
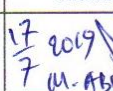
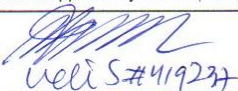
Prepared by 12/6/2019 AGUNG #189	Checked & reviewed by HP 12/6/2019 M. ABDI TUDAN #009#	Checked & Approval by SMBR (QC) 12/6/2019 #419277
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Lampiran 4. Modified Compaction Test




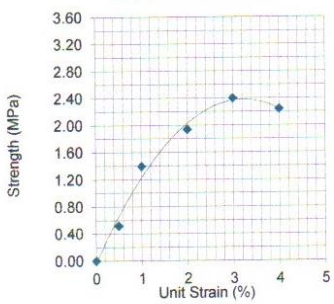

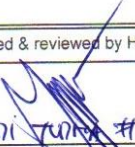
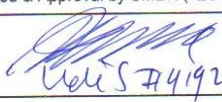
His Infrastructure Improvement Contract C 1583266																																																								
 <small>CHEVRON PACIFIC INDONESIA</small>	 <small>A Sengul M&E - Brown & Root Company</small>	MODIFIED COMPACTION TEST ASTM D - 1557																																																						
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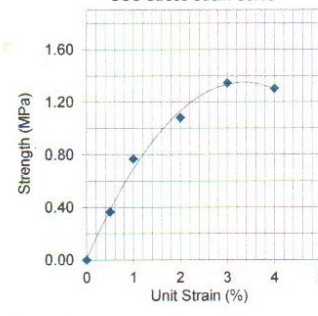
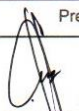


Lampiran 9.. UCS Tanah + 5% semen tujuh hari Sampel 2

His Infrastructure Improvement Contract C 1583266																																																																																																																
 CHEVRON PACIFIC INDONESIA	 Sambutan, Bantul, Yogyakarta	UNCONFINED COMPRESSIVE STRENGTH TEST (ASTM D-1633)					 LABORATORIUM JALAN PT. HARAP PANJANG Branch Office- Duri Phone (+62765) 596389, Fax (+62765) 596399																																																																																																									
Method : Modified Material type : SOIL CEMENT BASE Date of Moulding : 10-Jun-19 Tested date : 17-Jun-19 Type of Binder : Cement 5.0% Road Section : Infrastructure Improvement South Segment 5E - 99 Station : SPL 1																																																																																																																
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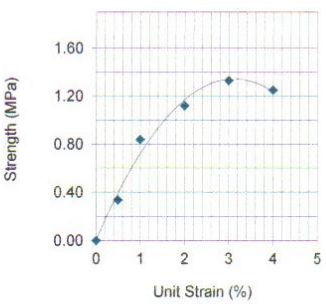


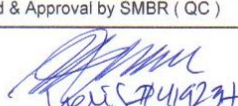
Lampiran 11.. UCS Tanah + 5% semen 28 hari Sampel 2

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Lampiran 12.. UCS Tanah + 6% semen tiga hari Sampel 1

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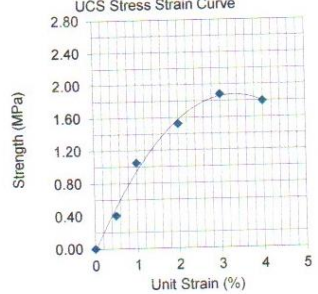
Lampiran 13.. UCS Tanah + 6% semen tiga hari Sampel 2

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 CHEVRON PACIFIC INDONESIA	 PT. HARAP PANJANG	UNCONFINED COMPRESSIVE STRENGTH TEST (ASTM D-1633)					LABORATORIUM JALAN PT. HARAP PANJANG Branch Office: Duri Phone (+62765) 596389, Fax (+62765) 596399																																																																																																									
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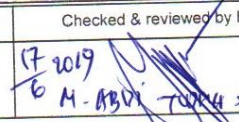
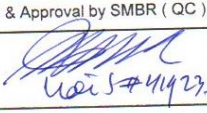
Lampiran 14.. UCS Tanah + 6% semen tujuh hari Sampel 1

His Infrastructure Improvement Contract C 1583266									
 		UNCONFINED COMPRESSIVE STRENGTH TEST (ASTM D-1633)				 LABORATORIUM JALAN PT. HARAP PANJANG Branch Office-Duri Phone (+62765) 596388, Fax (+62765) 596399			
Methode : Modified Material type : SOIL CEMENT BASE Date of Moulding : 10-Jun-19 Tested date : 17-Jun-19 Type of Binder : Cement 6.0% Road Section : Infrastructure Improvement South Segment 5E - 99 Station : SPL 1									
Sample Data-1 : Diameter : 10.14 cm Weight of Sample : 1993 gr Volume : 920.0cc Height of Sample : 11.4 cm Moisture Content : 11.71 % L C R : 12.8024 Initial Area : 80.79 cm ² Wet Unit Weight : 2.166 gr/cc Age : 7 days Dry Unit Weight : 1.939 gr/cc									
Deformation Dial Reading (.....x10 ³)	Load Dial (unit)	Sample Deformation ΔL	Unit Strain ΔL/LO (%)	Time (second)	Corrected Area (cm ²)	Total Load on sample (kg)	Strength of Total Unit		
							(Kg/Cm ²)	(Mpa)	After Corection
0		0	0	0	0	0	0	0	0
58	29.0	0.057	0.5	30	81.19	371.27	4.573	0.448	0.408
116	75.0	0.114	1.0	60	81.59	960.18	11.768	1.154	1.049
174	110.0	0.228	2.0	120	82.40	1408.26	17.090	1.675	1.523
232	137.0	0.342	3.0	180	83.21	1753.93	21.078	2.066	1.879
290	132.0	0.456	4.0	240	84.02	1689.92	20.114	1.972	1.793




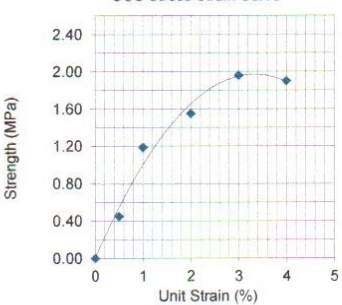


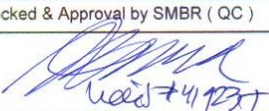
UCS Stress Strain Curve






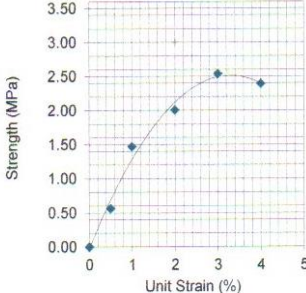



Remark :
Before testing sample soaked 4 hours
qu : 1.929 Mpa

Prepared by	Checked & reviewed by HP	Checked & Approval by SMBR (QC)
17/06  AKMAL F	17/06/19  M. ABDI TUPUH #09#	 Uci 5 # 41923




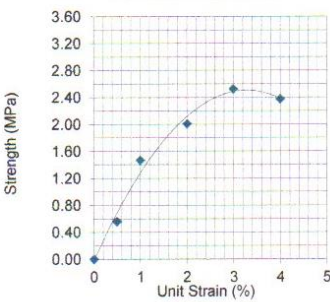


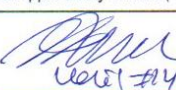
Lampiran 15.. UCS Tanah + 6% semen tujuh hari Sampel 2

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 CHEVRON PACIFIC INDONESIA	 SBR <small>Singapore, Kuala Lumpur & Pontianak</small>	UNCONFINED COMPRESSIVE STRENGTH TEST (ASTM D-1633)				 LABORATORIUM JALAN PT. HARAP PANJANG Branch Office: Duri Phone (+62765) 596389, Fax (+62765) 596399																																																																																																																														
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17/06/19  AKMAL F			17/06/19  M. ABDURRAHMAN #009#			 Ued +411231																																																																																																																														

Lampiran 16.. UCS Tanah + 6% semen 28 hari Sampel 1

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08/07/19  AKMAL F			08/07/2019  M. ABRI #009#			 49297																																																																																																																				

Lampiran 17.. UCS Tanah + 6% semen 28 hari Sampel 2

His Infrastructure Improvement Contract C 1583266																																																																																		
 CHEVRON PACIFIC INDONESIA		 PT. HARAP PANJANG		UNCONFINED COMPRESSIVE STRENGTH TEST (ASTM D-1633)				 LABORATORIUM JALAN PT. HARAP PANJANG Branch Office- Duri Phone (+62785) 596389, Fax (+62785) 596399																																																																										
Method : Modified Material type : SOIL CEMENT BASE Date of Moulding : 10-Jun-19 Tested date : 08-Jul-19 Type of Binder : Cement 6.0% Road Section : Infrastructure Improvement South Segment 5E - 99 Station : SPL 1																																																																																		
Sample Data-2 : <table style="width: 100%; border: none;"> <tr> <td style="width: 33%;">Diameter : 10.14 cm</td> <td style="width: 33%;">Weight of Sample : 1990 gr</td> <td style="width: 33%;">Volume : 920.0cc</td> </tr> <tr> <td>Height of Sample: 11.4 cm</td> <td>Moisture Content : 11.39 %</td> <td>L C R : 12.8024</td> </tr> <tr> <td>Initial Area : 80.79 cm²</td> <td>Wet Unit Weight : 2.163 gr/cc</td> <td>Age : 28 days</td> </tr> <tr> <td></td> <td>Dry Unit Weight : 1.941 gr/cc</td> <td></td> </tr> </table>										Diameter : 10.14 cm	Weight of Sample : 1990 gr	Volume : 920.0cc	Height of Sample: 11.4 cm	Moisture Content : 11.39 %	L C R : 12.8024	Initial Area : 80.79 cm ²	Wet Unit Weight : 2.163 gr/cc	Age : 28 days		Dry Unit Weight : 1.941 gr/cc																																																														
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Lampiran 18. Pengujian Batas Cair dan Plastis Tanah + 6% Semen



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PENGUJIAN BATAS CAIR DAN PLASTIS TANAH + 6% SEMEN

			Liquid limit								Plastic Limit	
Target Pukulan			15-20		21-24		26-30		31-40			
Jumlah Pukulan			16		23		28		33			
Kode Cawan			A1	B1	A2	B2	A3	B3	A4	B4	A5	B5
1	Berat Cawan Kosong	w_c	10,10	10,62	10,23	11,19	10,32	8,28	9,02	10,34	10,45	10,45
2	Berat Cawan + Tanah Basah	w_1	21,40	20,63	21,32	21,33	19,82	20,78	19,73	20,86	15,23	15,61
3	Berat Cawan + Tanah Kering	w_2	18,47	18,03	18,41	18,68	17,02	17,57	16,33	18,28	14,41	14,63
4	Berat Air	$w_w = w_1 - w_2$	2,93	2,60	2,91	2,65	2,80	3,21	3,40	2,58	0,82	0,98
5	Berat Tanah Kering	$w_s = w_2 - w_c$	8,37	7,41	8,18	7,49	6,70	9,29	7,31	7,94	3,96	4,18
6	Kadar Air	$w = \frac{w_w}{w_s} \times 100\%$	35,01	35,09	35,57	35,38	41,79	34,55	46,51	32,49	20,71	23,44
	Kadar Air Rata-Rata		35,05		35,48		38,17		39,50		22,08	

Batas Cair (LL) = 37,41 %

Batas Plastis (PL) = 22,08 %

Indeks PLastisitas (IP) = LL – PL = 15,33%

Lampiran 19. Pengujian Kuat Tekan Bebas (25% Limbah Keramik + 75% Semen) 3 Hari



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PENGUJIAN KUAT TEKAN BEBAS

(25% LIMBAH KERAMIK + 75% SEMEN)

Waktu	: 3 hari	Luas mula-mula (A_0)	: 26,768 cm ²
Diameter	: 5,84 cm	Volume	: 237,353 cm ³
Tinggi	: 8,87 cm	Berat Volume γ_b	: 1,783 gr/cm ³
Berat	: 423,11 gram		

Perubahan Tinggi			Luas Penampang (cross-section area)		Beban		Tekanan (Q)
Angka Dial Vertikal	ΔL (cm)	ϵ Regangan (strain)	Koreksi	Luas Terkoreksi A (cm ²)	Angka Dial Beban	Beban P (kg)	P / A
a	$a \times 10^{-3}$	$\Delta L / L_0$	$d = 1 - \epsilon$	$e = A_0 / d$	f	g	h
0	0	0,0000	1,0000	26,7681	0	0	0,0000
20	0,02	0,0023	0,9977	26,8286	4	0,412	0,0154
40	0,04	0,0045	0,9955	26,8894	5,5	0,5665	0,0211
60	0,06	0,0068	0,9932	26,9505	6	0,618	0,0229
80	0,08	0,0090	0,9910	27,0118	6	0,618	0,0229
100	0,1	0,0113	0,9887	27,0735	6	0,618	0,0228
120	0,12	0,0135	0,9865	27,1354	6	0,618	0,0228
140	0,14	0,0158	0,9842	27,1976	10	1,03	0,0379
160	0,16	0,0180	0,9820	27,2600	18	1,854	0,0680
180	0,18	0,0203	0,9797	27,3228	30	3,09	0,1131
200	0,2	0,0226	0,9774	27,3858	44	4,532	0,1655
220	0,22	0,0248	0,9752	27,4492	58	5,974	0,2176
240	0,24	0,0271	0,9729	27,5128	63	6,489	0,2359
260	0,26	0,0293	0,9707	27,5767	70	7,21	0,2615
280	0,28	0,0316	0,9684	27,6410	84	8,652	0,3130
300	0,3	0,0338	0,9662	27,7055	97	9,991	0,3606
320	0,32	0,0361	0,9639	27,7703	105	10,815	0,3894
340	0,34	0,0383	0,9617	27,8355	111	11,433	0,4107
360	0,36	0,0406	0,9594	27,9009	114	11,742	0,4208
380	0,38	0,0429	0,9571	27,9667	115	11,845	0,4235
400	0,4	0,0451	0,9549	28,0327	116	11,948	0,4262
420	0,42	0,0474	0,9526	28,0991	116	11,948	0,4252



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440	0,44	0,0496	0,9504	28,1658	117	12,051	0,4279
460	0,46	0,0519	0,9481	28,2328	118	12,154	0,4305
480	0,48	0,0541	0,9459	28,3001	119	12,257	0,4331
500	0,5	0,0564	0,9436	28,3678	124	12,772	0,4502
520	0,52	0,0586	0,9414	28,4357	126	12,978	0,4564
540	0,54	0,0609	0,9391	28,5040	129	13,287	0,4661
560	0,56	0,0632	0,9368	28,5727	130	13,39	0,4686
580	0,58	0,0654	0,9346	28,6416	131	13,493	0,4711
600	0,6	0,0677	0,9323	28,7109	131	13,493	0,4700
620	0,62	0,0699	0,9301	28,7805	131	13,493	0,4688
640	0,64	0,0722	0,9278	28,8505	131	13,493	0,4677
660	0,66	0,0744	0,9256	28,9208	135	13,905	0,4808
680	0,68	0,0767	0,9233	28,9915	135	13,905	0,4796
700	0,7	0,0789	0,9211	29,0624	139	14,317	0,4926
720	0,72	0,0812	0,9188	29,1338	145	14,935	0,5126
740	0,74	0,0835	0,9165	29,2055	154	15,862	0,5431
760	0,76	0,0857	0,9143	29,2775	166	17,098	0,5840
780	0,78	0,0880	0,9120	29,3499	176	18,128	0,6177
800	0,8	0,0902	0,9098	29,4227	188	19,364	0,6581
820	0,82	0,0925	0,9075	29,4958	198	20,394	0,6914
840	0,84	0,0947	0,9053	29,5693	210	21,63	0,7315
860	0,86	0,0970	0,9030	29,6432	222	22,866	0,7714
880	0,88	0,0992	0,9008	29,7174	235	24,205	0,8145
900	0,9	0,1015	0,8985	29,7920	248	25,544	0,8574
920	0,92	0,1038	0,8962	29,8670	263	27,089	0,9070
940	0,94	0,1060	0,8940	29,9424	274	28,222	0,9425
960	0,96	0,1083	0,8917	30,0181	286	29,458	0,9813
980	0,98	0,1105	0,8895	30,0942	303	31,209	1,0370
1000	1	0,1128	0,8872	30,1707	318	32,754	1,0856
1020	1,02	0,1150	0,8850	30,2476	332	34,196	1,1305
1040	1,04	0,1173	0,8827	30,3249	345	35,535	1,1718
1060	1,06	0,1195	0,8805	30,4026	358	36,874	1,2129
1080	1,08	0,1218	0,8782	30,4807	370	38,11	1,2503
1100	1,1	0,1241	0,8759	30,5592	384	39,552	1,2943
1120	1,12	0,1263	0,8737	30,6381	398	40,994	1,3380
1140	1,14	0,1286	0,8714	30,7174	413	42,539	1,3849



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1160	1,16	0,1308	0,8692	30,7971	430	44,29	1,4381
1180	1,18	0,1331	0,8669	30,8772	445	45,835	1,4844
1200	1,2	0,1353	0,8647	30,9577	460	47,38	1,5305
1220	1,22	0,1376	0,8624	31,0387	472	48,616	1,5663
1240	1,24	0,1398	0,8602	31,1201	480	49,44	1,5887
1260	1,26	0,1421	0,8579	31,2019	494	50,882	1,6307
1280	1,28	0,1444	0,8556	31,2842	508	52,324	1,6725
1300	1,3	0,1466	0,8534	31,3669	524	53,972	1,7207
1320	1,32	0,1489	0,8511	31,4500	538	55,414	1,7620
1340	1,34	0,1511	0,8489	31,5335	550	56,65	1,7965
1360	1,36	0,1534	0,8466	31,6176	563	57,989	1,8341
1380	1,38	0,1556	0,8444	31,7020	577	59,431	1,8747
1400	1,4	0,1579	0,8421	31,7869	590	60,77	1,9118
1420	1,42	0,1601	0,8399	31,8723	605	62,315	1,9551
1440	1,44	0,1624	0,8376	31,9581	619	63,757	1,9950
1460	1,46	0,1647	0,8353	32,0444	632	65,096	2,0314
1480	1,48	0,1669	0,8331	32,1312	643	66,229	2,0612
1500	1,5	0,1692	0,8308	32,2184	658	67,774	2,1036
1520	1,52	0,1714	0,8286	32,3061	672	69,216	2,1425
1540	1,54	0,1737	0,8263	32,3943	687	70,761	2,1844
1560	1,56	0,1759	0,8241	32,4830	700	72,1	2,2196
1580	1,58	0,1782	0,8218	32,5721	715	73,645	2,2610
1600	1,6	0,1804	0,8196	32,6618	729	75,087	2,2989
1620	1,62	0,1827	0,8173	32,7519	744	76,632	2,3398
1640	1,64	0,1850	0,8150	32,8425	759	78,177	2,3804
1660	1,66	0,1872	0,8128	32,9337	774	79,722	2,4207
1680	1,68	0,1895	0,8105	33,0253	790	81,37	2,4639
1700	1,7	0,1917	0,8083	33,1175	808	83,224	2,5130
1720	1,72	0,1940	0,8060	33,2102	824	84,872	2,5556
1740	1,74	0,1962	0,8038	33,3034	843	86,829	2,6072
1760	1,76	0,1985	0,8015	33,3971	820	84,46	2,5290
1780	1,78	0,2007	0,7993	33,4913	813	83,739	2,5003

Lampiran 20. Pengujian Kuat Tekan Bebas (25% Limbah Keramik + 75% Semen) 7 Hari



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PENGUJIAN KUAT TEKAN BEBAS

(25% LIMBAH KERAMIK + 75% SEMEN)

Waktu	: 7 hari	Luas mula-mula (A_0)	: 26,375 cm ²
Diameter	: 5,80 cm	Volume	: 217,622 cm ³
Tinggi	: 8,25 cm	Berat Volume γ_b	: 1,919 gr/
Berat	: 417,61 gram		

Perubahan Tinggi			Luas Penampang (cross-section area)		Beban		Tekanan (Q)
Angka Dial Vertikal	ΔL (cm)	ϵ Regangan (strain)	Koreksi	Luas Terkoreksi A (cm ²)	Angka Dial Beban	Beban P (kg)	P / A
a	$a \times 10^{-3}$	$\Delta L / L_0$	$d = 1 - \epsilon$	$e = A_0 / d$	f	g	h
0	0	0,0000	1,0000	26,3753	0	0	0,0000
20	0,02	0,0024	0,9976	26,4393	2	0,206	0,0078
40	0,04	0,0048	0,9952	26,5037	2	0,206	0,0078
60	0,06	0,0073	0,9927	26,5685	2	0,206	0,0078
80	0,08	0,0097	0,9903	26,6335	2	0,206	0,0077
100	0,1	0,0121	0,9879	26,6988	2	0,206	0,0077
120	0,12	0,0145	0,9855	26,7645	2	0,206	0,0077
140	0,14	0,0170	0,9830	26,8305	8	0,824	0,0307
160	0,16	0,0194	0,9806	26,8968	21	2,163	0,0804
180	0,18	0,0218	0,9782	26,9635	37	3,811	0,1413
200	0,2	0,0242	0,9758	27,0305	52	5,356	0,1981
220	0,22	0,0267	0,9733	27,0978	68	7,004	0,2585
240	0,24	0,0291	0,9709	27,1654	89	9,167	0,3375
260	0,26	0,0315	0,9685	27,2334	101	10,403	0,3820
280	0,28	0,0339	0,9661	27,3018	105	10,815	0,3961
300	0,3	0,0364	0,9636	27,3704	106	10,918	0,3989
320	0,32	0,0388	0,9612	27,4394	107	11,021	0,4016
340	0,34	0,0412	0,9588	27,5088	108	11,124	0,4044
360	0,36	0,0436	0,9564	27,5785	109	11,227	0,4071
380	0,38	0,0461	0,9539	27,6486	112	11,536	0,4172
400	0,4	0,0485	0,9515	27,7191	115	11,845	0,4273



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420	0,42	0,0509	0,9491	27,7898	118	12,154	0,4374
440	0,44	0,0533	0,9467	27,8610	118	12,154	0,4362
460	0,46	0,0558	0,9442	27,9325	120	12,36	0,4425
480	0,48	0,0582	0,9418	28,0044	123	12,669	0,4524
500	0,5	0,0606	0,9394	28,0767	127	13,081	0,4659
520	0,52	0,0630	0,9370	28,1493	131	13,493	0,4793
540	0,54	0,0654	0,9346	28,2223	138	14,214	0,5036
560	0,56	0,0679	0,9321	28,2957	141	14,523	0,5133
580	0,58	0,0703	0,9297	28,3695	145	14,935	0,5264
600	0,6	0,0727	0,9273	28,4436	157	16,171	0,5685
620	0,62	0,0751	0,9249	28,5182	172	17,716	0,6212
640	0,64	0,0776	0,9224	28,5931	181	18,643	0,6520
660	0,66	0,0800	0,9200	28,6685	193	19,879	0,6934
680	0,68	0,0824	0,9176	28,7442	206	21,218	0,7382
700	0,7	0,0848	0,9152	28,8203	220	22,66	0,7863
720	0,72	0,0873	0,9127	28,8969	235	24,205	0,8376
740	0,74	0,0897	0,9103	28,9738	249	25,647	0,8852
760	0,76	0,0921	0,9079	29,0512	264	27,192	0,9360
780	0,78	0,0945	0,9055	29,1289	276	28,428	0,9759
800	0,8	0,0970	0,9030	29,2071	290	29,87	1,0227
820	0,82	0,0994	0,9006	29,2857	303	31,209	1,0657
840	0,84	0,1018	0,8982	29,3648	318	32,754	1,1154
860	0,86	0,1042	0,8958	29,4442	332	34,196	1,1614
880	0,88	0,1067	0,8933	29,5241	343	35,329	1,1966
900	0,9	0,1091	0,8909	29,6044	356	36,668	1,2386
920	0,92	0,1115	0,8885	29,6852	369	38,007	1,2803
940	0,94	0,1139	0,8861	29,7664	381	39,243	1,3184
960	0,96	0,1163	0,8837	29,8481	395	40,685	1,3631
980	0,98	0,1188	0,8812	29,9302	410	42,23	1,4110
1000	1	0,1212	0,8788	30,0127	423	43,569	1,4517
1020	1,02	0,1236	0,8764	30,0957	438	45,114	1,4990
1040	1,04	0,1260	0,8740	30,1792	452	46,556	1,5427
1060	1,06	0,1285	0,8715	30,2631	466	47,998	1,5860



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1080	1,08	0,1309	0,8691	30,3475	480	49,44	1,6291
1100	1,1	0,1333	0,8667	30,4324	494	50,882	1,6720
1120	1,12	0,1357	0,8643	30,5178	505	52,015	1,7044
1140	1,14	0,1382	0,8618	30,6036	518	53,354	1,7434
1160	1,16	0,1406	0,8594	30,6899	531	54,693	1,7821
1180	1,18	0,1430	0,8570	30,7767	544	56,032	1,8206
1200	1,2	0,1454	0,8546	30,8640	559	57,577	1,8655
1220	1,22	0,1479	0,8521	30,9518	571	58,813	1,9001
1240	1,24	0,1503	0,8497	31,0401	584	60,152	1,9379
1260	1,26	0,1527	0,8473	31,1289	597	61,491	1,9754
1280	1,28	0,1551	0,8449	31,2182	610	62,83	2,0126
1300	1,3	0,1576	0,8424	31,3081	624	64,272	2,0529
1320	1,32	0,1600	0,8400	31,3984	638	65,714	2,0929
1340	1,34	0,1624	0,8376	31,4893	642	66,126	2,1000
1360	1,36	0,1648	0,8352	31,5807	666	68,598	2,1722
1380	1,38	0,1673	0,8327	31,6726	680	70,04	2,2114
1400	1,4	0,1697	0,8303	31,7650	695	71,585	2,2536
1420	1,42	0,1721	0,8279	31,8580	704	72,512	2,2761
1440	1,44	0,1745	0,8255	31,9516	718	73,954	2,3146
1460	1,46	0,1769	0,8231	32,0457	729	75,087	2,3431
1480	1,48	0,1794	0,8206	32,1403	738	76,014	2,3651
1500	1,5	0,1818	0,8182	32,2356	741	76,323	2,3677
1520	1,52	0,1842	0,8158	32,3313	750	77,25	2,3893
1540	1,54	0,1866	0,8134	32,4277	760	78,28	2,4140
1560	1,56	0,1891	0,8109	32,5246	776	79,928	2,4575
1580	1,58	0,1915	0,8085	32,6221	793	81,679	2,5038
1600	1,6	0,1939	0,8061	32,7202	805	82,915	2,5341
1620	1,62	0,1963	0,8037	32,8189	820	84,46	2,5735
1640	1,64	0,1988	0,8012	32,9182	835	86,005	2,6127
1660	1,66	0,2012	0,7988	33,0181	850	87,55	2,6516
1680	1,68	0,2036	0,7964	33,1186	867	89,301	2,6964
1700	1,7	0,2060	0,7940	33,2197	885	91,155	2,7440
1720	1,72	0,2085	0,7915	33,3214	910	93,73	2,8129



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1740	1,74	0,2109	0,7891	33,4238	930	95,79	2,8659
1760	1,76	0,2133	0,7867	33,5268	948	97,644	2,9124
1780	1,78	0,2157	0,7843	33,6304	968	99,704	2,9647
1800	1,8	0,2182	0,7818	33,7347	985	101,455	3,0074
1820	1,82	0,2206	0,7794	33,8396	1003	103,309	3,0529
1840	1,84	0,2230	0,7770	33,9451	1020	105,06	3,0950
1860	1,86	0,2254	0,7746	34,0514	1037	106,811	3,1368
1880	1,88	0,2279	0,7721	34,1583	1055	108,665	3,1812
1900	1,9	0,2303	0,7697	34,2658	1078	111,034	3,2404
1920	1,92	0,2327	0,7673	34,3741	1108	114,124	3,3201
1940	1,94	0,2351	0,7649	34,4830	1127	116,081	3,3663
1960	1,96	0,2375	0,7625	34,5926	1146	118,038	3,4122
1980	1,98	0,2400	0,7600	34,7030	1150	118,45	3,4133
2000	2	0,2424	0,7576	34,8140	1143	117,729	3,3817
2020	2,02	0,2448	0,7552	34,9257	1135	116,905	3,3472

Lampiran 21. Pengujian Kuat Tekan Bebas (25% Limbah Keramik + 75% Semen) 28 Hari



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PENGUJIAN KUAT TEKAN BEBAS

(25% LIMBAH KERAMIK + 75% SEMEN)

Waktu	: 28 hari	Luas mula-mula (A ₀)	: 25,089 cm ²
Diameter	: 5,65 cm	Volume	: 221,491 cm ³
Tinggi	: 8,83 cm	Berat Volume γ_b	: 1,867 gr/cm ³
Berat	: 413,70 gram		

Perubahan Tinggi			Luas Penampang (cross-section area)		Beban		Tekanan (Q)
Angka Dial Vertikal	ΔL (cm)	ϵ Regangan (strain)	Koreksi	Luas Terkoreksi A (cm ²)	Angka Dial Beban	Beban P (kg)	P / A
a	$a \times 10^{-3}$	$\Delta L / L_0$	$d = 1 - \epsilon$	$e = A_0 / d$	f	g	h
0	0	0,0000	1,0000	25,0896	0	0	0,0000
20	0,02	0,0023	0,9977	25,1466	5	0,515	0,0205
40	0,04	0,0045	0,9955	25,2038	5	0,515	0,0204
60	0,06	0,0068	0,9932	25,2613	5	0,515	0,0204
80	0,08	0,0091	0,9909	25,3191	19	1,957	0,0773
100	0,1	0,0113	0,9887	25,3771	33	3,399	0,1339
120	0,12	0,0136	0,9864	25,4354	49	5,047	0,1984
140	0,14	0,0159	0,9841	25,4939	61	6,283	0,2465
160	0,16	0,0181	0,9819	25,5527	73	7,519	0,2943
180	0,18	0,0204	0,9796	25,6118	92	9,476	0,3700
200	0,2	0,0227	0,9773	25,6712	105	10,815	0,4213
220	0,22	0,0249	0,9751	25,7309	114	11,742	0,4563
240	0,24	0,0272	0,9728	25,7908	117	12,051	0,4673
260	0,26	0,0295	0,9705	25,8510	120	12,36	0,4781
280	0,28	0,0317	0,9683	25,9115	122	12,566	0,4850
300	0,3	0,0340	0,9660	25,9722	124	12,772	0,4918
320	0,32	0,0362	0,9638	26,0333	124	12,772	0,4906
340	0,34	0,0385	0,9615	26,0946	124	12,772	0,4894
360	0,36	0,0408	0,9592	26,1563	129	13,287	0,5080
380	0,38	0,0430	0,9570	26,2182	134	13,802	0,5264
400	0,4	0,0453	0,9547	26,2804	142	14,626	0,5565
420	0,42	0,0476	0,9524	26,3429	153	15,759	0,5982
440	0,44	0,0498	0,9502	26,4057	165	16,995	0,6436



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460	0,46	0,0521	0,9479	26,4688	177	18,231	0,6888
480	0,48	0,0544	0,9456	26,5322	188	19,364	0,7298
500	0,5	0,0566	0,9434	26,5960	199	20,497	0,7707
520	0,52	0,0589	0,9411	26,6600	209	21,527	0,8075
540	0,54	0,0612	0,9388	26,7243	217	22,351	0,8364
560	0,56	0,0634	0,9366	26,7890	226	23,278	0,8689
580	0,58	0,0657	0,9343	26,8539	234	24,102	0,8975
600	0,6	0,0680	0,9320	26,9192	247	25,441	0,9451
620	0,62	0,0702	0,9298	26,9848	258	26,574	0,9848
640	0,64	0,0725	0,9275	27,0507	268	27,604	1,0205
660	0,66	0,0748	0,9252	27,1169	279	28,737	1,0597
680	0,68	0,0770	0,9230	27,1835	291	29,973	1,1026
700	0,7	0,0793	0,9207	27,2504	300	30,9	1,1339
720	0,72	0,0816	0,9184	27,3176	313	32,239	1,1802
740	0,74	0,0838	0,9162	27,3852	325	33,475	1,2224
760	0,76	0,0861	0,9139	27,4531	336	34,608	1,2606
780	0,78	0,0884	0,9116	27,5213	348	35,844	1,3024
800	0,8	0,0906	0,9094	27,5898	360	37,08	1,3440
820	0,82	0,0929	0,9071	27,6587	371	38,213	1,3816
840	0,84	0,0952	0,9048	27,7280	382	39,346	1,4190
860	0,86	0,0974	0,9026	27,7976	393	40,479	1,4562
880	0,88	0,0997	0,9003	27,8675	406	41,818	1,5006
900	0,9	0,1019	0,8981	27,9378	418	43,054	1,5411
920	0,92	0,1042	0,8958	28,0085	431	44,393	1,5850
940	0,94	0,1065	0,8935	28,0795	444	45,732	1,6287
960	0,96	0,1087	0,8913	28,1509	458	47,174	1,6758
980	0,98	0,1110	0,8890	28,2226	474	48,822	1,7299
1000	1	0,1133	0,8867	28,2947	488	50,264	1,7764
1020	1,02	0,1155	0,8845	28,3672	498	51,294	1,8082
1040	1,04	0,1178	0,8822	28,4401	510	52,53	1,8470
1060	1,06	0,1201	0,8799	28,5133	524	53,972	1,8929
1080	1,08	0,1223	0,8777	28,5869	537	55,311	1,9348
1100	1,1	0,1246	0,8754	28,6609	550	56,65	1,9766
1120	1,12	0,1269	0,8731	28,7352	560	57,68	2,0073
1140	1,14	0,1291	0,8709	28,8100	570	58,71	2,0378
1160	1,16	0,1314	0,8686	28,8851	575	59,225	2,0504
1180	1,18	0,1337	0,8663	28,9607	588	60,564	2,0912
1200	1,2	0,1359	0,8641	29,0366	600	61,8	2,1283
1220	1,22	0,1382	0,8618	29,1129	712	73,336	2,5190
1240	1,24	0,1405	0,8595	29,1897	725	74,675	2,5583


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1260	1,26	0,1427	0,8573	29,2668	738	76,014	2,5973
1280	1,28	0,1450	0,8550	29,3444	753	77,559	2,6431
1300	1,3	0,1473	0,8527	29,4223	766	78,898	2,6816
1320	1,32	0,1495	0,8505	29,5007	778	80,134	2,7163
1340	1,34	0,1518	0,8482	29,5795	794	81,782	2,7648
1360	1,36	0,1541	0,8459	29,6587	809	83,327	2,8095
1380	1,38	0,1563	0,8437	29,7383	823	84,769	2,8505
1400	1,4	0,1586	0,8414	29,8184	838	86,314	2,8947
1420	1,42	0,1609	0,8391	29,8989	850	87,55	2,9282
1440	1,44	0,1631	0,8369	29,9799	861	88,683	2,9581
1460	1,46	0,1654	0,8346	30,0612	875	90,125	2,9980
1480	1,48	0,1676	0,8324	30,1431	890	91,67	3,0412
1500	1,5	0,1699	0,8301	30,2253	903	93,009	3,0772
1520	1,52	0,1722	0,8278	30,3080	919	94,657	3,1232
1540	1,54	0,1744	0,8256	30,3912	934	96,202	3,1655
1560	1,56	0,1767	0,8233	30,4749	951	97,953	3,2142
1580	1,58	0,1790	0,8210	30,5589	965	99,395	3,2526
1600	1,6	0,1812	0,8188	30,6435	977	100,631	3,2839
1620	1,62	0,1835	0,8165	30,7285	990	101,97	3,3184
1640	1,64	0,1858	0,8142	30,8140	1004	103,412	3,3560
1660	1,66	0,1880	0,8120	30,9000	1019	104,957	3,3967
1680	1,68	0,1903	0,8097	30,9865	1035	106,605	3,4404
1700	1,7	0,1926	0,8074	31,0734	1053	108,459	3,4904
1720	1,72	0,1948	0,8052	31,1608	1067	109,901	3,5269
1740	1,74	0,1971	0,8029	31,2488	1079	111,137	3,5565
1760	1,76	0,1994	0,8006	31,3372	1094	112,682	3,5958
1780	1,78	0,2016	0,7984	31,4261	1112	114,536	3,6446
1800	1,8	0,2039	0,7961	31,5155	1128	116,184	3,6866
1820	1,82	0,2062	0,7938	31,6055	1143	117,729	3,7250
1840	1,84	0,2084	0,7916	31,6959	1159	119,377	3,7663
1860	1,86	0,2107	0,7893	31,7869	1176	121,128	3,8106
1880	1,88	0,2130	0,7870	31,8784	1193	122,879	3,8546
1900	1,9	0,2152	0,7848	31,9704	1208	124,424	3,8918
1920	1,92	0,2175	0,7825	32,0630	1210	124,63	3,8870
1940	1,94	0,2198	0,7802	32,1561	1210	124,63	3,8758
1960	1,96	0,2220	0,7780	32,2497	1210	124,63	3,8645
1980	1,98	0,2243	0,7757	32,3439	1210	124,63	3,8533
2000	2	0,2266	0,7734	32,4387	1211	124,733	3,8452
2020	2,02	0,2288	0,7712	32,5340	1213	124,939	3,8403
2040	2,04	0,2311	0,7689	32,6298	1213	124,939	3,8290
2060	2,06	0,2333	0,7667	32,7262	1214	125,042	3,8208



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2080	2,08	0,2356	0,7644	32,8232	1214	125,042	3,8096
2100	2,1	0,2379	0,7621	32,9208	1214	125,042	3,7983
2120	2,12	0,2401	0,7599	33,0190	1214	125,042	3,7870
2140	2,14	0,2424	0,7576	33,1177	1214	125,042	3,7757
2160	2,16	0,2447	0,7553	33,2170	1213	124,939	3,7613
2180	2,18	0,2469	0,7531	33,3170	1212	124,836	3,7469

Lampiran 22. Pengujian Kuat Tekan Bebas (50% Limbah Keramik + 50% Semen) 3 Hari



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PENGUJIAN KUAT TEKAN BEBAS

(50% LIMBAH KERAMIK + 50% SEMEN)

Waktu	: 3 hari	Luas mula-mula (A_0)	: 26,796 cm ²
Diameter	: 5,84 cm	Volume	: 227,200 cm ³
Tinggi	: 8,48 cm	Berat Volume γ_b	: 1,861 gr/cm ³
Berat	: 422,92 gram		

Perubahan Tinggi			Luas Penampang (cross-section area)		Beban		Tekanan (Q)
Angka Dial Vertikal	ΔL (cm)	ε Regangan (strain)	Koreksi	Luas Terkoreksi A (cm ²)	Angka Dial Beban	Beban P (kg)	P / A
a	$a \times 10^{-3}$	$\Delta L / L_0$	$d = 1 - \varepsilon$	$e = A_0 / d$	f	g	H
0	0	0,0000	1,0000	26,7956	0	0	0,0000
20	0,02	0,0024	0,9976	26,8590	2	0,206	0,0077
40	0,04	0,0047	0,9953	26,9227	3	0,309	0,0115
60	0,06	0,0071	0,9929	26,9866	3	0,309	0,0115
80	0,08	0,0094	0,9906	27,0509	3	0,309	0,0114
100	0,1	0,0118	0,9882	27,1154	3	0,309	0,0114
120	0,12	0,0142	0,9858	27,1803	3	0,309	0,0114
140	0,14	0,0165	0,9835	27,2455	4	0,412	0,0151
160	0,16	0,0189	0,9811	27,3110	10	1,03	0,0377
180	0,18	0,0212	0,9788	27,3768	18	1,854	0,0677
200	0,2	0,0236	0,9764	27,4430	28	2,884	0,1051
220	0,22	0,0259	0,9741	27,5094	37	3,811	0,1385
240	0,24	0,0283	0,9717	27,5762	44	4,532	0,1643
260	0,26	0,0307	0,9693	27,6433	50	5,15	0,1863
280	0,28	0,0330	0,9670	27,7107	51	5,253	0,1896
300	0,3	0,0354	0,9646	27,7785	51	5,253	0,1891
320	0,32	0,0377	0,9623	27,8466	52	5,356	0,1923
340	0,34	0,0401	0,9599	27,9150	52	5,356	0,1919
360	0,36	0,0425	0,9575	27,9838	52	5,356	0,1914
380	0,38	0,0448	0,9552	28,0529	52	5,356	0,1909
400	0,4	0,0472	0,9528	28,1223	52	5,356	0,1905
420	0,42	0,0495	0,9505	28,1921	52	5,356	0,1900
440	0,44	0,0519	0,9481	28,2623	53	5,459	0,1932



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460	0,46	0,0543	0,9457	28,3327	53	5,459	0,1927
480	0,48	0,0566	0,9434	28,4036	53	5,459	0,1922
500	0,5	0,0590	0,9410	28,4748	53	5,459	0,1917
520	0,52	0,0613	0,9387	28,5463	59	6,077	0,2129
540	0,54	0,0637	0,9363	28,6183	66	6,798	0,2375
560	0,56	0,0660	0,9340	28,6905	76	7,828	0,2728
580	0,58	0,0684	0,9316	28,7632	88	9,064	0,3151
600	0,6	0,0708	0,9292	28,8362	98	10,094	0,3500
620	0,62	0,0731	0,9269	28,9096	110	11,33	0,3919
640	0,64	0,0755	0,9245	28,9833	118	12,154	0,4193
660	0,66	0,0778	0,9222	29,0575	123	12,669	0,4360
680	0,68	0,0802	0,9198	29,1320	128	13,184	0,4526
700	0,7	0,0826	0,9174	29,2069	132	13,596	0,4655
720	0,72	0,0849	0,9151	29,2822	134	13,802	0,4713
740	0,74	0,0873	0,9127	29,3578	138	14,214	0,4842
760	0,76	0,0896	0,9104	29,4339	138	14,214	0,4829
780	0,78	0,0920	0,9080	29,5104	141	14,523	0,4921
800	0,8	0,0944	0,9056	29,5872	148	15,244	0,5152
820	0,82	0,0967	0,9033	29,6645	144	14,832	0,5000
840	0,84	0,0991	0,9009	29,7422	144	14,832	0,4987
860	0,86	0,1014	0,8986	29,8202	148	15,244	0,5112
880	0,88	0,1038	0,8962	29,8987	148	15,244	0,5099
900	0,9	0,1061	0,8939	29,9776	155	15,965	0,5326
920	0,92	0,1085	0,8915	30,0569	165	16,995	0,5654
940	0,94	0,1109	0,8891	30,1367	178	18,334	0,6084
960	0,96	0,1132	0,8868	30,2168	189	19,467	0,6442
980	0,98	0,1156	0,8844	30,2974	199	20,497	0,6765
1000	1	0,1179	0,8821	30,3784	211	21,733	0,7154
1020	1,02	0,1203	0,8797	30,4599	222	22,866	0,7507
1040	1,04	0,1227	0,8773	30,5418	235	24,205	0,7925
1060	1,06	0,1250	0,8750	30,6241	247	25,441	0,8308
1080	1,08	0,1274	0,8726	30,7069	260	26,78	0,8721
1100	1,1	0,1297	0,8703	30,7901	272	28,016	0,9099
1120	1,12	0,1321	0,8679	30,8738	284	29,252	0,9475
1140	1,14	0,1344	0,8656	30,9579	294	30,282	0,9782
1160	1,16	0,1368	0,8632	31,0425	305	31,415	1,0120
1180	1,18	0,1392	0,8608	31,1276	314	32,342	1,0390
1200	1,2	0,1415	0,8585	31,2131	326	33,578	1,0758
1220	1,22	0,1439	0,8561	31,2991	339	34,917	1,1156
1240	1,24	0,1462	0,8538	31,3856	353	36,359	1,1585



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1260	1,26	0,1486	0,8514	31,4725	367	37,801	1,2011
1280	1,28	0,1510	0,8490	31,5600	378	38,934	1,2337
1300	1,3	0,1533	0,8467	31,6479	390	40,17	1,2693
1320	1,32	0,1557	0,8443	31,7363	399	41,097	1,2950
1340	1,34	0,1580	0,8420	31,8252	408	42,024	1,3205
1360	1,36	0,1604	0,8396	31,9146	415	42,745	1,3394
1380	1,38	0,1628	0,8372	32,0046	426	43,878	1,3710
1400	1,4	0,1651	0,8349	32,0950	438	45,114	1,4056
1420	1,42	0,1675	0,8325	32,1859	449	46,247	1,4369
1440	1,44	0,1698	0,8302	32,2774	461	47,483	1,4711
1460	1,46	0,1722	0,8278	32,3693	472	48,616	1,5019
1480	1,48	0,1745	0,8255	32,4618	483	49,749	1,5325
1500	1,5	0,1769	0,8231	32,5549	494	50,882	1,5630
1520	1,52	0,1793	0,8207	32,6484	506	52,118	1,5963
1540	1,54	0,1816	0,8184	32,7425	516	53,148	1,6232
1560	1,56	0,1840	0,8160	32,8372	527	54,281	1,6530
1580	1,58	0,1863	0,8137	32,9324	538	55,414	1,6827
1600	1,6	0,1887	0,8113	33,0281	549	56,547	1,7121
1620	1,62	0,1911	0,8089	33,1244	560	57,68	1,7413
1640	1,64	0,1934	0,8066	33,2213	571	58,813	1,7703
1660	1,66	0,1958	0,8042	33,3187	583	60,049	1,8023
1680	1,68	0,1981	0,8019	33,4167	594	61,182	1,8309
1700	1,7	0,2005	0,7995	33,5153	610	62,83	1,8747
1720	1,72	0,2029	0,7971	33,6145	622	64,066	1,9059
1740	1,74	0,2052	0,7948	33,7142	635	65,405	1,9400
1760	1,76	0,2076	0,7924	33,8146	650	66,95	1,9799
1780	1,78	0,2099	0,7901	33,9156	664	68,392	2,0165
1800	1,8	0,2123	0,7877	34,0171	675	69,525	2,0438
1820	1,82	0,2146	0,7854	34,1193	690	71,07	2,0830
1840	1,84	0,2170	0,7830	34,2221	704	72,512	2,1189
1860	1,86	0,2194	0,7806	34,3255	715	73,645	2,1455
1880	1,88	0,2217	0,7783	34,4295	728	74,984	2,1779
1900	1,9	0,2241	0,7759	34,5342	744	76,632	2,2190
1920	1,92	0,2264	0,7736	34,6395	760	78,28	2,2598
1940	1,94	0,2288	0,7712	34,7454	777	80,031	2,3034
1960	1,96	0,2312	0,7688	34,8520	789	81,267	2,3318
1980	1,98	0,2335	0,7665	34,9593	799	82,297	2,3541
2000	2	0,2359	0,7641	35,0672	815	83,945	2,3938
2020	2,02	0,2382	0,7618	35,1758	832	85,696	2,4362
2040	2,04	0,2406	0,7594	35,2850	848	87,344	2,4754
2060	2,06	0,2430	0,7570	35,3950	862	88,786	2,5084



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2080	2,08	0,2453	0,7547	35,5056	878	90,434	2,5470
2100	2,1	0,2477	0,7523	35,6169	891	91,773	2,5767
2120	2,12	0,2500	0,7500	35,7289	908	93,524	2,6176
2140	2,14	0,2524	0,7476	35,8417	922	94,966	2,6496
2160	2,16	0,2547	0,7453	35,9551	933	96,099	2,6727
2180	2,18	0,2571	0,7429	36,0693	940	96,82	2,6843
2200	2,2	0,2595	0,7405	36,1842	951	97,953	2,7071
2220	2,22	0,2618	0,7382	36,2998	967	99,601	2,7438
2240	2,24	0,2642	0,7358	36,4161	983	101,249	2,7803
2260	2,26	0,2665	0,7335	36,5333	1001	103,103	2,8222
2280	2,28	0,2689	0,7311	36,6511	1017	104,751	2,8581
2300	2,3	0,2713	0,7287	36,7698	1032	106,296	2,8909
2320	2,32	0,2736	0,7264	36,8892	1053	108,459	2,9401
2340	2,34	0,2760	0,7240	37,0093	1070	110,21	2,9779
2360	2,36	0,2783	0,7217	37,1303	1084	111,652	3,0070
2380	2,38	0,2807	0,7193	37,2521	1093	112,579	3,0221
2400	2,4	0,2831	0,7169	37,3746	1100	113,3	3,0315
2420	2,42	0,2854	0,7146	37,4980	1111	114,433	3,0517
2440	2,44	0,2878	0,7122	37,6222	1124	115,772	3,0772
2460	2,46	0,2901	0,7099	37,7472	1128	116,184	3,0780
2480	2,48	0,2925	0,7075	37,8730	1129	116,287	3,0704
2500	2,5	0,2948	0,7052	37,9997	1129	116,287	3,0602
2520	2,52	0,2972	0,7028	38,1273	1130	116,39	3,0527
2540	2,54	0,2996	0,7004	38,2557	1130	116,39	3,0424
2560	2,56	0,3019	0,6981	38,3849	1131	116,493	3,0349
2580	2,58	0,3043	0,6957	38,5151	1132	116,596	3,0273
2600	2,6	0,3066	0,6934	38,6461	1132	116,596	3,0170
2620	2,62	0,3090	0,6910	38,7780	1133	116,699	3,0094
2640	2,64	0,3114	0,6886	38,9108	1134	116,802	3,0018
2660	2,66	0,3137	0,6863	39,0446	1135	116,905	2,9941
2680	2,68	0,3161	0,6839	39,1792	1125,5	115,9265	2,9589
2700	2,7	0,3184	0,6816	39,3148	1136	117,008	2,9762
2720	2,72	0,3208	0,6792	39,4513	1138	117,214	2,9711
2740	2,74	0,3232	0,6768	39,5888	1139	117,317	2,9634
2760	2,76	0,3255	0,6745	39,7273	1139	117,317	2,9531
2780	2,78	0,3279	0,6721	39,8667	1140	117,42	2,9453
2800	2,8	0,3302	0,6698	40,0071	1140	117,42	2,9350

Lampiran 23. Pengujian Kuat Tekan Bebas (50% Limbah Keramik + 50% Semen) 7 Hari



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PENGUJIAN KUAT TEKAN BEBAS

(50% LIMBAH KERAMIK + 50% SEMEN)

Waktu	: 7 hari	Luas mula-mula (A_0)	: 24,489 cm ²
Diameter	: 5,58 cm	Volume	: 213,377 cm ³
Tinggi	: 8,71 cm	Berat Volume γ_b	: 1,947 gr/cm ³
Berat	: 415,48 gram		

Perubahan Tinggi			Luas Penampang (cross-section area)		Beban		Tekanan (Q)
Angka Dial Vertikal	ΔL (cm)	ϵ Regangan (strain)	Koreksi	Luas Terkoreksi A (cm ²)	Angka Dial Beban	Beban P (kg)	P / A
a	$a \times 10^{-3}$	$\Delta L / L_0$	$d = 1 - \epsilon$	$e = A_0 / d$	f	g	h
0	0	0,0000	1,0000	24,4895	0	0	0,0000
20	0,02	0,0023	0,9977	24,5459	2	0,206	0,0084
40	0,04	0,0046	0,9954	24,6025	3	0,309	0,0126
60	0,06	0,0069	0,9931	24,6594	6	0,618	0,0251
80	0,08	0,0092	0,9908	24,7165	6	0,618	0,0250
100	0,1	0,0115	0,9885	24,7739	6	0,618	0,0249
120	0,12	0,0138	0,9862	24,8315	6	0,618	0,0249
140	0,14	0,0161	0,9839	24,8895	6	0,618	0,0248
160	0,16	0,0184	0,9816	24,9477	6	0,618	0,0248
180	0,18	0,0207	0,9793	25,0061	13	1,339	0,0535
200	0,2	0,0230	0,9770	25,0649	23	2,369	0,0945
220	0,22	0,0252	0,9748	25,1239	33	3,399	0,1353
240	0,24	0,0275	0,9725	25,1832	43	4,429	0,1759
260	0,26	0,0298	0,9702	25,2428	54	5,562	0,2203
280	0,28	0,0321	0,9679	25,3027	60	6,18	0,2442
300	0,3	0,0344	0,9656	25,3628	64	6,592	0,2599
320	0,32	0,0367	0,9633	25,4233	67	6,901	0,2714
340	0,34	0,0390	0,9610	25,4840	68	7,004	0,2748
360	0,36	0,0413	0,9587	25,5450	71	7,313	0,2863
380	0,38	0,0436	0,9564	25,6063	77	7,931	0,3097
400	0,4	0,0459	0,9541	25,6679	83	8,549	0,3331
420	0,42	0,0482	0,9518	25,7298	91	9,373	0,3643
440	0,44	0,0505	0,9495	25,7920	100	10,3	0,3993



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460	0,46	0,0528	0,9472	25,8545	108	11,124	0,4303
480	0,48	0,0551	0,9449	25,9173	114	11,742	0,4531
500	0,5	0,0574	0,9426	25,9804	117	12,051	0,4638
520	0,52	0,0597	0,9403	26,0439	117	12,051	0,4627
540	0,54	0,0620	0,9380	26,1076	120	12,36	0,4734
560	0,56	0,0643	0,9357	26,1716	122	12,566	0,4801
580	0,58	0,0666	0,9334	26,2360	126	12,978	0,4947
600	0,6	0,0689	0,9311	26,3007	129	13,287	0,5052
620	0,62	0,0712	0,9288	26,3657	129	13,287	0,5040
640	0,64	0,0735	0,9265	26,4310	129	13,287	0,5027
660	0,66	0,0757	0,9243	26,4966	129	13,287	0,5015
680	0,68	0,0780	0,9220	26,5626	134	13,802	0,5196
700	0,7	0,0803	0,9197	26,6289	143	14,729	0,5531
720	0,72	0,0826	0,9174	26,6955	152	15,656	0,5865
740	0,74	0,0849	0,9151	26,7625	160	16,48	0,6158
760	0,76	0,0872	0,9128	26,8298	168	17,304	0,6450
780	0,78	0,0895	0,9105	26,8974	178	18,334	0,6816
800	0,8	0,0918	0,9082	26,9654	187	19,261	0,7143
820	0,82	0,0941	0,9059	27,0338	197	20,291	0,7506
840	0,84	0,0964	0,9036	27,1024	206	21,218	0,7829
860	0,86	0,0987	0,9013	27,1715	213	21,939	0,8074
880	0,88	0,1010	0,8990	27,2408	223	22,969	0,8432
900	0,9	0,1033	0,8967	27,3106	231	23,793	0,8712
920	0,92	0,1056	0,8944	27,3806	242	24,926	0,9104
940	0,94	0,1079	0,8921	27,4511	253	26,059	0,9493
960	0,96	0,1102	0,8898	27,5219	259	26,677	0,9693
980	0,98	0,1125	0,8875	27,5931	273	28,119	1,0191
1000	1	0,1148	0,8852	27,6646	283	29,149	1,0537
1020	1,02	0,1171	0,8829	27,7366	290	29,87	1,0769
1040	1,04	0,1194	0,8806	27,8089	300	30,9	1,1112
1060	1,06	0,1217	0,8783	27,8815	309	31,827	1,1415
1080	1,08	0,1240	0,8760	27,9546	318	32,754	1,1717
1100	1,1	0,1262	0,8738	28,0280	329	33,887	1,2090
1120	1,12	0,1285	0,8715	28,1019	345	35,535	1,2645
1140	1,14	0,1308	0,8692	28,1761	356	36,668	1,3014
1160	1,16	0,1331	0,8669	28,2507	367	37,801	1,3381
1180	1,18	0,1354	0,8646	28,3257	380	39,14	1,3818
1200	1,2	0,1377	0,8623	28,4011	393	40,479	1,4253
1220	1,22	0,1400	0,8600	28,4769	405	41,715	1,4649
1240	1,24	0,1423	0,8577	28,5531	422	43,466	1,5223



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1260	1,26	0,1446	0,8554	28,6297	431	44,393	1,5506
1280	1,28	0,1469	0,8531	28,7068	441	45,423	1,5823
1300	1,3	0,1492	0,8508	28,7842	450	46,35	1,6103
1320	1,32	0,1515	0,8485	28,8621	459	47,277	1,6380
1340	1,34	0,1538	0,8462	28,9404	464	47,792	1,6514
1360	1,36	0,1561	0,8439	29,0191	475	48,925	1,6860
1380	1,38	0,1584	0,8416	29,0982	485	49,955	1,7168
1400	1,4	0,1607	0,8393	29,1778	497	51,191	1,7544
1420	1,42	0,1630	0,8370	29,2578	509	52,427	1,7919
1440	1,44	0,1653	0,8347	29,3383	520	53,56	1,8256
1460	1,46	0,1676	0,8324	29,4192	534	55,002	1,8696
1480	1,48	0,1699	0,8301	29,5005	547	56,341	1,9098
1500	1,5	0,1722	0,8278	29,5823	560	57,68	1,9498
1520	1,52	0,1745	0,8255	29,6646	572	58,916	1,9861
1540	1,54	0,1767	0,8233	29,7473	580	59,74	2,0082
1560	1,56	0,1790	0,8210	29,8305	595	61,285	2,0544
1580	1,58	0,1813	0,8187	29,9141	605	62,315	2,0831
1600	1,6	0,1836	0,8164	29,9982	617	63,551	2,1185
1620	1,62	0,1859	0,8141	30,0828	632	65,096	2,1639
1640	1,64	0,1882	0,8118	30,1679	643	66,229	2,1953
1660	1,66	0,1905	0,8095	30,2534	653	67,259	2,2232
1680	1,68	0,1928	0,8072	30,3395	675	69,525	2,2916
1700	1,7	0,1951	0,8049	30,4260	690	71,07	2,3358
1720	1,72	0,1974	0,8026	30,5130	700	72,1	2,3629
1740	1,74	0,1997	0,8003	30,6005	715	73,645	2,4067
1760	1,76	0,2020	0,7980	30,6885	728	74,984	2,4434
1780	1,78	0,2043	0,7957	30,7771	739	76,117	2,4732
1800	1,8	0,2066	0,7934	30,8661	750	77,25	2,5027
1820	1,82	0,2089	0,7911	30,9557	765	78,795	2,5454
1840	1,84	0,2112	0,7888	31,0457	778	80,134	2,5812
1860	1,86	0,2135	0,7865	31,1363	788	81,164	2,6067
1880	1,88	0,2158	0,7842	31,2275	803	82,709	2,6486
1900	1,9	0,2181	0,7819	31,3192	818	84,254	2,6902
1920	1,92	0,2204	0,7796	31,4114	836	86,108	2,7413
1940	1,94	0,2227	0,7773	31,5041	854	87,962	2,7921
1960	1,96	0,2250	0,7750	31,5974	863	88,889	2,8132
1980	1,98	0,2272	0,7728	31,6913	877	90,331	2,8503
2000	2	0,2295	0,7705	31,7857	889	91,567	2,8808
2020	2,02	0,2318	0,7682	31,8807	903	93,009	2,9174
2040	2,04	0,2341	0,7659	31,9762	915	94,245	2,9473
2060	2,06	0,2364	0,7636	32,0724	930	95,79	2,9867



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2080	2,08	0,2387	0,7613	32,1691	944	97,232	3,0225
2100	2,1	0,2410	0,7590	32,2664	959	98,777	3,0613
2120	2,12	0,2433	0,7567	32,3642	970	99,91	3,0870
2140	2,14	0,2456	0,7544	32,4627	982	101,146	3,1158
2160	2,16	0,2479	0,7521	32,5618	996	102,588	3,1506
2180	2,18	0,2502	0,7498	32,6615	1013	104,339	3,1946
2200	2,2	0,2525	0,7475	32,7618	1028	105,884	3,2319
2220	2,22	0,2548	0,7452	32,8627	1041	107,223	3,2628
2240	2,24	0,2571	0,7429	32,9642	1055	108,665	3,2965
2260	2,26	0,2594	0,7406	33,0664	1070	110,21	3,3330
2280	2,28	0,2617	0,7383	33,1692	1074	110,622	3,3351
2300	2,3	0,2640	0,7360	33,2726	1075	110,725	3,3278
2320	2,32	0,2663	0,7337	33,3767	1076	110,828	3,3205
2340	2,34	0,2686	0,7314	33,4815	1077	110,931	3,3132
2360	2,36	0,2709	0,7291	33,5869	1077	110,931	3,3028
2380	2,38	0,2732	0,7268	33,6929	1077	110,931	3,2924
2400	2,4	0,2755	0,7245	33,7997	1077,5	110,9825	3,2835
2420	2,42	0,2777	0,7223	33,9071	1078	111,034	3,2747
2440	2,44	0,2800	0,7200	34,0152	1079	111,137	3,2673
2460	2,46	0,2823	0,7177	34,1240	1079	111,137	3,2569
2480	2,48	0,2846	0,7154	34,2335	1080	111,24	3,2494
2500	2,5	0,2869	0,7131	34,3437	1080	111,24	3,2390
2520	2,52	0,2892	0,7108	34,4546	1072	110,416	3,2047
2540	2,54	0,2915	0,7085	34,5662	1064	109,592	3,1705

Lampiran 24. Pengujian Kuat Tekan Bebas (50% Limbah Keramik + 50% Semen) 28 Hari



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PENGUJIAN KUAT TEKAN BEBAS

(50% LIMBAH KERAMIK + 50% SEMEN)

Waktu	: 28 hari	Luas mula-mula (A_0)	: 26,795 cm ²
Diameter	: 5,84 cm	Volume	: 227,200 cm ³
Tinggi	: 8,48 cm	Berat Volume γ_b	: 1,861 gr/cm ³
Berat	: 422,92 gram		

Perubahan Tinggi			Luas Penampang (cross-section area)		Beban		Tekanan (Q)
Angka Dial Vertikal	ΔL (cm)	ϵ Regangan (strain)	Koreksi	Luas Terkoreksi A (cm ²)	Angka Dial Beban	Beban P (kg)	P / A
a	$a \times 10^{-3}$	$\Delta L / L_0$	$d = 1 - \epsilon$	$e = A_0 / d$	f	g	h
0	0	0,0000	1,0000	26,7956	0	0	0,0000
20	0,02	0,0024	0,9976	26,8590	6	0,618	0,0230
40	0,04	0,0047	0,9953	26,9227	6	0,618	0,0230
60	0,06	0,0071	0,9929	26,9866	6	0,618	0,0229
80	0,08	0,0094	0,9906	27,0509	6	0,618	0,0228
100	0,1	0,0118	0,9882	27,1154	6	0,618	0,0228
120	0,12	0,0142	0,9858	27,1803	6	0,618	0,0227
140	0,14	0,0165	0,9835	27,2455	12	1,236	0,0454
160	0,16	0,0189	0,9811	27,3110	19	1,957	0,0717
180	0,18	0,0212	0,9788	27,3768	26	2,678	0,0978
200	0,2	0,0236	0,9764	27,4430	32	3,296	0,1201
220	0,22	0,0259	0,9741	27,5094	40	4,12	0,1498
240	0,24	0,0283	0,9717	27,5762	52	5,356	0,1942
260	0,26	0,0307	0,9693	27,6433	63	6,489	0,2347
280	0,28	0,0330	0,9670	27,7107	68	7,004	0,2528
300	0,3	0,0354	0,9646	27,7785	74	7,622	0,2744
320	0,32	0,0377	0,9623	27,8466	88	9,064	0,3255
340	0,34	0,0401	0,9599	27,9150	102	10,506	0,3764
360	0,36	0,0425	0,9575	27,9838	109	11,227	0,4012
380	0,38	0,0448	0,9552	28,0529	110	11,33	0,4039
400	0,4	0,0472	0,9528	28,1223	112	11,536	0,4102
420	0,42	0,0495	0,9505	28,1921	114	11,742	0,4165
440	0,44	0,0519	0,9481	28,2623	118	12,154	0,4300



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460	0,46	0,0543	0,9457	28,3327	118	12,154	0,4290
480	0,48	0,0566	0,9434	28,4036	123	12,669	0,4460
500	0,5	0,0590	0,9410	28,4748	126	12,978	0,4558
520	0,52	0,0613	0,9387	28,5463	128	13,184	0,4618
540	0,54	0,0637	0,9363	28,6183	128	13,184	0,4607
560	0,56	0,0660	0,9340	28,6905	129	13,287	0,4631
580	0,58	0,0684	0,9316	28,7632	131	13,493	0,4691
600	0,6	0,0708	0,9292	28,8362	134	13,802	0,4786
620	0,62	0,0731	0,9269	28,9096	136	14,008	0,4845
640	0,64	0,0755	0,9245	28,9833	138	14,214	0,4904
660	0,66	0,0778	0,9222	29,0575	141	14,523	0,4998
680	0,68	0,0802	0,9198	29,1320	144	14,832	0,5091
700	0,7	0,0826	0,9174	29,2069	150	15,45	0,5290
720	0,72	0,0849	0,9151	29,2822	158	16,274	0,5558
740	0,74	0,0873	0,9127	29,3578	166	17,098	0,5824
760	0,76	0,0896	0,9104	29,4339	175	18,025	0,6124
780	0,78	0,0920	0,9080	29,5104	184	18,952	0,6422
800	0,8	0,0944	0,9056	29,5872	194	19,982	0,6754
820	0,82	0,0967	0,9033	29,6645	206	21,218	0,7153
840	0,84	0,0991	0,9009	29,7422	216	22,248	0,7480
860	0,86	0,1014	0,8986	29,8202	226	23,278	0,7806
880	0,88	0,1038	0,8962	29,8987	230	23,69	0,7923
900	0,9	0,1061	0,8939	29,9776	245	25,235	0,8418
920	0,92	0,1085	0,8915	30,0569	254	26,162	0,8704
940	0,94	0,1109	0,8891	30,1367	266	27,398	0,9091
960	0,96	0,1132	0,8868	30,2168	278	28,634	0,9476
980	0,98	0,1156	0,8844	30,2974	289	29,767	0,9825
1000	1	0,1179	0,8821	30,3784	300	30,9	1,0172
1020	1,02	0,1203	0,8797	30,4599	312	32,136	1,0550
1040	1,04	0,1227	0,8773	30,5418	322	33,166	1,0859
1060	1,06	0,1250	0,8750	30,6241	326	33,578	1,0965
1080	1,08	0,1274	0,8726	30,7069	340	35,02	1,1405
1100	1,1	0,1297	0,8703	30,7901	350	36,05	1,1708
1120	1,12	0,1321	0,8679	30,8738	362	37,286	1,2077
1140	1,14	0,1344	0,8656	30,9579	378	38,934	1,2576
1160	1,16	0,1368	0,8632	31,0425	391	40,273	1,2973
1180	1,18	0,1392	0,8608	31,1276	403	41,509	1,3335
1200	1,2	0,1415	0,8585	31,2131	414	42,642	1,3662
1220	1,22	0,1439	0,8561	31,2991	429	44,187	1,4118
1240	1,24	0,1462	0,8538	31,3856	445	45,835	1,4604



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1260	1,26	0,1486	0,8514	31,4725	460	47,38	1,5054
1280	1,28	0,1510	0,8490	31,5600	473	48,719	1,5437
1300	1,3	0,1533	0,8467	31,6479	485	49,955	1,5785
1320	1,32	0,1557	0,8443	31,7363	498	51,294	1,6163
1340	1,34	0,1580	0,8420	31,8252	510	52,53	1,6506
1360	1,36	0,1604	0,8396	31,9146	523	53,869	1,6879
1380	1,38	0,1628	0,8372	32,0046	540	55,62	1,7379
1400	1,4	0,1651	0,8349	32,0950	555	57,165	1,7811
1420	1,42	0,1675	0,8325	32,1859	570	58,71	1,8241
1440	1,44	0,1698	0,8302	32,2774	588	60,564	1,8764
1460	1,46	0,1722	0,8278	32,3693	605	62,315	1,9251
1480	1,48	0,1745	0,8255	32,4618	612	63,036	1,9419
1500	1,5	0,1769	0,8231	32,5549	625	64,375	1,9774
1520	1,52	0,1793	0,8207	32,6484	640	65,92	2,0191
1540	1,54	0,1816	0,8184	32,7425	655	67,465	2,0605
1560	1,56	0,1840	0,8160	32,8372	672	69,216	2,1079
1580	1,58	0,1863	0,8137	32,9324	688	70,864	2,1518
1600	1,6	0,1887	0,8113	33,0281	701	72,203	2,1861
1620	1,62	0,1911	0,8089	33,1244	718	73,954	2,2326
1640	1,64	0,1934	0,8066	33,2213	736	75,808	2,2819
1660	1,66	0,1958	0,8042	33,3187	760	78,28	2,3494
1680	1,68	0,1981	0,8019	33,4167	778	80,134	2,3980
1700	1,7	0,2005	0,7995	33,5153	795	81,885	2,4432
1720	1,72	0,2029	0,7971	33,6145	814	83,842	2,4942
1740	1,74	0,2052	0,7948	33,7142	848	87,344	2,5907
1760	1,76	0,2076	0,7924	33,8146	870	89,61	2,6500
1780	1,78	0,2099	0,7901	33,9156	888	91,464	2,6968
1800	1,8	0,2123	0,7877	34,0171	908	93,524	2,7493
1820	1,82	0,2146	0,7854	34,1193	943	97,129	2,8467
1840	1,84	0,2170	0,7830	34,2221	963	99,189	2,8984
1860	1,86	0,2194	0,7806	34,3255	982	101,146	2,9467
1880	1,88	0,2217	0,7783	34,4295	1003	103,309	3,0006
1900	1,9	0,2241	0,7759	34,5342	1018	104,854	3,0362
1920	1,92	0,2264	0,7736	34,6395	1040	107,12	3,0924
1940	1,94	0,2288	0,7712	34,7454	1060	109,18	3,1423
1960	1,96	0,2312	0,7688	34,8520	1083	111,549	3,2006
1980	1,98	0,2335	0,7665	34,9593	1108	114,124	3,2645
2000	2	0,2359	0,7641	35,0672	1125	115,875	3,3044
2020	2,02	0,2382	0,7618	35,1758	1140	117,42	3,3381
2040	2,04	0,2406	0,7594	35,2850	1159	119,377	3,3832
2060	2,06	0,2430	0,7570	35,3950	1174	120,922	3,4164



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2080	2,08	0,2453	0,7547	35,5056	1189	122,467	3,4492
2100	2,1	0,2477	0,7523	35,6169	1205	124,115	3,4847
2120	2,12	0,2500	0,7500	35,7289	1225	126,175	3,5315
2140	2,14	0,2524	0,7476	35,8417	1231	126,793	3,5376
2160	2,16	0,2547	0,7453	35,9551	1232	126,896	3,5293
2180	2,18	0,2571	0,7429	36,0693	1235	127,205	3,5267

Lampiran 25. Pengujian Kuat Tekan Bebas (75% Limbah Keramik + 25% Semen) 3 Hari



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**PENGUJIAN KUAT TEKAN BEBAS
(75% LIMBAH KERAMIK + 25% SEMEN)**

Waktu	: 3 hari	Luas mula-mula (A ₀)	: 27,163 cm ²
Diameter	: 5,88 cm	Volume	: 232,468 cm ³
Tinggi	: 8,56 cm	Berat Volume γ _b	: 1,746 gr/cm ³
Berat	: 405,90 gram	Lampiran 25	

Perubahan Tinggi			Luas Penampang (cross-section area)		Beban		Tekanan (Q)
Angka Dial Vertikal	ΔL (cm)	ε Regangan (strain)	Koreksi	Luas Terkoreksi A (cm ²)	Angka Dial Beban	Beban P (kg)	P / A
a	a x 10 ⁻³	ΔL / L ₀	d = 1 - ε	e = A ₀ / d	f	g	h
0	0	0,0000	1,0000	27,1639	0	0	0,0000
20	0,02	0,0023	0,9977	27,2275	5	0,515	0,0189
40	0,04	0,0047	0,9953	27,2915	6	0,618	0,0226
60	0,06	0,0070	0,9930	27,3557	6	0,618	0,0226
80	0,08	0,0093	0,9907	27,4202	6	0,618	0,0225
100	0,1	0,0117	0,9883	27,4851	6	0,618	0,0225
120	0,12	0,0140	0,9860	27,5502	8	0,824	0,0299
140	0,14	0,0164	0,9836	27,6157	15	1,545	0,0559
160	0,16	0,0187	0,9813	27,6814	24	2,472	0,0893
180	0,18	0,0210	0,9790	27,7475	31	3,193	0,1151
200	0,2	0,0234	0,9766	27,8139	38	3,914	0,1407
220	0,22	0,0257	0,9743	27,8806	49	5,047	0,1810
240	0,24	0,0280	0,9720	27,9477	61	6,283	0,2248
260	0,26	0,0304	0,9696	28,0150	65	6,695	0,2390
280	0,28	0,0327	0,9673	28,0827	84	8,652	0,3081
300	0,3	0,0351	0,9649	28,1507	91	9,373	0,3330
320	0,32	0,0374	0,9626	28,2191	104	10,712	0,3796
340	0,34	0,0397	0,9603	28,2877	114	11,742	0,4151
360	0,36	0,0421	0,9579	28,3568	118	12,154	0,4286
380	0,38	0,0444	0,9556	28,4261	118	12,154	0,4276
400	0,4	0,0467	0,9533	28,4958	118	12,154	0,4265
420	0,42	0,0491	0,9509	28,5658	120	12,36	0,4327
440	0,44	0,0514	0,9486	28,6362	122	12,566	0,4388



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460	0,46	0,0538	0,9462	28,7069	122	12,566	0,4377
480	0,48	0,0561	0,9439	28,7780	124	12,772	0,4438
500	0,5	0,0584	0,9416	28,8494	128	13,184	0,4570
520	0,52	0,0608	0,9392	28,9212	134	13,802	0,4772
540	0,54	0,0631	0,9369	28,9934	143	14,729	0,5080
560	0,56	0,0654	0,9346	29,0659	154	15,862	0,5457
580	0,58	0,0678	0,9322	29,1387	163	16,789	0,5762
600	0,6	0,0701	0,9299	29,2120	173	17,819	0,6100
620	0,62	0,0724	0,9276	29,2856	185	19,055	0,6507
640	0,64	0,0748	0,9252	29,3595	194	19,982	0,6806
660	0,66	0,0771	0,9229	29,4339	214	22,042	0,7489
680	0,68	0,0795	0,9205	29,5086	222	22,866	0,7749
700	0,7	0,0818	0,9182	29,5837	234	24,102	0,8147
720	0,72	0,0841	0,9159	29,6592	246	25,338	0,8543
740	0,74	0,0865	0,9135	29,7351	260	26,78	0,9006
760	0,76	0,0888	0,9112	29,8113	273	28,119	0,9432
780	0,78	0,0911	0,9089	29,8880	284	29,252	0,9787
800	0,8	0,0935	0,9065	29,9650	298	30,694	1,0243
820	0,82	0,0958	0,9042	30,0425	310	31,93	1,0628
840	0,84	0,0982	0,9018	30,1203	324	33,372	1,1080
860	0,86	0,1005	0,8995	30,1986	338	34,814	1,1528
880	0,88	0,1028	0,8972	30,2772	350	36,05	1,1907
900	0,9	0,1052	0,8948	30,3563	364	37,492	1,2351
920	0,92	0,1075	0,8925	30,4358	380	39,14	1,2860
940	0,94	0,1098	0,8902	30,5157	393	40,479	1,3265
960	0,96	0,1122	0,8878	30,5960	406	41,818	1,3668
980	0,98	0,1145	0,8855	30,6768	418	43,054	1,4035
1000	1	0,1168	0,8832	30,7580	429	44,187	1,4366
1020	1,02	0,1192	0,8808	30,8396	438	45,114	1,4629
1040	1,04	0,1215	0,8785	30,9216	450	46,35	1,4990
1060	1,06	0,1239	0,8761	31,0041	456	46,968	1,5149
1080	1,08	0,1262	0,8738	31,0870	449	46,247	1,4877
1100	1,1	0,1285	0,8715	31,1704	442	45,526	1,4606

Lampiran 26. Pengujian Kuat Tekan Bebas (75% Limbah Keramik + 25% Semen) 7 Hari



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PENGUJIAN KUAT TEKAN BEBAS

(75% LIMBAH KERAMIK + 25% SEMEN)

Waktu	: 7 hari	Luas mula-mula (A_0)	: 25,009 cm ²
Diameter	: 5,64 cm	Volume	: 217,685 cm ³
Tinggi	: 8,70 cm	Berat Volume γ_b	: 1,987 gr/cm ³
Berat	: 432,63 gram		

Perubahan Tinggi			Luas Penampang (cross-section area)		Beban		Tekanan (Q)
Angka Dial Vertikal	ΔL (cm)	ε Regangan (strain)	Koreksi	Luas Terkoreksi A (cm ²)	Angka Dial Beban	Beban P (kg)	P / A
a	$a \times 10^{-3}$	$\Delta L / L_0$	$d = 1 - \varepsilon$	$e = A_0 / d$	f	g	h
0	0	0,0000	1,0000	25,0098	0	0	0,0000
20	0,02	0,0023	0,9977	25,0674	5	0,515	0,0205
40	0,04	0,0046	0,9954	25,1253	5	0,515	0,0205
60	0,06	0,0069	0,9931	25,1834	5	0,515	0,0204
80	0,08	0,0092	0,9908	25,2418	5	0,515	0,0204
100	0,1	0,0115	0,9885	25,3005	5	0,515	0,0204
120	0,12	0,0138	0,9862	25,3594	5	0,515	0,0203
140	0,14	0,0161	0,9839	25,4186	8	0,824	0,0324
160	0,16	0,0184	0,9816	25,4781	19	1,957	0,0768
180	0,18	0,0207	0,9793	25,5379	27	2,781	0,1089
200	0,2	0,0230	0,9770	25,5980	38	3,914	0,1529
220	0,22	0,0253	0,9747	25,6583	46	4,738	0,1847
240	0,24	0,0276	0,9724	25,7189	51	5,253	0,2042
260	0,26	0,0299	0,9701	25,7799	54	5,562	0,2157
280	0,28	0,0322	0,9678	25,8411	55	5,665	0,2192
300	0,3	0,0345	0,9655	25,9026	55	5,665	0,2187
320	0,32	0,0368	0,9632	25,9644	56	5,768	0,2222
340	0,34	0,0391	0,9609	26,0264	56	5,768	0,2216
360	0,36	0,0414	0,9586	26,0888	56	5,768	0,2211
380	0,38	0,0437	0,9563	26,1515	56	5,768	0,2206
400	0,4	0,0460	0,9540	26,2145	57	5,871	0,2240
420	0,42	0,0483	0,9517	26,2778	57	5,871	0,2234
440	0,44	0,0506	0,9494	26,3414	57	5,871	0,2229



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460	0,46	0,0528	0,9472	26,4053	62	6,386	0,2418
480	0,48	0,0551	0,9449	26,4695	62	6,386	0,2413
500	0,5	0,0574	0,9426	26,5340	73	7,519	0,2834
520	0,52	0,0597	0,9403	26,5989	84	8,652	0,3253
540	0,54	0,0620	0,9380	26,6640	93	9,579	0,3592
560	0,56	0,0643	0,9357	26,7295	104	10,712	0,4008
580	0,58	0,0666	0,9334	26,7953	109	11,227	0,4190
600	0,6	0,0689	0,9311	26,8614	112	11,536	0,4295
620	0,62	0,0712	0,9288	26,9279	113	11,639	0,4322
640	0,64	0,0735	0,9265	26,9947	114	11,742	0,4350
660	0,66	0,0758	0,9242	27,0618	116	11,948	0,4415
680	0,68	0,0781	0,9219	27,1293	121	12,463	0,4594
700	0,7	0,0804	0,9196	27,1970	125	12,875	0,4734
720	0,72	0,0827	0,9173	27,2652	130	13,39	0,4911
740	0,74	0,0850	0,9150	27,3336	135	13,905	0,5087
760	0,76	0,0873	0,9127	27,4025	135	13,905	0,5074
780	0,78	0,0896	0,9104	27,4716	136	14,008	0,5099
800	0,8	0,0919	0,9081	27,5411	138	14,214	0,5161
820	0,82	0,0942	0,9058	27,6110	139	14,317	0,5185
840	0,84	0,0965	0,9035	27,6812	141	14,523	0,5247
860	0,86	0,0988	0,9012	27,7518	141	14,523	0,5233
880	0,88	0,1011	0,8989	27,8227	144	14,832	0,5331
900	0,9	0,1034	0,8966	27,8941	154	15,862	0,5687
920	0,92	0,1057	0,8943	27,9657	161	16,583	0,5930
940	0,94	0,1080	0,8920	28,0378	168	17,304	0,6172
960	0,96	0,1103	0,8897	28,1102	176	18,128	0,6449
980	0,98	0,1126	0,8874	28,1830	185	19,055	0,6761
1000	1	0,1149	0,8851	28,2561	194	19,982	0,7072
1020	1,02	0,1172	0,8828	28,3297	204	21,012	0,7417
1040	1,04	0,1195	0,8805	28,4036	217	22,351	0,7869
1060	1,06	0,1218	0,8782	28,4779	225	23,175	0,8138
1080	1,08	0,1241	0,8759	28,5526	235	24,205	0,8477
1100	1,1	0,1264	0,8736	28,6277	243	25,029	0,8743
1120	1,12	0,1287	0,8713	28,7032	251	25,853	0,9007
1140	1,14	0,1310	0,8690	28,7791	260	26,78	0,9305
1160	1,16	0,1333	0,8667	28,8554	270	27,81	0,9638
1180	1,18	0,1356	0,8644	28,9321	278	28,634	0,9897
1200	1,2	0,1379	0,8621	29,0092	288	29,664	1,0226
1220	1,22	0,1402	0,8598	29,0867	297	30,591	1,0517
1240	1,24	0,1425	0,8575	29,1647	308	31,724	1,0878



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1260	1,26	0,1448	0,8552	29,2430	319	32,857	1,1236
1280	1,28	0,1471	0,8529	29,3218	331	34,093	1,1627
1300	1,3	0,1494	0,8506	29,4010	340	35,02	1,1911
1320	1,32	0,1517	0,8483	29,4807	352	36,256	1,2298
1340	1,34	0,1540	0,8460	29,5607	365	37,595	1,2718
1360	1,36	0,1563	0,8438	29,6412	377	38,831	1,3100
1380	1,38	0,1585	0,8415	29,7222	389	40,067	1,3481
1400	1,4	0,1608	0,8392	29,8036	403	41,509	1,3928
1420	1,42	0,1631	0,8369	29,8854	416	42,848	1,4337
1440	1,44	0,1654	0,8346	29,9677	429	44,187	1,4745
1460	1,46	0,1677	0,8323	30,0504	441	45,423	1,5116
1480	1,48	0,1700	0,8300	30,1336	453	46,659	1,5484
1500	1,5	0,1723	0,8277	30,2173	462	47,586	1,5748
1520	1,52	0,1746	0,8254	30,3014	476	49,028	1,6180
1540	1,54	0,1769	0,8231	30,3860	489	50,367	1,6576
1560	1,56	0,1792	0,8208	30,4710	501	51,603	1,6935
1580	1,58	0,1815	0,8185	30,5566	514	52,942	1,7326
1600	1,6	0,1838	0,8162	30,6426	529	54,487	1,7781
1620	1,62	0,1861	0,8139	30,7291	540	55,62	1,8100
1640	1,64	0,1884	0,8116	30,8161	553	56,959	1,8483
1660	1,66	0,1907	0,8093	30,9036	566	58,298	1,8864
1680	1,68	0,1930	0,8070	30,9916	577	59,431	1,9176
1700	1,7	0,1953	0,8047	31,0801	593	61,079	1,9652
1720	1,72	0,1976	0,8024	31,1691	605	62,315	1,9993
1740	1,74	0,1999	0,8001	31,2586	615	63,345	2,0265
1760	1,76	0,2022	0,7978	31,3487	627	64,581	2,0601
1780	1,78	0,2045	0,7955	31,4392	640	65,92	2,0967
1800	1,8	0,2068	0,7932	31,5303	653	67,259	2,1332
1820	1,82	0,2091	0,7909	31,6219	668	68,804	2,1758
1840	1,84	0,2114	0,7886	31,7140	683	70,349	2,2182
1860	1,86	0,2137	0,7863	31,8067	696	71,688	2,2539
1880	1,88	0,2160	0,7840	31,8999	709	73,027	2,2893
1900	1,9	0,2183	0,7817	31,9937	720	74,16	2,3180
1920	1,92	0,2206	0,7794	32,0880	733	75,499	2,3529
1940	1,94	0,2229	0,7771	32,1829	745	76,735	2,3843
1960	1,96	0,2252	0,7748	32,2783	758	78,074	2,4188
1980	1,98	0,2275	0,7725	32,3744	772	79,516	2,4561
2000	2	0,2298	0,7702	32,4709	784	80,752	2,4869
2020	2,02	0,2321	0,7679	32,5681	797	82,091	2,5206
2040	2,04	0,2344	0,7656	32,6658	811	83,533	2,5572
2060	2,06	0,2367	0,7633	32,7642	824	84,872	2,5904



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2080	2,08	0,2390	0,7610	32,8631	839	86,417	2,6296
2100	2,1	0,2413	0,7587	32,9626	850	87,55	2,6560
2120	2,12	0,2436	0,7564	33,0628	868	89,404	2,7041
2140	2,14	0,2459	0,7541	33,1635	872	89,816	2,7083
2160	2,16	0,2482	0,7518	33,2649	881	90,743	2,7279
2180	2,18	0,2505	0,7495	33,3668	891	91,773	2,7504
2200	2,2	0,2528	0,7472	33,4694	904	93,112	2,7820
2220	2,22	0,2551	0,7449	33,5727	915	94,245	2,8072
2240	2,24	0,2574	0,7426	33,6765	924	95,172	2,8261
2260	2,26	0,2597	0,7403	33,7811	924	95,172	2,8173
2280	2,28	0,2619	0,7381	33,8862	920	94,76	2,7964

Lampiran 27. Pengujian Kuat Tekan Bebas (75% Limbah Keramik + 25% Semen) 28 Hari



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PENGUJIAN KUAT TEKAN BEBAS

(75% LIMBAH KERAMIK + 25% SEMEN)

Waktu	: 28 hari	Luas mula-mula (A_0)	: 26,979 cm ²
Diameter	: 5,86 cm	Volume	: 230,188 cm ³
Tinggi	: 8,53 cm	Berat Volume γ_b	: 1,724 gr/cm ³
Berat	: 396,87 gram		

Perubahan Tinggi			Luas Penampang (cross-section area)		Beban		Tekanan (Q)
Angka Dial Vertikal	ΔL (cm)	ϵ Regangan (strain)	Koreksi	Luas Terkoreksi A (cm ²)	Angka Dial Beban	Beban P (kg)	P / A
a	$a \times 10^{-3}$	$\Delta L / L_0$	$d = 1 - \epsilon$	$e = A_0 / d$	f	g	h
0	0	0,0000	1,0000	26,9795	0	0	0,0000
20	0,02	0,0023	0,9977	27,0429	5	0,515	0,0190
40	0,04	0,0047	0,9953	27,1065	7	0,721	0,0266
60	0,06	0,0070	0,9930	27,1705	7	0,721	0,0265
80	0,08	0,0094	0,9906	27,2348	7	0,721	0,0265
100	0,1	0,0117	0,9883	27,2994	7	0,721	0,0264
120	0,12	0,0141	0,9859	27,3643	7	0,721	0,0263
140	0,14	0,0164	0,9836	27,4296	7	0,721	0,0263
160	0,16	0,0188	0,9812	27,4951	8	0,824	0,0300
180	0,18	0,0211	0,9789	27,5609	14	1,442	0,0523
200	0,2	0,0234	0,9766	27,6271	20	2,06	0,0746
220	0,22	0,0258	0,9742	27,6936	30	3,09	0,1116
240	0,24	0,0281	0,9719	27,7603	40	4,12	0,1484
260	0,26	0,0305	0,9695	27,8275	48	4,944	0,1777
280	0,28	0,0328	0,9672	27,8949	59	6,077	0,2179
300	0,3	0,0352	0,9648	27,9627	71	7,313	0,2615
320	0,32	0,0375	0,9625	28,0308	84	8,652	0,3087
340	0,34	0,0398	0,9602	28,0992	97	9,991	0,3556
360	0,36	0,0422	0,9578	28,1680	111	11,433	0,4059
380	0,38	0,0445	0,9555	28,2371	121	12,463	0,4414
400	0,4	0,0469	0,9531	28,3065	129	13,287	0,4694
420	0,42	0,0492	0,9508	28,3763	140	14,42	0,5082
440	0,44	0,0516	0,9484	28,4465	149	15,347	0,5395



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460	0,46	0,0539	0,9461	28,5169	159	16,377	0,5743
480	0,48	0,0563	0,9437	28,5878	168	17,304	0,6053
500	0,5	0,0586	0,9414	28,6590	178	18,334	0,6397
520	0,52	0,0609	0,9391	28,7305	187	19,261	0,6704
540	0,54	0,0633	0,9367	28,8024	198	20,394	0,7081
560	0,56	0,0656	0,9344	28,8747	207	21,321	0,7384
580	0,58	0,0680	0,9320	28,9473	218	22,454	0,7757
600	0,6	0,0703	0,9297	29,0203	234	24,102	0,8305
620	0,62	0,0727	0,9273	29,0936	247	25,441	0,8745
640	0,64	0,0750	0,9250	29,1674	257	26,471	0,9076
660	0,66	0,0774	0,9226	29,2415	267	27,501	0,9405
680	0,68	0,0797	0,9203	29,3159	278	28,634	0,9767
700	0,7	0,0820	0,9180	29,3908	288	29,664	1,0093
720	0,72	0,0844	0,9156	29,4661	298	30,694	1,0417
740	0,74	0,0867	0,9133	29,5417	309	31,827	1,0774
760	0,76	0,0891	0,9109	29,6177	320	32,96	1,1128
780	0,78	0,0914	0,9086	29,6941	331	34,093	1,1481
800	0,8	0,0938	0,9062	29,7709	342	35,226	1,1832
820	0,82	0,0961	0,9039	29,8481	355	36,565	1,2250
840	0,84	0,0985	0,9015	29,9257	367	37,801	1,2632
860	0,86	0,1008	0,8992	30,0038	379	39,037	1,3011
880	0,88	0,1031	0,8969	30,0822	389	40,067	1,3319
900	0,9	0,1055	0,8945	30,1610	401	41,303	1,3694
920	0,92	0,1078	0,8922	30,2403	415	42,745	1,4135
940	0,94	0,1102	0,8898	30,3199	430	44,29	1,4608
960	0,96	0,1125	0,8875	30,4000	441	45,423	1,4942
980	0,98	0,1149	0,8851	30,4805	451	46,453	1,5240
1000	1	0,1172	0,8828	30,5614	463	47,689	1,5604
1020	1,02	0,1195	0,8805	30,6428	471	48,513	1,5832
1040	1,04	0,1219	0,8781	30,7246	484	49,852	1,6225
1060	1,06	0,1242	0,8758	30,8069	495	50,985	1,6550
1080	1,08	0,1266	0,8734	30,8895	508	52,324	1,6939
1100	1,1	0,1289	0,8711	30,9727	520	53,56	1,7293
1120	1,12	0,1313	0,8687	31,0562	532	54,796	1,7644
1140	1,14	0,1336	0,8664	31,1403	546	56,238	1,8060
1160	1,16	0,1360	0,8640	31,2247	563	57,989	1,8571
1180	1,18	0,1383	0,8617	31,3097	578	59,534	1,9015
1200	1,2	0,1406	0,8594	31,3951	593	61,079	1,9455
1220	1,22	0,1430	0,8570	31,4810	607	62,521	1,9860
1240	1,24	0,1453	0,8547	31,5673	617	63,551	2,0132



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1260	1,26	0,1477	0,8523	31,6541	630	64,89	2,0500
1280	1,28	0,1500	0,8500	31,7414	644	66,332	2,0898
1300	1,3	0,1524	0,8476	31,8292	656	67,568	2,1228
1320	1,32	0,1547	0,8453	31,9175	670	69,01	2,1621
1340	1,34	0,1571	0,8429	32,0062	685	70,555	2,2044
1360	1,36	0,1594	0,8406	32,0955	698	71,894	2,2400
1380	1,38	0,1617	0,8383	32,1852	713	73,439	2,2818
1400	1,4	0,1641	0,8359	32,2755	727	74,881	2,3201
1420	1,42	0,1664	0,8336	32,3663	741	76,323	2,3581
1440	1,44	0,1688	0,8312	32,4575	755	77,765	2,3959
1460	1,46	0,1711	0,8289	32,5493	770	79,31	2,4366
1480	1,48	0,1735	0,8265	32,6416	785	80,855	2,4771
1500	1,5	0,1758	0,8242	32,7345	798	82,194	2,5109
1520	1,52	0,1782	0,8218	32,8278	812	83,636	2,5477
1540	1,54	0,1805	0,8195	32,9217	822	84,666	2,5717
1560	1,56	0,1828	0,8172	33,0162	835	86,005	2,6049
1580	1,58	0,1852	0,8148	33,1112	852	87,756	2,6503
1600	1,6	0,1875	0,8125	33,2067	867	89,301	2,6892
1620	1,62	0,1899	0,8101	33,3028	877	90,331	2,7124
1640	1,64	0,1922	0,8078	33,3994	894	92,082	2,7570
1660	1,66	0,1946	0,8054	33,4966	904	93,112	2,7797
1680	1,68	0,1969	0,8031	33,5944	920	94,76	2,8207
1700	1,7	0,1992	0,8008	33,6927	934	96,202	2,8553
1720	1,72	0,2016	0,7984	33,7917	950	97,85	2,8957
1740	1,74	0,2039	0,7961	33,8912	964	99,292	2,9297
1760	1,76	0,2063	0,7937	33,9913	983	101,249	2,9787
1780	1,78	0,2086	0,7914	34,0919	1004	103,412	3,0333
1800	1,8	0,2110	0,7890	34,1932	1017	104,751	3,0635
1820	1,82	0,2133	0,7867	34,2951	1031	106,193	3,0964
1840	1,84	0,2157	0,7843	34,3976	1046	107,738	3,1321
1860	1,86	0,2180	0,7820	34,5007	1057	108,871	3,1556
1880	1,88	0,2203	0,7797	34,6044	1067	109,901	3,1759
1900	1,9	0,2227	0,7773	34,7088	1078	111,034	3,1990
1920	1,92	0,2250	0,7750	34,8138	1089	112,167	3,2219
1940	1,94	0,2274	0,7726	34,9194	1105	113,815	3,2594
1960	1,96	0,2297	0,7703	35,0257	1116	114,948	3,2818
1980	1,98	0,2321	0,7679	35,1326	1131	116,493	3,3158
2000	2	0,2344	0,7656	35,2402	1144	117,832	3,3437
2020	2,02	0,2368	0,7632	35,3484	1156	119,068	3,3684
2040	2,04	0,2391	0,7609	35,4573	1168	120,304	3,3929
2060	2,06	0,2414	0,7586	35,5669	1179	121,437	3,4143



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2080	2,08	0,2438	0,7562	35,6771	1191	122,673	3,4384
2100	2,1	0,2461	0,7539	35,7881	1201	123,703	3,4565
2120	2,12	0,2485	0,7515	35,8997	1209	124,527	3,4687
2140	2,14	0,2508	0,7492	36,0120	1218	125,454	3,4837
2160	2,16	0,2532	0,7468	36,1250	1222	125,866	3,4842
2180	2,18	0,2555	0,7445	36,2388	1217	125,351	3,4590
2200	2,2	0,2579	0,7421	36,3533	1214	125,042	3,4396

Lampiran 28. Pengujian Kuat Tekan Bebas (100% Limbah Keramik + 0% Semen) 3 Hari



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PENGUJIAN KUAT TEKAN BEBAS
(100% LIMBAH KERAMIK + 0% SEMEN)

Waktu	: 3 hari	Luas mula-mula (A_0)	: 34,482 cm ²
Diameter	: 6,63 cm	Volume	: 251,718 cm ³
Tinggi	: 7,30 cm	Berat Volume γ_b	: 1,850 gr/cm ³
Berat	: 465,73 gram		

Perubahan Tinggi			Luas Penampang (cross-section area)		Beban		Tekanan (Q)
Angka Dial Vertikal	ΔL (cm)	ε Regangan (strain)	Koreksi	Luas Terkoreksi A (cm ²)	Angka Dial Beban	Beban P (kg)	P / A
a	$a \times 10^{-3}$	$\Delta L / L_0$	$d = 1 - \varepsilon$	$e = A_0 / d$	f	g	h
0	0	0,0000	1,0000	34,4820	0	0	0,0000
20	0,02	0,0027	0,9973	34,5768	5	0,515	0,0149
40	0,04	0,0055	0,9945	34,6720	6	0,618	0,0178
60	0,06	0,0082	0,9918	34,7678	6	0,618	0,0178
80	0,08	0,0110	0,9890	34,8641	6	0,618	0,0177
100	0,1	0,0137	0,9863	34,9609	6	0,618	0,0177
120	0,12	0,0164	0,9836	35,0583	6	0,618	0,0176
140	0,14	0,0192	0,9808	35,1563	6	0,618	0,0176
160	0,16	0,0219	0,9781	35,2547	8	0,824	0,0234
180	0,18	0,0247	0,9753	35,3538	12	1,236	0,0350
200	0,2	0,0274	0,9726	35,4533	15	1,545	0,0436
220	0,22	0,0301	0,9699	35,5535	18	1,854	0,0521
240	0,24	0,0329	0,9671	35,6542	21	2,163	0,0607
260	0,26	0,0356	0,9644	35,7555	24	2,472	0,0691
280	0,28	0,0384	0,9616	35,8574	28	2,884	0,0804
300	0,3	0,0411	0,9589	35,9598	31	3,193	0,0888
320	0,32	0,0438	0,9562	36,0629	36	3,708	0,1028
340	0,34	0,0466	0,9534	36,1665	40	4,12	0,1139
360	0,36	0,0493	0,9507	36,2707	44	4,532	0,1249
380	0,38	0,0521	0,9479	36,3755	48	4,944	0,1359
400	0,4	0,0548	0,9452	36,4810	52	5,356	0,1468
420	0,42	0,0575	0,9425	36,5870	56	5,768	0,1577
440	0,44	0,0603	0,9397	36,6937	57	5,871	0,1600



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460	0,46	0,0630	0,9370	36,8010	57	5,871	0,1595
480	0,48	0,0658	0,9342	36,9089	58	5,974	0,1619
500	0,5	0,0685	0,9315	37,0175	58	5,974	0,1614
520	0,52	0,0712	0,9288	37,1267	58	5,974	0,1609
540	0,54	0,0740	0,9260	37,2365	59	6,077	0,1632
560	0,56	0,0767	0,9233	37,3470	59	6,077	0,1627
580	0,58	0,0795	0,9205	37,4582	59	6,077	0,1622
600	0,6	0,0822	0,9178	37,5700	59	6,077	0,1618
620	0,62	0,0849	0,9151	37,6825	60	6,18	0,1640
640	0,64	0,0877	0,9123	37,7956	60	6,18	0,1635
660	0,66	0,0904	0,9096	37,9095	68	7,004	0,1848
680	0,68	0,0932	0,9068	38,0240	72	7,416	0,1950
700	0,7	0,0959	0,9041	38,1392	77	7,931	0,2079
720	0,72	0,0986	0,9014	38,2551	80	8,24	0,2154
740	0,74	0,1014	0,8986	38,3718	83	8,549	0,2228
760	0,76	0,1041	0,8959	38,4891	88	9,064	0,2355
780	0,78	0,1068	0,8932	38,6072	92	9,476	0,2454
800	0,8	0,1096	0,8904	38,7260	96	9,888	0,2553
820	0,82	0,1123	0,8877	38,8455	101	10,403	0,2678
840	0,84	0,1151	0,8849	38,9658	105	10,815	0,2776
860	0,86	0,1178	0,8822	39,0868	107	11,021	0,2820
880	0,88	0,1205	0,8795	39,2085	110	11,33	0,2890
900	0,9	0,1233	0,8767	39,3311	110	11,33	0,2881
920	0,92	0,1260	0,8740	39,4544	110	11,33	0,2872
940	0,94	0,1288	0,8712	39,5784	111	11,433	0,2889
960	0,96	0,1315	0,8685	39,7033	112	11,536	0,2906
980	0,98	0,1342	0,8658	39,8289	113	11,639	0,2922
1000	1	0,1370	0,8630	39,9554	113	11,639	0,2913
1020	1,02	0,1397	0,8603	40,0826	115	11,845	0,2955
1040	1,04	0,1425	0,8575	40,2107	118	12,154	0,3023
1060	1,06	0,1452	0,8548	40,3395	120	12,36	0,3064
1080	1,08	0,1479	0,8521	40,4693	122	12,566	0,3105
1100	1,1	0,1507	0,8493	40,5998	122	12,566	0,3095
1120	1,12	0,1534	0,8466	40,7312	123	12,669	0,3110
1140	1,14	0,1562	0,8438	40,8634	125	12,875	0,3151
1160	1,16	0,1589	0,8411	40,9965	127	13,081	0,3191
1180	1,18	0,1616	0,8384	41,1305	128	13,184	0,3205
1200	1,2	0,1644	0,8356	41,2654	129	13,287	0,3220
1220	1,22	0,1671	0,8329	41,4011	129	13,287	0,3209
1240	1,24	0,1699	0,8301	41,5378	129	13,287	0,3199



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1260	1,26	0,1726	0,8274	41,6753	130	13,39	0,3213
1280	1,28	0,1753	0,8247	41,8137	134	13,802	0,3301
1300	1,3	0,1781	0,8219	41,9531	138	14,214	0,3388
1320	1,32	0,1808	0,8192	42,0934	139	14,317	0,3401
1340	1,34	0,1836	0,8164	42,2347	139	14,317	0,3390
1360	1,36	0,1863	0,8137	42,3769	140	14,42	0,3403
1380	1,38	0,1890	0,8110	42,5201	140	14,42	0,3391
1400	1,4	0,1918	0,8082	42,6642	140	14,42	0,3380
1420	1,42	0,1945	0,8055	42,8093	140	14,42	0,3368
1440	1,44	0,1973	0,8027	42,9554	138	14,214	0,3309
1460	1,46	0,2000	0,8000	43,1025	135	13,905	0,3226

Lampiran 29. Pengujian Kuat Tekan Bebas (100% Limbah Keramik + 0% Semen) 7 Hari



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PENGUJIAN KUAT TEKAN BEBAS
(100% LIMBAH KERAMIK + 0% SEMEN)

Waktu : 7 hari Luas mula-mula (A_0) : 26,457 cm²
Diameter : 5,80 cm Volume : 234,517 cm³
Tinggi : 8,86 cm Berat Volume γ_b : 1,786 gr/cm³
Berat : 419,04 gram

Perubahan Tinggi			Luas Penampang (cross-section area)		Beban		Tekanan (Q)
Angka Dial Vertikal	ΔL (cm)	ϵ Regangan (strain)	Koreksi	Luas Terkoreksi A (cm ²)	Angka Dial Beban	Beban P (kg)	P / A
a	a x 10 ⁻³	$\Delta L / L_0$	d = 1 - ϵ	e = A_0 / d	f	g	h
0	0	0,0000	1,0000	26,4572	0	0	0,0000
20	0,02	0,0023	0,9977	26,5171	4	0,412	0,0155
40	0,04	0,0045	0,9955	26,5772	4	0,412	0,0155
60	0,06	0,0068	0,9932	26,6376	4	0,412	0,0155
80	0,08	0,0090	0,9910	26,6982	4	0,412	0,0154
100	0,1	0,0113	0,9887	26,7591	4	0,412	0,0154
120	0,12	0,0135	0,9865	26,8203	6	0,618	0,0230
140	0,14	0,0158	0,9842	26,8818	15	1,545	0,0575
160	0,16	0,0181	0,9819	26,9436	25	2,575	0,0956
180	0,18	0,0203	0,9797	27,0056	35	3,605	0,1335
200	0,2	0,0226	0,9774	27,0680	44	4,532	0,1674
220	0,22	0,0248	0,9752	27,1306	55	5,665	0,2088
240	0,24	0,0271	0,9729	27,1935	63	6,489	0,2386
260	0,26	0,0293	0,9707	27,2567	68	7,004	0,2570
280	0,28	0,0316	0,9684	27,3203	79	8,137	0,2978
300	0,3	0,0338	0,9662	27,3841	93	9,579	0,3498
320	0,32	0,0361	0,9639	27,4482	109	11,227	0,4090
340	0,34	0,0384	0,9616	27,5126	118	12,154	0,4418
360	0,36	0,0406	0,9594	27,5773	124	12,772	0,4631
380	0,38	0,0429	0,9571	27,6423	127	13,081	0,4732
400	0,4	0,0451	0,9549	27,7076	129	13,287	0,4795
420	0,42	0,0474	0,9526	27,7732	135	13,905	0,5007
440	0,44	0,0496	0,9504	27,8392	138	14,214	0,5106



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460	0,46	0,0519	0,9481	27,9054	145	14,935	0,5352
480	0,48	0,0542	0,9458	27,9720	153	15,759	0,5634
500	0,5	0,0564	0,9436	28,0389	153	15,759	0,5620
520	0,52	0,0587	0,9413	28,1061	160	16,48	0,5864
540	0,54	0,0609	0,9391	28,1736	169	17,407	0,6178
560	0,56	0,0632	0,9368	28,2415	181	18,643	0,6601
580	0,58	0,0654	0,9346	28,3096	193	19,879	0,7022
600	0,6	0,0677	0,9323	28,3782	205	21,115	0,7441
620	0,62	0,0699	0,9301	28,4470	219	22,557	0,7929
640	0,64	0,0722	0,9278	28,5162	230	23,69	0,8308
660	0,66	0,0745	0,9255	28,5857	243	25,029	0,8756
680	0,68	0,0767	0,9233	28,6556	255	26,265	0,9166
700	0,7	0,0790	0,9210	28,7258	268	27,604	0,9609
720	0,72	0,0812	0,9188	28,7963	283	29,149	1,0122
740	0,74	0,0835	0,9165	28,8672	294	30,282	1,0490
760	0,76	0,0857	0,9143	28,9384	308	31,724	1,0963
780	0,78	0,0880	0,9120	29,0100	322	33,166	1,1433
800	0,8	0,0903	0,9097	29,0820	334	34,402	1,1829
820	0,82	0,0925	0,9075	29,1543	348	35,844	1,2295
840	0,84	0,0948	0,9052	29,2270	363	37,389	1,2793
860	0,86	0,0970	0,9030	29,3000	373	38,419	1,3112
880	0,88	0,0993	0,9007	29,3734	387	39,861	1,3570
900	0,9	0,1015	0,8985	29,4471	398	40,994	1,3921
920	0,92	0,1038	0,8962	29,5213	412	42,436	1,4375
940	0,94	0,1060	0,8940	29,5958	425	43,775	1,4791
960	0,96	0,1083	0,8917	29,6707	438	45,114	1,5205
980	0,98	0,1106	0,8894	29,7459	449	46,247	1,5547
1000	1	0,1128	0,8872	29,8216	443	45,629	1,5301
1020	1,02	0,1151	0,8849	29,8976	437	45,011	1,5055

Lampiran 30. Pengujian Kuat Tekan Bebas (100% Limbah Keramik + 0% Semen) 28 Hari



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**PENGUJIAN KUAT TEKAN BEBAS
(100% LIMBAH KERAMIK + 0% SEMEN)**

Waktu	: 28 hari	Luas mula-mula (A_0)	: 24,323 cm ²
Diameter	: 5,57 cm	Volume	: 208,887 cm ³
Tinggi	: 8,59 cm	Berat Volume γ_b	: 1,912 gr/cm ³
Berat	: 399,44 gram		

Perubahan Tinggi			Luas Penampang (cross-section area)		Beban		Tekanan (Q)
Angka Dial Vertikal	ΔL (cm)	ϵ Regangan (strain)	Koreksi	Luas Terkoreksi A (cm ²)	Angka Dial Beban	Beban P (kg)	P / A
a	$a \times 10^{-3}$	$\Delta L / L_0$	$d = 1 - \epsilon$	$e = A_0 / d$	f	g	h
0	0	0,0000	1,0000	24,3232	0	0	0,0000
20	0,02	0,0023	0,9977	24,3799	12	1,236	0,0507
40	0,04	0,0047	0,9953	24,4370	19	1,957	0,0801
60	0,06	0,0070	0,9930	24,4943	25	2,575	0,1051
80	0,08	0,0093	0,9907	24,5519	27	2,781	0,1133
100	0,1	0,0116	0,9884	24,6097	30	3,09	0,1256
120	0,12	0,0140	0,9860	24,6679	37	3,811	0,1545
140	0,14	0,0163	0,9837	24,7263	42	4,326	0,1750
160	0,16	0,0186	0,9814	24,7849	47	4,841	0,1953
180	0,18	0,0210	0,9790	24,8439	58	5,974	0,2405
200	0,2	0,0233	0,9767	24,9031	67	6,901	0,2771
220	0,22	0,0256	0,9744	24,9626	67	6,901	0,2765
240	0,24	0,0279	0,9721	25,0224	68	7,004	0,2799
260	0,26	0,0303	0,9697	25,0825	69	7,107	0,2833
280	0,28	0,0326	0,9674	25,1429	69	7,107	0,2827
300	0,3	0,0349	0,9651	25,2036	69	7,107	0,2820
320	0,32	0,0373	0,9627	25,2646	75	7,725	0,3058
340	0,34	0,0396	0,9604	25,3258	80	8,24	0,3254
360	0,36	0,0419	0,9581	25,3874	83	8,549	0,3367
380	0,38	0,0442	0,9558	25,4492	85	8,755	0,3440
400	0,4	0,0466	0,9534	25,5114	93	9,579	0,3755
420	0,42	0,0489	0,9511	25,5739	104	10,712	0,4189
440	0,44	0,0512	0,9488	25,6366	114	11,742	0,4580



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460	0,46	0,0536	0,9464	25,6997	126	12,978	0,5050
480	0,48	0,0559	0,9441	25,7631	135	13,905	0,5397
500	0,5	0,0582	0,9418	25,8268	144	14,832	0,5743
520	0,52	0,0605	0,9395	25,8909	154	15,862	0,6126
540	0,54	0,0629	0,9371	25,9552	163	16,789	0,6468
560	0,56	0,0652	0,9348	26,0199	174	17,922	0,6888
580	0,58	0,0675	0,9325	26,0848	188	19,364	0,7423
600	0,6	0,0699	0,9301	26,1502	199	20,497	0,7838
620	0,62	0,0722	0,9278	26,2158	206	21,218	0,8094
640	0,64	0,0745	0,9255	26,2818	218	22,454	0,8544
660	0,66	0,0769	0,9231	26,3481	229	23,587	0,8952
680	0,68	0,0792	0,9208	26,4147	238	24,514	0,9280
700	0,7	0,0815	0,9185	26,4817	250	25,75	0,9724
720	0,72	0,0838	0,9162	26,5490	262	26,986	1,0165
740	0,74	0,0862	0,9138	26,6166	276	28,428	1,0681
760	0,76	0,0885	0,9115	26,6846	287	29,561	1,1078
780	0,78	0,0908	0,9092	26,7530	302	31,106	1,1627
800	0,8	0,0932	0,9068	26,8217	313	32,239	1,2020
820	0,82	0,0955	0,9045	26,8908	325	33,475	1,2449
840	0,84	0,0978	0,9022	26,9602	338	34,814	1,2913
860	0,86	0,1001	0,8999	27,0299	349	35,947	1,3299
880	0,88	0,1025	0,8975	27,1001	363	37,389	1,3797
900	0,9	0,1048	0,8952	27,1706	374	38,522	1,4178
920	0,92	0,1071	0,8929	27,2414	387	39,861	1,4632
940	0,94	0,1095	0,8905	27,3127	398	40,994	1,5009
960	0,96	0,1118	0,8882	27,3843	412	42,436	1,5496
980	0,98	0,1141	0,8859	27,4563	425	43,775	1,5944
1000	1	0,1164	0,8836	27,5287	438	45,114	1,6388
1020	1,02	0,1188	0,8812	27,6014	451	46,453	1,6830
1040	1,04	0,1211	0,8789	27,6745	465	47,895	1,7307
1060	1,06	0,1234	0,8766	27,7481	477	49,131	1,7706
1080	1,08	0,1258	0,8742	27,8220	491	50,573	1,8177
1100	1,1	0,1281	0,8719	27,8963	506	52,118	1,8683
1120	1,12	0,1304	0,8696	27,9710	518	53,354	1,9075
1140	1,14	0,1327	0,8673	28,0461	533	54,899	1,9575
1160	1,16	0,1351	0,8649	28,1216	546	56,238	1,9998
1180	1,18	0,1374	0,8626	28,1975	560	57,68	2,0456
1200	1,2	0,1397	0,8603	28,2739	573	59,019	2,0874
1220	1,22	0,1421	0,8579	28,3506	589	60,667	2,1399
1240	1,24	0,1444	0,8556	28,4278	604	62,212	2,1884



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1260	1,26	0,1467	0,8533	28,5054	618	63,654	2,2331
1280	1,28	0,1490	0,8510	28,5834	634	65,302	2,2846
1300	1,3	0,1514	0,8486	28,6618	648	66,744	2,3287
1320	1,32	0,1537	0,8463	28,7407	660	67,98	2,3653
1340	1,34	0,1560	0,8440	28,8200	687	70,761	2,4553
1360	1,36	0,1584	0,8416	28,8998	700	72,1	2,4948
1380	1,38	0,1607	0,8393	28,9799	713	73,439	2,5341
1400	1,4	0,1630	0,8370	29,0606	734	75,602	2,6015
1420	1,42	0,1653	0,8347	29,1417	745	76,735	2,6332
1440	1,44	0,1677	0,8323	29,2232	760	78,28	2,6787
1460	1,46	0,1700	0,8300	29,3052	777	80,031	2,7309
1480	1,48	0,1723	0,8277	29,3876	789	81,267	2,7653
1500	1,5	0,1747	0,8253	29,4706	795	81,885	2,7785
1520	1,52	0,1770	0,8230	29,5540	804	82,812	2,8021
1540	1,54	0,1793	0,8207	29,6378	814	83,842	2,8289
1560	1,56	0,1816	0,8184	29,7222	833	85,799	2,8867
1580	1,58	0,1840	0,8160	29,8070	845	87,035	2,9200
1600	1,6	0,1863	0,8137	29,8923	859	88,477	2,9599
1620	1,62	0,1886	0,8114	29,9781	872	89,816	2,9961
1640	1,64	0,1910	0,8090	30,0644	886	91,258	3,0354
1660	1,66	0,1933	0,8067	30,1512	900	92,7	3,0745
1680	1,68	0,1956	0,8044	30,2385	914	94,142	3,1133
1700	1,7	0,1980	0,8020	30,3263	927	95,481	3,1485
1720	1,72	0,2003	0,7997	30,4146	940	96,82	3,1833
1740	1,74	0,2026	0,7974	30,5034	956	98,468	3,2281
1760	1,76	0,2049	0,7951	30,5928	970	99,91	3,2658
1780	1,78	0,2073	0,7927	30,6826	985	101,455	3,3066
1800	1,8	0,2096	0,7904	30,7730	997	102,691	3,3370
1820	1,82	0,2119	0,7881	30,8640	1006	103,618	3,3572
1840	1,84	0,2143	0,7857	30,9555	1018	104,854	3,3873
1860	1,86	0,2166	0,7834	31,0475	1031	106,193	3,4203
1880	1,88	0,2189	0,7811	31,1400	1040	107,12	3,4399
1900	1,9	0,2212	0,7788	31,2332	1042	107,326	3,4363
1920	1,92	0,2236	0,7764	31,3268	1042	107,326	3,4260
1940	1,94	0,2259	0,7741	31,4211	1040	107,12	3,4092
1960	1,96	0,2282	0,7718	31,5159	1037	106,811	3,3891

Lampiran 31. Pengujian CBR (25% Limbah Keramik + 75% Semen) 7 Hari



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PENGUJIAN CBR

(25% LIMBAH KERAMIK + 75% SEMEN)

Waktu	: 7 hari	OMC	: 11,79 %
Diameter	: 15,214 cm	MDD	: 1,938 gr/cm ³
Tinggi	: 13 cm	Kadar Air Asal	: 20,17 %
Volume	: 3230,5 gram	Jumlah air Ditambah	: 539,992 gr
Berat RING	: 4540 gr		

Angka Dial Vertikal	Penetrasi		Pembacaan arloji	Beban (lb) (Pemb. Arloji x kalibrasi)
	mm	ΔL (inchi)		
a	$b = a \times 10^2$	$c = b \times 0,03937$	c	$d = c \times 5,497$
0	0	0,000	0	0
32	0,32	0,013	24	131,928
64	0,64	0,025	40	219,88
96	0,96	0,038	58	318,826
128	1,28	0,050	81	445,257
160	1,6	0,063	108	593,676
192	1,92	0,076	138	758,586
224	2,24	0,088	167	917,999
256	2,56	0,101	214	1176,358
288	2,88	0,113	263	1445,711
320	3,2	0,126	315	1731,555
352	3,52	0,139	362	1989,914
384	3,84	0,151	405	2226,285
416	4,16	0,164	443	2435,171
448	4,48	0,176	474	2605,578
480	4,8	0,189	500	2748,5
512	5,12	0,202	523	2874,931
544	5,44	0,214	540	2968,38
576	5,76	0,227	556	3056,332
608	6,08	0,239	570	3133,29
640	6,4	0,252	581	3193,757
672	6,72	0,265	590	3243,23
704	7,04	0,277	598	3287,206
736	7,36	0,290	608	3342,176
768	7,68	0,302	616	3386,152
800	8	0,315	624	3430,128
832	8,32	0,328	631	3468,607
864	8,64	0,340	639	3512,583



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896	8,96	0,353	646	3551,062
928	9,28	0,365	653	3589,541
960	9,6	0,378	659	3622,523
992	9,92	0,391	666	3661,002
1024	10,24	0,403	672	3693,984
1056	10,56	0,416	678	3726,966
1088	10,88	0,428	683	3754,451
1120	11,2	0,441	689	3787,433
1152	11,52	0,454	695	3820,415
1184	11,84	0,466	699	3842,403
1216	12,16	0,479	703	3864,391
1248	12,48	0,491	708	3891,876
1280	12,8	0,504	713	3919,361

Lampiran 32. Pengujian CBR (50% Limbah Keramik + 50% Semen) 7 Hari



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PENGUJIAN CBR

(50% LIMBAH KERAMIK + 50% SEMEN)

Waktu	: 7 hari	OMC	: 11,79 %
Diameter	: 15,214 cm	MDD	: 1,938 gr/cm ³
Tinggi	: 13 cm	Kadar Air Asal	: 20,17 %
Volume	: 3230,5 gram	Jumlah air Ditambah	: 539,992 gr
Berat RING	: 4540 gr		

Angka Dial Vertikal	Penetrasi		Pembacaan arloji	Beban (lb) (Pemb. Arloji x kalibrasi)
	mm	ΔL (inchi)		
a	$b = a \times 10^2$	$c = b \times 0,03937$	c	$d = c \times 5,497$
0	0	0,000	0	0
32	0,32	0,013	26	142,922
64	0,64	0,025	59	324,323
96	0,96	0,038	94	516,718
128	1,28	0,050	130	714,61
160	1,6	0,063	166	912,502
192	1,92	0,076	199	1093,903
224	2,24	0,088	230	1264,31
256	2,56	0,101	259	1423,723
288	2,88	0,113	286	1572,142
320	3,2	0,126	308	1693,076
352	3,52	0,139	328	1803,016
384	3,84	0,151	345	1896,465
416	4,16	0,164	359	1973,423
448	4,48	0,176	370	2033,89
480	4,8	0,189	381	2094,357
512	5,12	0,202	390	2143,83
544	5,44	0,214	398	2187,806
576	5,76	0,227	405	2226,285
608	6,08	0,239	413	2270,261
640	6,4	0,252	419	2303,243
672	6,72	0,265	425	2336,225
704	7,04	0,277	430	2363,71
736	7,36	0,290	436	2396,692
768	7,68	0,302	441	2424,177
800	8	0,315	447	2457,159
832	8,32	0,328	453	2490,141
864	8,64	0,340	457	2512,129



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896	8,96	0,353	463	2545,111
928	9,28	0,365	466	2561,602
960	9,6	0,378	471	2589,087
992	9,92	0,391	476	2616,572
1024	10,24	0,403	480	2638,56
1056	10,56	0,416	485	2666,045
1088	10,88	0,428	489	2688,033
1120	11,2	0,441	493	2710,021
1152	11,52	0,454	498	2737,506
1184	11,84	0,466	501	2753,997
1216	12,16	0,479	506	2781,482
1248	12,48	0,491	510	2803,47
1280	12,8	0,504	515	2830,955

Lampiran 33. Pengujian CBR (75% Limbah Keramik + 25% Semen) 7 Hari



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PENGUJIAN CBR

(75% LIMBAH KERAMIK + 25% SEMEN)

Waktu	: 7 hari	OMC	: 11,79 %
Diameter	: 15,214 cm	MDD	: 1,938 gr/cm ³
Tinggi	: 13 cm	Kadar Air Asal	: 20,17 %
Volume	: 3230,5 gram	Jumlah air Ditambah	: 539,992 gr
Berat RING	: 4540 gr		

Angka Dial Vertikal	Penetrasi		Pembacaan arloji	Beban (lb) (Pemb. Arloji x kalibrasi)
	mm	ΔL (inchi)		
a	$b = a \times 10^2$	$c = b \times 0,03937$	c	$d = c \times 5,497$
0	0	0,000	0	0
32	0,32	0,013	21	115,437
64	0,64	0,025	34	186,898
96	0,96	0,038	46	252,862
128	1,28	0,050	55	302,335
160	1,6	0,063	64	351,808
192	1,92	0,076	74	406,778
224	2,24	0,088	83	456,251
256	2,56	0,101	91	500,227
288	2,88	0,113	98	538,706
320	3,2	0,126	106	582,682
352	3,52	0,139	113	621,161
384	3,84	0,151	120	659,64
416	4,16	0,164	125	687,125
448	4,48	0,176	130	714,61
480	4,8	0,189	135	742,095
512	5,12	0,202	139	764,083
544	5,44	0,214	143	786,071
576	5,76	0,227	145	797,065
608	6,08	0,239	150	824,55
640	6,4	0,252	153	841,041
672	6,72	0,265	156	857,532
704	7,04	0,277	159	874,023
736	7,36	0,290	161	885,017
768	7,68	0,302	164	901,508
800	8	0,315	166	912,502
832	8,32	0,328	169	928,993



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864	8,64	0,340	171	939,987
896	8,96	0,353	174	956,478
928	9,28	0,365	176	967,472
960	9,6	0,378	178	978,466
992	9,92	0,391	181	994,957
1024	10,24	0,403	183	1005,951
1056	10,56	0,416	185	1016,945
1088	10,88	0,428	188	1033,436
1120	11,2	0,441	190	1044,43
1152	11,52	0,454	191	1049,927
1184	11,84	0,466	194	1066,418
1216	12,16	0,479	198	1088,406
1248	12,48	0,491	200	1099,4
1280	12,8	0,504	203	1115,891

Lampiran 34. Pengujian CBR (100% Limbah Keramik + 0% Semen) 7 Hari



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PENGUJIAN CBR

(100% LIMBAH KERAMIK + 0% SEMEN)

Waktu	: 7 hari	OMC	: 11,79 %
Diameter	: 15,214 cm	MDD	: 1,938 gr/cm ³
Tinggi	: 13 cm	Kadar Air Asal	: 20,17 %
Volume	: 3230,5 gram	Jumlah air Ditambah	: 539,992 gr
Berat RING	: 4540 gr		

Angka Dial Vertikal	Penetrasi		Pembacaan arloji	Beban (lb) (Pemb. Arloji x kalibrasi)
	mm	ΔL (inchi)		
a	$b = a \times 10^2$	$c = b \times 0,03937$	c	$d = c \times 5,497$
0	0	0,000	0	0
32	0,32	0,013	12	65,964
64	0,64	0,025	17	93,449
96	0,96	0,038	23	126,431
128	1,28	0,050	28	153,916
160	1,6	0,063	32	175,904
192	1,92	0,076	36	197,892
224	2,24	0,088	39	214,383
256	2,56	0,101	42	230,874
288	2,88	0,113	46	252,862
320	3,2	0,126	49	269,353
352	3,52	0,139	51	280,347
384	3,84	0,151	54	296,838
416	4,16	0,164	56	307,832
448	4,48	0,176	58	318,826
480	4,8	0,189	61	335,317
512	5,12	0,202	63	346,311
544	5,44	0,214	65	357,305
576	5,76	0,227	67	368,299
608	6,08	0,239	69	379,293
640	6,4	0,252	71	390,287
672	6,72	0,265	72	395,784
704	7,04	0,277	75	412,275
736	7,36	0,290	75,5	415,0235
768	7,68	0,302	77	423,269
800	8	0,315	79	434,263
832	8,32	0,328	81	445,257
864	8,64	0,340	82	450,754



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896	8,96	0,353	84	461,748
928	9,28	0,365	85	467,245
960	9,6	0,378	86,5	475,4905
992	9,92	0,391	88	483,736
1024	10,24	0,403	90	494,73
1056	10,56	0,416	91	500,227
1088	10,88	0,428	92,5	508,4725
1120	11,2	0,441	94	516,718
1152	11,52	0,454	95	522,215
1184	11,84	0,466	96	527,712
1216	12,16	0,479	97	533,209
1248	12,48	0,491	99	544,203
1280	12,8	0,504	101	555,197


Lampiran 35. Uji Kandungan Limbah Keramik



UPT LABORATORIUM

HASIL ANALISIS

NOMOR KODE LAB : LS.09.10.19/383
NAMA PEMOHON : Yohanes Marendra Christyosakti
ALAMAT PEMOHON : Universita Atma Jaya Yogyakarta
JENIS ANALISIS : Al₂O₃, SiO₃, CaO, dan Fe
JUMLAH SAMPEL : 3
TANGGAL MASUK : 9 Oktober 2019
TANGGAL PENGUJIAN : 13 Oktober-31 Oktober 2019

NO	Kode	Fe	Al ₂ O ₃	CaO	SiO ₃
	Sampel	Ekstrak HNO ₃ +HClO ₄			
		%			
1	Fly Ash UI 1	0,61	0,84	0,56	0,12
2	Fly Ash UI 2	0,60	0,82	0,55	0,11
3	Fly Ash UI 3	59,00	0,82	0,54	0,11

Yogyakarta, 1 November 2019
 Ka. Bag. Adm UPT Laboratorium

 Roostriyanti


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