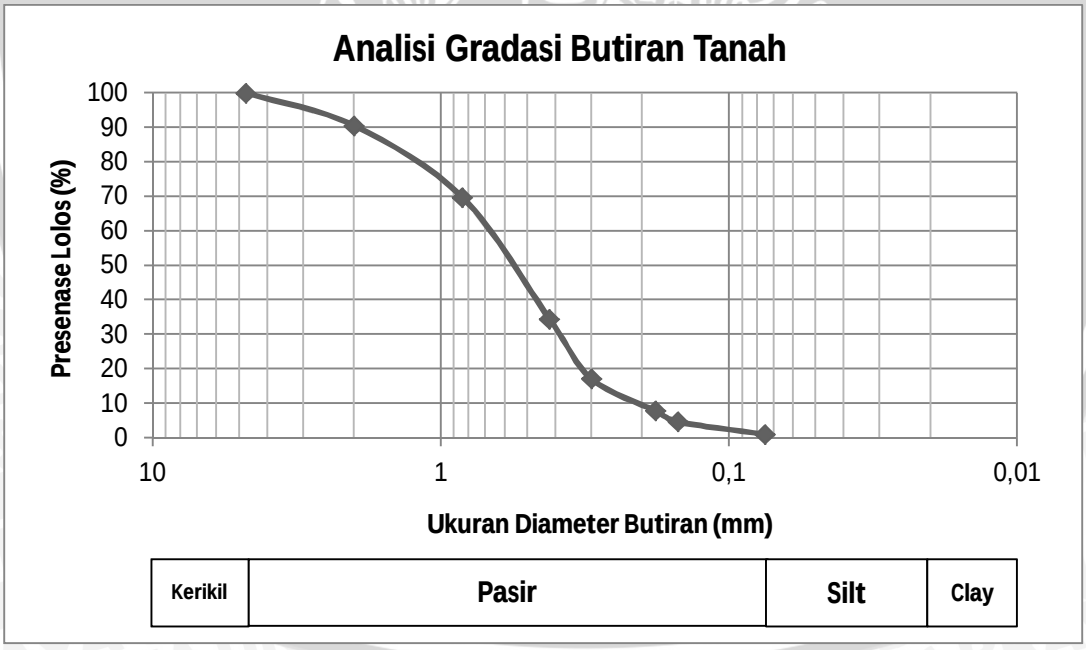
LAMPIRAN

Lampiran 1

Analisis Gradasi Butiran Tanah

Diameter ayakan	Berat tanah (gr)	Berat kumulatif (gr)	Persen tertahan (%)	Persen lolos (%)
4,75 mm (no. 4)	0	0	0,00	100,00
2,00 mm (no. 10)	47,4	47,4	9,48	90,52
0,84 mm (no. 20)	104,5	151,9	30,38	69,62
0,42 mm (no. 40)	175,9	327,8	65,56	34,44
0,30 mm (no. 50)	86,6	414,4	82,88	17,12
0,18 mm (no. 80)	46,4	460,8	92,16	7,84
0,15 mm (no. 100)	15,9	476,7	95,34	4,66
0,075 mm (no.200)	18,2	494,9	98,98	1,02
PAN	5,1	500	100,00	0,00



$D_{60} = 0,70$

$D_{30} = 0,40$

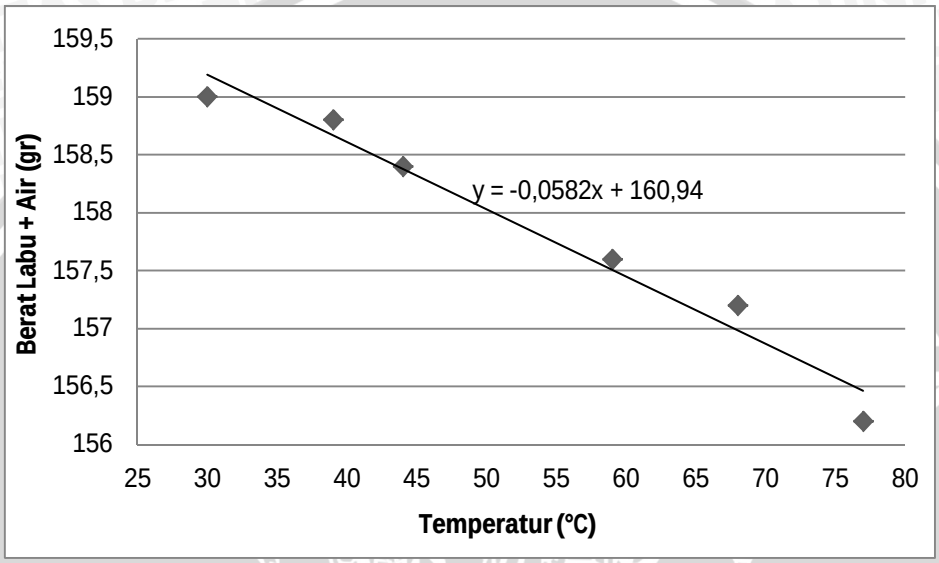
$D_{10} = 0,20$

$$C_u = \frac{0,70}{0,20} = 3,50 < 6$$

Lampiran 2

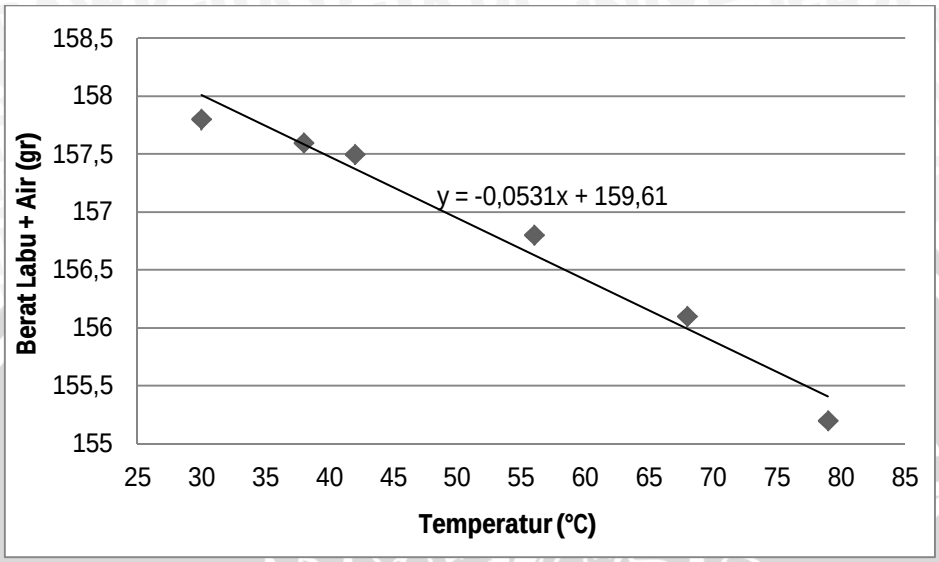
Hasil Analisis *Specific Gravity* Tanah

Labu ukur	A					
No.	1	2	3	4	5	6
Berat Labu + Air (gr)	156,2	157,2	157,6	158,4	158,8	159,0
Temperatur (°C)	77	68	59	44	39	30



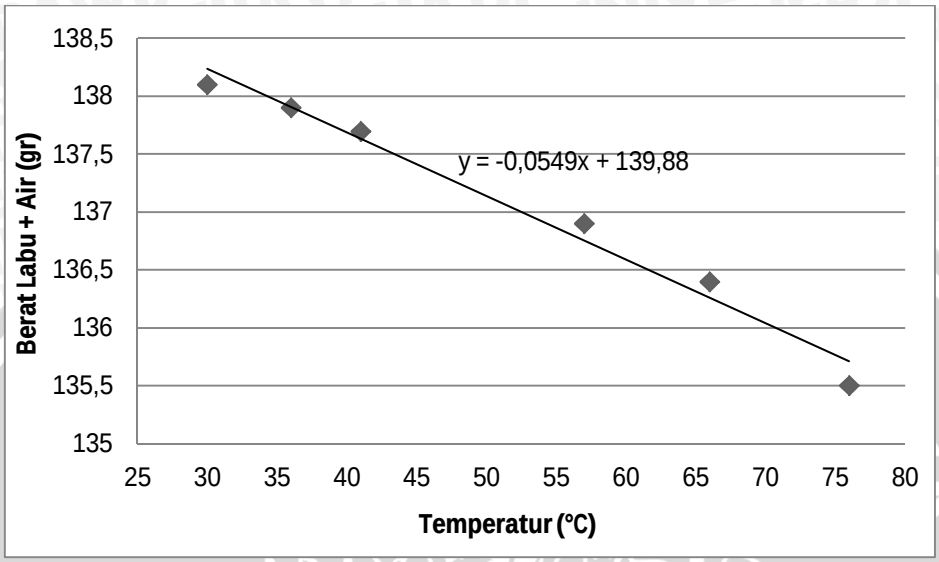
Uraian	Keterangan	Satuan	Perhitungan					
Berat labu ukur	Dari hasi percobaan	gr	55,8					
Berat tanah kering (WS)	diketahui	gr	20					
Berat labu ukur+ air+tanah (W1)	Dari hasi percobaan	gr	170,0	170,6	171,2	171,7	172,0	171,8
Temperatur	diketahui	°C	72	60	48	39	33	30
Berat labu ukur + air (W2)	(-0,0582T)+160,94	gr	156,75	157,45	158,15	158,67	159,02	159,19
Spesific Gravity air (Gt)	diketahui	-	0,9737	0,9789	0,9838	0,9907	0,9926	0,9957
Spesific Gravity tanah (Gs)	(Gt*Ws)/(W2+Ws-W1)	-	2,8852	2,8589	2,8325	2,8427	2,8282	2,6933
Gs rata-rata	∑Gs/6	-	2,8235					

Labu ukur	B					
No.	1	2	3	4	5	6
Berat Labu + Air (gr)	155,2	156,1	156,8	157,5	157,6	157,8
Temperatur (°C)	79	68	56	42	38	30



Uraian	Keterangan	Satuan	Perhitungan					
Berat labu ukur	Dari hasi percobaan	gr	59,3					
Berat tanah kering (WS)	diketahui	gr	20					
Berat labu ukur+ air+tanah (W1)	Dari hasi percobaan	gr	168,8	169,5	170,3	170,7	171	170,9
Temperatur	diketahui	°C	72	57	47	38	32	30
Berat labu ukur + air (W2)	(-0,0531T)+159,61	gr	155,79	156,58	157,11	157,59	157,91	158,02
Spesific Gravity air (Gt)	diketahui	-	0,9724	0,9789	0,9852	0,9915	0,9930	0,9957
Spesific Gravity tanah (Gs)	(Gt*Ws)/(W2+Ws-W1)	-	2,7835	2,7640	2,8916	2,8772	2,8738	2,7981
Gs rata-rata	∑Gs/6	-	2,8313					

Labu ukur	C					
No.	1	2	3	4	5	6
Berat Labu + Air (gr)	135,5	136,4	136,9	137,7	137,9	138,1
Temperatur (°C)	76	66	57	41	36	30



Uraian	Keterangan	Satuan	Perhitungan					
Berat labu ukur	Dari hasi percobaan	gr	38,9					
Berat tanah kering (WS)	diketahui	gr	20					
Berat labu ukur+ air+tanah (W1)	Dari hasi percobaan	gr	149,4	150,1	150,6	150,8	151,1	150,0
Temperatur	diketahui	°C	72	57	47	38	32	30
Berat labu ukur + air (W2)	(-0,0549T)+139,88	gr	135,93	136,75	137,30	137,79	138,12	138,23
Spesific Gravity air (Gt)	diketahui	-	0,9743	0,9800	0,9848	0,9919	0,9937	0,9957
Spesific Gravity tanah (Gs)	(Gt*Ws)/(W2+Ws-W1)	-	2,9854	2,9471	2,9398	2,8365	2,8298	2,4188
Gs rata-rata	∑Gs/6	-	2,8262					

Lampiran 3

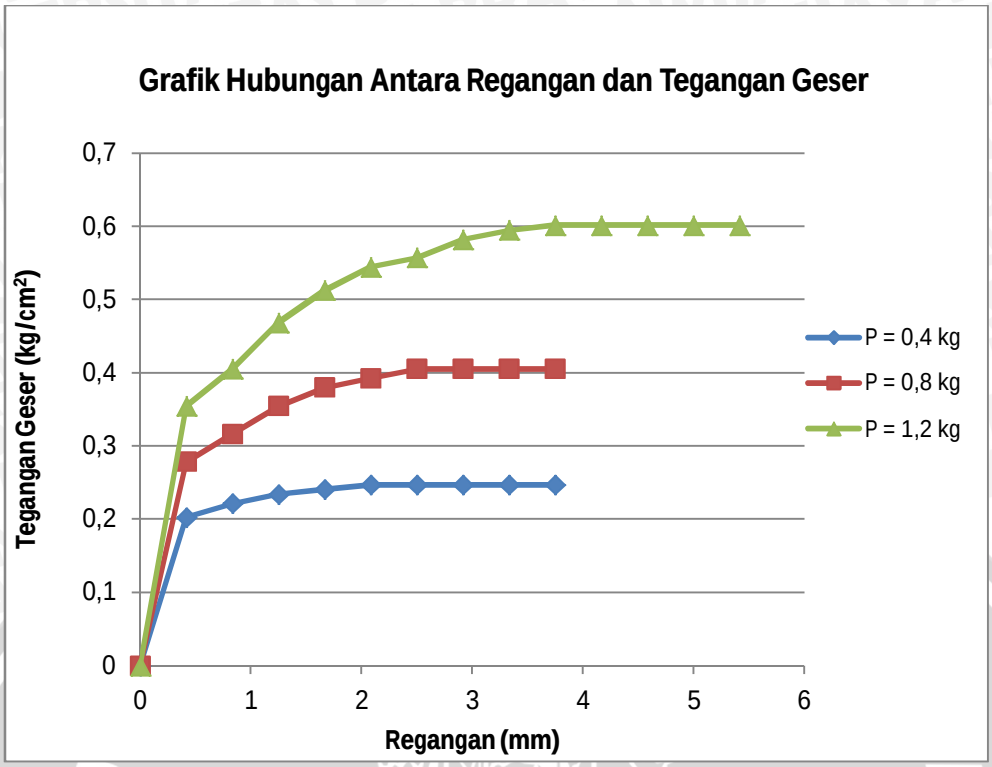
Hasil Analisis Uji Geser Langsung *(Direct Shear)*

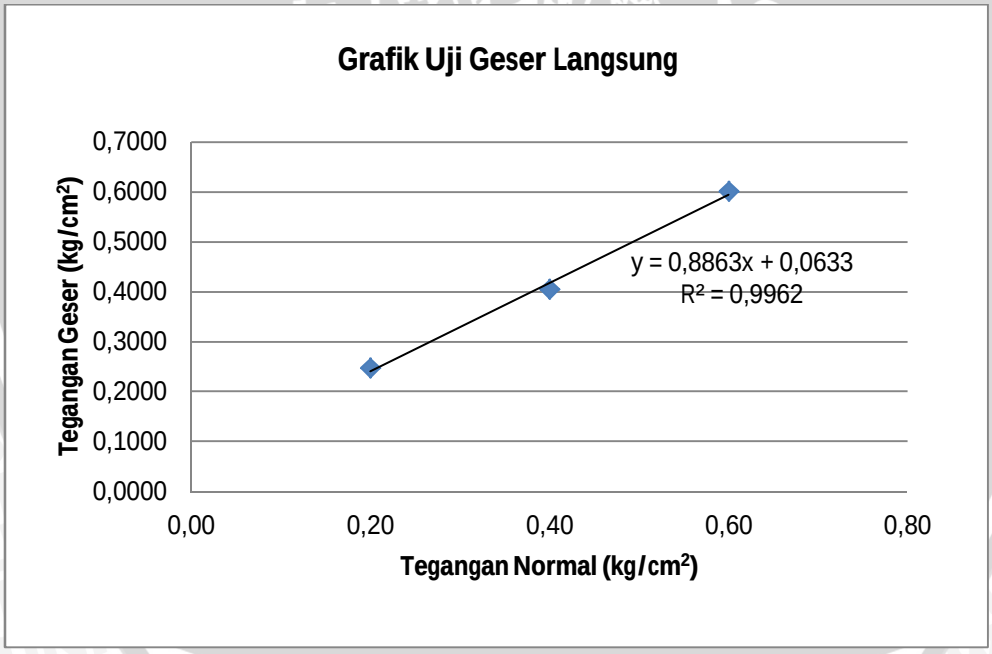
Lapisan 3

Kalibrasi Alat = 0,358 Diameter Sampel = 6 cm

Tinggi Sampel = 2 cm Luas Sampel = 28,274cm^2

Normal Force	P_1 = 0,4 kg			P_2 = 0,8 kg			P_3 = 1,2 kg		
Normal Stress	σ_1 = 0,20 kg/cm^2			σ_2 = 0,40 kg/cm^3			σ_3 = 0,60 kg/cm^4		
Geseran Horizontal	*Dial Reading*	*Shear Force*	*Shear Stress*	*Dial Reading*	*Shear Force*	*Shear Stress*	*Dial Reading*	*Shear Force*	*Shear Stress*
0	0	0	0	0	0	0	0	0	0
25	16,0	5,7280	0,2026	22,0	7,8760	0,2786	28,0	10,0240	0,3545
50	17,5	6,2650	0,2216	25,0	8,9500	0,3165	32,0	11,4560	0,4052
75	18,5	6,6230	0,2342	28,0	10,0240	0,3545	37,0	13,2460	0,4685
100	19,0	6,8020	0,2406	30,0	10,7400	0,3799	40,5	14,4990	0,5128
125	19,5	6,9810	0,2469	31,0	11,0980	0,3925	43,0	15,3940	0,5445
150	19,5	6,9810	0,2469	32,0	11,4560	0,4052	44,0	15,7520	0,5571
175	19,5	6,9810	0,2469	32,0	11,4560	0,4052	46,0	16,4680	0,5824
200	19,5	6,9810	0,2469	32,0	11,4560	0,4052	47,0	16,8260	0,5951
225	19,5	6,9810	0,2469	32,0	11,4560	0,4052	47,5	17,0050	0,6014
250							47,5	17,0050	0,6014
275							47,5	17,0050	0,6014
300							47,5	17,0050	0,6014
325							47,5	17,0050	0,6014
350									
375									
400									





$c = 0{,}0633 \text{ kg/cm}^2$

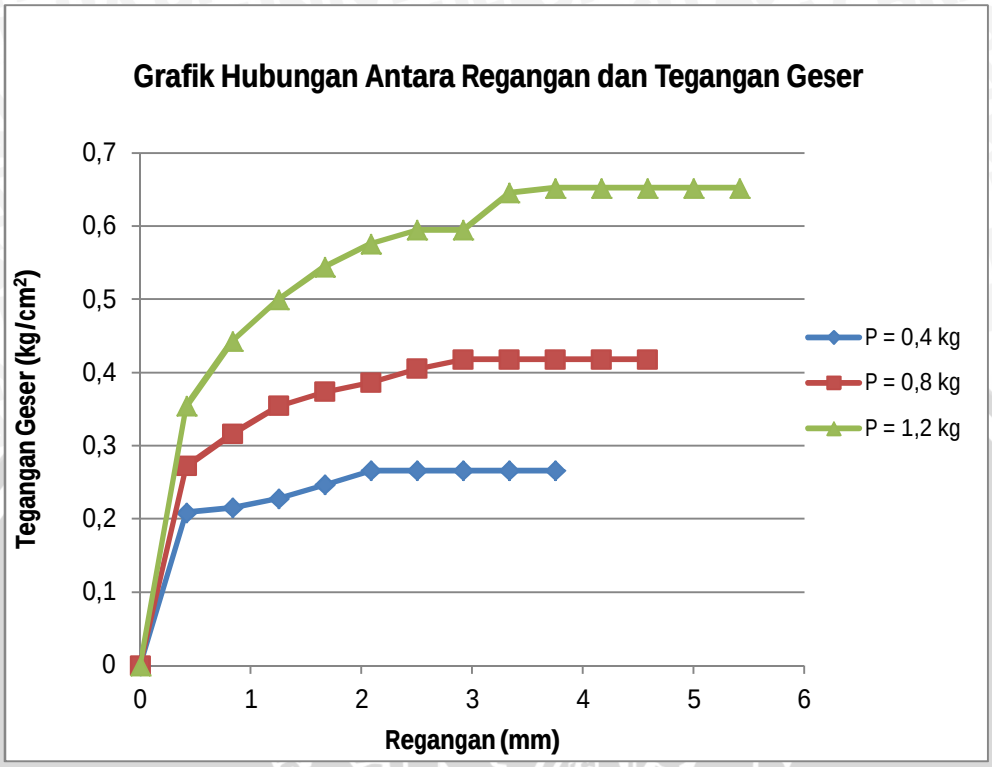
$\phi = 38{,}36°$

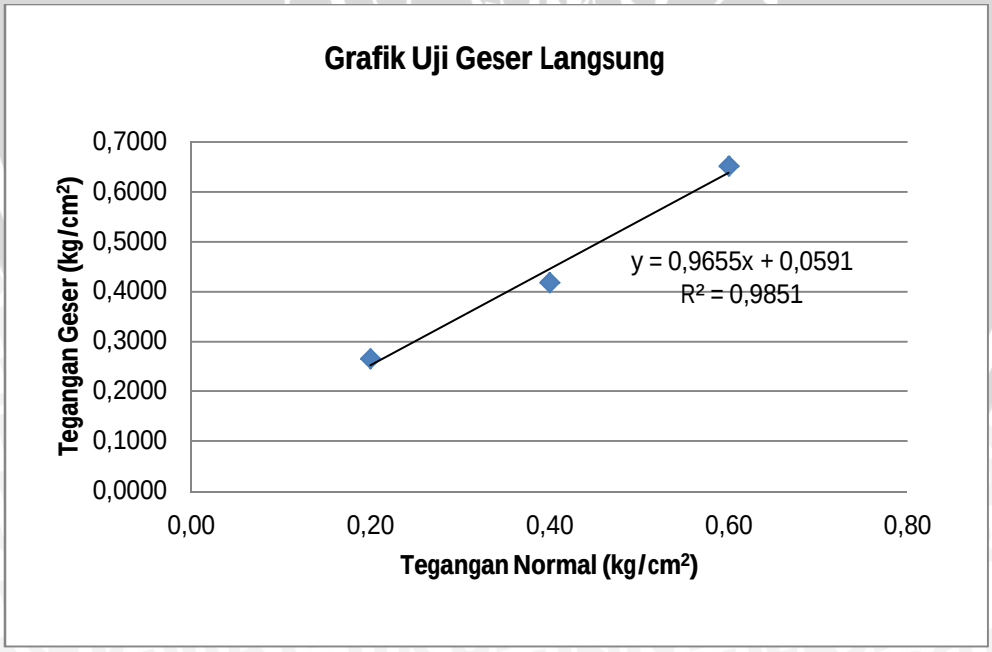
Lapisan 5

Kalibrasi Alat = 0,358 Diameter Sampel = 6 cm

Tinggi Sampel = 2 cm Luas Sampel = 28,274cm^2

Normal Force	P_1 = 0,4 kg			P_2 = 0,8 kg			P_3 = 1,2 kg		
Normal Stress	σ_1 = 0,20 kg/cm^2			σ_2 = 0,40 kg/cm^3			σ_3 = 0,60 kg/cm^4		
Geseran Horizontal	*Dial Reading*	*Shear Force*	*Shear Stress*	*Dial Reading*	*Shear Force*	*Shear Stress*	*Dial Reading*	*Shear Force*	*Shear Stress*
0	0	0	0	0	0	0	0	0	0
25	16,5	5,9070	0,2089	21,5	7,6970	0,2722	28,0	10,0240	0,3545
50	17,0	6,0860	0,2153	25,0	8,9500	0,3165	35,0	12,5300	0,4432
75	18,0	6,4440	0,2279	28,0	10,0240	0,3545	39,5	14,1410	0,5001
100	19,5	6,9810	0,2469	29,5	10,5610	0,3735	43,0	15,3940	0,5445
125	21,0	7,5180	0,2659	30,5	10,9190	0,3862	45,5	16,2890	0,5761
150	21,0	7,5180	0,2659	32,0	11,4560	0,4052	47,0	16,8260	0,5951
175	21,0	7,5180	0,2659	33,0	11,8140	0,4178	47,0	16,8260	0,5951
200	21,0	7,5180	0,2659	33,0	11,8140	0,4178	51,0	18,2580	0,6458
225	21,0	7,5180	0,2659	33,0	11,8140	0,4178	51,5	18,4370	0,6521
250				33,0	11,8140	0,4178	51,5	18,4370	0,6521
275				33,0	11,8140	0,4178	51,5	18,4370	0,6521
300							51,5	18,4370	0,6521
325							51,5	18,4370	0,6521
350									
375									
400									





$c = 0{,}0591 \text{ kg/cm}^2$

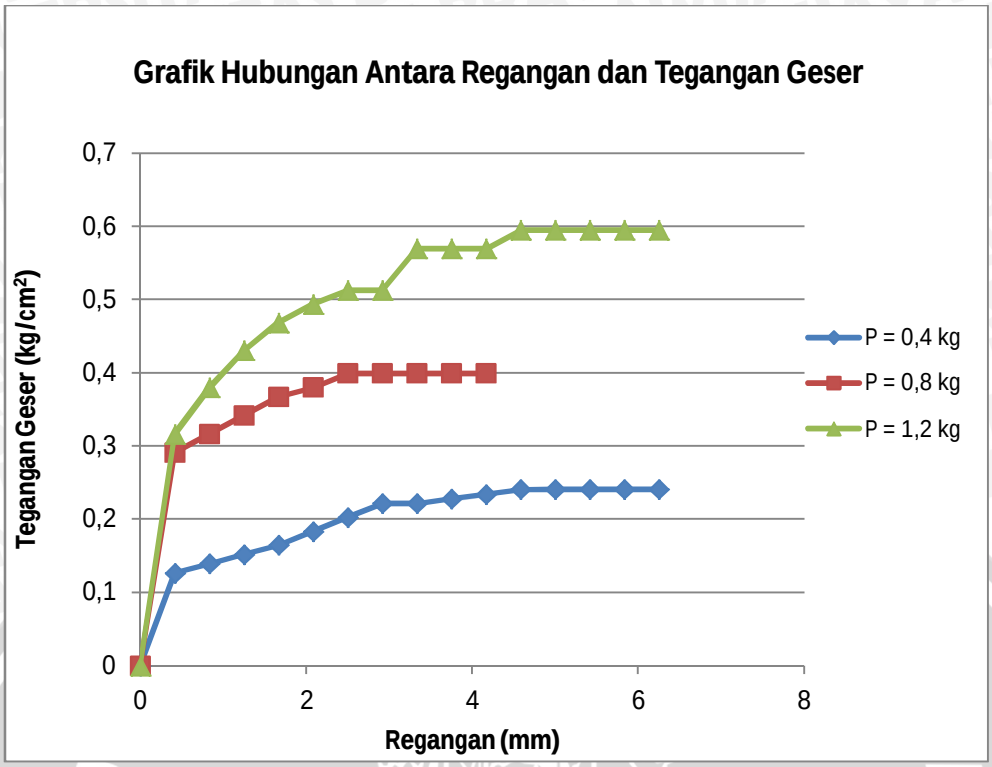
$\phi = 37{,}22°$

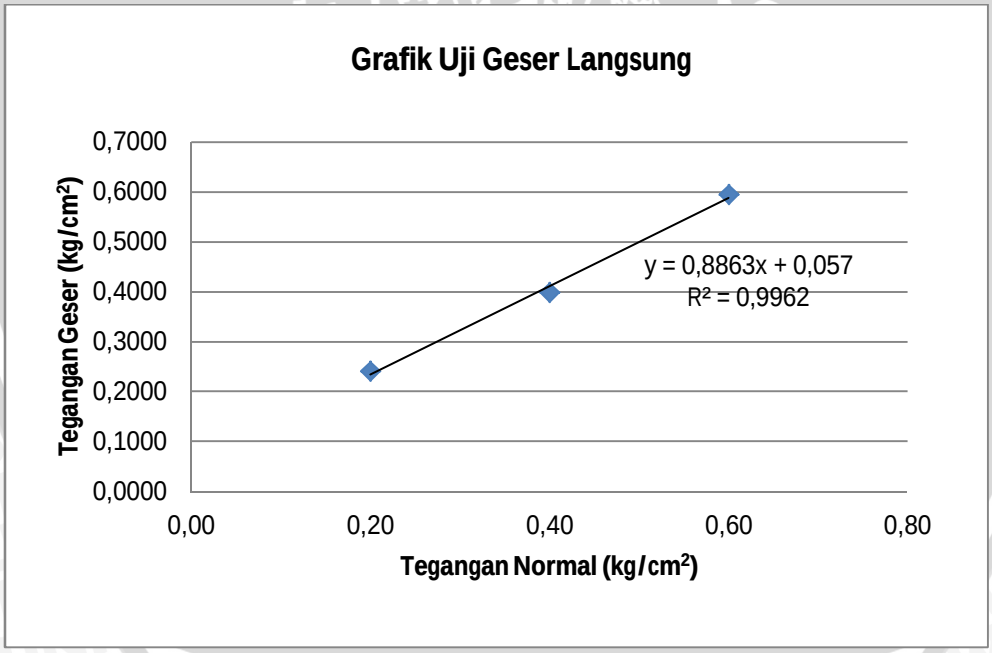
Lapisan 7

Kalibrasi Alat = 0,358 Diameter Sampel = 6 cm

Tinggi Sampel = 2 cm Luas Sampel = 28,274cm^2

Normal Force	P_1 = 0,4 kg			P_2 = 0,8 kg			P_3 = 1,2 kg		
Normal Stress	σ_1 = 0,20 kg/cm^2			σ_2 = 0,40 kg/cm^3			σ_3 = 0,60 kg/cm^4		
Geseran Horizontal	*Dial Reading*	*Shear Force*	*Shear Stress*	*Dial Reading*	*Shear Force*	*Shear Stress*	*Dial Reading*	*Shear Force*	*Shear Stress*
0	0	0	0	0	0	0	0	0	0
25	10,0	3,5800	0,1266	23,0	8,2340	0,2912	25,0	8,9500	0,3165
50	11,0	3,9380	0,1393	25,5	8,9500	0,3165	30,0	10,7400	0,3799
75	12,0	4,2960	0,1519	27,0	9,6660	0,3419	34,0	12,1720	0,4305
100	13,0	4,6540	0,1646	29,0	10,3820	0,3672	37,0	13,2460	0,4685
125	14,5	5,1910	0,1836	30,0	11,7400	0,3799	39,0	13,9620	0,4938
150	16,0	5,7280	0,2026	31,5	11,2770	0,3988	40,5	14,4990	0,5128
175	17,5	6,2650	0,2216	31,5	11,2770	0,3988	40,5	14,4990	0,5128
200	17,5	6,2650	0,2216	31,5	11,2770	0,3988	45,0	16,1100	0,5698
225	18,0	6,4440	0,2279	31,5	11,2770	0,3988	45,0	16,1100	0,5698
250	18,5	6,6230	0,2342	31,5	11,2770	0,3988	45,0	16,1100	0,5698
275	19,0	6,8020	0,2406				47,0	16,8260	0,5951
300	19,0	6,8020	0,2406				47,0	16,8260	0,5951
325	19,0	6,8020	0,2406				47,0	16,8260	0,5951
350	19,0	6,8020	0,2406				47,0	16,8260	0,5951
375	19,0	6,8020	0,2406				47,0	16,8260	0,5951
400									





$c = 0{,}057\ kg/cm^2$

$\phi = 38{,}36$

Lampiran 4

Hasil Uji Pemadatan Standar

Data:

Berat Mould = 4260 gram

Diameter Sampel = 10,16 cm

Tinggi Sampel = 11,50 cm

Kadar Air

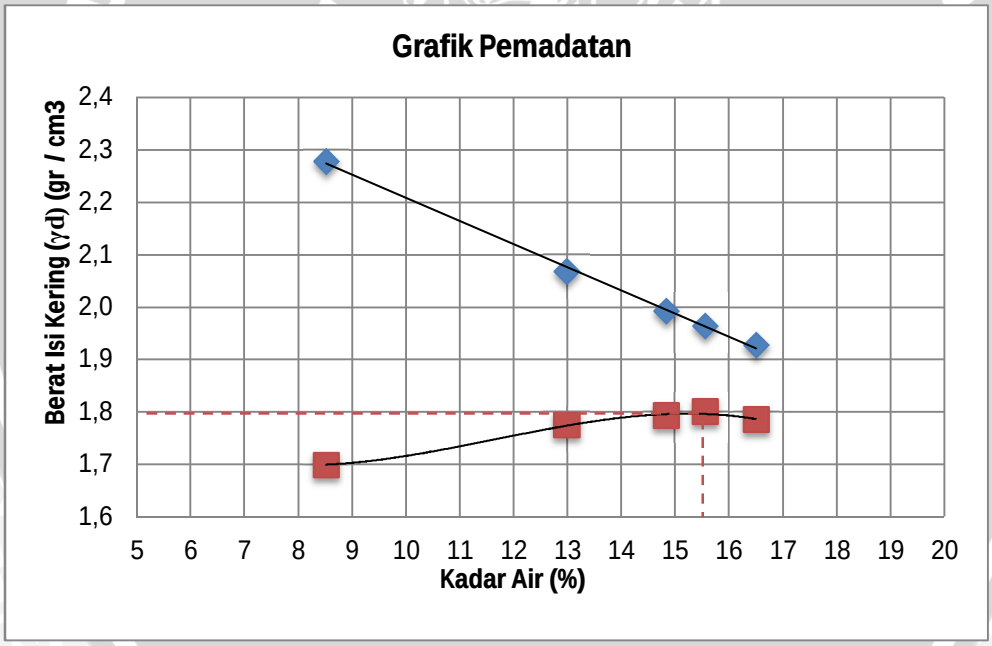
Penambahan air	ml	200			300			400			500			600		
		atas	tengah	bawah	atas	tengah	bawah	atas	tengah	bawah	atas	tengah	bawah	atas	tengah	bawah
Berat Cawan	gr	5,60	5,70	4,20	5,70	6,00	5,90	5,70	5,80	5,60	4,20	4,30	5,70	5,70	5,60	4,20
Berat Tanah basah + Cawan	gr	23,90	29,00	22,60	30,70	35,70	33,00	31,20	36,00	29,30	28,90	30,10	28,00	32,50	29,20	25,70
Berat Tanah Kering + Cawan	gr	22,60	27,20	21,00	28,50	32,40	29,10	27,90	31,90	26,40	25,60	26,60	25,00	28,70	25,70	22,80
Berat air (Ww)	gr	1,30	1,80	1,60	2,20	3,30	3,90	3,30	4,10	2,90	3,30	3,50	3,00	3,80	3,50	2,90
Berat Tanah Kering (Ws)	gr	17,00	21,50	16,80	22,80	26,40	23,20	22,20	26,10	20,80	21,40	22,30	19,30	23,00	20,10	18,60
Kadar Air	%	7,65	8,37	9,52	9,65	12,50	16,81	14,86	15,71	13,94	15,42	15,70	15,54	16,52	17,41	15,59
Kadar Air rata-rata	%	8,51			12,99			14,84			15,55			16,51		

Kepadatan

Penambahan Air	ml	200	300	400	500	600
Berat Cetakan	gr	4260	4260	4260	4260	4260
Berat Tanah Basah + Cetakan	gr	5980	6130	6180	6200	6200
Berat Tanah Basah	gr	1720	1870	1920	1940	1940
Isi Cetakan	cm^3	932,717	932,717	932,717	932,717	932,717
Berat Isi Basah (γw)	gr/cm^3	1,844	2,005	2,059	2,080	2,080
Berat Isi Kering (γd)	gr/cm^3	1,699	1,774	1,793	1,800	1,785

Zero Air Void

Penambahan Air	ml	200	300	400	500	600
Kadar air	%	8,514	12,986	14,839	15,553	16,509
Gs		2,827	2,827	2,827	2,827	2,827
Berat Jenis Air (γw)	gr/cm^3	1,000	1,000	1,000	1,000	1,000
Berat Jenis Air *Zero Air Void* (γZAV)	gr/cm^3	2,279	2,068	1,992	1,964	1,927



Lampiran 5

Pemadatan Model Test

$\gamma_{d\ rencana}$: 1,386 gr/cm^3 = 1386 kg/m^3

Luas boks : 0,98 m^2

Berat tanah untuk tinggi rencana 10 cm: 1386 x 0,098 = 135,83 kg

Hasil Pengujian Pemadatan

Jumlah Tumbukan	**-**	225
Berat isi kering maksimum di laboratorium	**gr/cm^3**	1,80
Berat isi kering model	**gr/cm^3**	1,386
Kepadatan Relatif (RC)	**%**	77,00

Lampiran 6

Hasil Pengujian Kadar Air dan Kepadatan Pasir pada Model Lereng

Dinding Penahan Tanah dengan Lebar Celah 1 cm

Kadar Air

Lapisan		1		2		3		4		5		6		7	
Berat cawan + tanah basah	gram	19,3	19,5	18,6	19,7	22,0	20,5	21,7	21,6	19,3	20,6	18,7	18,7	21,1	20,3
Berat cawan + tanah kering	gram	18,0	18,3	17,4	18,6	20,7	19,2	20,8	20,5	18,3	19,5	17,6	17,9	20,1	19,4
Berat cawan	gram	4,3	4,1	4,3	4,2	5,9	4,3	5,6	6,1	4,1	5,2	4,0	4,1	5,2	4,2
Berat tanah kering	gram	13,7	14,2	13,1	14,4	14,8	14,9	15,2	14,4	14,2	14,3	13,6	13,8	14,9	15,2
Berat air	gram	1,3	1,2	1,2	1,1	1,3	1,3	0,9	1,1	1,0	1,1	1,1	0,8	1,0	0,9
Kadar air	%	9,49	8,45	9,16	7,64	8,78	8,72	5,92	7,64	7,04	7,69	8,09	5,80	6,71	5,92
Kadar air rata-rata (%)		7,65													

Kepadatan

Lapisan		1		2		3		4		5		6		7	
Berat ring + tanah	gram	33,0	33,4	32,3	33,5	34,1	34,2	34,1	33,5	33,2	33,4	32,7	32,6	33,9	34,1
Berat ring	gram	18	18	18	18	18	18	18	18	18	18	18	18	18	18
Diameter ring	cm	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3
Tinggi ring	cm	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5
Volume ring	cm^3	10,38	10,38	10,38	10,38	10,38	10,38	10,38	10,38	10,38	10,38	10,38	10,38	10,38	10,38
Berat tanah	gram	15,0	15,4	14,3	15,5	16,1	16,2	16,1	15,5	15,2	15,4	14,7	14,6	15,9	16,1
γt	gr/cm^3	1,445	1,483	1,377	1,493	1,551	1,560	1,551	1,493	1,464	1,483	1,416	1,406	1,532	1,551
Kadar air	%	9,49	8,45	9,16	7,64	8,78	8,72	5,92	7,64	7,04	7,69	8,09	5,80	6,71	5,92
γd	gr/cm^3	1,308	1,358	1,251	1,379	1,415	1,424	1,459	1,379	1,361	1,369	1,301	1,325	1,429	1,459
γt rata-rata	gr/cm^3	1,486													
γd rata-rata	gr/cm^3	1,373													

Dinding Penahan Tanah dengan Lebar Celah 1,5 cm

Kadar Air

Lapisan		1		2		3		4		5		6		7	
Berat cawan + tanah basah	gram	20,9	21,8	21,1	20,1	20,8	19,9	21,7	21,1	19,9	21,8	21,2	20,6	20,2	19,9
Berat cawan + tanah kering	gram	19,7	20,6	19,8	18,7	19,8	19,0	20,4	19,9	18,7	20,8	20,4	19,7	19,1	18,9
Berat cawan	gram	5,7	5,9	5,6	4,2	5,5	4,0	5,7	4,2	4,5	5,7	5,7	5,6	5,3	4,1
Berat tanah kering	gram	14,0	14,7	14,2	14,5	14,3	15,0	14,7	15,7	14,2	15,1	14,7	14,1	13,8	14,8
Berat air	gram	1,2	1,2	1,3	1,4	1,0	0,9	1,3	1,2	1,2	1,0	0,8	0,9	1,1	1,0
Kadar air	%	8,57	8,16	9,15	9,66	6,99	6,00	8,84	7,64	8,45	6,62	5,44	6,38	7,97	6,76
Kadar air rata-rata (%)		7,62													

Kepadatan

Lapisan		1		2		3		4		5		6		7	
Berat ring + tanah	gram	33,2	33,9	33,5	33,9	33,3	33,9	34,0	34,9	33,4	34,1	33,5	33,0	32,9	33,8
Berat ring	gram	18	18	18	18	18	18	18	18	18	18	18	18	18	18
Diameter ring	cm	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3
Tinggi ring	cm	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5
Volume ring	cm^3	10,38	10,38	10,38	10,38	10,38	10,38	10,38	10,38	10,38	10,38	10,38	10,38	10,38	10,38
Berat tanah	gram	15,2	15,9	15,5	15,9	15,3	15,9	16,0	16,9	15,4	16,1	15,5	15,0	14,9	15,8
γt	gr/cm^3	1,464	1,532	1,493	1,532	1,474	1,532	1,541	1,628	1,483	1,551	1,493	1,445	1,435	1,522
Kadar air	%	8,57	8,16	9,15	9,66	6,99	6,00	8,84	7,64	8,45	6,62	5,44	6,38	7,97	6,76
γd	gr/cm^3	1,339	1,407	1,356	1,384	1,371	1,440	1,405	1,503	1,358	1,448	1,412	1,353	1,321	1,419
γt rata-rata	gr/cm^3	1,509													
γd rata-rata	gr/cm^3	1,394													

Dinding Penahan Tanah dengan Lebar Celah 2 cm

Kadar Air

Lapisan		1		2		3		4		5		6		7	
Berat cawan + tanah basah	gram	21,5	22,7	20,7	20,0	20,3	22,7	22,6	22,0	20,8	20,2	20,5	20,0	21,1	20,4
Berat cawan + tanah kering	gram	20,3	21,2	19,4	18,7	19,0	21,2	21,4	20,8	19,9	19,4	19,7	19,3	20,3	19,6
Berat cawan	gram	5,9	6,1	5,6	4,3	5,6	5,7	6,1	6,0	6,1	5,6	4,0	4,2	5,9	5,7
Berat tanah kering	gram	14,4	15,1	13,8	14,4	13,4	15,5	15,3	14,8	13,8	13,8	15,7	15,1	14,4	13,9
Berat air	gram	1,2	1,5	1,3	1,3	1,3	1,5	1,2	1,2	0,9	0,8	0,8	0,7	0,8	0,8
Kadar air	%	8,33	9,93	9,42	9,03	9,70	9,68	7,84	8,11	6,52	5,80	5,10	4,64	5,56	5,76
Kadar air rata-rata (%)		7,53													

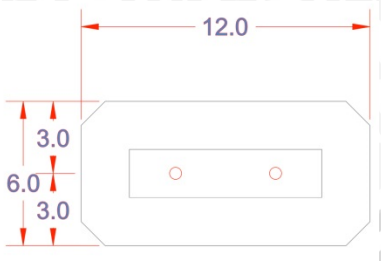
Kepadatan

Lapisan		1		2		3		4		5		6		7	
Berat ring + tanah	gram	33,6	34,6	33,1	33,7	32,7	35,0	34,5	34,0	32,7	32,6	34,5	33,8	33,2	32,7
Berat ring	gram	18	18	18	18	18	18	18	18	18	18	18	18	18	18
Diameter ring	cm	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3
Tinggi ring	cm	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5
Volume ring	cm^3	10,38	10,38	10,38	10,38	10,38	10,38	10,38	10,38	10,38	10,38	10,38	10,38	10,38	10,38
Berat tanah	gram	15,6	16,6	15,1	15,7	14,7	17,0	16,5	16,0	14,7	14,6	16,5	15,8	15,2	14,7
γt	gr/cm^3	1,503	1,599	1,454	1,512	1,416	1,638	1,589	1,541	1,416	1,406	1,589	1,522	1,464	1,416
Kadar air	%	8,33	9,93	9,42	9,03	9,70	9,68	7,84	8,11	6,52	5,80	5,10	4,64	5,56	5,76
γd	gr/cm^3	1,377	1,440	1,317	1,376	1,279	1,479	1,465	1,416	1,324	1,325	1,508	1,451	1,383	1,334
γt rata-rata	gr/cm^3	1,505													
γd rata-rata	gr/cm^3	1,391													

Lampiran 7

Analisis Momen Lentur Nominal Pasangan Bata Beton Bertulang

Pasangan Bata Beton Bertulang dengan Lebar Celah 1 cm



Titik berat tulangan: x = 3 cm dari serat bawah

Tinggi efektif penampang (d) = 6 - 3 = 3 cm

Gaya tarik tulangan (T) =

$$As.fy = (\frac{1}{4} x\ \pi\ x\ 0{,}5^2\ x\ 2)\ x\ 2400 = 942{,}478\ kg$$

Gaya tekan beton (Cc) =

$$0{,}85.f'c.b.a = 0{,}85\ x\ 194{,}8\ x\ 12\ x\ a = 1986{,}96\ a\ kg$$

Keseimbangan gaya: C = T

Cc = T

$$1986{,}96\ a = 942{,}478$$

a = 0,47 cm

Letak garis netral (c)

$$c = \frac{a}{\beta 1} = \frac{0{,}47}{0{,}85} = 0{,}553\ cm$$

Kontrol regangan tarik baja (εs) = $\varepsilon_c . \frac{d-c}{c}$

$$= \frac{0{,}003\ (3 - 0{,}553)}{0{,}553} = 0.0132$$

Tegangan baja tarik (fs) =

$\varepsilon s.Es = 0{,}0132\ x\ 200000 = 26400\ kg/cm^2 > 2400\ kg/cm^2$

fs > fy (tulangan tarik sudah leleh)

Momen lentur nominal (Mn)

= As.fy.(d-a/2)

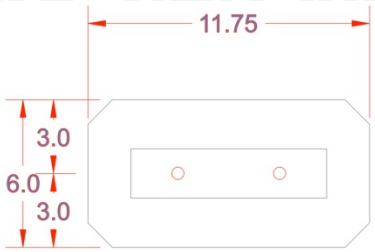
= 942,478 x (3-0,47/2) = 2605,952 kgcm = 26,06 kgm

Momen desain maksimum (Mu)

= ϕ.Mn = 0,8.26,06 = 20,85 kgm

Momen desain maksimum (Mu) dinding = 7 x 20,85 = 145,95 kgm

Pasangan Bata Beton Bertulang dengan Lebar Celah 1,5 cm



Titik berat tulangan : x = 3 cm dari serat bawah

Tinggi efektif penampang (d) = 6 - 3 = 3 cm

Gaya tarik tulangan (T) =

$$As.fy = \frac{1}{4} x \pi x 0.5^2 x 2 x 2400 = 942{,}478 \text{ kg}$$

Gaya tekan beton (Cc) =

$$0{,}85.f'c.b.a = 0{,}85 \times 194{,}8 \times 11{,}75 \times a = 1945{,}565\, a \text{ kg}$$

Keseimbangan gaya: C = T

Cc = T

$$1945{,}565\, a = 942{,}478$$

a = 0,48 cm

Letak garis netral (c)

$$c = \frac{a}{\beta 1} = \frac{0{,}48}{0{,}85} = 0{,}565 \text{ cm}$$

Kontrol regangan tarik baja (εs) = $\varepsilon_c . \frac{d-c}{c}$

$$= \frac{0{,}003\ (3 - 0{,}565)}{0{,}565} = 0.0129$$

Tegangan baja tarik (fs) =

$\varepsilon s.Es = 0{,}0129 \times 200000 = 25800$ kg/cm^2 > 2400 kg/cm^2

fs > fy (tulangan tarik sudah leleh)

Momen lentur nominal (Mn)

= As.fy.(d-a/2)

= 942,478 x (3-0,48/2) = 2601,239 kgcm = 26,01 kgm

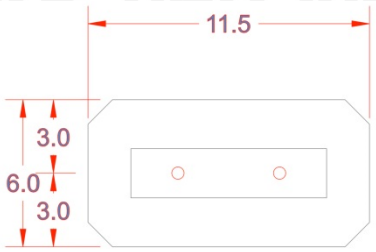
Momen desain maksimum (Mu)

= ϕ.Mn = 0,8.26,01 = 20,81 kgm

Momen desain maksimum (Mu) dinding

= 7 x 20,81 = 145,67 kgm

Pasangan Bata Beton Bertulang dengan Lebar Celah 2 cm



Titik berat tulangan : x = 3 cm dari serat bawah

Tinggi efektif penampang (d) = 6 - 3 = 3 cm

Gaya tarik tulangan (T) =

$$As.fy = \frac{1}{4} x\, \pi\, x\, 0.5^2\, x\, 2\, x\, 2400 = 942{,}478 \text{ kg}$$

Gaya tekan beton (Cc) =

$$0{,}85.f'c.b.a = 0{,}85\, x\, 194{,}8\, x\, 11{,}5\, x\, a = 1904{,}17\, a \text{ kg}$$

Keseimbangan gaya: C = T

Cc = T

$$1904{,}17\, a = 942{,}478$$

a = 0,5 cm

Letak garis netral (c)

$$c = \frac{a}{\beta 1} = \frac{0{,}5}{0{,}85} = 0{,}588 \text{ cm}$$

Kontrol regangan tarik baja (εs) = $\varepsilon_c . \frac{d-c}{c}$

$$= \frac{0{,}003\,(3 - 0{,}588)}{0{,}588} = 0.0123$$

Tegangan baja tarik (fs) =

$\varepsilon s.Es = 0{,}0123 \times 200000 = 24600 \text{ kg/cm}^2 > 2400 \text{ kg/cm}^2$

fs > fy (tulangan tarik sudah leleh)

Momen lentur nominal (Mn)

= As.fy.(d-a/2)

= 942,478 x (3-0,5/2) = 2591,814 kgcm = 25,92 kgm

Momen desain maksimum (Mu)

= ϕ.Mn = 0,8.25,92 = 20,74 kgm

Momen desain maksimum (Mu) dinding

= 7 x 20,74 = 145,18 kgm

Lampiran 8

Analisis Beban Rencana

Beban akibat tekanan tanah aktif (Pa)

γ_{lab} RC 77% = 1386 kg/m^3

ϕ = 37,98°

c = 0

Karena c = 0, maka

$\sigma_a = K_a.\gamma.z$

$$K_a = \frac{1-\sin\phi}{1+\sin\phi} = \tan^2\left(45-\frac{\phi}{2}\right)$$

$$K_a = \tan^2\left(45-\frac{37,98°}{2}\right)$$

= 0,2381

Pada z = 0, σ_a = 0, pada z = 50 cm, σ_a = 0,2381.1386.0,5 = 165,0033 kg/m^2

Gaya aktif

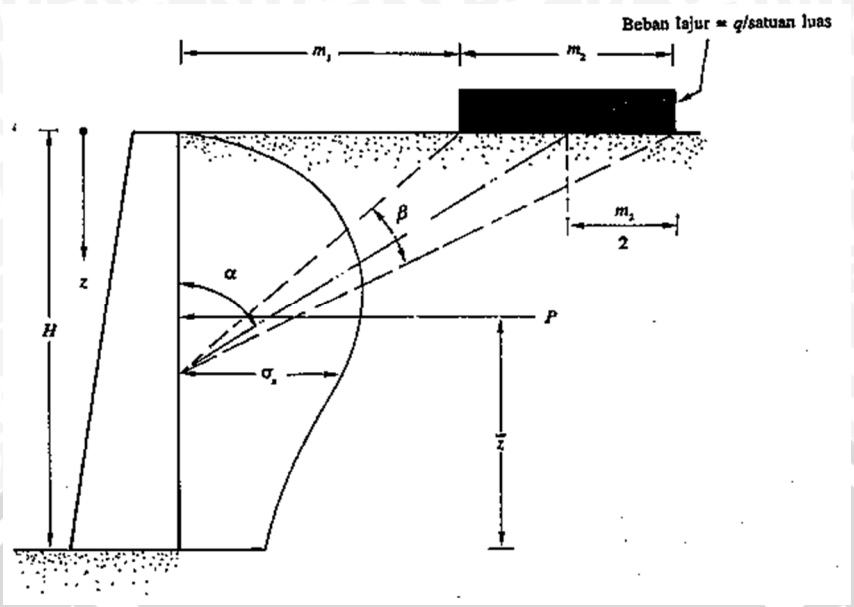
$P_a = 0,5\ K_a\ \gamma H^2$

$P_a = 0,5.0,2381.1386.0,5^2$

= 41,2508 kg/m

Diagram distribusi tekanan berbentuk segitiga, jadi, P_a akan bekerja pada jarak (50/3) = 16,67 cm di atas dasar tembok.

Beban akibat beban lajur(P)



m1 = 10 cm H = 0,5 m

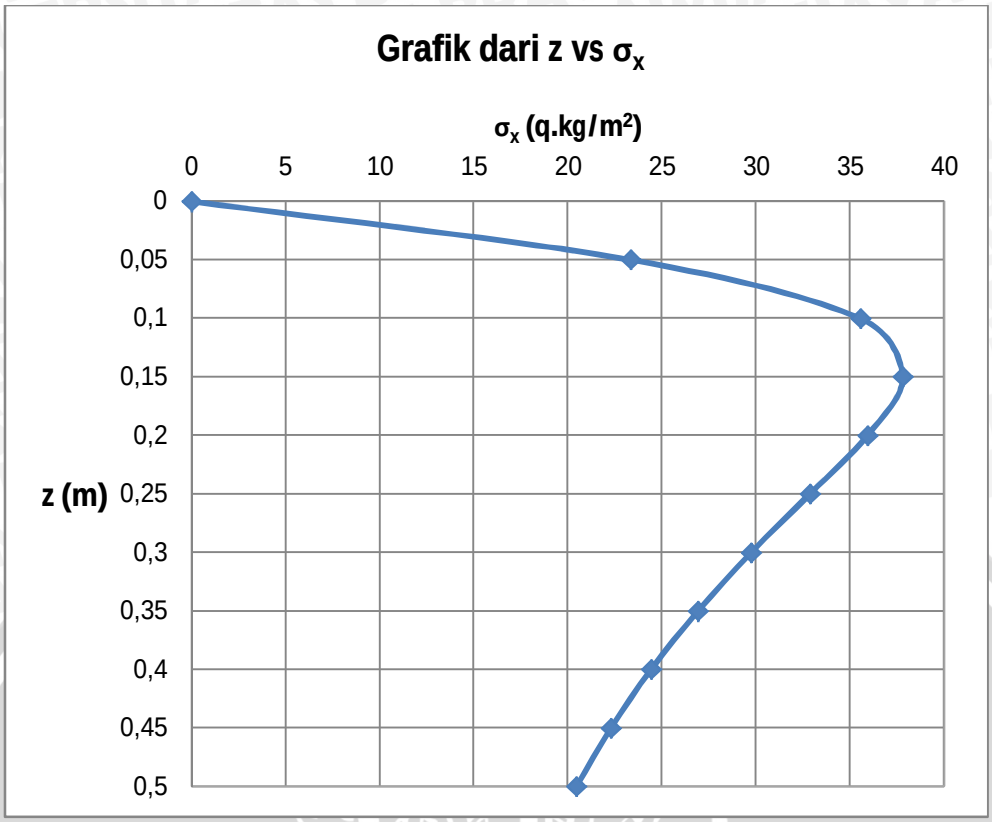
m2 = 10 cm q

Menurut teori elastisitas, tegangan arah horizontal σ_x pada kedalaman z yang bekerja pada tembok, dapat dituliskan sebagai berikut:

$$\sigma_x = \frac{q}{H}\left(\beta - \sin\beta\cos 2\alpha\right)$$

Tabel distribusi tekanan arah horizontal akibat beban lajur (P)

No.	z (m)	α (°)	β (°)	sin β	cos 2α	σ_x (q.kg/m^2)
1	0	0	0	0	1	0
2	0,05	71,5651	12,5288	0,9487	0,9059	23,3388
3	0,10	56,3099	18,4349	0,8320	0,8000	35,5385
4	0,15	45,0000	19,4400	0,7071	0,7785	37,7791
5	0,20	36,8699	18,4349	0,6000	0,8000	35,9098
6	0,25	30,9638	16,8584	0,5145	0,8318	32,8609
7	0,30	26,5651	15,2551	0,4472	0,8615	29,7396
8	0,35	23,1986	13,7995	0,3939	0,8862	26,9008
9	0,40	20,5560	12,5288	0,3511	0,9059	24,4214
10	0,45	18,4349	11,4337	0,3162	0,9214	22,2847
11	0,50	16,6992	10,4915	0,2873	0,9337	20,4464



Tabel luas dan titik berat grafik z vs σ_x

No.	z (m)	Persegi			Segitiga		
		A	titik berat	A x titik berat	A	titik berat	A x titik berat
1	0 - 0,05	0	0	0	0,5835	0,4667	0,2723
2	0,05 - 0,10	1,1669	0,4250	0,4959	0,3050	0,4167	0,1271
3	0,10 - 0,15	1,7769	0,3750	0,6663	0,0560	0,3667	0,0205
4	0,15 - 0,20	1,7955	0,3250	0,5835	0,0467	0,3333	0,0156
5	0,20 - 0,25	1,6430	0,2750	0,4518	0,0762	0,2833	0,0216
6	0,25 - 0,30	1,4870	0,2250	0,3346	0,0780	0,2333	0,0182
7	0,30 - 0,35	1,3450	0,1750	0,2354	0,0710	0,1833	0,0130
8	0,35 - 0,40	1,2211	0,1250	0,1526	0,0620	0,1333	0,0083
9	0,40 - 0,45	1,1142	0,0750	0,0836	0,0534	0,0833	0,0045
10	0,45 - 0,50	1,0223	0,0250	0,0256	0,0460	0,0333	0,0015
Jumlah		12,5720		3,0294	1,3778		0,5025

Titik berat resultan gaya akibat beban lajur:

$$\bar{z} = \frac{\sum(A \times titikberat)}{\sum(A)}$$

$$\bar{z} = \frac{3{,}0294 + 0{,}5025}{12{,}5720 + 1{,}3778} = 0{,}2532\text{m dari tumpuan.}$$

$$\theta_1(derajat) = \tan^{-1}\left(\frac{m_1}{H}\right)$$

$$\theta_1(derajat) = \tan^{-1}\left(\frac{10}{50}\right) = 11{,}31$$

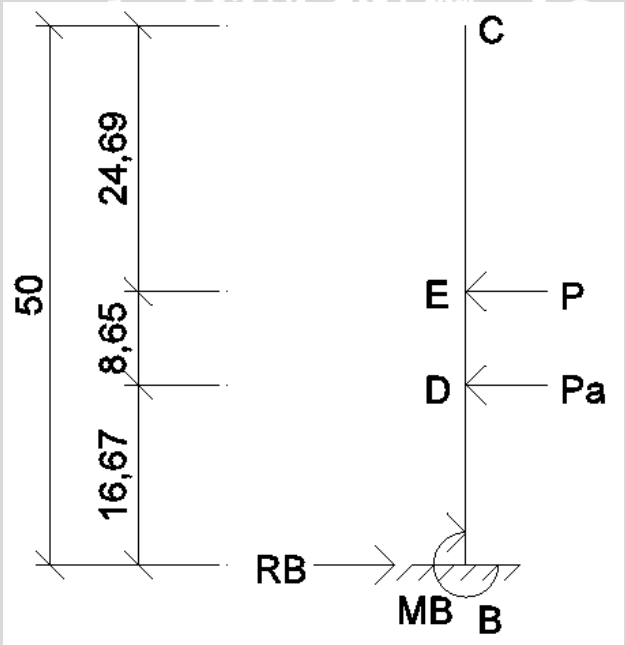
$$\theta_2(derajat) = \tan^{-1}\left(\frac{m_1 + m_2}{H}\right)$$

$$\theta_2(derajat) = \tan^{-1}\left(\frac{10+10}{50}\right) = 21{,}80$$

$$P = \frac{q}{90}\left[H(\theta_2 - \theta_1)\right]$$

$$P = \frac{q}{90}\left[0{,}5(21{,}8 - 11{,}31)\right] = 0{,}0583q$$

Statika:



Dinding dengan celah 1 cm

ΣMB = 145,95 kgm

145,95 = Pa.0,1667 + P.0,2532

145,95 = 41,2508.0,1667 + P.0,2532

145,95 = 6,8765 + P.0,2532

P.0,2532 = 139,0735

P = 549,2634

0,0583q = 549,2634

q = 9421,3276 kg/m^2

Lebar pondasi = 10 cm

q = 9421,3276.0,1 = 942,13276 kg/m

q_{lap} = 1/3q = 1/3. 942,13276 = 314,0442 kg/m

Dinding dengan celah 1,5 cm

$\Sigma MB = 145{,}67\ kgm$

145,67 = Pa.0,1667 + P.0,2532

145,67 = 41,2508.0,1667 + P.0,2532

145,67 = 6,8765 + P.0,2532

P.0,2532 = 138,7935

P = 548,1576

0,0583q = 548,1576

q = 9402,3602 kg/m^2

Lebar pondasi = 10 cm

q = 9402,3602.0,1 = 940,23602 kg/m

q_{lap} = 1/3q = 1/3. 940,23602 = 313,4120 kg/m

Dinding dengan celah 2 cm

$\Sigma MB = 145{,}18\ kgm$

145,18 = Pa.0,1667 + P.0,2532

145,18 = 41,2508.0,1667 + P.0,2532

145,18 = 6,8765 + P.0,2532

P.0,2532 = 138,3035

P = 546,2223

0,0583q = 546,2223

q = 9369,1647 kg/m^2

Lebar pondasi = 10 cm

q = 9369,1647.0,1 = 936,91647 kg/m

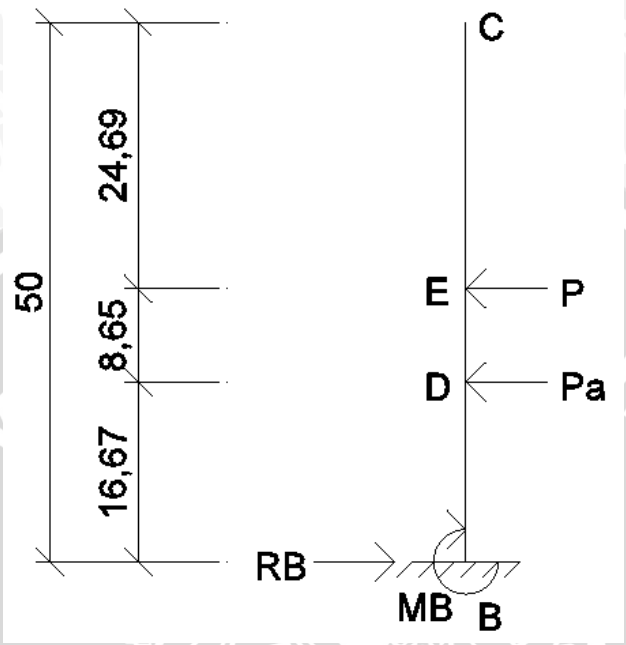
q_{lap} = 1/3q = 1/3. 936,91647 = 312,3055 kg/m

Untuk mengurangi resiko kerusakan dinding yang tidak diinginkan maka beban yang digunakan pada saat pengujian model tes sebesar 200 kg/m

Lampiran 9

Hasil Analisis Deformasi Lateral dengan Metode Balok Konjugit Sebagai Balok Kantilever

Statika:



Pa = 41,2508 kg/m

$$P = \frac{2000}{90}\left[0{,}5\left(21{,}8 - 11{,}31\right)\right] = 116{,}5556 kg/m$$

RB = Pa + P = 41,2508 + 116,5556 = 157,8064 kg

ΣMB = Pa. 0,1667 + P. 0,2532

ΣMB = 41,2508.0,1667 + 116,5556.0,2532

ΣMB = 36,3884 kgm

ΣMD = MB – RB. 0,1667

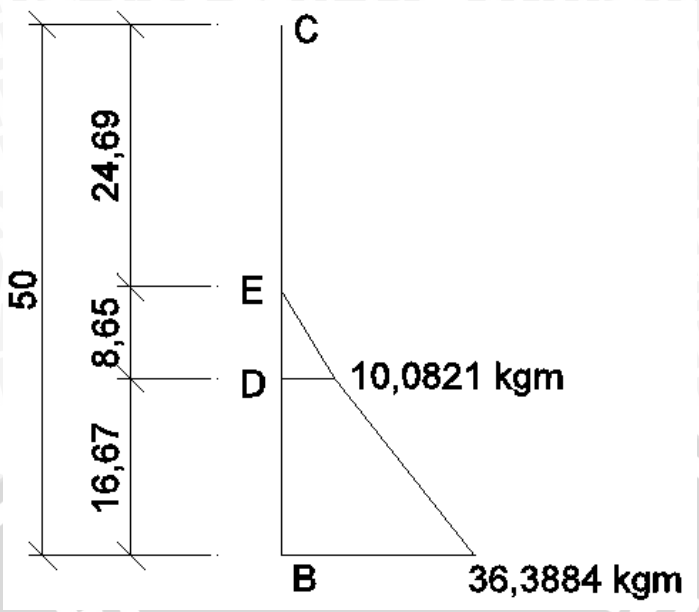
ΣMD = 36,3884 – 157,8064.0,1667

ΣMD = 10,0821 kgm

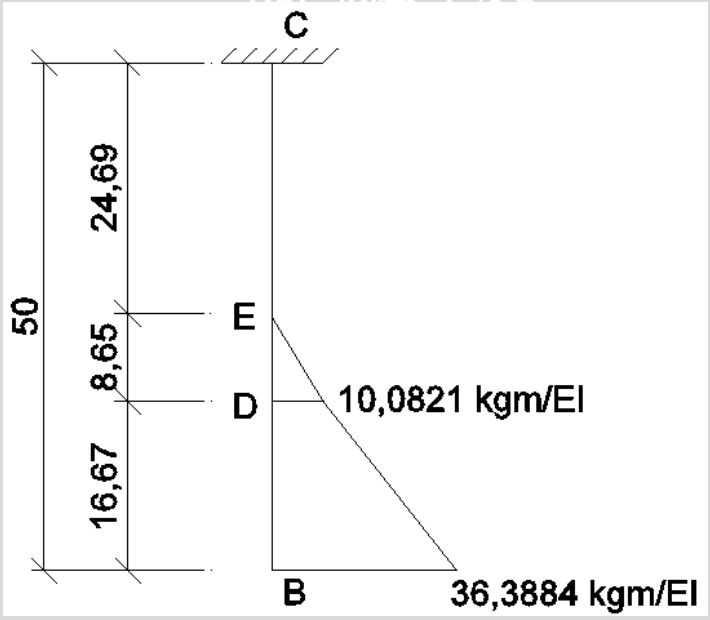
ΣME = MB – RB. 0,2532 + Pa. 0,0865

ΣME = 36,3884 – 157,8064.0,2532 + 41,2508.0,0865

ΣME = 0 kgm



Gambar Diagram Momen



Gambar Balok Konjugit

Total beban konjugit

$$Q = \frac{10{,}0821 \times 0{,}0865}{2EI} + \frac{(10{,}0821 + 36{,}3884) \times 0{,}1667}{2EI}$$

Reaksi balok konjugit

$$RC = Q = \frac{0{,}4360}{EI} + \frac{3{,}8733}{EI} = \frac{4{,}3093}{EI}$$

$$MC = \frac{\left(0{,}2469 + \frac{2}{3} \times 0{,}0865\right)(10{,}0821 \times 0{,}0865)}{2EI} + \frac{\left(0{,}3333 + \frac{1}{2} \times 0{,}1667\right)(10{,}0821 \times 0{,}1667)}{EI} +$$

$$\frac{\left(0{,}3333 + \frac{2}{3} \times 0{,}1667\right)(26{,}3063 \times 0{,}1667)}{2EI}$$

$$MC = \frac{0{,}1328}{EI} + \frac{0{,}7003}{EI} + \frac{0{,}9745}{EI} = \frac{1{,}8076}{EI}$$

Jadi lenturan ujung adalah:

$$\nabla_c = MC = \frac{1{,}8076}{EI}$$

$$E = 4700\sqrt{f'c} = 4700 \times \sqrt{19{,}48} = 20743{,}9919 Mpa = 207439{,}919 kg/cm^2$$

$$E = 2074399190 kg/m^2$$

Dinding dengan celah 1 cm

$$I = \frac{1}{12} \times 0{,}12 \times 0{,}06^3 = 0{,}00000216 m^4$$

$$\nabla_c = \frac{1{,}8076}{EI} = \frac{1{,}8076}{2074399190 \times 0{,}00000216} = 0{,}0004034 m = 0{,}4034 mm$$

Dinding dengan celah 1,5 cm

$$I = \frac{1}{12} \times 0{,}1175 \times 0{,}06^3 = 0{,}000002115 m^4$$

$$\nabla_c = \frac{1{,}8076}{EI} = \frac{1{,}8076}{2074399190 \times 0{,}000002115} = 0{,}0004120 m = 0{,}4120 mm$$

Dinding dengan celah 2 cm

$$I = \frac{1}{12} \times 0{,}115 \times 0{,}06^3 = 0{,}00000207 m^4$$

$$\nabla_c = \frac{1{,}8076}{EI} = \frac{1{,}8076}{2074399190 \times 0{,}00000207} = 0{,}0004210 m = 0{,}4210 mm$$

Sebagai Balok Konsol

Beban akibat tekanan tanah aktif (Pa)

γ_{lab} RC 77% = 1386 kg/m^3

ϕ = 37,98˚

c = 0

Karena c = 0, maka

$\sigma_a = K_a.\gamma.z$

$$K_a = \frac{1-\sin\phi}{1+\sin\phi} = \tan^2\left(45-\frac{\phi}{2}\right)$$

$$K_a = \tan^2\left(45-\frac{37{,}98°}{2}\right)$$

= 0,2381

Pada z = 0, σ_a = 0, pada z = 70 cm, σ_a = 0,2381.1386.0,7 = 231,0046 kg/m^2

Gaya aktif

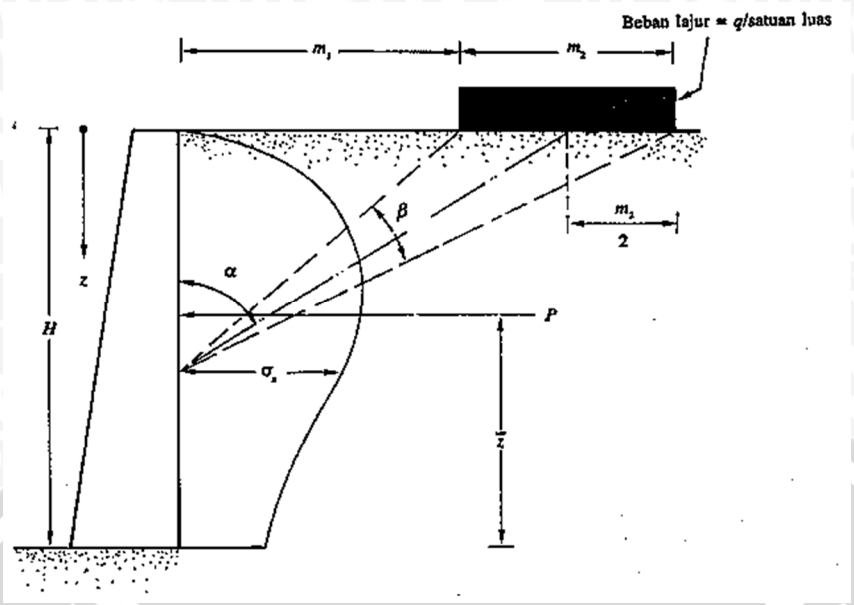
$P_a = 0{,}5\ K_a\ \gamma H^2$

$P_a = 0{,}5.0{,}2381.1386.0{,}7^2$

= 80,8516 kg/m

Diagram distribusi tekanan berbentuk segitiga, jadi, P_a akan bekerja pada jarak (70/3) = 23,33 cm di atas dasar tembok.

Beban akibat beban lajur(P)



m1 = 10 cm H = 0,5 m

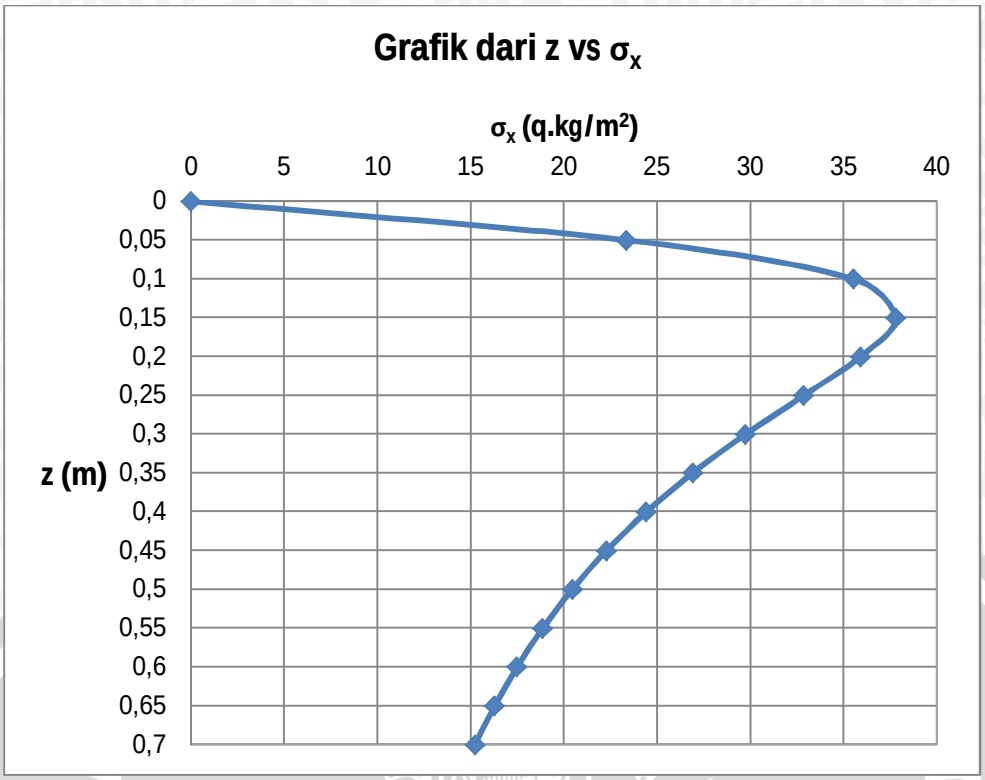
m2 = 10 cm q

Menurut teori elastisitas, tegangan arah horizontal σ_x pada kedalaman z yang bekerja pada tembok, dapat dituliskan sebagai berikut:

$$\sigma_x = \frac{q}{H}\left(\beta - \sin\beta\cos 2\alpha\right)$$

Tabel distribusi tekanan arah horizontal akibat beban lajur (P)

No.	z (m)	α (°)	β (°)	sin β	cos 2α	σ_x (q.kg/m^2)
1	0	0	0	0	1	0
2	0,05	71,5651	12,5288	0,9487	0,9059	23,3388
3	0,10	56,3099	18,4349	0,8320	0,8000	35,5385
4	0,15	45,0000	19,4400	0,7071	0,7785	37,7791
5	0,20	36,8699	18,4349	0,6000	0,8000	35,9098
6	0,25	30,9638	16,8584	0,5145	0,8318	32,8609
7	0,30	26,5651	15,2551	0,4472	0,8615	29,7396
8	0,35	23,1986	13,7995	0,3939	0,8862	26,9008
9	0,40	20,5560	12,5288	0,3511	0,9059	24,4214
10	0,45	18,4349	11,4337	0,3162	0,9214	22,2847
11	0,50	16,6992	10,4915	0,2873	0,9337	20,4464
12	0,55	15,2551	9,6783	0,2631	0,9435	18,8601
13	0,60	14,0362	8,9726	0,2425	0,9514	17,4837
14	0,65	12,9946	8,3566	0,2249	0,9578	16,2825
15	0,70	12,0948	7,8153	0,2095	0,9630	15,2270



Tabel luas dan titik berat grafik z vs σ_x

No.	z (m)	Persegi			Segitiga		
		A	titik berat	A x titik berat	A	titik berat	A x titik berat
1	0 - 0,05	0	0	0	0,5835	0,6667	0,3890
2	0,05 - 0,10	1,1669	0,6250	0,7293	0,3050	0,6167	0,1881
3	0,10 - 0,15	1,7769	0,5750	1,0217	0,0560	0,5667	0,0317
4	0,15 - 0,20	1,7955	0,5250	0,9426	0,0467	0,5333	0,0249
5	0,20 - 0,25	1,6430	0,4750	0,7804	0,0762	0,4833	0,0368
6	0,25 - 0,30	1,4870	0,4250	0,6320	0,0780	0,4333	0,0338
7	0,30 - 0,35	1,3450	0,3750	0,5044	0,0710	0,3833	0,0272
8	0,35 - 0,40	1,2211	0,3250	0,3968	0,0620	0,3333	0,0207
9	0,40 - 0,45	1,1142	0,2750	0,3064	0,0534	0,2833	0,0151
10	0,45 - 0,50	1,0223	0,2250	0,2300	0,0460	0,2333	0,0107
11	0,50 - 0,55	0,9430	0,1750	0,1650	0,0397	0,1833	0,0073
12	0,55 - 0,60	0,8742	0,1250	0,1093	0,0344	0,1333	0,0046
13	0,60 - 0,65	0,8141	0,0750	0,0611	0,0300	0,0833	0,0025
14	0,65 - 0,70	0,7614	0,0250	0,0190	0,0264	0,0333	0,0009
Jumlah		15,9647		5,8982	1,5083		0,7933

Titik berat resultan gaya akibat beban lajur:

$$\bar{z} = \frac{\sum(A \times titikberat)}{\sum(A)}$$

$$\bar{z} = \frac{5{,}8982 + 0{,}7933}{15{,}9647 + 1{,}5083} = 0{,}3830\text{m dari tumpuan.}$$

$$\theta_1(derajat) = \tan^{-1}\left(\frac{m_1}{H}\right)$$

$$\theta_1(derajat) = \tan^{-1}\left(\frac{10}{70}\right) = 8{,}13$$

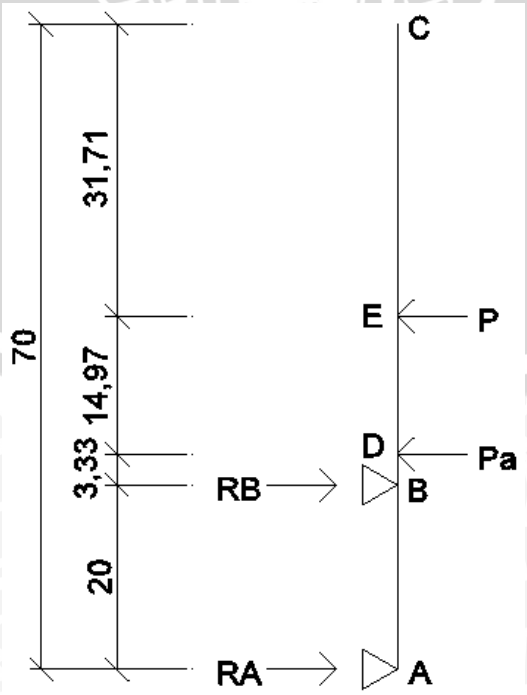
$$\theta_2(derajat) = \tan^{-1}\left(\frac{m_1 + m_2}{H}\right)$$

$$\theta_2(derajat) = \tan^{-1}\left(\frac{10+10}{70}\right) = 15{,}94$$

$$P = \frac{q}{90}\left[H(\theta_2 - \theta_1)\right]$$

$$P = \frac{q}{90}\left[0{,}7(15{,}94 - 8{,}13)\right] = 0{,}0607q$$

Statika:



Pa = 80,8516 kg/m

$$P = \frac{2000}{90}\left[0{,}7(15{,}94 - 8{,}13)\right] = 121{,}4889 kg/m$$

$\Sigma MA = 0$

RB × 0,2 – Pa × 0,2333 – P × 0,3830 = 0

0,2RB – 80,8516 × 0,2333 – 121,4889 × 0,3830 = 0

0,2 RB = 18,8627 + 46,5302

$$RB = \frac{65{,}3929}{0{,}2} = 326{,}9645 \text{ kgm}$$

$\Sigma MB = 0$

–RA × 0,2 – Pa × 0,0333 – P × 0,1830 = 0

–0,2RA – 80,8516 × 0,0333 – 121,4889 × 0,1830 = 0

–0,2 RA = 2,6923 + 22,2325

$$RA = -\frac{24{,}9248}{0{,}2} = -124{,}6240 \text{ kgm}$$

Kontrol

RA + RB = Pa + P

-124,6240 + 326,9645 = 80,8516 + 121,4889

202,3405 kg = 202,3405 kg ...OK!

MBA = RA × 0,2

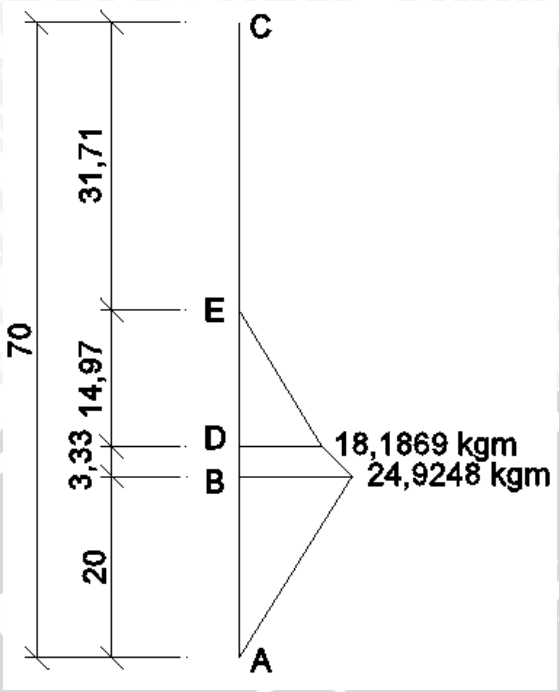
MBA = –124,6240 × 0,2

MBA = –24,9248 kgm

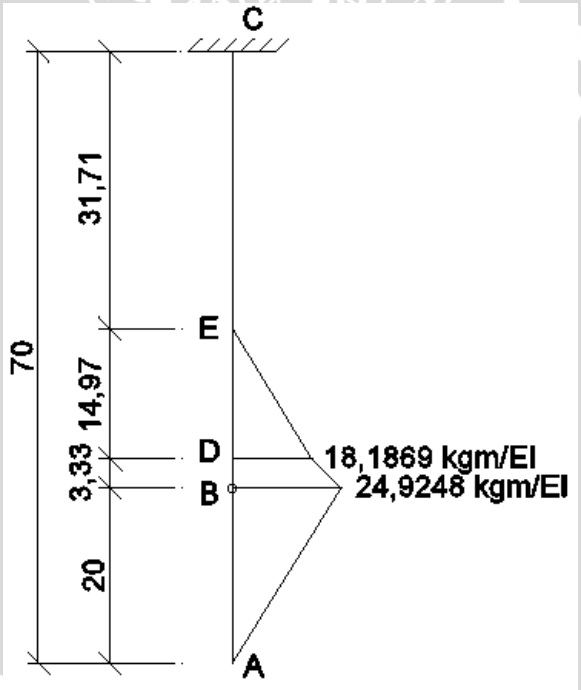
MD = –P × 0,1497

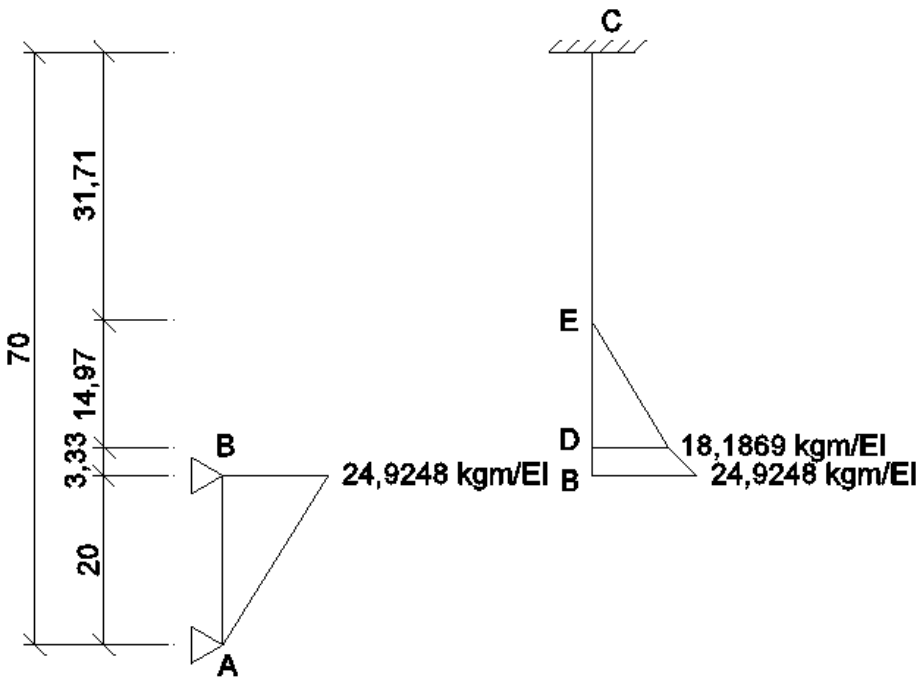
MD = –121,4889 × 0,1497

MD = –18,1869 kgm



Gambar Diagram Momen





Gambar Balok Konjugit

Total beban konjugit

$$Q = \frac{18{,}1869 \times 0{,}1497}{2EI} + \frac{(18{,}1869 + 24{,}9248) \times 0{,}0333}{2EI}$$

Reaksi balok konjugit

$$RC = Q = \frac{1{,}3613}{EI} + \frac{0{,}7178}{EI} = \frac{2{,}0791}{EI}$$

$$MC = \frac{\left(0{,}3171 + \frac{2}{3} \times 0{,}1497\right)(18{,}1869 \times 0{,}1497)}{2EI} + \frac{\left(0{,}4668 + \frac{1}{2} \times 0{,}0333\right)(18{,}1869 \times 0{,}0333)}{EI} +$$

$$\frac{\left(0{,}4668 + \frac{2}{3} \times 0{,}0333\right)(6{,}7379 \times 0{,}0333)}{2EI}$$

$$MC = \frac{0{,}5675}{EI} + \frac{0{,}2928}{EI} + \frac{0{,}0549}{EI} = \frac{0{,}9152}{EI}$$

Jadi lenturan ujung adalah:

$$\nabla_c = MC = \frac{0{,}9152}{EI}$$

$$E = 4700\sqrt{f'c} = 4700 \times \sqrt{19{,}48} = 20743{,}9919 Mpa = 207439{,}919 kg/cm^2$$

$$E = 2074399190 kg/m^2$$

Dinding dengan celah 1 cm

$$I = \frac{1}{12} \times 0{,}12 \times 0{,}06^3 = 0{,}00000216 m^4$$

$$\nabla_c = \frac{0{,}9152}{EI} = \frac{0{,}9152}{2074399190 \times 0{,}00000216} = 0{,}0002042 m = 0{,}2042 mm$$

Dinding dengan celah 1,5 cm

$$I = \frac{1}{12} \times 0{,}1175 \times 0{,}06^3 = 0{,}000002115 m^4$$

$$\nabla_c = \frac{0{,}9152}{EI} = \frac{0{,}9152}{2074399190 \times 0{,}000002115} = 0{,}0002086 m = 0{,}2086 mm$$

Dinding dengan celah 2 cm

$$I = \frac{1}{12} \times 0{,}115 \times 0{,}06^3 = 0{,}00000207 m^4$$

$$\nabla_c = \frac{0{,}9152}{EI} = \frac{0{,}9152}{2074399190 \times 0{,}00000207} = 0{,}0002131 m = 0{,}2131 mm$$

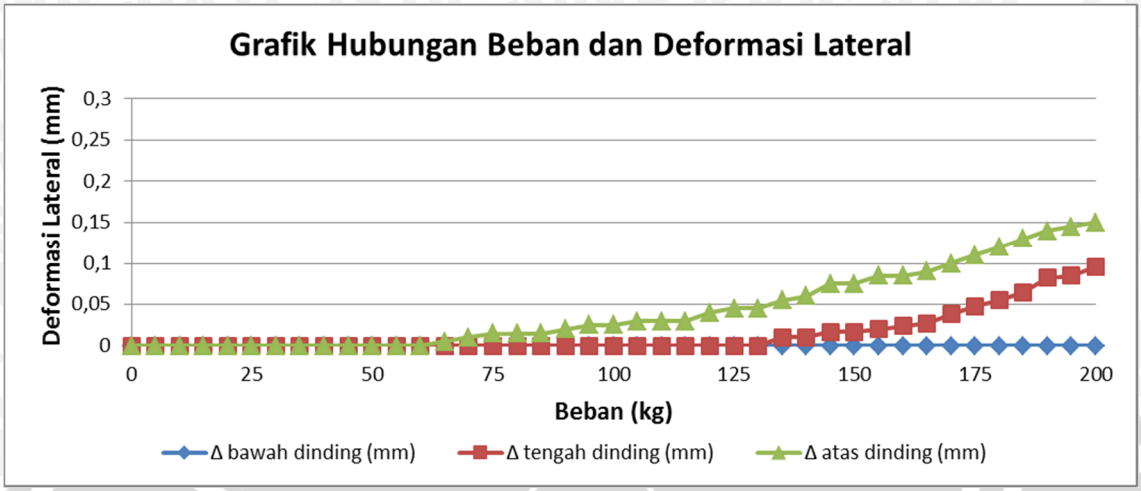
Lampiran 10

Nilai Deformasi Lateral Hasil Eksperimen

Dinding dengan Lebar Celah 1 cm

No	Beban (kg)	LVDT bawah dinding (mm)	Δ bawah dinding (mm)	LVDT tengah dinding (mm)	Δ tengah dinding (mm)	LVDT atas dinding	Δ atas dinding (mm)
1	0	0,115	0	0,096	0	870	0
2	5	0,115	0	0,096	0	870	0
3	10	0,115	0	0,096	0	870	0
4	15	0,115	0	0,096	0	870	0
5	20	0,115	0	0,096	0	870	0
6	25	0,115	0	0,096	0	870	0
7	30	0,115	0	0,096	0	870	0
8	35	0,115	0	0,096	0	870	0
9	40	0,115	0	0,096	0	870	0
10	45	0,115	0	0,096	0	870	0
11	50	0,115	0	0,096	0	870	0
12	55	0,115	0	0,096	0	870	0
13	60	0,115	0	0,096	0	870	0
14	65	0,115	0	0,096	0	869	0,005
15	70	0,115	0	0,096	0	868	0,010
16	75	0,115	0	0,096	0	867	0,015
17	80	0,115	0	0,096	0	867	0,015
18	85	0,115	0	0,096	0	867	0,015
19	90	0,115	0	0,096	0	866	0,020
20	95	0,115	0	0,096	0	865	0,025
21	100	0,115	0	0,096	0	865	0,025
22	105	0,115	0	0,096	0	864	0,030
23	110	0,115	0	0,096	0	864	0,030
24	115	0,115	0	0,096	0	864	0,030
25	120	0,115	0	0,096	0	862	0,040
26	125	0,115	0	0,096	0	861	0,045
27	130	0,115	0	0,096	0	861	0,045
28	135	0,115	0	0,106	0,010	859	0,055
29	140	0,115	0	0,106	0,010	858	0,060
30	145	0,115	0	0,113	0,017	855	0,075
31	150	0,115	0	0,113	0,017	855	0,075
32	155	0,115	0	0,116	0,020	853	0,085
33	160	0,115	0	0,120	0,024	853	0,085
34	165	0,115	0	0,123	0,027	852	0,090
35	170	0,115	0	0,134	0,038	850	0,100
36	175	0,115	0	0,144	0,048	848	0,110
37	180	0,115	0	0,151	0,055	846	0,120

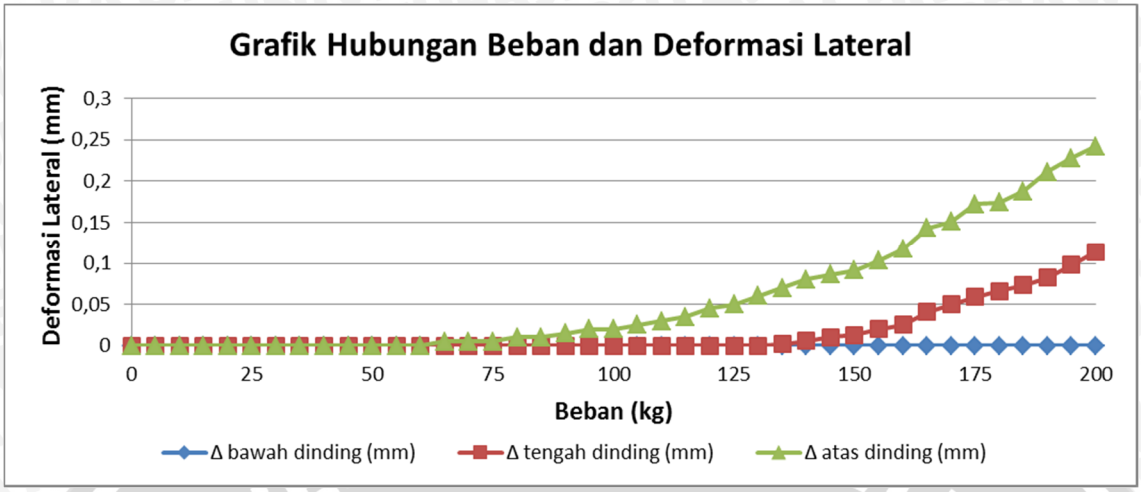
38	185	0,115	0	0,161	0,065	844	0,130
39	190	0,115	0	0,178	0,082	842	0,140
40	195	0,115	0	0,181	0,085	841	0,145
41	200	0,115	0	0,192	0,096	840	0,150



Dinding dengan Lebar Celah 1,5 cm

No	Beban (kg)	LVDT bawah dinding (mm)	Δ bawah dinding (mm)	LVDT tengah dinding (mm)	Δ tengah dinding (mm)	LVDT atas dinding	Δ atas dinding (mm)
1	0	20,231	0	12,756	0	2056	0
2	5	20,231	0	12,756	0	2056	0
3	10	20,231	0	12,756	0	2056	0
4	15	20,231	0	12,756	0	2056	0
5	20	20,231	0	12,756	0	2056	0
6	25	20,231	0	12,756	0	2056	0
7	30	20,231	0	12,756	0	2056	0
8	35	20,231	0	12,756	0	2056	0
9	40	20,231	0	12,756	0	2056	0
10	45	20,231	0	12,756	0	2056	0
11	50	20,231	0	12,756	0	2056	0
12	55	20,231	0	12,756	0	2056	0
13	60	20,231	0	12,756	0	2056	0
14	65	20,231	0	12,756	0	2055	0,005
15	70	20,231	0	12,756	0	2055	0,005
16	75	20,231	0	12,756	0	2055	0,005
17	80	20,231	0	12,756	0	2054	0,010
18	85	20,231	0	12,756	0	2054	0,010
19	90	20,231	0	12,756	0	2053	0,015
20	95	20,231	0	12,756	0	2052	0,020
21	100	20,231	0	12,756	0	2052	0,020
22	105	20,231	0	12,756	0	2051	0,025
23	110	20,231	0	12,756	0	2050	0,030
24	115	20,231	0	12,756	0	2049	0,035
25	120	20,231	0	12,756	0	2047	0,045
26	125	20,231	0	12,756	0	2046	0,050
27	130	20,231	0	12,756	0	2044	0,060
28	135	20,231	0	12,758	0,002	2042	0,070
29	140	20,231	0	12,762	0,006	2040	0,080
30	145	20,240	0	12,775	0,010	2037	0,086
31	150	20,240	0	12,778	0,013	2036	0,091
32	155	20,248	0	12,793	0,020	2032	0,103
33	160	20,249	0	12,799	0,025	2029	0,117
34	165	20,253	0	12,819	0,041	2023	0,143
35	170	20,255	0	12,830	0,050	2021	0,151
36	175	20,259	0	12,843	0,059	2016	0,172
37	180	20,262	0	12,853	0,066	2015	0,174
38	185	20,268	0	12,866	0,073	2011	0,188
39	190	20,270	0	12,877	0,082	2006	0,211

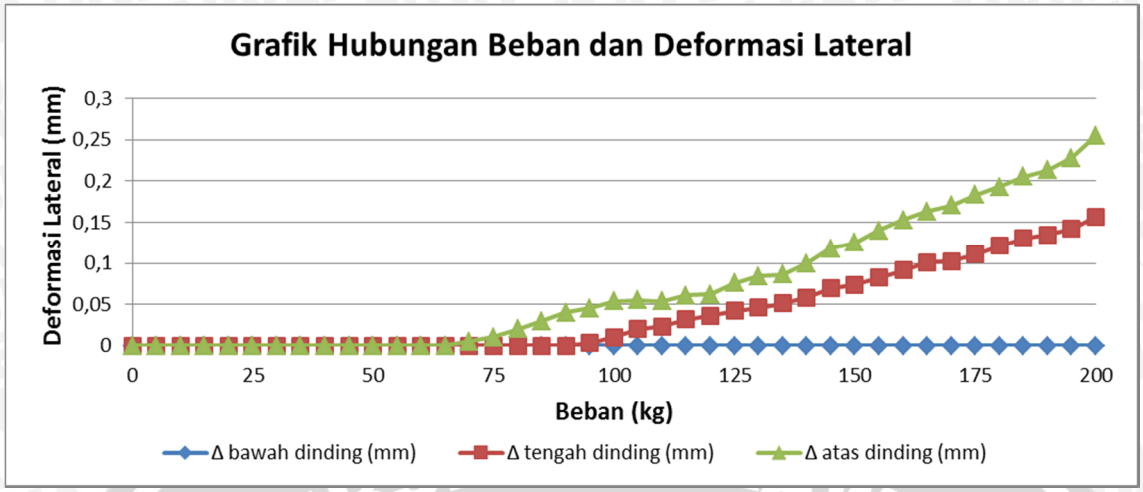
40	195	20,273	0	12,896	0,098	2002	0,228
41	200	20,279	0	12,918	0,114	1998	0,242



Dinding dengan Lebar Celah 2 cm

No	Beban (kg)	LVDT bawah dinding (mm)	Δ bawah dinding (mm)	LVDT tengah dinding (mm)	Δ tengah dinding (mm)	LVDT atas dinding (mm)	Δ atas dinding (mm)
1	0	31,421	0	19,966	0	4781	0
2	5	31,421	0	19,966	0	4781	0
3	10	31,421	0	19,966	0	4781	0
4	15	31,421	0	19,966	0	4781	0
5	20	31,421	0	19,966	0	4781	0
6	25	31,421	0	19,966	0	4781	0
7	30	31,421	0	19,966	0	4781	0
8	35	31,421	0	19,966	0	4781	0
9	40	31,421	0	19,966	0	4781	0
10	45	31,421	0	19,966	0	4781	0
11	50	31,421	0	19,966	0	4781	0
12	55	31,421	0	19,966	0	4781	0
13	60	31,421	0	19,966	0	4781	0
14	65	31,421	0	19,966	0	4781	0
15	70	31,421	0	19,966	0	4780	0,005
16	75	31,421	0	19,966	0	4779	0,010
17	80	31,421	0	19,966	0	4777	0,020
18	85	31,421	0	19,966	0	4775	0,030
19	90	31,421	0	19,966	0	4773	0,040
20	95	31,421	0	19,969	0,003	4772	0,045
21	100	31,427	0	19,982	0,010	4769	0,054
22	105	31,431	0	19,996	0,020	4768	0,055
23	110	31,437	0	20,005	0,023	4767	0,054
24	115	31,440	0	20,017	0,032	4765	0,061
25	120	31,449	0	20,030	0,036	4763	0,062
26	125	31,455	0	20,042	0,042	4759	0,076
27	130	31,462	0	20,053	0,046	4756	0,084
28	135	31,470	0	20,066	0,051	4754	0,086
29	140	31,476	0	20,079	0,058	4750	0,100
30	145	31,478	0	20,092	0,069	4746	0,118
31	150	31,481	0	20,100	0,074	4744	0,125
32	155	31,486	0	20,113	0,082	4740	0,140
33	160	31,488	0	20,124	0,091	4737	0,153
34	165	31,493	0	20,139	0,101	4734	0,163
35	170	31,501	0	20,148	0,102	4731	0,170
36	175	31,503	0	20,159	0,111	4728	0,183
37	180	31,508	0	20,174	0,121	4725	0,193
38	185	31,516	0	20,191	0,130	4721	0,205
39	190	31,518	0	20,198	0,135	4719	0,213
40	195	31,523	0	20,210	0,142	4715	0,228

41	200	31,526	0	20,228	0,157	4709	0,255



Lampiran 11

Analisis Debit Aliran Air Secara Analitis dan Aktual

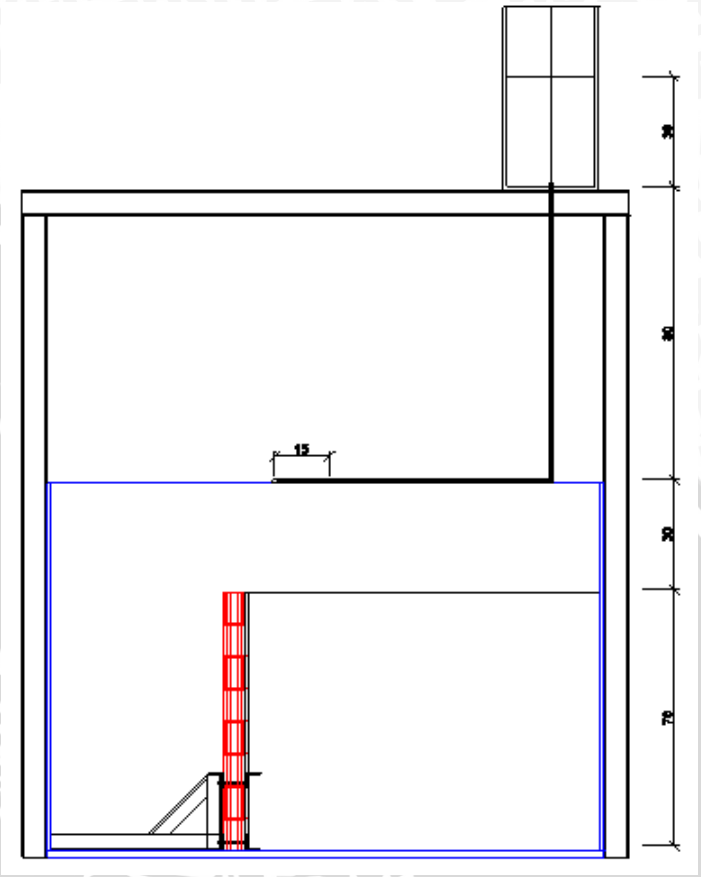
Dimensi galon:

Diameter : 26 cm

Tinggi : 50 cm

Tinggi air : 30 cm

Diameter kran : 1 cm



Kecepatan air yang keluar dari galon:

g = 9,8 m/s^2

V = $\sqrt{2gh}$

= $\sqrt{2.9,8.0,3}$

= 2,425 m/detik

= 2425 mm/detik

Debit air yang keluar dari galon:

Q = A.V

= (1/4.π.d^2).V

= (1/4.π.10^2).2425

= 190459,055 mm^3/detik

Intensitas hujan rencana yang turun:

I = Q/A$_{area}$

= 190459,055/(980.970)

= 0,200 mm/detik

= 720 mm/jam

Debit aktual air yang keluar dari galon:

Q = 1000 ml/13detik = 1000000 mm^3/13detik = 76923,07692 mm3/detik

Intensitas hujan yang turun:

I = Q/A_{area}

= 76923,07692/(980.970)

= 0,08 mm/detik

= 288 mm/jam

Lama hujan yang turun:

t = 138 menit