

**LAMPIRAN**  
**LAMPIRAN 1 PEMERIKSAAN MATERIAL**  
**PEMERIKSAAN GRADASI BESAR AGREGAT HALUS**

**Daftar Ayakan**

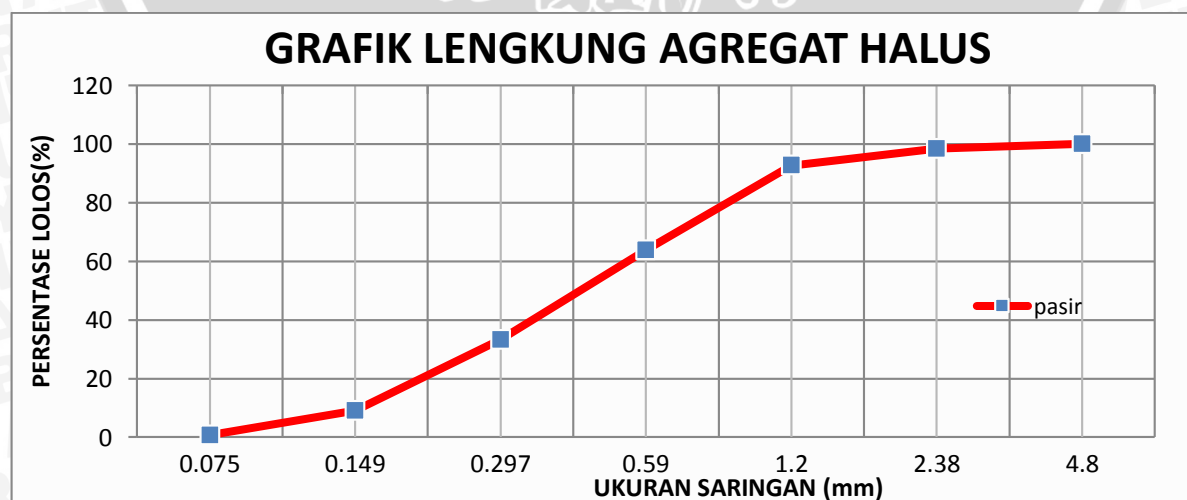
Ukuran Saringan		Tertahan		Komulatif	
no	mm	gram	(%)	Tertahan (%)	Lolos (%)
4		0	0	0	100
8		16.6	1.66299339	1.662993388	98.33700661
16		56.7	5.6802244	7.343217792	92.65678221
30		287.8	28.8318974	36.17511521	63.82488479
50		305.3	30.5850531	66.7601683	33.2398317
100		241.8	24.2236025	90.98377079	9.016229213
200		83.4	8.35503907	99.33880986	0.661190142
PAN		6.6	0.66119014		0
Total		998.2	100	302.2640753	

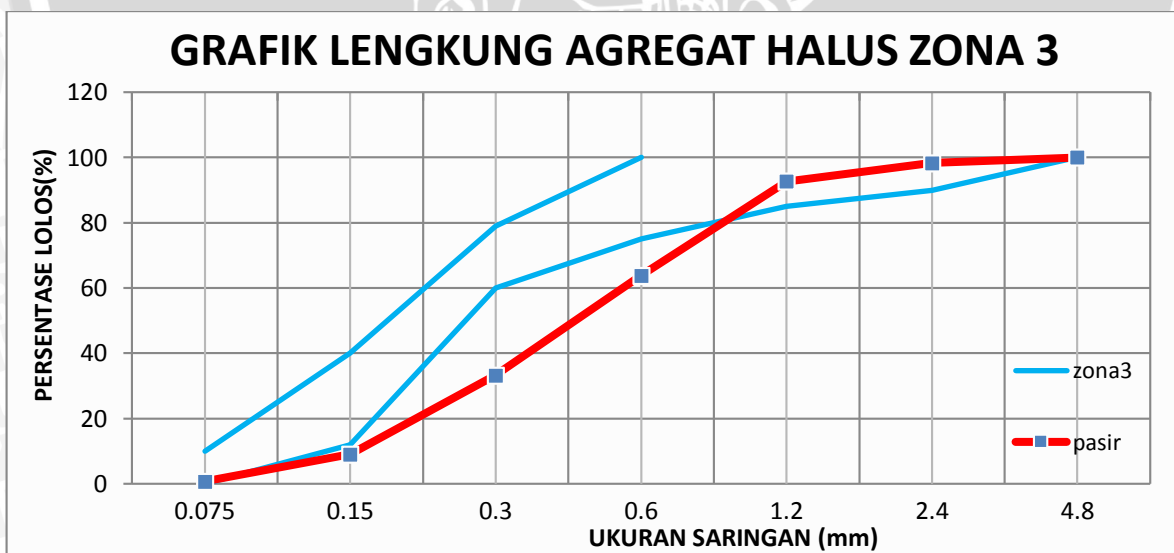
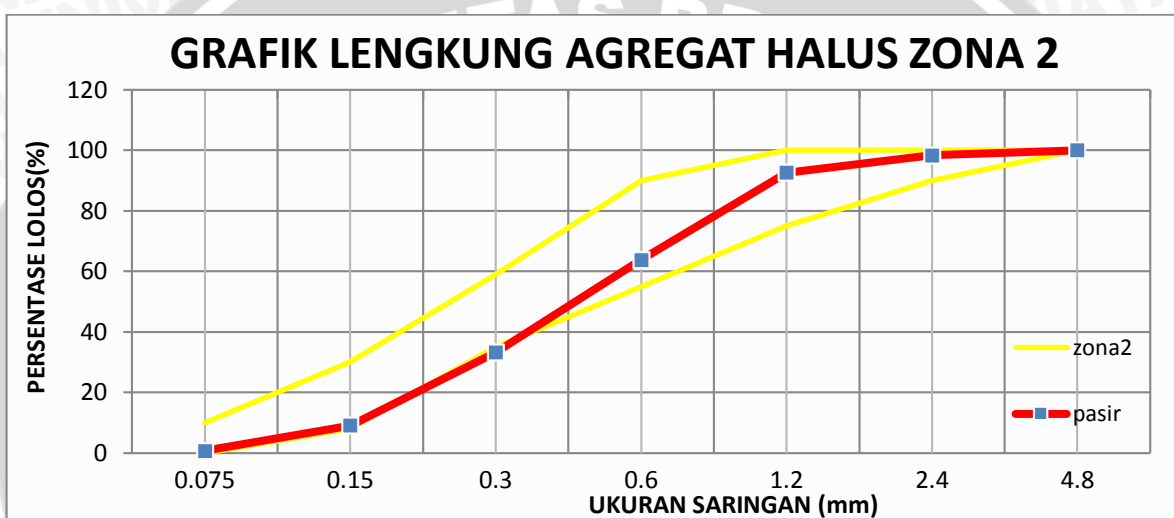
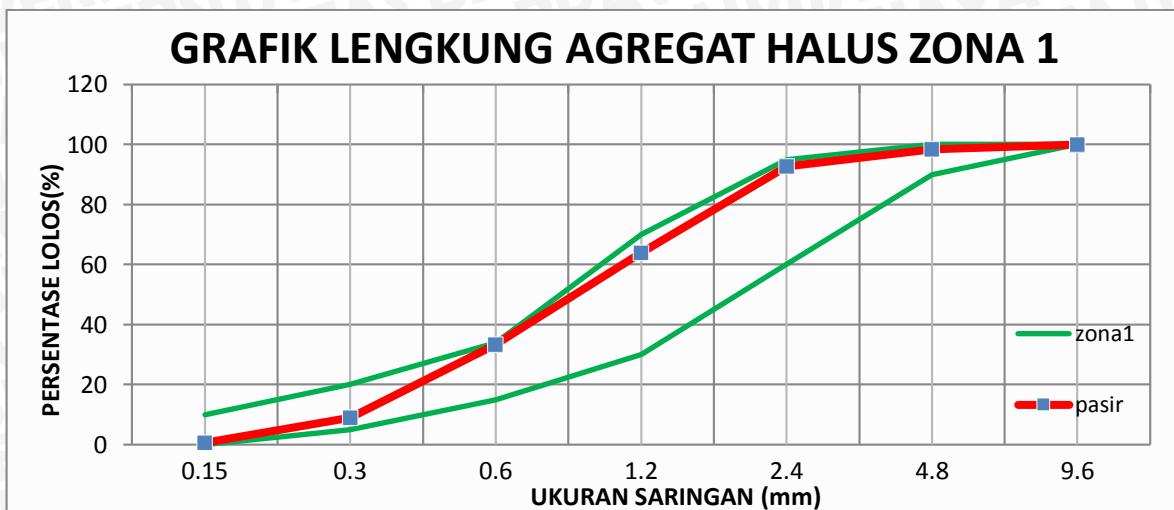
Agregat Halus yang diuji 1000 gram

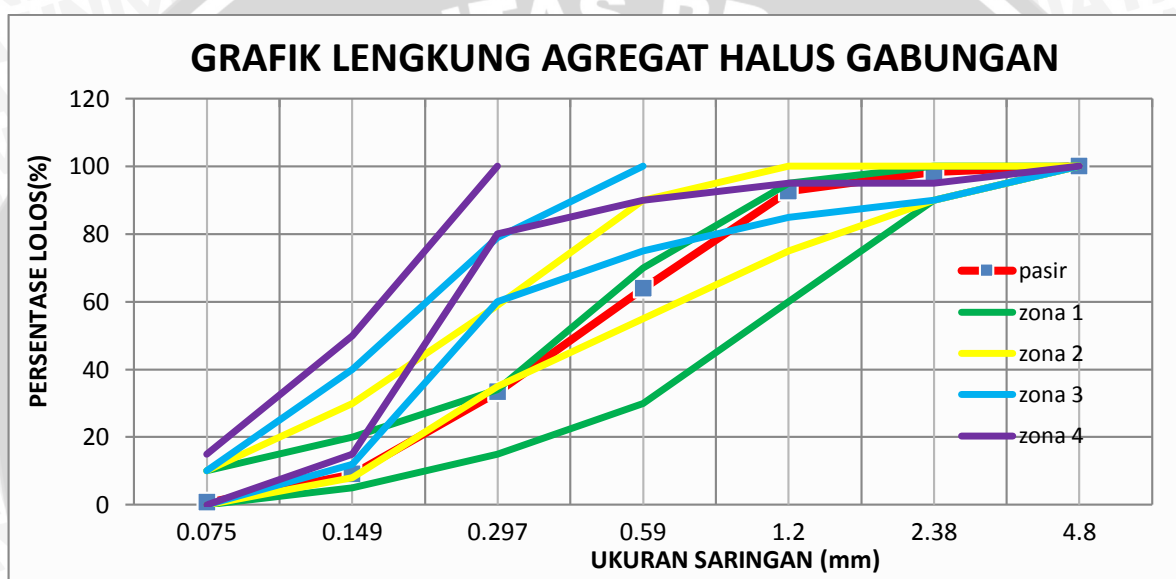
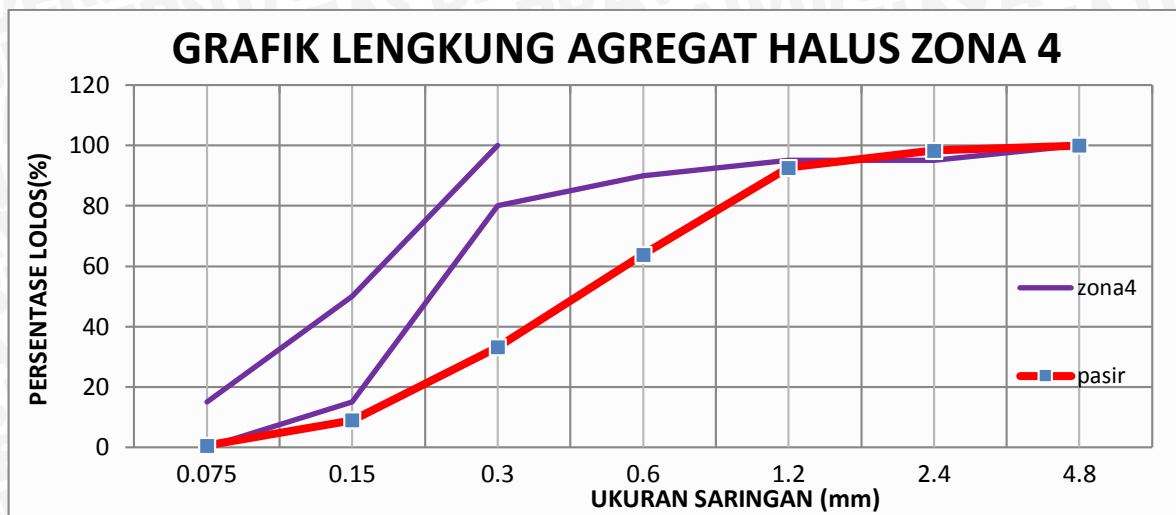
Kehilangan = 1000 gram – 998.2 gram  
 = 1,8 gram

Modulus halus pasir = 302,2640753 : 100  
 = 3,02

Dari grafik zone gradasi, dapat disimpulkan bahwa pasir benda uji termasuk dalam zone 1







## PEMERIKSAAN GRADASI BESAR AGREGAT KASAR

### Daftar Ayakan

Ukuran Saringan		Tertahan		Komulatif	
no	mm	gram	%	Tertahan (%)	Lolos (%)
1"		0	0	0.00	100.00
3/4"	19.1	28.8	0.57748992	0.58	99.42
1/2"	12.7	1460.2	29.2795412	29.86	70.14
3/8"	9.5	1390	27.8719095	57.73	42.27
4		2086.4	41.8359367	99.56	0.44
8		0	0	99.56	0.435122616
16		0	0	99.56	0.435122616
30		0	0	99.56	0.435122616
50		0	0	99.56	0.435122616
100		0	0	99.56	0.435122616
200		0	0	99.56	0.435122616
PAN		21.7	0		100.00
Total		4987.1		785.118	

Agregat kasar yang diuji 5000 gram

Kehilangan = 5000 gram – 4987.1 gram

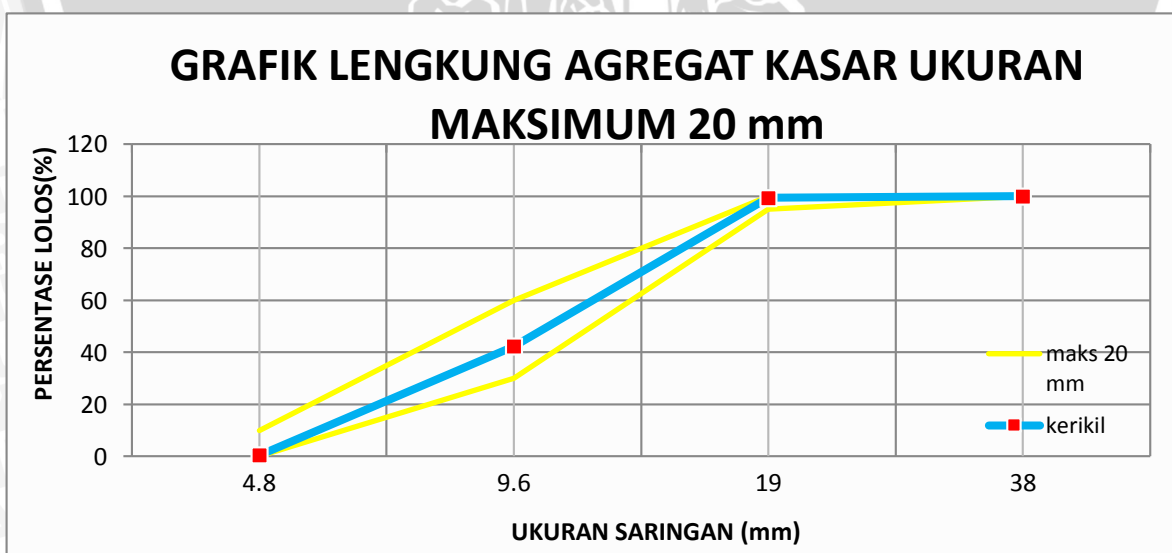
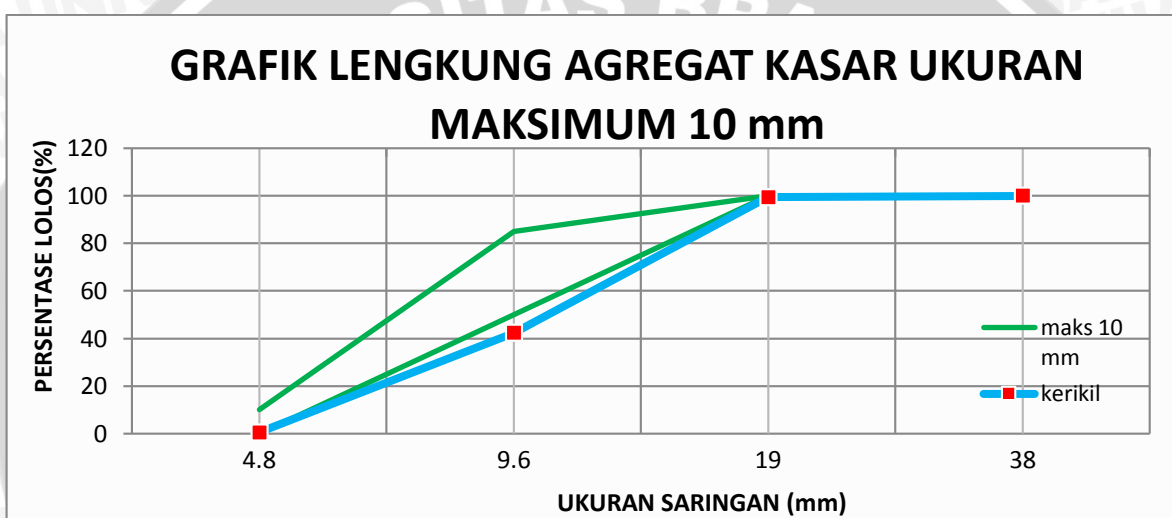
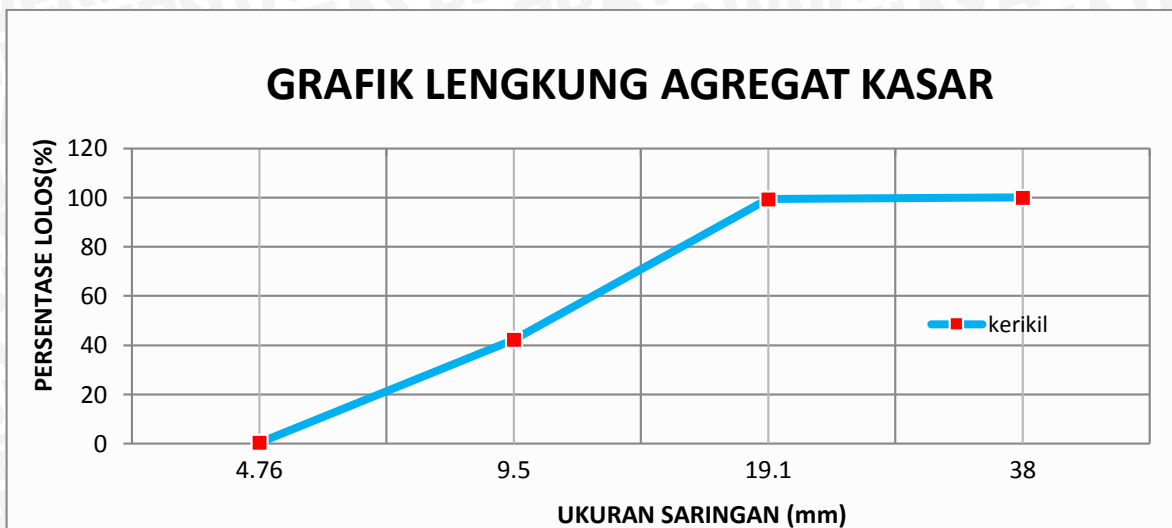
= 12,9 gram

Modulus kerikil = 785,118 : 100

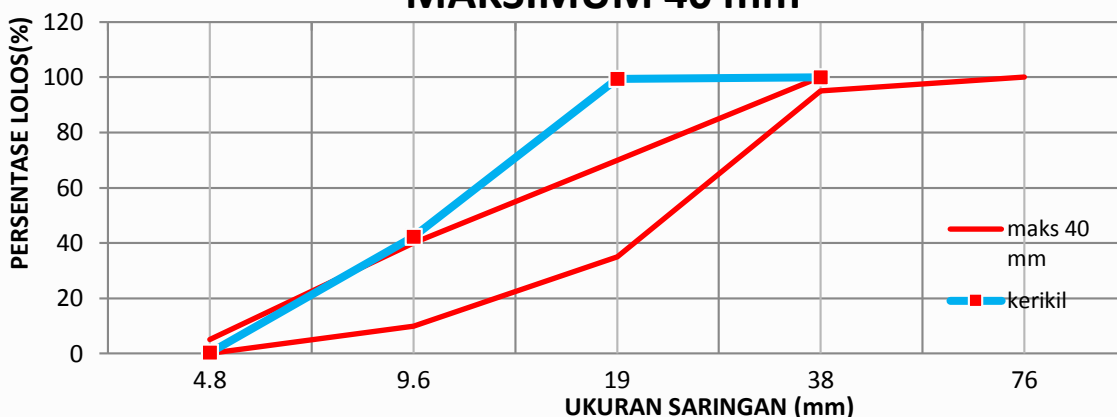
= 7,85

Dari grafik zone gradasi, dapat disimpulkan bahwa kerikil benda uji masuk dalam grafik lengkung agregat kasar ukuran maksimum 20 mm.

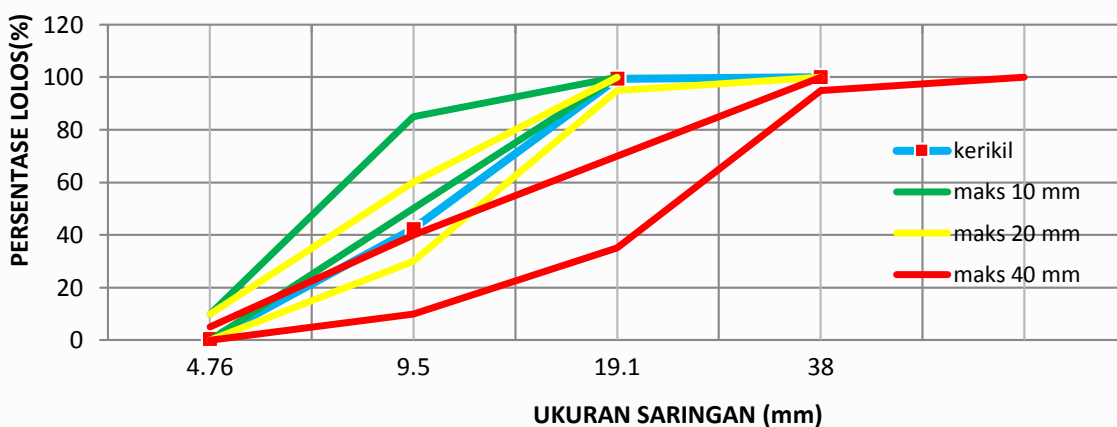




### GRAFIK LENGKUNG AGREGAT KASAR UKURAN MAKSIMUM 40 mm



### GRAFIK LENGKUNG AGREGAT KASAR GABUNGAN



## PEMERIKSAAN AIR AGREGAT HALUS DAN KASAR

### Analisis Kadar Air Agregat Halus

Nomor Talam			A	B
1	Berat talam + contoh basah	(gr)	51.9	51.4
2	berat talam + contoh kering	(gr)	51.7	51.2
3	Berat air =(1)-(2)	(gr)	0.2	0.2
4	Berat talam	(gr)	3.9	4.3
5	Berat contoh kering=(2)-(4)	(gr)	47.8	46.9
6	Kadar air =(3)/(5)	(%)	0.418	0.426
7	Kadar air rata - rata	(%)	0.422	

### Analisis Kadar Air Agregat Kasar

Nomor Talam			A	B
1	Berat talam + contoh basah	(gr)	39.5	47
2	berat talam + contoh kering	(gr)	38.2	45.1
3	Berat air =(1)-(2)	(gr)	1.3	1.9
4	Berat talam	(gr)	5	5.8
5	Berat contoh kering=(2)-(4)	(gr)	33.2	39.3
6	Kadar air =(3)/(5)	(%)	3.916	4.835
7	Kadar air rata - rata	(%)	4.375	

## PEMERIKSAAN BERAT ISI AGREGAT

### Pemeriksaan Berat Isi Agregat Halus

1	Berat takaran	(gr)	1060	
2	Berat takaran + air	(gr)	3000	
3	Berat air = (2)-(1)	(gr)	1940	
4	Voluke air = (3)/(1)	(cc)	1.830	
	<b>Cara</b>		<b>RODDED</b>	<b>SHOVELED</b>
5	Berat takaran	(gr)	1060	1060
6	Berat takaran + benda uji	(gr)	4360	3880
7	Berat benda uji =(6)-(5)	(gr)	3300	2820
8	Berat isi agregat halus =(7)/(4)	(gr/cc)	1803.1	1540.8
9	Berat isi agregat halus rata - rata	(gr/cc)	0.539	0.461

### Pemeriksaan Berat Isi Agregat Kasar

1	Berat takaran	(gr)	1060	
2	Berat takaran + air	(gr)	3000	
3	Berat air =(2)-(1)	(gr)	1940	
4	Voluke air = (3)/(1)	(cc)	1.830	
	<b>Cara</b>		<b>RODDED</b>	<b>SHOVELED</b>
5	Berat takaran	(gr)	1060	1060
6	Berat takaran + benda uji	(gr)	4160	3880
7	Berat benda uji =(6)-(5)	(gr)	3100	2820
8	Berat isi agregat kasar =(7)/(4)	(gr/cc)	1693.8	1540.8
9	Berat isi agregat kasar rata - rata	(gr/cc)	0.524	0.476



**PEMERIKSAAN BERAT JENIS DAN  
PENYERAPAN AGREGAT  
Berat Jenis dan Penyerapan Agregat Halus**

Nomor Contoh	A
Berat Benda Uji Kering Permukaan Jenuh (Bj)	500
Berat Benda Uji Kering Oven (Bk)	485.2
Berat Piknometer Diisi Air (B)	1350.6
Berat Piknometer + Benda Uji (SSD) + air (Bt)	1662.1

Nomor Contoh	A
Berat Jenis Curah $Bk/(B+500-Bt)$	2.574
Berat Jenis Kering Permukaan Jenuh $500/(B+500-Bt)$	2.652
Berat Jenis Semu $Bk/(B+Bk-Bt)$	2.793
Penyerapan (%) $(500-Bk)/Bk \times 100\%$	3.050

**Berat Jenis dan Penyerapan Agregat Kasar**

Nomor Contoh	A
Berat Benda Uji Kering Permukaan Jenuh (Bj)	5000
Berat Benda Uji Kering Oven (Bk)	4979.8
Berat Benda Uji Di Dalam Air (Ba)	3010

Nomor Contoh	A
Berat Jenis Curah $Bk/(Bj-Ba)$	2.502
Berat Jenis Kering Permukaan Jenuh $Bj/(Bj-Ba)$	2.513
Berat Jenis Semu $Bk/(Bk-Ba)$	2.528
Penyerapan (%) $(Bj-Bk)/Bk \times 100\%$	0.406

## LAMPIRAN 2 PERENCANAAN MIX DESIGN

No	Uraian	Tabel/Grafik Perhitungan	Nilai
1	Kuat tekan yang di isyaratkan (7 hari)	Ditetapkan	25 MPa
2	Nilai tambah(margin)	Diketahui	12 MPa
3	Kuat tekan rata - rata yang direncanakan	(1)+(2)	37 MPa
5	Jenis semen	Ditetapkan	Type 1
6	Jenis agregat : kasar	Ditetapkan	Batu pecah
	Jenis agregat : halus	Ditetapkan	Alami
7	Faktor Air Semen Bebas	Gmbr. 1	0.49
8	Faktor Air Semen Maksimum	Ditetapkan	0.6
9	Slump	Ditetapkan	60-180 mm
10	Ukuran agregat maksimum	Ditetapkan	20 mm
11	Kadar air bebas	Tabel 11 & Rumus Agrt. Gab	205 kg/m <sup>3</sup>
12	Kadar semen	(11)/(7)	418.16 kg/m <sup>3</sup>
13	Kadar semen maksimum	Ditetapkan	- kg/m <sup>3</sup>
14	Kadar semen minimum	Ditetapkan	275 kg/m <sup>3</sup>
15	Faktor air semen penyesuaian	-	-
16	Gradasi agregat halus	Tabel 13	Zona 1
17	Persen agregat halus	Gmbr. 3-5	60 %
18	Berat jenis relatif(SSD)	Diketahui	2.57 kg/m <sup>3</sup>
19	Berat isi beton	Grafik 16	2325 kg/m <sup>3</sup>
20	Kadar Agregat Gabungan	(19)-(12)-(11)	1701.94 kg/m <sup>3</sup>
21	Kadar Agregat Halus	(17)*(20)	1021.16 kg/m <sup>3</sup>
22	Kadar Agregat Kasar	(20)-(21)	680.77 kg/m <sup>3</sup>

Banyaknya Bahan	Semen kg	Air kg(lt)	Agregat Halus kg	Agregat Kasar kg	Jumlah
Tiap 1 m <sup>3</sup>	418.16	205	1021.16	680.77	2325
Proporsi (teoritis)	1	0.49	2.44	1.63	
Superplasticizer	1.50%				

## LAMPIRAN 3 DATA HASIL PENGUJIAN BALOK

### Balok Beton Normal-1 (BN-1)

NO	LOADCELL		TRANSDUSER			Retak
	BEBAN kg	CH1 mm	CH2 mm	CH3 mm	Lendutan mm	
1	0	0	0	0	0.000	
2	20	0	0.09	0.1	0.040	
3	40	0	0.16	0.18	0.070	
4	60	0.03	0.225	0.24	0.120	
5	80	0.05	0.265	0.28	0.150	
6	100	0.11	0.33	0.36	0.205	
7	120	0.18	0.405	0.43	0.280	
8	140	0.25	0.48	0.51	0.350	
9	160	0.32	0.565	0.59	0.430	
10	180	0.39	0.64	0.68	0.495	
11	200	0.46	0.74	0.76	0.590	
12	220	0.53	0.82	0.84	0.665	
13	240	0.61	0.91	0.92	0.755	
14	260	0.7	1.005	1	0.855	
15	280	0.84	1.145	1.13	1.000	
16	300	0.94	1.245	1.25	1.090	
17	320	1.06	1.365	1.37	1.210	
18	340	1.18	1.48	1.49	1.325	1
19	360	1.31	1.64	1.62	1.485	2
20	380	1.47	1.82	1.77	1.670	
21	400	1.55	1.94	1.88	1.775	
22	420	1.65	2.055	2	1.880	
23	440	1.75	2.17	2.12	1.985	
24	460	1.88	2.315	2.24	2.135	3
25	480	2	2.425	2.39	2.230	
26	500	2.14	2.58	2.5	2.400	4
27	520	2.25	2.72	2.65	2.520	5
28	540	2.38	2.87	2.75	2.685	6
29	560	2.49	2.975	2.87	2.785	7
30	580	2.62	3.145	3	2.955	8
31	600	2.76	3.275	3.12	3.095	
32	620	2.88	3.41	3.24	3.230	
33	640	3	3.525	3.37	3.340	9
34	660	3.15	3.67	3.52	3.485	
35	680	3.27	3.835	3.64	3.650	
36	700	3.4	3.98	3.78	3.790	
37	720	3.52	4.105	3.9	3.915	
38	740	3.65	4.24	4.02	4.055	
39	760	3.8	4.425	4.17	4.240	
40	780	3.92	4.59	4.3	4.400	
41	800	4.05	4.71	4.48	4.495	
42	820	4.21	4.89	4.59	4.700	
43	840	4.32	5.015	4.71	4.820	
44	860	4.46	5.15	4.84	4.960	
45	880	4.62	5.33	4.96	5.160	
46	900	4.75	5.465	5.07	5.305	
47	920	4.92	5.67	5.21	5.525	
48	940	5.15	5.92	5.42	5.785	
49	960	5.35	6.075	5.66	5.920	
50	952	7.52	7.9	7.97	7.675	
51	1035	8.6	10.525	8.8	10.425	10
52	1092	11.18	13.025	11.55	12.840	
53	1136	12.75	15.525	13.12	15.340	
54	1191	15.41	18.025	15.05	17.845	
55	1172	17.85	20.525	16.75	19.975	
56	1138	18.95	23.025	18.6	22.850	
57	1082	22.35	25.525	20.33	24.515	
58	1026	27.12	28.025	25.02	26.975	
59	982	29.73	30.525	28.05	29.685	
60	891	32.45	33.025	30.85	32.225	



## Balok Beton Normal-2 (BN-2)

NO	LOADCELL		TRANSDUSER			Retak
	BEBAN kg	CH1 mm	CH2 mm	CH3 mm	Lendutan mm	
1	0	0	0	0	0.000	
2	20	0	0.005	0.06	-0.025	
3	40	0	0.005	0.13	-0.060	
4	60	0	0.005	0.19	-0.090	
5	80	0	0.005	0.24	-0.115	
6	100	0.05	0.005	0.3	-0.120	
7	120	0.11	0.035	0.36	-0.090	
8	140	0.18	0.11	0.46	-0.030	
9	160	0.29	0.235	0.57	0.095	
10	180	0.31	0.275	0.6	0.130	
11	200	0.39	0.355	0.7	0.200	
12	220	0.45	0.44	0.75	0.290	
13	240	0.53	0.525	0.85	0.365	
14	260	0.63	0.63	0.94	0.475	
15	280	0.71	0.73	1.02	0.575	
16	300	0.81	0.835	1.11	0.685	
17	320	0.89	0.93	1.2	0.775	
18	340	0.99	1.05	1.33	0.880	
19	360	1.11	1.185	1.44	1.020	
20	380	1.21	1.295	1.54	1.130	
21	400	1.33	1.43	1.71	1.240	
22	420	1.43	1.555	1.79	1.375	
23	440	1.55	1.67	1.9	1.495	
24	460	1.86	1.795	2.02	1.715	1
25	480	1.89	1.95	2.15	1.820	2
26	500	1.9	2.04	2.34	1.820	3
27	520	2.02	2.185	2.38	2.005	4
28	540	2.11	2.305	2.48	2.120	5
29	560	2.26	2.45	2.66	2.250	6
30	580	2.37	2.605	2.73	2.425	7
31	600	2.46	2.705	2.84	2.515	8
32	620	2.59	2.84	2.98	2.645	9
33	640	2.71	2.97	3.11	2.770	
34	660	2.82	3.1	3.22	2.900	
35	680	2.93	3.235	3.35	3.025	
36	700	3.05	3.365	3.46	3.160	
37	720	3.18	3.495	3.59	3.290	
38	740	3.29	3.635	3.7	3.430	
39	760	3.4	3.76	3.82	3.550	
40	780	3.55	3.92	3.98	3.705	10
41	800	3.65	4.01	4.07	3.800	
42	820	3.72	4.115	4.17	3.890	
43	840	3.85	4.25	4.33	4.010	
44	860	3.98	4.395	4.42	4.175	11
45	880	4.11	4.54	4.55	4.320	12
46	900	4.35	4.81	4.8	4.585	
47	920	4.45	4.94	4.9	4.715	
48	940	4.55	5.055	5	4.830	
49	960	4.68	5.215	5.13	4.990	
50	980	4.81	5.35	5.29	5.110	
51	1000	5.01	5.545	5.44	5.330	
52	1002	5.15	5.8	5.6	5.575	
53	988	7.3	8.47	7.05	8.345	
54	1024	9.38	10.97	9.34	10.950	
55	1074	11.35	13.47	11.33	13.460	
56	1132	12.85	15.97	12.4	15.745	
57	1165	14.76	18.47	14.8	18.450	
58	1201	16.76	20.97	16.94	20.880	
59	1182	18.68	23.47	19.66	22.980	
60	1177	19.66	25.97	20.36	25.620	
61	1125	21.69	28.47	22.8	27.915	
62	1064	23.21	30.97	23.9	30.625	
63	963	24.56	33.47	27.52	31.990	



## Balok Beton Normal-3 (BN-3)

NO	LOADCELL		TRANSDUSER			Retak
	BEBAN kg	CH1 mm	CH2 mm	CH3 mm	Lendutan mm	
1	0	0	0	0	0.000	
2	20	0.13	0.145	0.12	0.140	
3	40	0.18	0.2	0.19	0.195	
4	60	0.25	0.26	0.25	0.260	
5	80	0.32	0.34	0.32	0.340	
6	100	0.39	0.4	0.39	0.400	
7	120	0.45	0.475	0.45	0.475	
8	140	0.52	0.565	0.54	0.555	
9	160	0.61	0.665	0.63	0.655	
10	180	0.71	0.775	0.75	0.755	
11	200	0.82	0.89	0.85	0.875	
12	220	0.9	0.995	0.96	0.965	
13	240	1.05	1.125	1.1	1.100	
14	260	1.12	1.225	1.2	1.185	
15	280	1.24	1.38	1.32	1.340	
16	300	1.38	1.525	1.45	1.490	
17	320	1.48	1.635	1.64	1.555	
18	340	1.62	1.805	1.77	1.730	
19	360	1.75	1.98	1.95	1.880	
20	380	1.88	2.09	2.09	1.985	1
21	400	2	2.23	2.22	2.120	2
22	420	2.14	2.4	2.44	2.250	
23	440	2.25	2.55	2.55	2.400	3
24	460	2.42	2.71	2.75	2.545	4
25	480	2.52	2.85	2.85	2.685	5
26	500	2.66	2.98	3	2.810	6
27	520	2.81	3.16	3.19	2.970	7
28	540	2.94	3.315	3.33	3.120	
29	560	3.09	3.45	3.47	3.260	
30	580	3.19	3.575	3.64	3.350	8
31	600	3.34	3.735	3.78	3.515	
32	620	3.45	3.895	3.9	3.670	
33	640	3.59	4.02	4.05	3.790	
34	660	3.73	4.18	4.22	3.935	9
35	680	3.86	4.355	4.35	4.110	
36	700	3.98	4.505	4.46	4.265	
37	720	4.1	4.645	4.6	4.395	
38	740	4.25	4.95	4.75	4.700	
39	760	4.37	4.97	4.95	4.680	
40	780	4.5	5.11	5.17	4.775	
41	800	4.65	5.31	5.35	4.960	
42	820	4.79	5.45	5.5	5.095	
43	840	4.92	5.62	5.67	5.245	
44	860	5.11	5.775	5.88	5.390	
45	880	5.24	5.96	6.04	5.560	
46	900	5.39	6.14	6.2	5.735	
47	920	5.56	6.355	6.45	5.910	
48	940	5.75	6.57	6.67	6.110	
49	960	6.25	7.175	7.55	6.525	
50	980	8.4	10.06	9.3	9.610	
51	1000	10.95	12.005	11.8	11.580	
52	1052	11.25	14.575	12.05	14.175	
53	1087	13.56	17.075	13.68	17.015	10
54	1156	15.82	19.575	15.06	19.195	
55	1198	18.1	22.075	17.25	21.650	11
56	1154	20.29	24.575	19.8	24.330	
57	1113	23.21	27.075	22.25	26.595	
58	1045	24.95	29.575	24.7	29.450	
59	983	26.69	32.075	26.9	31.970	

## Balok Beton SCC Zeolit Alam 5%-1 (ZA1-a)

NO	LOADCELL			TRANSDUSER		Retak
	BEBAN kg	CH1 mm	CH2 mm	CH3 mm	Lendutan mm	
1	0	0	0	0	0.000	
2	20	0.08	0.06	0.08	0.060	
3	40	0.12	0.125	0.14	0.115	
4	60	0.18	0.19	0.21	0.175	
5	80	0.25	0.27	0.29	0.250	
6	100	0.31	0.335	0.36	0.310	
7	120	0.38	0.41	0.43	0.385	
8	140	0.45	0.485	0.5	0.460	
9	160	0.51	0.57	0.59	0.530	
10	180	0.6	0.665	0.7	0.615	
11	200	0.69	0.75	0.78	0.705	
12	220	0.77	0.85	0.88	0.795	
13	240	0.86	0.965	0.98	0.905	
14	260	0.96	1.06	1.09	0.995	
15	280	1.08	1.19	1.23	1.115	
16	300	1.18	1.32	1.34	1.240	
17	320	1.28	1.445	1.53	1.320	
18	340	1.38	1.58	1.65	1.445	
19	360	1.5	1.7	1.79	1.555	
20	380	1.62	1.835	1.91	1.690	
21	400	1.75	1.985	2.05	1.835	1
22	420	1.85	2.1	2.2	1.925	2
23	440	1.99	2.25	2.33	2.080	3
24	460	2.06	2.355	2.44	2.165	4
25	480	2.21	2.525	2.59	2.335	5
26	500	2.33	2.655	2.72	2.460	6
27	520	2.44	2.77	2.82	2.580	7
28	540	2.59	2.925	2.99	2.725	8
29	560	2.69	3.085	3.2	2.830	9
30	580	2.82	3.21	3.25	2.995	
31	600	2.96	3.38	3.36	3.180	
32	620	3.06	3.505	3.5	3.285	
33	640	3.2	3.66	3.62	3.450	
34	660	3.31	3.79	3.74	3.575	
35	680	3.41	3.905	3.86	3.680	
36	700	3.58	4.08	4	3.870	
37	720	3.69	4.215	4.12	4.000	
38	740	3.81	4.355	4.25	4.135	
39	760	3.92	4.475	4.36	4.255	
40	780	4.05	4.61	4.47	4.400	
41	800	4.18	4.765	4.6	4.555	
42	820	4.31	4.9	4.75	4.680	
43	840	4.41	5.035	4.86	4.810	
44	860	4.55	5.195	4.98	4.980	10
45	880	4.69	5.36	5.12	5.145	
46	900	4.8	5.495	5.25	5.270	
47	920	4.98	5.665	5.44	5.435	
48	940	5.15	5.86	5.58	5.645	
49	960	5.25	6.02	5.72	5.785	
50	980	5.45	6.22	5.88	6.005	
51	1000	5.62	6.405	6.07	6.180	
52	1020	5.81	6.665	6.25	6.445	
53	1006	7.19	9.52	7.39	9.420	
54	1092	7.78	12.02	7.82	12.000	
55	1110	8.52	14.52	9.14	14.210	
56	1083	9.52	17.02	10.23	16.665	
57	1142	11.83	19.52	11.42	19.725	11
58	1175	13.41	22.02	14.75	21.350	
59	1195	13.75	24.52	16.38	23.205	
60	1219	15.75	27.02	18.41	25.690	
61	1205	17.85	29.52	20.62	28.135	
62	1187	19.87	32.02	22.04	30.935	
63	1143	20.99	34.52	25.1	32.465	
64	930	23.1	37.02	28.83	34.155	

## Balok Beton SCC Zeolit Alam 5%-2 (ZA1-b)

NO	LOADCELL		TRANSDUSER			Retak
	BEBAN kg	CH1 mm	CH2 mm	CH3 mm	Lendutan mm	
1	0	0	0	0	0.000	
2	20	0.06	0.07	0	0.040	
3	40	0.12	0.125	0	0.065	
4	60	0.14	0.175	0	0.105	
5	80	0.22	0.23	0	0.120	
6	100	0.27	0.295	0.08	0.200	
7	120	0.32	0.355	0.16	0.275	
8	140	0.37	0.41	0.19	0.320	
9	160	0.42	0.485	0.25	0.400	
10	180	0.48	0.55	0.34	0.480	
11	200	0.51	0.59	0.37	0.520	
12	220	0.56	0.655	0.41	0.580	
13	240	0.65	0.75	0.52	0.685	
14	260	0.71	0.82	0.59	0.760	
15	280	0.8	0.92	0.69	0.865	
16	300	0.9	1	0.81	0.955	
17	320	1	1.145	0.89	1.090	
18	340	1.08	1.235	1	1.195	
19	360	1.16	1.31	1.09	1.275	
20	380	1.25	1.42	1.19	1.390	
21	400	1.35	1.525	1.29	1.495	1
22	420	1.5	1.67	1.43	1.635	2
23	440	1.59	1.77	1.53	1.740	
24	460	1.68	1.875	1.63	1.850	3
25	480	1.79	1.995	1.75	1.975	
26	500	1.92	2.135	1.89	2.120	4
27	520	2.02	2.245	2	2.235	
28	540	2.12	2.37	2.12	2.370	5
29	560	2.24	2.5	2.23	2.495	6
30	580	2.35	2.61	2.36	2.605	
31	600	2.45	2.75	2.48	2.735	7
32	620	2.56	2.915	2.58	2.905	8
33	640	2.7	3	2.72	2.990	9
34	660	2.82	3.125	2.84	3.115	10
35	680	2.9	3.225	2.94	3.205	11
36	700	3.03	3.32	3.04	3.315	
37	720	3.15	3.475	3.17	3.465	
38	740	3.25	3.6	3.29	3.580	
39	760	3.39	3.73	3.4	3.725	
40	780	3.46	3.845	3.52	3.815	
41	800	3.61	3.975	3.64	3.960	
42	820	3.75	4.09	3.75	4.090	
43	840	3.85	4.21	3.86	4.205	
44	860	3.96	4.35	3.98	4.340	
45	880	4.08	4.495	4.1	4.485	
46	900	4.18	4.61	4.2	4.600	
47	920	4.32	4.745	4.32	4.745	
48	940	4.41	4.82	4.42	4.815	
49	960	4.52	4.955	4.52	4.955	
50	980	4.66	5.105	4.64	5.095	
51	1000	4.78	5.235	4.75	5.220	
52	1020	4.88	5.41	4.86	5.400	
53	1040	5.05	5.51	5	5.485	
54	1060	5.15	5.64	5.11	5.620	
55	1080	5.35	5.825	5.3	5.800	
56	1100	5.91	6.135	5.68	6.020	
57	1075	8.56	8.76	8.5	8.730	
58	1134	10.84	11.26	10.42	11.050	
59	1137	13	13.76	12.56	13.540	
60	1100	15.08	16.26	14.57	16.005	
61	1183	17.19	18.76	17.77	18.470	
62	1197	19.36	21.26	19.75	21.065	
63	1214	21.68	23.76	22.02	23.590	



64	1165	24.45	26.26	25.08	25.945
65	1089	27.25	28.76	27.27	28.750
66	1058	30.2	31.26	30.4	31.160
67	973	33.43	33.76	32.2	33.145
68	846	35.28	36.26	33.9	35.570

### Balok Beton SCC Zeolit Alam 5%-3 (ZA1-c)

NO	LOADCELL		TRANSDUSER			Retak
	BEBAN kg	CH1 mm	CH2 mm	CH3 mm	Lendutan mm	
1	0	0	0	0	0.000	
2	20	0.06	0.1	0.06	0.100	
3	40	0.11	0.155	0.11	0.155	
4	60	0.15	0.215	0.18	0.200	
5	80	0.22	0.29	0.26	0.270	
6	100	0.3	0.36	0.32	0.350	
7	120	0.36	0.435	0.39	0.420	
8	140	0.41	0.505	0.46	0.480	
9	160	0.49	0.575	0.53	0.555	
10	180	0.55	0.645	0.59	0.625	
11	200	0.62	0.72	0.68	0.690	
12	220	0.7	0.805	0.75	0.780	
13	240	0.78	0.895	0.84	0.865	
14	260	0.89	0.995	0.92	0.980	
15	280	0.98	1.095	1	1.085	
16	300	1.02	1.195	1.1	1.155	
17	320	1.16	1.315	1.2	1.295	
18	340	1.28	1.435	1.32	1.415	
19	360	1.38	1.55	1.42	1.530	
20	380	1.48	1.665	1.53	1.640	
21	400	1.6	1.785	1.65	1.760	1
22	420	1.7	1.895	1.76	1.865	2
23	440	1.8	2.01	1.88	1.970	3
24	460	1.91	2.13	1.97	2.100	4
25	480	2	2.245	2.06	2.215	5
26	500	2.1	2.33	2.19	2.285	6
27	520	2.22	2.44	2.3	2.400	
28	540	2.32	2.59	2.41	2.545	
29	560	2.43	2.695	2.51	2.655	7
30	580	2.54	2.83	2.65	2.775	
31	600	2.65	2.955	2.78	2.890	
32	620	2.76	3.095	2.88	3.035	8
33	640	2.86	3.165	2.98	3.105	
34	660	3	3.355	3.13	3.290	
35	680	3.1	3.47	3.22	3.410	
36	700	3.22	3.6	3.35	3.535	
37	720	3.36	3.72	3.46	3.670	
38	740	3.44	3.825	3.56	3.765	
39	760	3.55	3.915	3.67	3.855	
40	780	3.65	4.05	3.79	3.980	
41	800	3.75	4.175	3.89	4.105	
42	820	3.85	4.28	4	4.205	
43	840	3.98	4.435	4.11	4.370	
44	860	4.09	4.58	4.24	4.505	
45	880	4.19	4.685	4.35	4.605	
46	900	4.31	4.84	4.49	4.750	9
47	920	4.4	4.925	4.59	4.830	
48	940	4.52	5.045	4.7	4.955	10
49	960	4.65	5.22	4.84	5.125	11
50	980	4.79	5.35	4.96	5.265	12
51	1000	4.91	5.495	5.08	5.410	13
52	1020	5.05	5.675	5.22	5.590	
53	1040	5.18	5.8	5.35	5.715	
54	1060	5.32	5.955	5.55	5.840	
55	1080	5.52	6.195	5.72	6.095	
56	1043	6.1	6.79	6.16	6.760	



57	1121	8.61	9.3	8.93	9.140
58	1158	10.85	11.8	10.85	11.800
59	1186	13.15	14.3	13	14.225
60	1217	16.09	16.8	14.86	16.185
61	1186	19.62	19.3	17.7	18.340
62	1125	23.15	21.8	19.5	19.975
63	1103	25.29	24.3	21.26	22.285
64	1077	28.62	26.8	22.97	23.975
65	1062	31.9	29.3	24.77	25.735
66	1040	35.3	31.8	26.4	27.350
67	1014	35.8	34.3	28.65	30.725
68	894	36.25	36.8	31.08	34.215

### Balok Beton SCC Zeolit Alam 10%-1 (ZA2-a)

NO	LOADCELL		TRANSDUSER			Retak
	BEBAN kg	CH1 mm	CH2 mm	CH3 mm	Lendutan mm	
1	0	0	0	0	0.000	
2	20	0.05	0.05	0.06	0.045	
3	40	0.1	0.09	0.1	0.090	
4	60	0.14	0.13	0.15	0.125	
5	80	0.19	0.175	0.19	0.175	
6	100	0.22	0.22	0.23	0.215	
7	120	0.26	0.275	0.29	0.260	
8	140	0.3	0.325	0.34	0.305	
9	160	0.35	0.375	0.39	0.355	
10	180	0.4	0.435	0.44	0.415	
11	200	0.45	0.495	0.5	0.470	
12	220	0.5	0.56	0.55	0.535	
13	240	0.55	0.62	0.61	0.590	
14	260	0.6	0.675	0.64	0.655	
15	280	0.66	0.735	0.72	0.705	
16	300	0.71	0.8	0.78	0.765	
17	320	0.78	0.875	0.84	0.845	
18	340	0.85	0.945	0.9	0.920	
19	360	0.92	1.035	1	0.995	
20	380	0.98	1.12	1.07	1.075	
21	400	1.06	1.21	1.16	1.160	
22	420	1.18	1.32	1.26	1.280	
23	440	1.26	1.42	1.35	1.375	
24	460	1.34	1.495	1.43	1.450	
25	480	1.42	1.605	1.55	1.540	
26	500	1.54	1.72	1.65	1.665	
27	520	1.62	1.815	1.74	1.755	
28	540	1.74	1.945	1.86	1.885	
29	560	1.81	2.04	1.99	1.950	
30	580	1.94	2.155	2.1	2.075	
31	600	2.01	2.26	2.2	2.165	
32	620	2.09	2.325	2.3	2.220	
33	640	2.18	2.435	2.39	2.330	
34	660	2.28	2.56	2.54	2.430	
35	680	2.38	2.665	2.66	2.525	
36	700	2.5	2.79	2.75	2.665	
37	720	2.59	2.885	2.88	2.740	
38	740	2.68	2.985	2.96	2.845	
39	760	2.73	3.095	3.06	2.930	
40	780	2.86	3.205	3.16	3.055	
41	800	2.95	3.305	3.27	3.145	
42	820	3.04	3.415	3.35	3.260	
43	840	3.14	3.525	3.46	3.365	
44	860	3.24	3.645	3.56	3.485	
45	880	3.33	3.755	3.68	3.580	
46	900	3.43	3.885	3.8	3.700	
47	920	3.52	3.95	3.9	3.760	
48	940	3.61	4.055	3.99	3.865	
49	960	3.71	4.17	4.09	3.980	

50	980	3.82	4.295	4.22	4.095	
51	1000	3.9	4.4	4.31	4.195	
52	1020	4	4.525	4.41	4.320	
53	1040	4.1	4.635	4.51	4.430	1
54	1060	4.2	4.745	4.62	4.535	2
55	1080	4.31	4.87	4.74	4.655	3
56	1100	4.41	4.995	4.84	4.780	4
57	1120	4.51	5.12	5	4.875	
58	1140	4.67	5.295	5.12	5.070	5
59	1160	4.96	5.72	5.51	5.445	
60	1180	5.65	6.67	5.68	6.655	
61	1130	6.72	8.24	7.29	7.955	6
62	1192	7.77	9.675	7.8	9.660	
63	1100	8.74	11.175	8.43	11.330	
64	1100	9.15	12.675	9.86	12.320	
65	1118	11.18	14.175	10.51	13.840	
66	1120	12.6	15.675	12.71	15.620	
67	1124	13.95	17.175	13.94	17.170	
68	1120	15.26	18.675	15.1	18.595	
69	1185	16.6	20.175	16.28	20.015	
389	1195	17.83	21.675	17.5	21.510	
71	1200	18.98	23.175	18.68	23.025	
72	1205	20.1	24.675	20	24.625	7
73	1215	21.54	26.175	21.58	26.155	8
74	1225	22.78	27.675	23	27.565	
75	1230	23.98	29.175	24.4	28.965	9
76	1240	25.24	30.675	25.84	30.375	10
77	1248	26.36	32.175	27.12	31.795	
78	1254	27.59	33.675	27.5	33.630	
79	1260	28.81	35.175	28.95	35.105	
80	1265	30.08	36.675	29.36	36.315	
81	1275	31.4	38.175	31	37.975	11
82	1280	32.6	39.675	32.6	39.675	
83	1212	33.79	41.175	34.05	41.045	
84	1144	34.95	42.675	35.75	42.275	
85	1083	35.98	42.98	36.15	42.895	

### Balok Beton SCC Zeolit Alam 10%-2 (ZA2-b)

NO	LOADCELL		TRANSDUSER			Lendutan mm	Retak
	BEBAN kg	CH1 mm	CH2 mm	CH3 mm			
1	0	0	0	0	0.000		
2	20	0.03	0.03	0.02	0.025		
3	40	0.08	0.085	0.09	0.080		
4	60	0.14	0.145	0.15	0.140		
5	80	0.19	0.21	0.21	0.200		
6	100	0.22	0.255	0.26	0.235		
7	120	0.28	0.315	0.31	0.300		
8	140	0.33	0.36	0.37	0.340		
9	160	0.39	0.44	0.44	0.415		
10	180	0.45	0.49	0.51	0.460		
11	200	0.5	0.55	0.56	0.520		
12	220	0.57	0.625	0.64	0.590		
13	240	0.65	0.71	0.73	0.670		
14	260	0.71	0.8	0.81	0.750		
15	280	0.8	0.88	0.9	0.830		
16	300	0.88	0.98	0.98	0.930		
17	320	0.96	1.065	1.06	1.015		
18	340	1.05	1.17	1.16	1.115		
19	360	1.12	1.25	1.24	1.190		
20	380	1.24	1.37	1.37	1.305		
21	400	1.33	1.495	1.47	1.425		
22	420	1.45	1.615	1.59	1.545		
23	440	1.6	1.785	1.74	1.715		
24	460	1.66	1.85	1.81	1.775		
25	480	1.75	1.95	1.92	1.865		

26	500	1.85	2.085	2.04	1.990	
27	520	1.94	2.16	2.13	2.065	
28	540	2.03	2.25	2.24	2.145	1
29	560	2.1	2.36	2.34	2.240	
30	580	2.2	2.465	2.42	2.355	2.3
31	600	2.28	2.58	2.55	2.445	
32	620	2.39	2.675	2.65	2.545	4
33	640	2.51	2.825	2.76	2.700	
34	660	2.6	2.92	2.86	2.790	
35	680	2.71	3.035	2.95	2.915	5.6
36	700	2.82	3.175	3.09	3.040	7
37	720	2.9	3.275	3.16	3.145	
38	740	3	3.36	3.29	3.215	8
39	760	3.1	3.48	3.41	3.325	
40	780	3.22	3.62	3.52	3.470	
41	800	3.31	3.725	3.6	3.580	
42	820	3.41	3.825	3.71	3.675	
43	840	3.48	3.915	3.8	3.755	
44	860	3.64	4.075	3.95	3.920	
45	880	3.75	4.185	4.05	4.035	
46	900	3.82	4.305	4.14	4.145	
47	920	3.94	4.425	4.26	4.265	
48	940	4.04	4.525	4.37	4.360	
49	960	4.19	4.7	4.5	4.545	
50	980	4.3	4.82	4.6	4.670	
51	1000	4.4	4.92	4.7	4.770	
52	1020	4.51	5.06	4.82	4.905	
53	1040	4.64	5.2	4.94	5.050	
54	1060	4.8	5.38	5.1	5.230	
55	1080	5	5.595	5.29	5.450	
56	1100	5.19	5.8	5.47	5.660	
57	1015	5.92	6.825	6.08	6.745	
58	1050	7.4	8.325	7.1	8.175	
59	1082	8.68	9.825	8.4	9.685	
60	1103	10.13	11.325	9.72	11.120	
61	1127	11.7	12.825	11.05	12.500	
62	1102	12.64	14.325	12.03	14.020	
63	1085	14.2	15.825	13.94	15.695	
64	1150	15.36	17.325	15.32	17.305	
65	1198	17.52	18.825	16.66	18.395	
66	1219	18.6	20.325	18.1	20.075	
67	1244	19.92	21.825	19.8	21.765	
68	1268	20.9	23.325	21.11	23.220	
69	1269	22.41	24.825	23.12	24.470	
70	1266	23.18	26.325	23.22	26.305	
71	1257	24.44	27.825	24.7	27.695	
72	1256	25.55	29.325	26.34	28.930	
73	1221	26.83	30.825	28.14	30.170	
74	1223	27.9	32.325	29.55	31.500	
75	1200	29.18	33.825	31.12	32.855	
76	1182	30.33	35.325	32.69	34.145	
77	1009	31.34	36.825	34.9	35.045	

### Balok Beton SCC Zeolit Alam 10%-3 (ZA2-c)

NO	LOADCELL		TRANSDUSER			Retak
	BEBAN kg	CH1 mm	CH2 mm	CH3 mm	Lendutan mm	
1	0	0	0	0	0.000	
2	20	0	0.025	0	0.025	
3	40	0	0.075	0	0.075	
4	60	0	0.13	0.06	0.100	
5	80	0	0.175	0.11	0.120	
6	100	0.08	0.245	0.16	0.205	
7	120	0.1	0.295	0.24	0.225	
8	140	0.15	0.36	0.29	0.290	
9	160	0.21	0.42	0.36	0.345	



10	180	0.29	0.475	0.41	0.415	
11	200	0.35	0.55	0.49	0.480	
12	220	0.41	0.61	0.55	0.540	
13	240	0.49	0.695	0.62	0.630	
14	260	0.58	0.78	0.71	0.715	
15	280	0.64	0.865	0.79	0.790	
16	300	0.71	0.94	0.86	0.865	
17	320	0.8	1.035	0.95	0.960	
18	340	0.89	1.135	1.04	1.060	
19	360	0.96	1.22	1.15	1.125	
20	380	1.04	1.32	1.23	1.225	
21	400	1.14	1.425	1.34	1.325	
22	420	1.24	1.565	1.45	1.460	
23	440	1.34	1.705	1.58	1.585	
24	460	1.44	1.79	1.68	1.670	
25	480	1.51	1.895	1.79	1.755	
26	500	1.62	2.025	1.91	1.880	
27	520	1.72	2.13	2	1.990	1
28	540	1.83	2.24	2.13	2.090	2
29	560	1.94	2.37	2.24	2.220	3
30	580	2.05	2.53	2.35	2.380	4
31	600	2.14	2.625	2.45	2.470	
32	620	2.24	2.73	2.58	2.560	5
33	640	2.34	2.85	2.68	2.680	6
34	660	2.44	2.97	2.79	2.795	
35	680	2.54	3.105	2.88	2.935	
36	700	2.64	3.225	3	3.045	
37	720	2.74	3.325	3.1	3.145	
38	740	2.84	3.42	3.21	3.235	
39	760	2.96	3.54	3.35	3.345	
40	780	3.06	3.685	3.46	3.485	7
41	800	3.18	3.8	3.58	3.600	
42	820	3.28	3.915	3.68	3.715	
43	840	3.38	4.04	3.79	3.835	
44	860	3.48	4.17	3.92	3.950	
45	880	3.58	4.27	4.03	4.045	
46	900	3.68	4.38	4.14	4.150	
47	920	3.78	4.515	4.25	4.280	
48	940	3.94	4.66	4.41	4.425	
49	960	4.04	4.79	4.5	4.560	
50	980	4.18	4.935	4.65	4.700	
51	1000	4.3	5.075	4.74	4.855	
52	1020	4.4	5.185	4.89	4.940	
53	1040	4.54	5.33	5.04	5.080	
54	1060	4.7	5.525	5.18	5.285	
55	1080	4.85	5.7	5.35	5.450	8
56	1100	5.15	6.145	5.83	5.805	
57	1070	7.04	8.835	7.36	8.675	
58	1079	8.75	11.335	8.88	11.270	
59	1103	10.41	13.835	11.1	13.490	
60	1166	12.38	16.335	13.9	15.575	
61	1175	14.11	18.835	15	18.390	
62	1242	15.95	21.335	17.85	20.385	
63	1274	18.05	23.835	20.65	22.535	
64	1273	21.91	26.335	22.6	25.990	
65	1262	23.71	28.835	24.55	28.415	
66	1233	25.61	31.335	27.35	30.465	
67	1202	28.49	33.835	29.32	33.420	
68	1144	30.31	36.335	31.9	35.540	

### Balok Beton SCC Zeolit Alam 15%-1 (ZA3-a)

NO	LOADCELL		TRANSDUSER			Retak
	BEBAN	CHI	CH2	CH3	Lendutan	
	kg	mm	mm	mm	mm	
1	0	0	0	0	0.000	
2	10	0.04	0.01	0.03	0.005	



3	20	0.05	0.04	0.05	0.040	
4	30	0.08	0.075	0.09	0.070	
5	40	0.1	0.1	0.11	0.095	
6	50	0.12	0.125	0.14	0.115	
7	60	0.14	0.15	0.18	0.130	
8	70	0.18	0.18	0.2	0.170	
9	80	0.19	0.195	0.22	0.180	
10	90	0.19	0.21	0.24	0.185	
11	100	0.22	0.24	0.27	0.215	
12	110	0.24	0.26	0.3	0.230	
13	120	0.26	0.29	0.34	0.250	
14	130	0.29	0.325	0.37	0.285	
15	140	0.32	0.365	0.4	0.325	
16	150	0.35	0.39	0.43	0.350	
17	160	0.37	0.425	0.46	0.380	
18	170	0.4	0.45	0.49	0.405	
19	180	0.45	0.5	0.53	0.460	
20	190	0.48	0.52	0.56	0.480	
21	200	0.51	0.565	0.58	0.530	
22	210	0.53	0.58	0.63	0.530	
23	220	0.56	0.62	0.66	0.570	
24	230	0.59	0.655	0.7	0.600	
25	240	0.62	0.69	0.75	0.625	
26	250	0.66	0.735	0.79	0.670	
27	260	0.69	0.775	0.8	0.720	
28	270	0.74	0.805	0.88	0.735	
29	280	0.77	0.86	0.91	0.790	
30	290	0.79	0.895	0.98	0.800	
31	300	0.85	0.955	1.1	0.830	
32	310	0.89	0.985	1.16	0.850	
33	320	0.92	1.05	1.1	0.960	
34	330	0.94	1.075	1.13	0.980	
35	340	0.98	1.12	1.19	1.015	
36	350	1.03	1.185	1.23	1.085	
37	360	1.08	1.225	1.29	1.120	
38	370	1.11	1.285	1.32	1.180	
39	380	1.15	1.32	1.38	1.205	
40	390	1.2	1.385	1.44	1.265	
41	400	1.25	1.445	1.49	1.325	
42	410	1.28	1.495	1.54	1.365	
43	420	1.33	1.54	1.61	1.400	
44	430	1.38	1.605	1.65	1.470	
45	440	1.43	1.655	1.74	1.500	
46	450	1.48	1.705	1.78	1.555	
47	460	1.52	1.775	1.84	1.615	
48	470	1.58	1.845	1.89	1.690	
49	480	1.61	1.9	2	1.705	1
50	490	1.68	1.95	2.03	1.775	
51	500	1.72	2.02	2.09	1.835	2
52	510	1.81	2.12	2.14	1.955	3
53	520	1.84	2.165	2.19	1.990	4
54	530	1.89	2.23	2.27	2.040	
55	540	1.95	2.325	2.34	2.130	
56	550	2	2.38	2.4	2.180	
57	560	2.07	2.47	2.49	2.260	
58	570	2.12	2.53	2.56	2.310	
59	580	2.18	2.6	2.65	2.365	
60	590	2.25	2.675	2.7	2.450	
61	600	2.3	2.74	2.8	2.490	
62	610	2.36	2.825	3	2.505	5
63	620	2.54	3.045	3.05	2.790	
64	630	2.6	3.095	3.09	2.850	
65	640	2.62	3.14	3.17	2.865	6
66	650	2.69	3.225	3.22	2.960	
67	660	2.72	3.325	3.24	3.065	
68	670	2.75	3.37	3.31	3.090	
69	680	2.81	3.44	3.37	3.160	
70	690	2.85	3.52	3.45	3.220	

71	700	2.93	3.595	3.5	3.310	7
72	710	2.99	3.7	3.55	3.420	
73	720	3.08	3.76	3.65	3.475	
74	730	3.12	3.83	3.73	3.525	
75	740	3.21	3.91	3.78	3.625	
76	750	3.27	3.97	3.84	3.685	
77	760	3.32	4.06	3.9	3.770	
78	770	3.39	4.145	3.97	3.855	
79	780	3.45	4.21	4.03	3.920	
80	790	3.52	4.29	4.1	4.000	
81	800	3.59	4.37	4.2	4.065	8
82	810	3.65	4.455	4.26	4.150	
83	820	3.75	4.54	4.33	4.250	
84	830	3.8	4.62	4.39	4.325	9
85	840	3.88	4.69	4.46	4.400	10
86	850	3.93	4.76	4.5	4.475	
87	860	3.99	4.86	4.56	4.575	
88	870	4.09	4.935	4.65	4.655	11
89	880	4.16	5.025	4.73	4.740	
90	890	4.24	5.095	4.76	4.835	
91	900	4.33	5.175	4.83	4.925	
92	910	4.39	5.24	4.88	4.995	
93	920	4.49	5.325	4.94	5.100	
94	930	4.52	5.4	5.02	5.150	
95	940	4.58	5.535	5.12	5.265	
96	950	4.69	5.675	5.22	5.410	
97	960	4.7	5.815	5.32	5.505	
98	970	4.89	5.98	5.46	5.695	
99	980	5.03	6.175	5.65	5.865	
100	990	5.19	6.78	6.15	6.300	
101	1000	5.35	7.81	7	6.985	
102	1010	5.47	9.16	8.15	7.820	
103	986	6.83	10.925	9.5	9.590	
104	1075	7.11	13.425	10.8	11.580	12
105	1102	8.32	15.925	12.85	13.660	13
106	1146	9.65	18.425	13.1	16.700	
107	1198	10.69	20.925	14.15	19.195	
108	1233	11.3	23.425	14.25	21.950	
109	1253	12.68	25.925	20.05	22.240	
110	1252	14.43	28.425	20.35	25.465	
111	1247	15.43	30.925	23.65	26.815	
112	1246	18.53	33.425	26.05	29.665	
113	1239	20.03	35.925	26.87	32.505	
114	1207	20.93	38.425	27.9	34.940	
115	1184	25.74	40.925	31.4	38.095	
116	1104	33.45	43.425	37.25	41.525	

### Balok Beton SCC Zeolit Alam 15%-2 (ZA3-b)

NO	LOADCELL		TRANSDUSER			Retak
	BEBAN kg	CH1 mm	CH2 mm	CH3 mm	Lendutan mm	
1	0	0	0	0	0.000	
2	10	0.03	0.035	0.03	0.035	
3	20	0.06	0.06	0.06	0.060	
4	30	0.08	0.085	0.08	0.085	
5	40	0.11	0.115	0.11	0.115	
6	50	0.13	0.14	0.13	0.140	
7	60	0.14	0.155	0.15	0.150	
8	70	0.17	0.19	0.18	0.185	
9	80	0.19	0.21	0.19	0.210	
10	90	0.21	0.245	0.24	0.230	
11	100	0.25	0.27	0.26	0.265	
12	110	0.27	0.295	0.28	0.290	
13	120	0.29	0.315	0.31	0.305	
14	130	0.32	0.345	0.34	0.335	
15	140	0.35	0.38	0.36	0.375	

16	150	0.37	0.405	0.4	0.390	
17	160	0.4	0.435	0.44	0.415	
18	170	0.42	0.475	0.45	0.460	
19	180	0.46	0.52	0.5	0.500	
20	190	0.49	0.54	0.53	0.520	
21	200	0.51	0.565	0.55	0.545	
22	210	0.54	0.595	0.59	0.570	
23	220	0.56	0.635	0.62	0.605	
24	230	0.59	0.65	0.64	0.625	
25	240	0.61	0.695	0.67	0.665	
26	250	0.65	0.73	0.71	0.700	
27	260	0.66	0.74	0.73	0.705	
28	270	0.7	0.795	0.78	0.755	
29	280	0.74	0.83	0.82	0.790	
30	290	0.78	0.87	0.85	0.835	
31	300	0.8	0.9	0.89	0.855	
32	310	0.84	0.95	0.95	0.895	
33	320	0.88	1.02	1	0.960	
34	330	0.93	1.05	1.04	0.995	
35	340	0.96	1.09	1.08	1.030	
36	350	1	1.135	1.14	1.065	
37	360	1.08	1.215	1.19	1.160	
38	370	1.11	1.265	1.24	1.200	
39	380	1.14	1.3	1.28	1.230	
40	390	1.18	1.365	1.34	1.285	
41	400	1.22	1.405	1.37	1.330	
42	410	1.28	1.465	1.45	1.380	
43	420	1.35	1.525	1.5	1.450	
44	430	1.38	1.58	1.55	1.495	
45	440	1.44	1.655	1.62	1.565	
46	450	1.51	1.745	1.69	1.655	
47	460	1.57	1.8	1.75	1.710	
48	470	1.61	1.9	1.8	1.805	
49	480	1.68	1.93	1.86	1.840	
50	490	1.69	1.955	1.94	1.830	
51	500	1.78	2.065	2	1.955	
52	510	1.86	2.13	2.08	2.020	
53	520	1.91	2.21	2.13	2.100	1
54	530	1.94	2.285	2.2	2.155	2
55	540	2.08	2.39	2.32	2.270	3
56	550	2.11	2.435	2.39	2.295	4
57	560	2.19	2.535	2.47	2.395	
58	570	2.24	2.59	2.51	2.455	5
59	580	2.31	2.69	2.63	2.530	
60	590	2.4	2.78	2.71	2.625	
61	600	2.43	2.84	2.75	2.680	6
62	610	2.5	2.915	2.81	2.760	
63	620	2.55	2.95	2.86	2.795	
64	630	2.62	3.055	2.96	2.885	
65	640	2.7	3.145	3.05	2.970	
66	650	2.77	3.215	3.11	3.045	
67	660	2.88	3.32	3.21	3.155	
68	670	2.92	3.395	3.27	3.220	
69	680	3.03	3.505	3.37	3.335	
70	690	3.08	3.56	3.44	3.380	
71	700	3.19	3.66	3.52	3.495	
72	710	3.25	3.745	3.61	3.565	7
73	720	3.3	3.805	3.61	3.650	8
74	730	3.41	3.92	3.75	3.750	
75	740	3.48	4.01	3.8	3.850	9
76	750	3.55	4.05	3.9	3.875	
77	760	3.6	4.14	3.96	3.960	
78	770	3.66	4.165	4.02	3.985	
79	780	3.71	4.27	4.09	4.080	
80	790	3.79	4.35	4.15	4.170	
81	800	3.85	4.42	4.24	4.225	
82	810	3.95	4.52	4.3	4.345	
83	820	4	4.585	4.36	4.405	



84	830	4.1	4.685	4.44	4.515	
85	840	4.14	4.745	4.5	4.565	
86	850	4.24	4.805	4.59	4.630	
87	860	4.31	4.92	4.63	4.760	
88	870	4.36	4.98	4.71	4.805	
89	880	4.41	5.06	4.76	4.885	
90	890	4.51	5.155	4.84	4.990	10
91	900	4.58	5.19	4.92	5.020	
92	910	4.65	5.305	5	5.130	
93	920	4.69	5.355	5.05	5.175	
94	930	4.8	5.505	5.16	5.325	
95	940	4.91	5.605	5.24	5.440	
96	950	4.99	5.69	5.29	5.540	
97	960	5.05	5.775	5.39	5.605	
98	970	5.13	5.865	5.5	5.680	
99	980	5.25	5.995	5.59	5.825	11
100	990	6.25	7.41	5.84	7.205	
101	1000	6.9	8.325	6.6	8.175	
102	955	7.58	9.005	7.25	8.840	
103	970	7.85	9.505	7.5	9.330	
104	990	8.24	10.005	7.84	9.805	
105	990	8.65	10.505	8.19	10.275	
106	1003	9.04	11.005	8.57	10.770	
107	1009	9.44	11.505	8.92	11.245	
108	1014	9.82	12.005	9.35	11.770	
109	1013	10.16	12.505	9.78	12.315	
110	1015	10.44	13.005	10.2	12.885	
111	1023	10.76	13.505	10.6	13.425	
112	1023	11.08	14.005	10.96	13.945	
113	1030	11.45	14.505	11.4	14.480	
114	1036	11.78	15.005	11.86	14.965	
115	1038	12.13	15.505	12.35	15.395	
116	1043	12.47	16.005	12.85	15.815	
117	1051	12.83	16.505	13.37	16.235	
118	1057	13.25	17.005	13.85	16.705	
119	1061	13.56	17.505	14.23	17.170	
120	1059	13.92	18.005	15.72	17.105	
121	1067	14.3	18.505	15.18	18.065	
122	1079	14.7	19.005	15.63	18.540	
123	1087	15.06	19.505	16.07	19.000	
124	1088	15.44	20.005	16.54	19.455	
125	1093	15.81	20.505	17.02	19.900	
126	1092	16.17	21.005	17.42	20.380	
127	1104	16.61	21.505	17.94	20.840	
128	1106	16.92	22.005	18.3	21.315	
129	1111	17.36	22.505	18.75	21.810	
130	1088	17.92	23.005	19.14	22.395	
131	1093	18.54	23.505	19.52	23.015	
132	1099	19.08	24.005	19.88	23.605	
133	1094	19.68	24.505	20.27	24.210	
134	1116	20.28	25.005	20.69	24.800	
135	1108	20.9	25.505	21.06	25.425	
136	1132	21.45	27.005	21.35	26.955	
137	1141	22.72	28.505	22.82	28.455	
138	1160	24.05	30.005	24.29	29.885	
139	1175	25.23	31.505	25.55	31.345	
140	1182	26.62	33.005	26.88	32.875	
141	1187	27.94	34.505	28.35	34.300	
142	1199	29.25	36.005	28.73	35.745	
143	1207	30.64	37.505	30.15	37.260	
144	1212	31.99	39.005	30.5	38.260	
145	1229	33.28	40.505	30.9	39.315	
146	1236	34.68	42.005	31.3	40.315	
147	1249	36.09	43.505	31.65	41.285	
148	1242	37.42	45.005	31.92	42.255	
149	1236	38.72	46.505	33.4	43.845	
150	1224	41.02	48.005	34.77	44.880	
151	1212	42.35	49.505	35.14	45.900	



### Balok Beton SCC Zeolit Alam 15%-3 (ZA3-c)

NO	LOADCELL		TRANSDUSER			Retak
	BEBAN kg	CH1 mm	CH2 mm	CH3 mm	Lendutan mm	
1	0	0	0	0	0.000	
2	20	0.04	0.055	0.05	0.050	
3	40	0.08	0.11	0.1	0.100	
4	60	0.12	0.16	0.15	0.145	
5	80	0.18	0.21	0.2	0.200	
6	100	0.22	0.26	0.25	0.245	
7	120	0.28	0.31	0.31	0.295	
8	140	0.33	0.37	0.36	0.355	
9	160	0.38	0.44	0.42	0.420	
10	180	0.43	0.485	0.46	0.470	
11	200	0.48	0.535	0.52	0.515	
12	220	0.53	0.59	0.58	0.565	
13	240	0.58	0.665	0.64	0.635	
14	260	0.64	0.72	0.69	0.695	
15	280	0.7	0.8	0.76	0.770	
16	300	0.76	0.87	0.82	0.840	
17	320	0.82	0.93	0.89	0.895	
18	340	0.9	1.01	0.96	0.980	
19	360	0.95	1.085	1.04	1.040	
20	380	1.01	1.15	1.1	1.105	
21	400	1.08	1.225	1.16	1.185	
22	420	1.16	1.325	1.27	1.270	
23	440	1.24	1.405	1.34	1.355	
24	460	1.3	1.47	1.4	1.420	
25	480	1.4	1.585	1.52	1.525	
26	500	1.46	1.67	1.57	1.615	
27	520	1.55	1.775	1.68	1.710	
28	540	1.64	1.865	1.78	1.795	
29	560	1.75	1.99	1.89	1.920	
30	580	1.89	2.11	2.05	2.030	
31	600	1.99	2.26	2.18	2.165	
32	620	2.1	2.395	2.26	2.315	
33	640	2.2	2.525	2.42	2.415	
34	660	2.32	2.65	2.52	2.550	
35	680	2.44	2.79	2.64	2.690	
36	700	2.62	2.95	2.8	2.860	
37	720	2.69	3.095	2.94	2.970	
38	740	2.8	3.225	3.05	3.100	
39	760	2.92	3.33	3.25	3.165	
40	780	3.1	3.49	3.34	3.370	
41	800	3.15	3.605	3.42	3.470	
42	820	3.3	3.755	3.56	3.625	
43	840	3.41	3.87	3.66	3.745	
44	860	3.55	4.005	3.76	3.900	
45	880	3.64	4.11	3.9	3.980	
46	900	3.75	4.235	4.05	4.085	
47	920	3.85	4.4	4.16	4.245	
48	940	3.95	4.495	4.25	4.345	
49	960	4.11	4.665	4.41	4.515	
50	980	4.25	4.805	4.53	4.665	
51	1000	4.38	4.98	4.66	4.840	
52	1020	4.52	5.15	4.82	5.000	
53	1040	4.69	5.305	4.98	5.160	1
54	1060	4.91	5.555	5.24	5.390	2
55	1022	5.75	6.605	6.1	6.430	3
56	1091	6.8	7.94	7.45	7.615	4
57	1103	7.6	8.94	8.36	8.560	
58	1114	8.35	9.94	9.29	9.470	5
59	1104	9.11	10.94	10.22	10.385	
60	1135	9.96	11.94	11.1	11.370	
61	1123	10.75	12.94	11.98	12.325	6
62	1157	11.64	13.94	12.62	13.450	
63	1163	11.96	14.94	12.68	14.580	

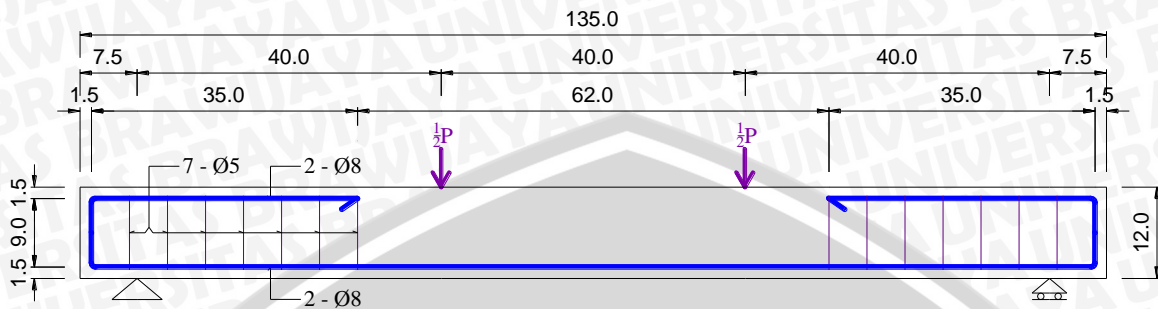
64	1137	12.81	15.94	13.58	15.555	
65	1157	13.64	16.94	14.48	16.520	
66	1156	14.44	17.94	15.44	17.440	
67	1189	15.31	18.94	16.34	18.425	
68	1197	16.2	19.94	17.15	19.465	
69	1205	17.09	20.94	18.04	20.465	
389	1219	17.96	21.94	18.9	21.470	
71	1232	18.8	22.94	19.78	22.450	
72	1234	19.98	24.44	21.25	23.805	7
73	1248	21.14	25.94	22.65	25.185	8
74	1263	22.19	27.44	23.36	26.855	
75	1251	22.33	28.94	23.73	28.240	9
76	1247	24.34	30.44	25.16	30.030	
77	1251	25.54	31.94	25.7	31.860	
78	1248	26.63	33.44	27.05	33.230	
79	1239	28.15	34.94	28.29	34.870	
80	1232	29.41	36.44	29.73	36.280	
81	1233	30.52	37.94	31.04	37.680	
82	1235	31.74	39.44	32.63	38.995	
83	1204	32.95	40.94	33.19	40.820	
84	1176	34.33	42.44	34.18	42.515	
85	1117	35.01	43.94	35.68	43.605	
86	1084	36.18	45.44	36.23	45.415	
87	1067	37.22	46.94	37.52	46.790	
88	1039	38.35	48.44	38.93	48.150	



## LAMPIRAN 4 PERHITUNGAN TEORITIS BEBAN ULTIMIT

### Beban Ultimit Balok Beton Normal

#### Analisis Momen Nominal ( $M_n$ )



$$b = 8 \text{ cm} = 80 \text{ mm}$$

$$h = 12 \text{ cm} = 120 \text{ mm}$$

$$d' = 1,5 \text{ cm} = 15 \text{ mm}$$

$$d = h - d' = 12 - 1,5 = 10,5 \text{ cm} = 105 \text{ mm}$$

$$f'c = 255,4 \text{ kg/cm}^2 = 25,54 \text{ Mpa}$$

$$f_y = 2400 \text{ kg/cm}^2 = 240 \text{ Mpa}$$

$$A_{s \text{ min}} = \frac{1,4 \times b \times d}{f_y} = \frac{1,4 \times 80 \times 105}{240} = 49 \text{ mm}^2 = 0,49 \text{ cm}^2$$

Maka digunakan tulangan 2 - Ø8 dengan  $A_s = 1,01 \text{ cm}^2$

$$a = \frac{A_s \times f_y}{0,85 \times f'c \times b} = \frac{1,01 \times 2400}{0,85 \times 255,4 \times 8} = 1,39 \text{ cm}$$

$$T = A_s \times f_y = 1,01 \times 2400 = 2424 \text{ kg}$$

$$z = d - \frac{1}{2} a = 10,5 - \frac{1}{2} 1,39 = 9,8 \text{ cm}$$

$$M_n = T \times z = 2424 \times 9,8 = 23760 \text{ kgcm} = 237,60 \text{ kgm}$$

#### Analisis Beban Maksimum

$$R_A = \frac{1}{2} P = v$$

$$M_n = (R_A \times L)$$

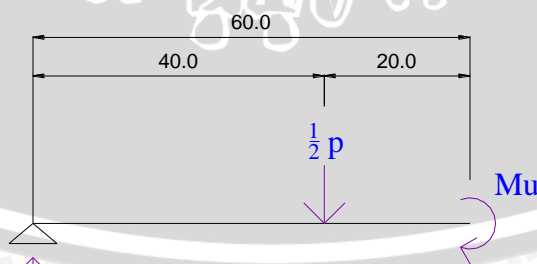
$$237,60 = \frac{1}{2} P \times 0,4$$

$$237,55 = 0,20 P$$

$$P = \frac{237,60}{0,20}$$

$$P = 1188,02 \text{ kg}$$

$$R_A = \frac{1}{2} p$$





### Beban Ultimit Balok SCC Zeolit Alam 5%

#### Analisis Momen Nominal ( $M_n$ )

$$b = 8 \text{ cm} = 80 \text{ mm}$$

$$h = 12 \text{ cm} = 120 \text{ mm}$$

$$d' = 1,5 \text{ cm} = 15 \text{ mm}$$

$$d = h - d' = 12 - 1,5 = 10,5 \text{ cm} = 105 \text{ mm}$$

$$f'c = 260,1 \text{ kg/cm}^2 = 26,01 \text{ Mpa}$$

$$f_y = 2400 \text{ kg/cm}^2 = 240 \text{ Mpa}$$

$$A_s \text{ min} = \frac{1,4 \times b \times d}{f_y} = \frac{1,4 \times 80 \times 105}{240} = 49 \text{ mm}^2 = 0,49 \text{ cm}^2$$

Maka digunakan tulangan 2 -  $\varnothing 8$  dengan  $A_s = 1,01 \text{ cm}^2$

$$a = \frac{A_s \times f_y}{0,85 \times f'c \times b} = \frac{1,01 \times 2400}{0,85 \times 260,1 \times 8} = 1,37 \text{ cm}$$

$$T = A_s \times f_y = 1,01 \times 2400 = 2424 \text{ kg}$$

$$z = d - \frac{1}{2} a = 10,5 - \frac{1}{2} 1,37 = 9,81 \text{ cm}$$

$$M_n = T \times z = 2424 \times 9,81 = 23791 \text{ kgcm} = 237,91 \text{ kgm}$$

#### Analisis Beban Maksimum

$$R_A = \frac{1}{2} P = v$$

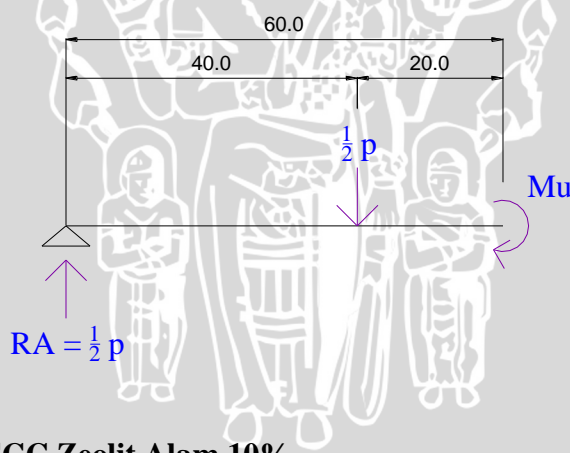
$$M_n = (R_A \times L)$$

$$237,91 = \frac{1}{2} P \times 0,4$$

$$237,91 = 0,20 P$$

$$P = \frac{237,91}{0,20}$$

$$P = 1189,53 \text{ kg}$$



### Beban Ultimit Balok SCC Zeolit Alam 10%

#### Analisis Momen Nominal ( $M_n$ )

$$b = 8 \text{ cm} = 80 \text{ mm}$$

$$h = 12 \text{ cm} = 120 \text{ mm}$$

$$d' = 1,5 \text{ cm} = 15 \text{ mm}$$

$$d = h - d' = 12 - 1,5 = 10,5 \text{ cm} = 105 \text{ mm}$$

$$f'c = 284,0 \text{ kg/cm}^2 = 28,40 \text{ Mpa}$$

$$f_y = 2400 \text{ kg/cm}^2 = 240 \text{ Mpa}$$

$$A_s \text{ min} = \frac{1,4 \times b \times d}{f_y} = \frac{1,4 \times 80 \times 105}{240} = 49 \text{ mm}^2 = 0,49 \text{ cm}^2$$

Maka digunakan tulangan 2 - Ø8 dengan  $A_s = 1,01 \text{ cm}^2$

$$a = \frac{A_s \times f_y}{0,85 \times f'_c \times b} = \frac{1,01 \times 2400}{0,85 \times 284,0 \times 8} = 1,26 \text{ cm}$$

$$T = A_s \times f_y = 1,01 \times 2400 = 2424 \text{ kg}$$

$$z = d - \frac{1}{2}a = 10,5 - \frac{1}{2}1,26 = 9,87 \text{ cm}$$

$$M_n = T \times z = 2424 \times 9,87 = 23931 \text{ kgcm} = 239,31 \text{ kgm}$$

### **Analisis Beban Maksimum**

$$R_A = \frac{1}{2} P = v$$

$$M_n = (R_A \times L)$$

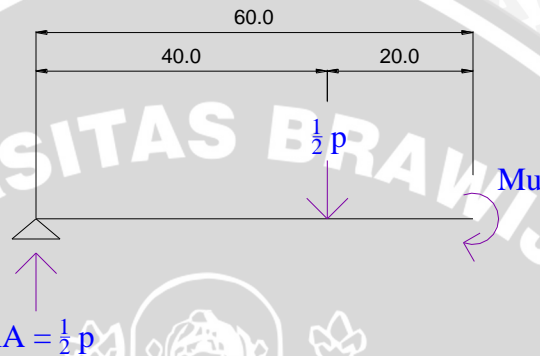
$$239,31 = \frac{1}{2} P \times 0,4$$

$$239,31 = 0,20 P$$

$$P = \frac{239,31}{0,20}$$

$$P = 1196,54 \text{ kg}$$

$$R_A = \frac{1}{2} p$$



### **Beban Ultimit Balok SCC Zeolit Alam 15%**

#### **Analisis Momen Nominal ( $M_n$ )**

$$b = 8 \text{ cm} = 80 \text{ mm}$$

$$h = 12 \text{ cm} = 120 \text{ mm}$$

$$d' = 1,5 \text{ cm} = 15 \text{ mm}$$

$$d = h - d' = 12 - 1,5 = 10,5 \text{ cm} = 105 \text{ mm}$$

$$f'_c = 268,8 \text{ kg/cm}^2 = 26,88 \text{ Mpa}$$

$$f_y = 2400 \text{ kg/cm}^2 = 240 \text{ Mpa}$$

$$A_{s \text{ min}} = \frac{1,4 \times b \times d}{f_y} = \frac{1,4 \times 80 \times 105}{240} = 49 \text{ mm}^2 = 0,49 \text{ cm}^2$$

Maka digunakan tulangan 2 - Ø8 dengan  $A_s = 1,01 \text{ cm}^2$

$$a = \frac{A_s \times f_y}{0,85 \times f'_c \times b} = \frac{1,01 \times 2400}{0,85 \times 268,8 \times 8} = 1,33 \text{ cm}$$

$$T = A_s \times f_y = 1,01 \times 2400 = 2424 \text{ kg}$$

$$z = d - \frac{1}{2}a = 10,5 - \frac{1}{2}1,33 = 9,84 \text{ cm}$$

$$M_n = T \times z = 2424 \times 9,84 = 23845 \text{ kgcm} = 238,45 \text{ kgm}$$

**Analisis Beban Maksimum**

$$R_A = \frac{1}{2} P = v$$

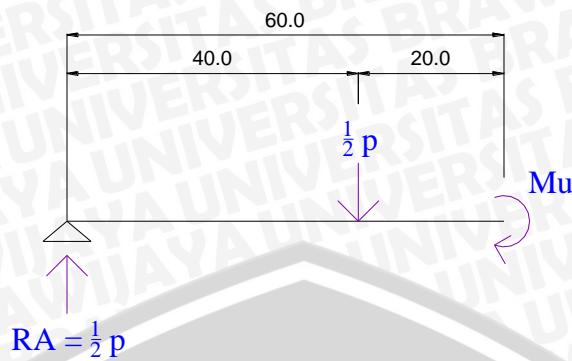
$$M_n = (R_a \times L)$$

$$238,45 = \frac{1}{2} P \times 0,4$$

$$238,45 = 0,20 P$$

$$P = \frac{238,45}{0,20}$$

$$P = 1192,23 \text{ kg}$$





## LAMPIRAN 5 PERHITUNGAN MOMEN ULTIMIT DAN KUAT LENTUR

### Momen Ultimit Balok Beton Normal-1 (BN-1)

$$Mu = \frac{1}{6} \cdot p \cdot l$$

$$P = 1196,7 \text{ kg}$$

$$L = 120 \text{ cm} = 1,2 \text{ m}$$

$$Mu = (1/6) \times 1196,7 \times 1,2 = 239,33 \text{ kgm}$$

### Momen Ultimit Balok SCC Zeolit Alam 5% (ZA1)

$$Mu = \frac{1}{6} \cdot p \cdot l$$

$$P = 1216,7 \text{ kg}$$

$$L = 120 \text{ cm} = 1,2 \text{ m}$$

$$Mu = (1/6) \times 1216,7 \times 1,2 = 243,3 \text{ kgm}$$

### Momen Ultimit Balok SCC Zeolit Alam 5% (ZA1)

$$Mu = \frac{1}{6} \cdot p \cdot l$$

$$P = 1216,7 \text{ kg}$$

$$L = 120 \text{ cm} = 1,2 \text{ m}$$

$$Mu = (1/6) \times 1216,7 \times 1,2 = 243,3 \text{ kgm}$$

### Momen Ultimit Balok SCC Zeolit Alam 10% (ZA2)

$$Mu = \frac{1}{6} \cdot p \cdot l$$

$$P = 1274,3 \text{ kg}$$

$$L = 120 \text{ cm} = 1,2 \text{ m}$$

$$Mu = (1/6) \times 1274,3 \times 1,2 = 254,9 \text{ kgm}$$

### Momen Ultimit Balok SCC Zeolit Alam 15% (ZA3)

$$Mu = \frac{1}{6} \cdot p \cdot l$$

$$P = 1255,0 \text{ kg}$$

$$L = 120 \text{ cm} = 1,2 \text{ m}$$

$$\text{Mu} = (1/6) \times 1255,0 \times 1,2 = 251,0 \text{ kgm}$$

#### **Kuat Lentur Balok Beton Normal-1 (BN-1)**

$$f_r = \frac{M \cdot y}{I}$$

$$M = 239,33 \text{ kgm} = 23933 \text{ kgcm}$$

$$y = 6,043 \text{ cm} \quad I = 1168,8 \text{ cm}^4$$

$$F_r = (23933 \times 6,043) / 1168,8 = 123,73 \text{ kg/cm}^2$$

#### **Kuat Lentur Balok SCC Zeolit Alam 5% (ZA1)**

$$f_r = \frac{M \cdot y}{I}$$

$$M = 243,33 \text{ kgm} = 24333 \text{ kgcm}$$

$$y = 6,043 \text{ cm} \quad I = 1168,8 \text{ cm}^4$$

$$F_r = (24333 \times 6,043) / 1168,8 = 125,80 \text{ kg/cm}^2$$

#### **Kuat Lentur Balok SCC Zeolit Alam 10% (ZA2)**

$$f_r = \frac{M \cdot y}{I}$$

$$M = 254,87 \text{ kgm} = 25487 \text{ kgcm}$$

$$y = 6,043 \text{ cm} \quad I = 1168,8 \text{ cm}^4$$

$$F_r = (25487 \times 6,043) / 1168,8 = 131,77 \text{ kg/cm}^2$$

#### **Kuat Lentur Balok SCC Zeolit Alam 15% (ZA3)**

$$f_r = \frac{M \cdot y}{I}$$

$$M = 251,00 \text{ kgm} = 25100 \text{ kgcm}$$

$$y = 6,043 \text{ cm} \quad I = 1168,8 \text{ cm}^4$$

$$F_r = (25100 \times 6,043) / 1168,8 = 129,77 \text{ kg/cm}^2$$

## LAMPIRAN 6 PERHITUNGAN KEKAKUAN DAN DAKTILITAS

### Kekakuan Beton Normal

$$\begin{aligned} \text{Beban retak} &= 940 \text{ kg} \\ \text{Lendutan} &= 6,11 \text{ mm} \\ \text{Kekakuan} &= P/\Delta \\ &= 940/6,11 = 153,85 \text{ kg/mm} \end{aligned}$$

### Kekakuan Beton SCC Zeolit Alam 5%

$$\begin{aligned} \text{Beban retak} &= 1080 \text{ kg} \\ \text{Lendutan} &= 6,095 \text{ mm} \\ \text{Kekakuan} &= P/\Delta \\ &= 1080/6,095 = 177,19 \text{ kg/mm} \end{aligned}$$

### Kekakuan Beton SCC Zeolit Alam 10%

$$\begin{aligned} \text{Beban retak} &= 1100 \text{ kg} \\ \text{Lendutan} &= 5,805 \text{ mm} \\ \text{Kekakuan} &= P/\Delta \\ &= 1100/5,805 = 189,49 \text{ kg/mm} \end{aligned}$$

### Kekakuan Beton SCC Zeolit Alam 15%

$$\begin{aligned} \text{Beban retak} &= 1010 \text{ kg} \\ \text{Lendutan} &= 7,82 \text{ mm} \\ \text{Kekakuan} &= P/\Delta \\ &= 1010/7,82 = 129,16 \text{ kg/mm} \end{aligned}$$

### Daktilitas Beton Normal

$$\begin{aligned} \text{Ultimit} &: P = 1198 \text{ kg} \\ &\quad \delta = 21,650 \text{ mm} \\ \text{Turun 20\%} &: P = 958,4 \text{ kg} \\ &\quad \delta = \text{Tidak terbaca} \\ \text{Turun 15\%} &: P = 1018,3 \text{ kg} \\ &\quad \delta = 29,450 \text{ mm} \\ \text{Leleh pertama} &: \delta = 6,11 \text{ mm} \end{aligned}$$



$$\text{Daktilitas} = 29,450/6,11 = 4,820$$

#### **Daktilitas Beton SCC Zeolit Alam 5%**

$$\text{Ultimit} : P = 1217 \text{ kg}$$

$$\delta = 16,185 \text{ mm}$$

$$\text{Turun 20\%} : P = 973,6 \text{ kg}$$

$$\delta = \text{Tidak terbaca}$$

$$\text{Turun 15\%} : P = 1034,45 \text{ kg}$$

$$\delta = 30,725 \text{ mm}$$

$$\text{Leleh pertama} : \delta = 6,095 \text{ mm}$$

$$\text{Daktilitas} = 30,725/6,095 = 5,041$$

#### **Daktilitas Beton SCC Zeolit Alam 10%**

$$\text{Ultimit} : P = 1274 \text{ kg}$$

$$\delta = 22,535 \text{ mm}$$

$$\text{Turun 20\%} : P = 1019,2 \text{ kg}$$

$$\delta = \text{Tidak terbaca}$$

$$\text{Turun 15\%} : P = 1082,9 \text{ kg}$$

$$\delta = 35,540 \text{ mm}$$

$$\text{Leleh pertama} : \delta = 5,805 \text{ mm}$$

$$\text{Daktilitas} = 35,540/5,805 = 6,122$$

#### **Daktilitas Beton SCC Zeolit Alam 15%**

$$\text{Ultimit} : P = 1253 \text{ kg}$$

$$\delta = 22,240 \text{ mm}$$

$$\text{Turun 20\%} : P = 1002,4 \text{ kg}$$

$$\delta = \text{Tidak terbaca}$$

$$\text{Turun 15\%} : P = 1065,05 \text{ kg}$$

$$\delta = 41,525 \text{ mm}$$

$$\text{Leleh pertama} : \delta = 7,820 \text{ mm}$$

$$\text{Daktilitas} = 41,525/7,820 = 5,310$$

## LAMPIRAN 7 UJI HIPOTESIS

### Pengujian Hipotesis Pengaruh Variasi Kadar Zeolit Alam terhadap Kuat Lentur Balok SCC dengan Metode ANOVA

Kadar Additon	Sampel	Kuat Lentur (kg/cm <sup>2</sup> )		
		5%	10%	15%
1,5%	1	126.04	132.35	129.56
	2	125.53	131.21	129.15
	3	125.84	131.73	130.59

Terdapat 3 variasi kadar zeolit alam dengan masing-masing variasi dibuat 3 sampel uji dengan waktu pengujian pada umur 28 hari.

1. Hipotesis ( $H_0$  dan  $H_1$ ) dalam bentuk kalimat :
  - a.  $H_0$  = Hipotesis awal yang menyatakan bahwa tidak ada pengaruh penggunaan variasi kadar zeolit alam pada balok SCC terhadap kuat lentur balok.
  - b.  $H_1$  = Hipotesis alternatif yang menyatakan ada pengaruh penggunaan variasi kadar zeolit alam pada balok SCC terhadap kuat lentur balok.
2. Hipotesis  $H_0$  dan  $H_1$  dalam bentuk statistika :

$$H_0 = \alpha_1 = \alpha_2 = \alpha_3 \dots = \alpha_n$$

$$H_1 = \alpha_1 \neq \alpha_2 \neq \alpha_3 \dots \neq \alpha_n$$

3. Daftar statistika induk

Kadar Additon	Sampel	Kuat Lentur (kg/cm <sup>2</sup> )			Total = T
		5%	10%	15%	
1,5%	1	126.04	132.35	129.56	
	2	125.53	131.21	129.15	
	3	125.84	131.73	130.59	
Statistika					
	n	3	3	3	9
	$\sum X$	377.41	395.30	389.30	1162.01
	$\sum X^2$	47479.311	52087.252	50519.257	150085.82

4. Menghitung Jumlah Kuadrat Antar Group (JK<sub>A</sub>)

$$JK_A = \frac{(\sum X_{Ai})^2}{n_{Ai}} - \frac{(\sum X_T)^2}{N}$$

$$JK_A = \left( \frac{377,41^2}{3} + \frac{395,30^2}{3} + \frac{389,30^2}{3} \right) - \frac{1162,01^2}{9}$$

$$= 150083,92 - 150028,66$$

$$= 55,26$$

5. Menghitung Derajat bebas Antar group dengan rumus :

$$\begin{aligned} Db_A &= A - 1 & A &= \text{jumlah group} \\ &= 3 - 1 \\ &= 2 \end{aligned}$$

6. Menghitung kuadrat Rerata Antar group ( $KR_A$ )

$$\begin{aligned} KR_A &= \frac{JK_A}{Db_A} \\ &= \frac{55,26}{2} \\ &= 27,63 \end{aligned}$$

7. Menghitung Jumlah Kuadrat Dalam group ( $JK_D$ )

$$\begin{aligned} JK_D &= \sum X^2_T - \frac{(\sum X_{Ai})^2}{n_{Ai}} \\ &= 150085,82 - 150083,92 \\ &= 1,90 \end{aligned}$$

8. Menghitung Derajat bebas Dalam group dengan rumus :

$$\begin{aligned} Db_D &= N - A \\ &= 9 - 3 \\ &= 6 \end{aligned}$$

9. Menghitung Kuadrat Rerata Dalam group ( $KR_D$ )

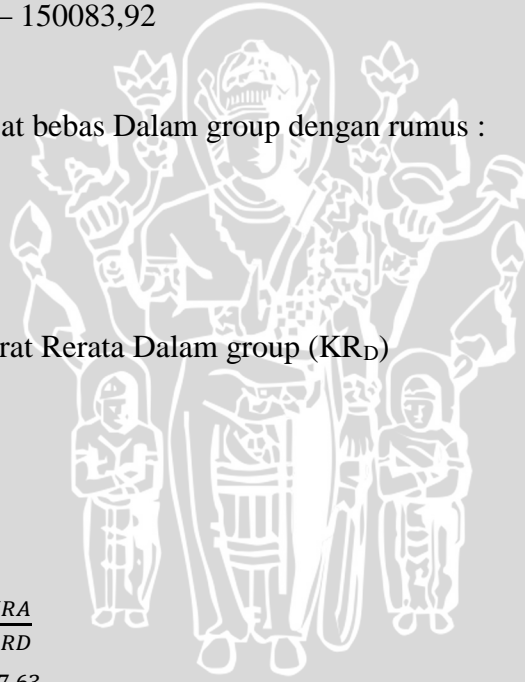
$$\begin{aligned} KR_D &= \frac{JK_D}{Db_D} \\ &= \frac{1,90}{6} \\ &= 0,32 \end{aligned}$$

10. F. Hitung

$$\begin{aligned} &= \frac{KRA}{KR_D} \\ &= \frac{27,63}{0,32} \\ &= 87,44 \end{aligned}$$

11. Taraf signifikan sebesar  $\alpha = 5\%$  dan  $1\%$

12. F. Tabel =  $\alpha = 5\% = 3,24$   
 $= 1\% = 5,29$





13. Tabel Ringkasan Anova

Sumber Varian (SV)	JK	db	KT	F hitung	F Tabel
Antar (A)	55.26	2	27.63	87.44	3.24 (5%)
Dalam (D)	1.90	6	0.32		
Total (T)	57.16	8			



### LAMPIRAN 8 DOKUMENTASI PENELITIAN



Gambar Proses Pembuatan Beton



Gambar Pengujian *Slumpflow*



Gambar Pengujian *V-funnel*



Gambar Cetakan Silinder 150 x 300 mm



Gambar Proses *Curing*





Gambar Bekisting dan Tulangan Balok



Proses Curing Balok



Gambar Proses Uji Tekan



Balok Siap Diuji



Gambar Pengujian Lentur Balok