CHAPTER VI

CONCLUSION AND SUGGESTION

6.1. Conclusion

Based on the result of this research, the conclusion that can be drawn are listed below:

1. Addition of CKD to the original soil decrease the plasticity index of the mixture from 31.42 % to as low as 10.5 % with the mixture with 20 % CKD addition. Mixture with 10 and 15 percent CKD addition also undergo plasticity index decrement. Although, the largest decrement is obtained from 20 % CKD addition.
2. Mixtures with 20 % CKD content and variation of 10 %, 15 %, and 20 % of RHA, undergo changes in their plasticity behavior.
3. The significant result of decrement of plasticity index are obtained after the mixtures are cured for 28 days, despite the mixture with 15 % and 20 % RHA addition experiences an increment in plasticity index after 36 days curing time.
4. Overall the plasticity index of soil mixed with CKD + RHA are decreasing, which indicates an improvement.
5. Mixtures with 20 % CKD content and variation of 10 %, 15 %, and 20 % of RHA, undergo an improvement. Every variation of

RHA addition show that soil shear strength is improving in every curing time.

6. Addition of CKD and RHA increases the mixture friction angle. Increasing value of friction angle might be because bigger grains material are formed which caused the plasticity index to decrease. In addition, increasing value of friction angle leads to soil shear strength increment. On the other hand, cohesion value do not affected by the addition of CKD and RHA.

6.2. Suggestion

Following this research, from laboratory tests and data analysis, there are several suggestions for next researchers, which are:

1. Soil with CKD as the stabilizer are promising topics in geotechnical engineering field, due to lack of research regarding CKD in Indonesia, it is better to make sure that CKD that is obtained from cement factory whether it contain the desired amount CaO.
2. CKD and RHA are both by-products in their respective industry. Which open the possibility of using it as a soil stabilization method in Indonesia, further research regarding the shear strength with unconfined compressive test and triaxial test are needed in order to make it happen.

3. Grain size distribution test also can be conducted in order to analyze the formation of grained material from CKD and RHA addition.
4. Minimize human error when operating the apparatus in the laboratory.

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APPENDIX I

Original Soil Properties

A. Water Content Test

Sample No.		1	2
Tin Box Weight (empty)	w1 gram	13,88	13,67
Tin Box Weight (wet soil)	w2 gram	75,44	78,60
Tin Box Weight (dried soil)	w3 gram	50,77	52,83
Water Weight	w4 = (w2-w3) gram	24,67	25,77
Dried Soil Weight	w5 = (w3-w1) gram	36,89	39,16
Water Content	w4/w5 x 100%	66,87	65,81
Average Water Content (%)		66,34	

B. Specific Gravity Test

	Picnometer Code	a	b
w1	Picnometer Weight (empty)	30,36	28,84
w2	Picnometer Weight (dried soil)	54,16	55,21
w3	Picnometer Weight (soil + water)	94,69	94,17
w4	Picnometer Weight + Water	80,04	78,14
A	w2-w1	23,80	26,37
B	w3-w4	14,65	16,03
C	A-B	9,15	10,34
G	Specific Gravity = A/C	2,6011	2,5503
	Average Specific Gravity	2,5757	

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C. Sieve Analysis

Sieve No.	Grain Size (mm)	Sieve Weight (gram)	Sieve Weight + Retained weight (gram)	Retained Weight (gram)	Passing Weight (gram)	Passing Percentage (%)
		a	b	c = (b - a)	d = (T - c)	(d / J) x 100 %
4	4,750	585,32	588,61	3,29	96,71	96,71
10	2,000	530,91	534,38	3,47	93,24	93,24
20	0,850	487,45	495,45	8,00	85,24	85,24
40	0,425	436,11	446,05	9,94	75,30	75,30
60	0,250	435,64	442,78	7,14	68,16	68,16
140	0,106	427,44	435,07	7,63	60,53	60,53
200	0,075	415,71	417,06	1,35	59,18	59,18
Pan				59,18		
Total Weight (T)				100,00		

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D. Hydrometer Analysis

Hydrometer Type	152
Meniscus Correction	m= 1
Berat Jenis Tanah	G= 2,3115
Koreksi Hidrometer 152	a= 1,0974

Oven Dried Weight (W)	100 gr
K****	1,0974
Reagen	Na_2SiO_3
Reagen Amount	2 tablespoons

Date	Time	Timer (Minutes)	Suspension Reading	Fluids Reading	Temperature °C	Meniscus Corrected Reading	Effective Depth	Constant	Grain Diameter (mm)	Corrected Reading	Lower Percentage %
		T	R1	R2	t °C	R' = R1+m	L* (mm)	K_h**	D	R = R1 - R2	p*** (%)
30-Nov-17	16.05	2	15	3	28	16	13,7	0,01391	0,03640	12	16,6884
	16.08	5	15	3	28	16	13,7	0,01391	0,02302	12	16,6884
	16.38	30	11	3	28	12	14,3	0,01391	0,00960	8	11,1256
	17.03	60	9	3	28	10	14,7	0,01391	0,00688	6	8,3442
	20.13	250	7	3	28	8	15,0	0,01391	0,00341	4	5,5628
01-Dec-17	16.03	1440	3	3	26	4	15,6	0,01391	0,00145	0	0,0000

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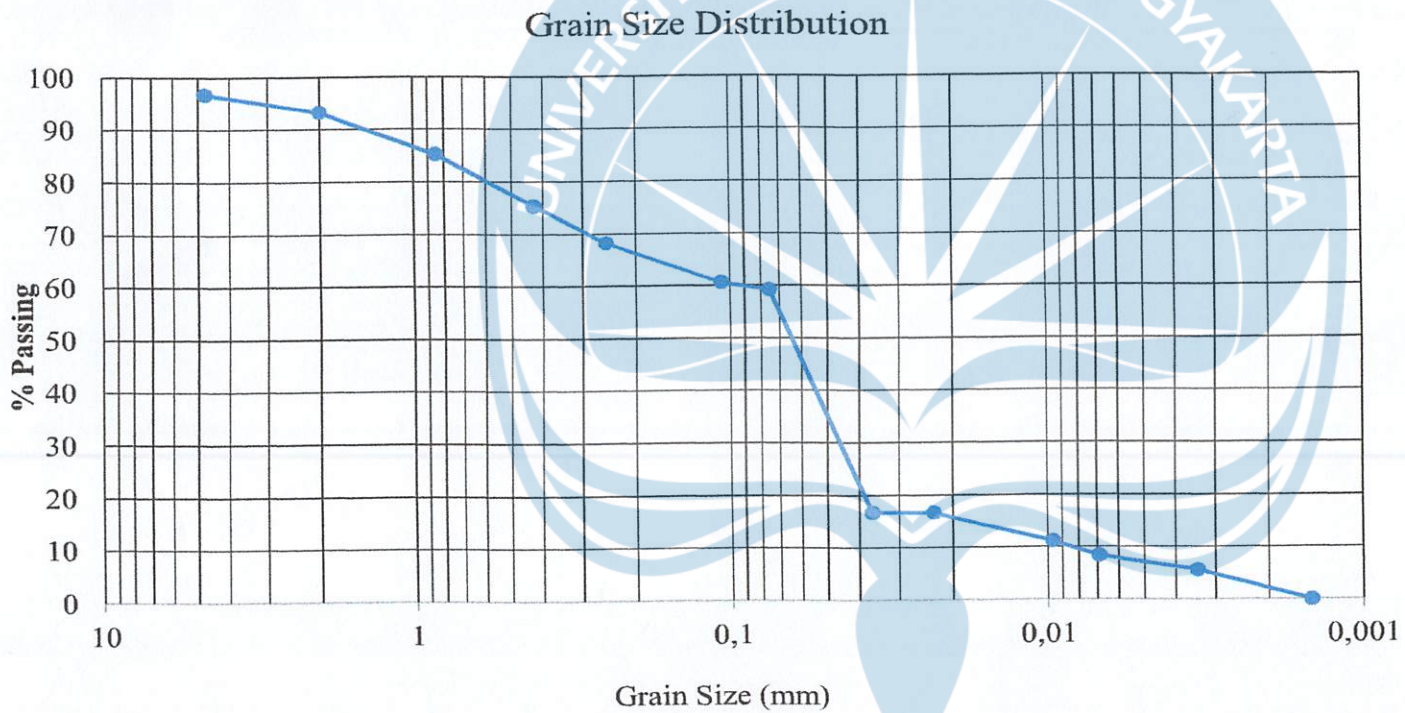
E. Grain Size Distribution Graph



Information:

Grain size

10 mm – 4.75 mm (gravel)

4.75 mm – 0.075 mm (sand)

0.075 mm – 0.005 mm (silt)

< 0.005 mm (clay)

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F. Plastic Limit Test

Original Soil

Project : Final Project

Location : Kasongan, Bantul, D.I. Yogyakarta

Date : 4th December 2017

Tin Box		A	B
Tin Box (empty)	w1 gram	13,54	13,83
Tin Box (wet soil)	w2 gram	17,03	17,12
Tin Box (dried soil)	w3 gram	16,21	16,32
Water Weight	w4 = (w2-w3) gram	0,82	0,8
Dried Soil Weight	w5 = (w3-w1) gram	2,67	2,49
Water Content	w4/w5 x 100%	30,711	32,128
Average Water Content		31,420	
Plastic Limit		31,420	

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G. Liquid Limit Test

Original Soil

Project : **Final Project** **Location** : **Kasongan, Bantul, D.I. Yogyakarta**

Date : **4th December 2017**

Test No.		1		2		3		4	
No. of Blows		16		23		29		39	
Tin Box		1-Left	1-Right	2-Left	2-Right	3-Left	3-Right	4-Left	4-Right
Tin Box Weight (empty)	wt (gram)	9,11	10,49	15,11	14,47	17,88	14,54	10,42	10,43
Tin Box Weight (wet soil)	w1 (gram)	61,53	53,16	61,96	67,83	61,67	60,76	56,29	55,55
Tin Box Weight (dry soil)	w2 (gram)	40,04	35,61	43,27	46,59	44,69	42,84	38,74	38,28
Water Weight	Ww = w1 - w2	21,49	17,55	18,69	21,24	16,98	17,92	17,55	17,27
Dried Soil Weight	Ws = w2 - wt	30,93	25,12	28,16	32,12	26,81	28,3	28,32	27,85
Water Content	w = (Ww / Ws) x 100%	69,479	69,864	66,370	66,127	63,334	63,321	61,970	62,010
Average Water Content		69,672		66,248		63,328		61,990	

Liquid Limit (LL) = 65.8975 %

$w100$ = 40.735 %

$w10$ = 70.93 %

Flow Index (I_f) = $w10 - w100$ = 30.195 %

Plasticity Index (PI) = LL – PL = 34.4774 %

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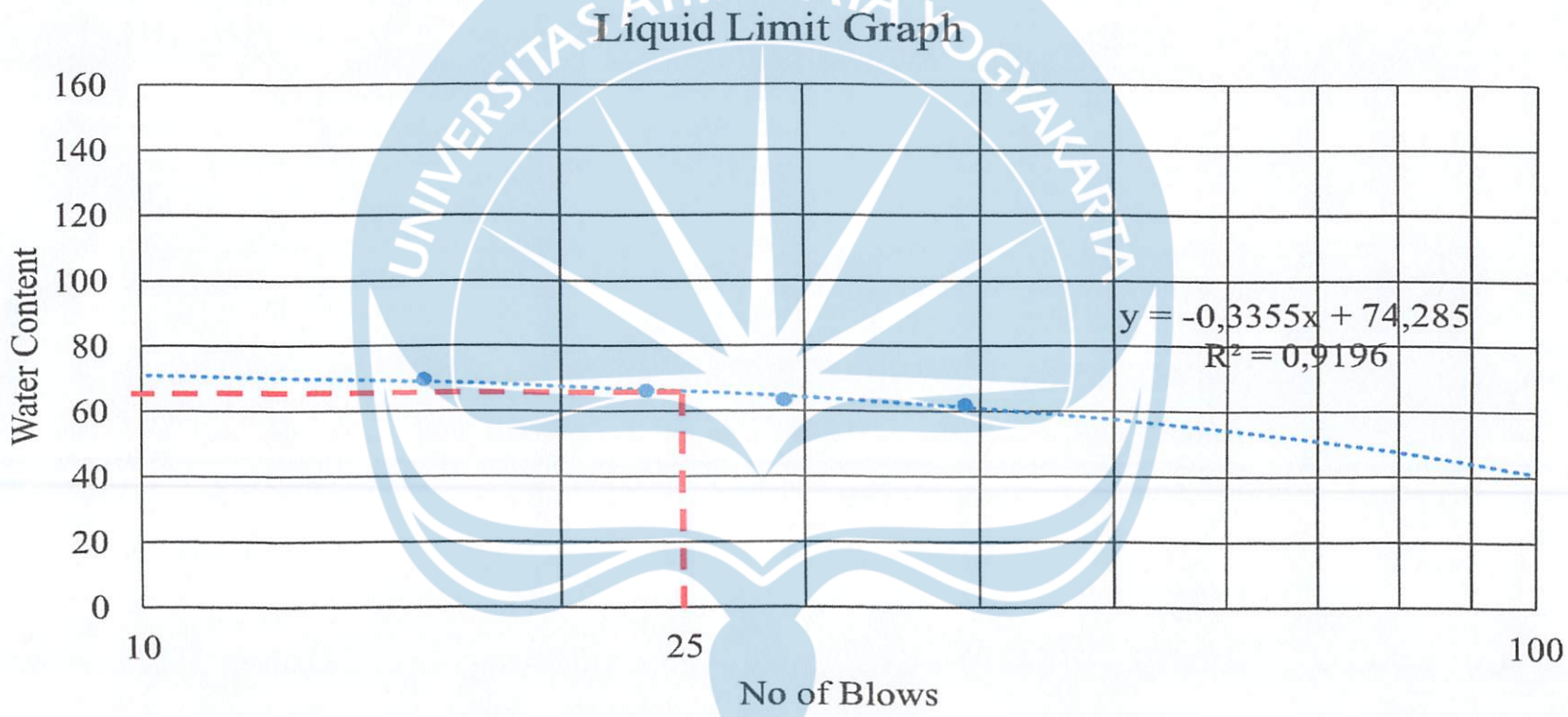

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H. DIRECT SHEAR TEST

Original Soil (0 day curing time)

Project : Final Project

Location: Kasongan, Bantul, D. I. Yogyakarta

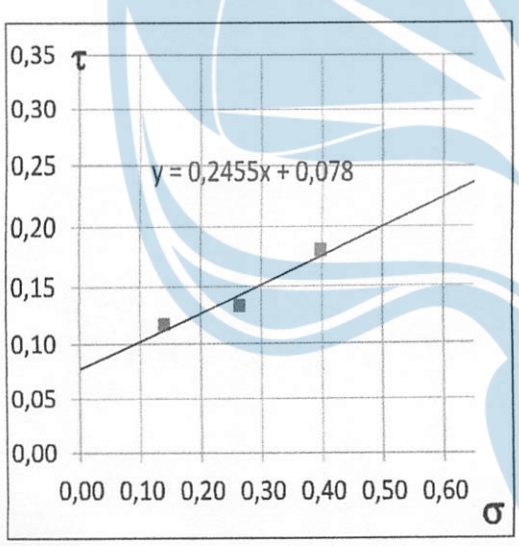
Date : 5th December 2017

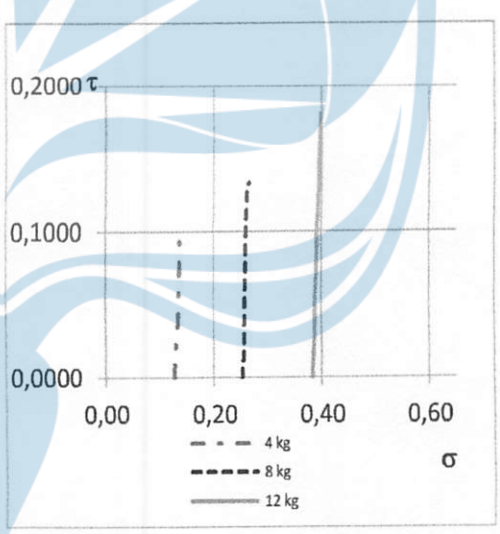
Load (kg)	τ (kg/cm²)	σ (kg/cm²)
4	0,1174	0,1398
8	0,1332	0,2645
12	0,1804	0,3979

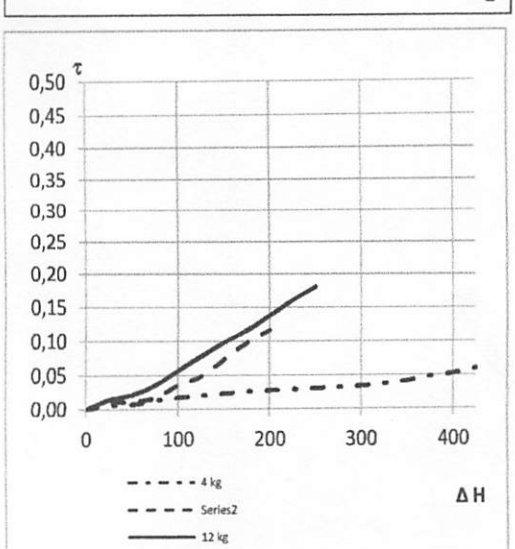
$c = 0.078$ kg/cm²

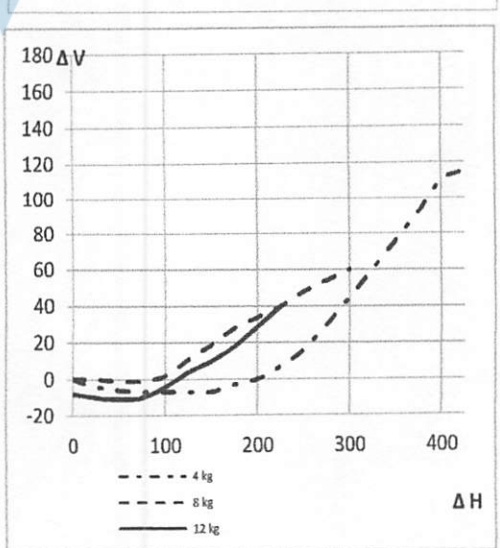
$\tan \phi = 0.2455$

$\phi = 13.79^{\circ}$









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Sample Data

Load : 4 kg

Diameter : 6.356 cm

Height : 2.4 cm

Area : 31.729 cm^2

Weight : 93.19 gr

ΔH ($x10^{-3}$ cm)	ΔV ($x10^{-3}$ cm)	ε (%)	Load Dial	Load kg	τ ($x10^{-3}$ cm)	σ ($x10^{-3}$ cm)
0	0	0,0000	0	0,00	0,0000	0,1261
25	-4	0,0039	4	0,18	0,0057	0,1266
50	-6	0,0079	5	0,22	0,0070	0,1271
75	-7	0,0118	9	0,40	0,0127	0,1276
100	-7	0,0157	12	0,53	0,0170	0,1281
125	-7	0,0197	14	0,62	0,0199	0,1286
150	-7	0,0236	16	0,71	0,0229	0,1291
175	-3	0,0275	18	0,80	0,0259	0,1296
200	0	0,0315	19	0,84	0,0273	0,1302
225	7	0,0354	20	0,88	0,0287	0,1307
250	16	0,0393	21	0,93	0,0305	0,1312
275	30	0,0433	22	0,97	0,0319	0,1318
300	45	0,0472	23	1,02	0,0337	0,1323
325	60	0,0511	25	1,11	0,0368	0,1329
350	76	0,0551	28	1,24	0,0413	0,1334
375	92	0,0590	32	1,42	0,0475	0,1340
400	110	0,0629	35	1,55	0,0521	0,1345
425	116	0,0669	40	1,77	0,0597	0,1351
450	130	0,0708	50	2,21	0,0749	0,1357
475	147	0,0747	57	2,48	0,0844	0,1362
500	152	0,0787	65	2,83	0,0967	0,1368
525	160	0,0826	70	3,10	0,1064	0,1374
550	170	0,0865	75	3,32	0,1145	0,1380
575	182	0,0905	76	3,36	0,1164	0,1386
600	183	0,0944	76	3,36	0,1169	0,1392
625	182	0,0983	76	3,36	0,1174	0,1398

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Sample Data

Load : 8 kg

Diameter : 6.358 cm

Height : 2.13 cm

Area : 31.749 cm^2

Weight : 113.59 gr

ΔH ($x10^{-3}$ cm)	ΔV ($x10^{-3}$ cm)	ε (%)	Load Dial	Load kg	τ ($x10^{-3}$ cm)	σ ($x10^{-3}$ cm)
0	0	0,0000	0	0	0,0000	0,2520
25	0	0,0039	7	0,31	0,0098	0,2530
50	-1	0,0079	8	0,35	0,0111	0,2540
75	-1	0,0118	12	0,53	0,0169	0,2550
100	2	0,0157	25	1,11	0,0355	0,2560
125	11	0,0197	34	1,5	0,0482	0,2570
150	19	0,0236	52	2,26	0,0729	0,2581
175	28	0,0275	68	3,01	0,0975	0,2591
200	34	0,0315	81	3,58	0,1164	0,2602
225	40	0,0354	90	3,98	0,1300	0,2612
250	48	0,0393	91	4,03	0,1321	0,2623
275	54	0,0433	91	4,03	0,1327	0,2634
300	60	0,0472	91	4,03	0,1332	0,2645

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Sample Data

Load : 8 kg

Diameter : 6.322 cm

Height : 2.04 cm

Area : 31.39 cm^2

Weight : 105.78 gr

ΔH ($x10^{-3}$ cm)	ΔV ($x10^{-3}$ cm)	ε (%)	Load Dial	Load kg	τ ($x10^{-3}$ cm)	σ ($x10^{-3}$ cm)
0	0	0,0000	0	0	0,0000	0,3823
25	-8,0	0,0039	10	0,44	0,0141	0,3838
50	-10,0	0,0079	15	0,66	0,0212	0,3853
75	-11,0	0,0118	25	1,11	0,0358	0,3868
100	-10,0	0,0157	40	1,77	0,0573	0,3884
125	-4,0	0,0197	55	2,39	0,0777	0,3899
150	4,0	0,0236	68	3,01	0,0982	0,3915
175	10,0	0,0275	80	3,54	0,1160	0,3931
200	18,0	0,0315	95	4,2	0,1381	0,3947
225	29,0	0,0354	110	4,87	0,1608	0,3963
250	40,0	0,0393	123	5,44	0,1804	0,3979

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APPENDIX II

SOIL + CKD

I. SOIL + 10 % CKD (0 day curing time)

A. PLASTIC LIMIT TEST

Project : **Final Project**

Location : **Kasongan, Bantul, D.I. Yogyakarta**

Date : **22md January 2018**

Tin Box		A	B
Tin Box (empty)	w1 gram	13.67	13,88
Tin Box (wet soil)	w2 gram	17,1	16.37
Tin Box (dried soil)	w3 gram	16,24	15.74
Water Weight	w4 = (w2-w3) gram	0,86	0,63
Dried Soil Weight	w5 = (w3-w1) gram	2,57	2,1.86
Water Content	w4/w5 x 100%	33.46	33.87
Average Water Content		33.667	
Plastic Limit		33.667	

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B. LIQUID LIMIT TEST

Project : **Final Project**

Location : **Kasongan, Bantul, D.I. Yogyakarta**

Date : **22nd January 2018**

Test No.		1		2		3		4	
No. of Blows		19		24		32		36	
Tin Box		1-Left	1-Right	2-Left	2-Right	3-Left	3-Right	4-Left	4-Right
Tin Box Weight (empty)	wt (gram)	13,61	16,88	8,36	9,27	13,5	13,69	13,63	13,75
Tin Box Weight (wet soil)	w1 (gram)	48,42	46,76	48,66	50,51	54,7	52,66	53,07	53,45
Tin Box Weight (dry soil)	w2 (gram)	36,08	35,21	33,98	35,44	40,5	39,26	39,82	40,1
Water Weight	Ww = w1 - w2	12,34	11,55	14,68	15,07	14,2	13,4	13,25	13,35
Dried Soil Weight	Ws = w2 - wt	22,47	18,33	25,62	26,17	27	25,57	26,19	26,35
Water Content	w = (Ww / Ws) x 100%	54,917	63,011	57,299	57,585	52,592	52,405	50,591	50,664
Average Water Content		58,964		57,442		52,498		50,627	

Liquid Limit (LL) = 56.2915 %

$w100$ = 17.869 %

$w10$ = 63.976 %

Flow Index (I_f) = $w10 - w100$ = 46.107 %

Plasticity Index (PI) = LL – PL = 22.6245 %

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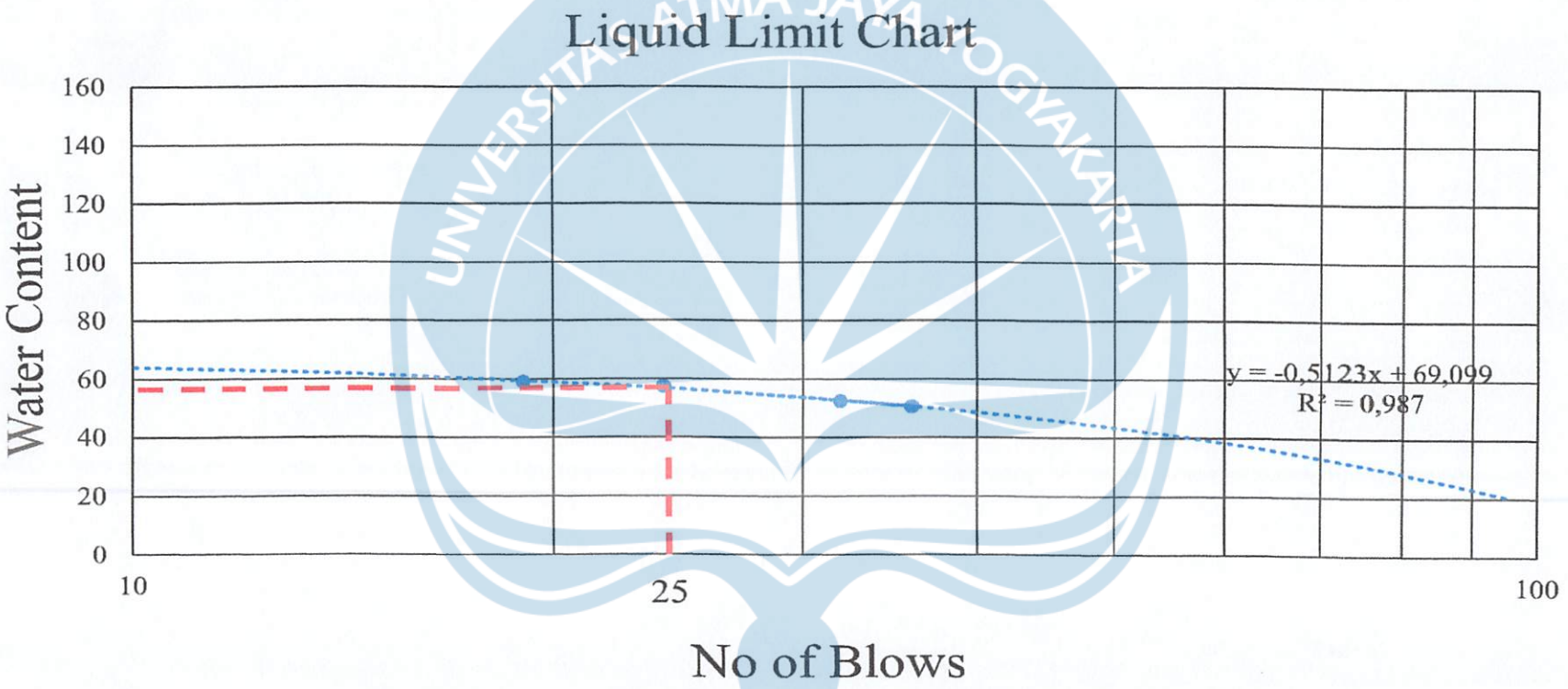

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II. SOIL + 15 % CKD (0 day curing time)

A. PLASTIC LIMIT TEST

Project : Final Project

Location : Kasongan, Bantul, D.I. Yogyakarta

Date : 22nd January 2018

Tin Box		A	B
Tin Box (empty)	w1 gram	13.65	13.73
Tin Box (wet soil)	w2 gram	18.05	17.45
Tin Box (dried soil)	w3 gram	16.9	16.5
Water Weight	w4 = (w2-w3) gram	1.15	0.95
Dried Soil Weight	w5 = (w3-w1) gram	3.25	2.77
Water Content	w4/w5 x 100%	35.385	34.296
Average Water Content		34.84	
Plastic Limit		34.84	

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B. LIQUID LIMIT TEST

Project : **Final Project**

Location : **Kasongan, Bantul, D.I. Yogyakarta**

Date : **22nd January 2018**

Test No.		1		2		3		4	
No. of Blows		17		23		29		38	
Tin Box		1-Left	1-Right	2-Left	2-Right	3-Left	3-Right	4-Left	4-Right
Tin Box Weight (empty)	wt (gram)	13,64	13,24	13,62	13,7	14,06	13,99	9,48	9,52
Tin Box Weight (wet soil)	w1 (gram)	53,24	58,14	53,58	62,03	61,53	60,47	46,28	47,47
Tin Box Weight (dry soil)	w2 (gram)	39,3	42,31	40,21	45,97	46,13	45,35	34,12	36,63
Water Weight	Ww = w1 - w2	13,94	15,83	13,37	16,06	15,4	15,12	12,16	10,84
Dried Soil Weight	Ws = w2 - wt	25,66	29,07	26,59	32,27	32,07	31,36	24,64	27,11
Water Content	w = (Ww / Ws) x 100%	54,325	54,454	50,282	49,767	48,02	48,214	49,350	39,985
Average Water Content		54,390		50,024		48,117		44,667	

Liquid Limit (LL) = 49.977 %

$w100$ = 16.302 %

$w10$ = 56.712 %

Flow Index (I_f) = $w10 - w100$ = 40.41 %

Plasticity Index (PI) = LL – PL = 15.137 %

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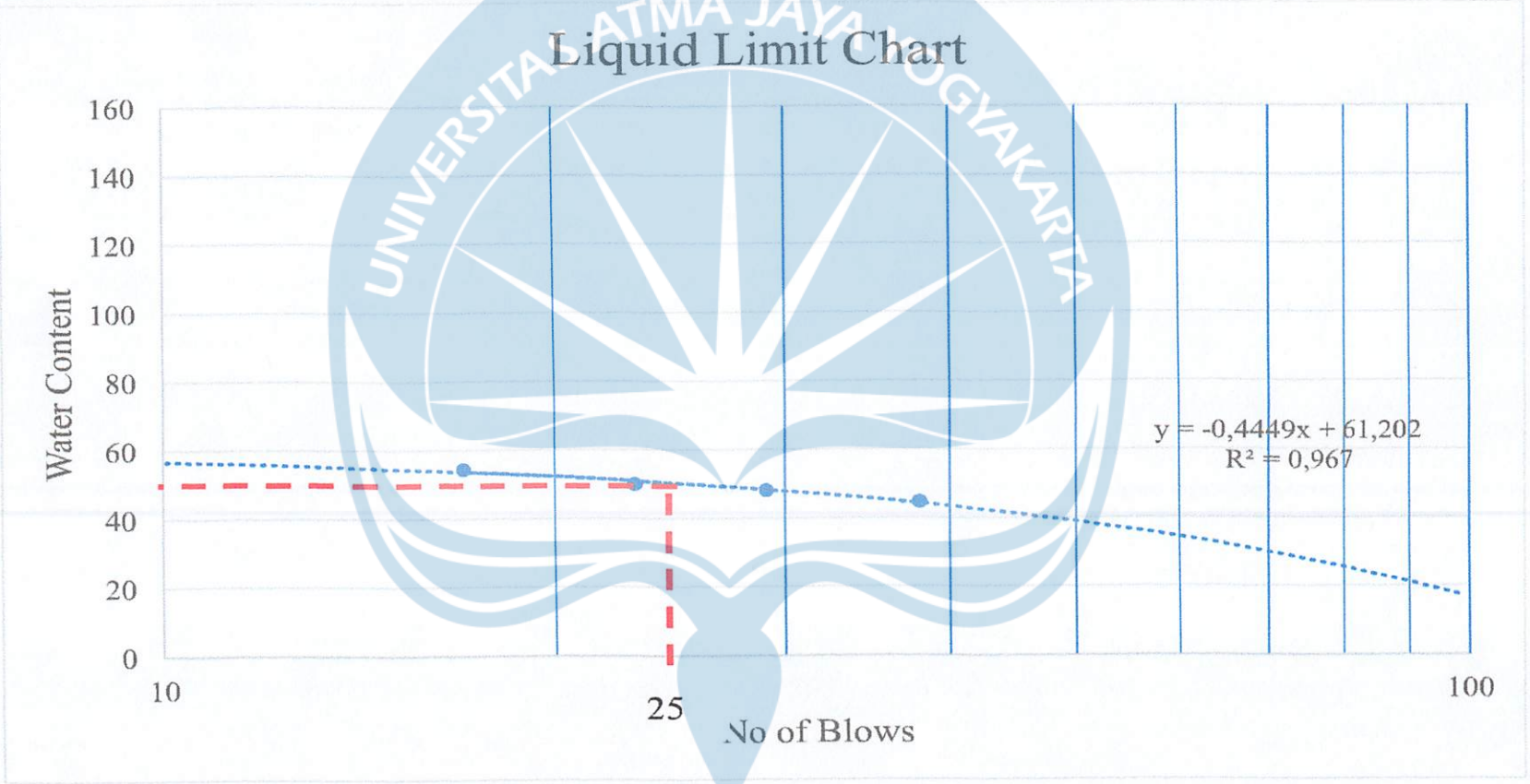

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III. SOIL + 20 % CKD (0 day curing time)

A. PLASTIC LIMIT TEST

Project : **Final Project**

Location : **Kasongan, Bantul, D.I. Yogyakarta**

Date : **22nd January 2018**

Tin Box		A	B
Tin Box (empty)	w1 gram	13,65	13,73
Tin Box (wet soil)	w2 gram	18,05	17,45
Tin Box (dried soil)	w3 gram	16,9	16,5
Water Weight	w4 = (w2-w3) gram	1,15	0,95
Dried Soil Weight	w5 = (w3-w1) gram	3,25	2,77
Water Content	w4/w5 x 100%	35,384	34,296
Average Water Content		34,840	
Plastic Limit		34,840	

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B. LIQUID LIMIT TEST

Project : **Final Project**

Location : **Kasongan, Bantul, D.I. Yogyakarta**

Date : **22nd January 2018**

Test No.		1		2		3		4	
No. of Blows		17		21		33		38	
Tin Box		1-Left	1-Right	2-Left	2-Right	3-Left	3-Right	4-Left	4-Right
Tin Box Weight (empty)	wt (gram)	8,34	9,26	13,6	13,5	13,85	13,65	13,71	13,64
Tin Box Weight (wet soil)	w1 (gram)	53,58	60,7	48,08	45,76	59,97	54,27	55,93	66,51
Tin Box Weight (dry soil)	w2 (gram)	38,07	43,22	36,67	35,02	46,12	42,05	43,63	51,04
Water Weight	Ww = w1 - w2	15,51	17,48	11,41	10,74	13,85	12,22	12,3	15,47
Dried Soil Weight	Ws = w2 - wt	29,73	33,96	23,07	21,52	32,27	28,4	29,92	37,4
Water Content	w = (Ww / Ws) x 100%	52,169	51,472	49,458	49,907	42,919	43,028	41,109	41,363
Average Water Content		51,820		49,682		42,973		41,236	

Liquid Limit (LL) = 47.591 %

$w100$ = 8.831 %

$w10$ = 55.343 %

Flow Index (I_f) = $w10 - w100$ = 46.512 %

Plasticity Index (PI) = LL – PL = 10.4985 %

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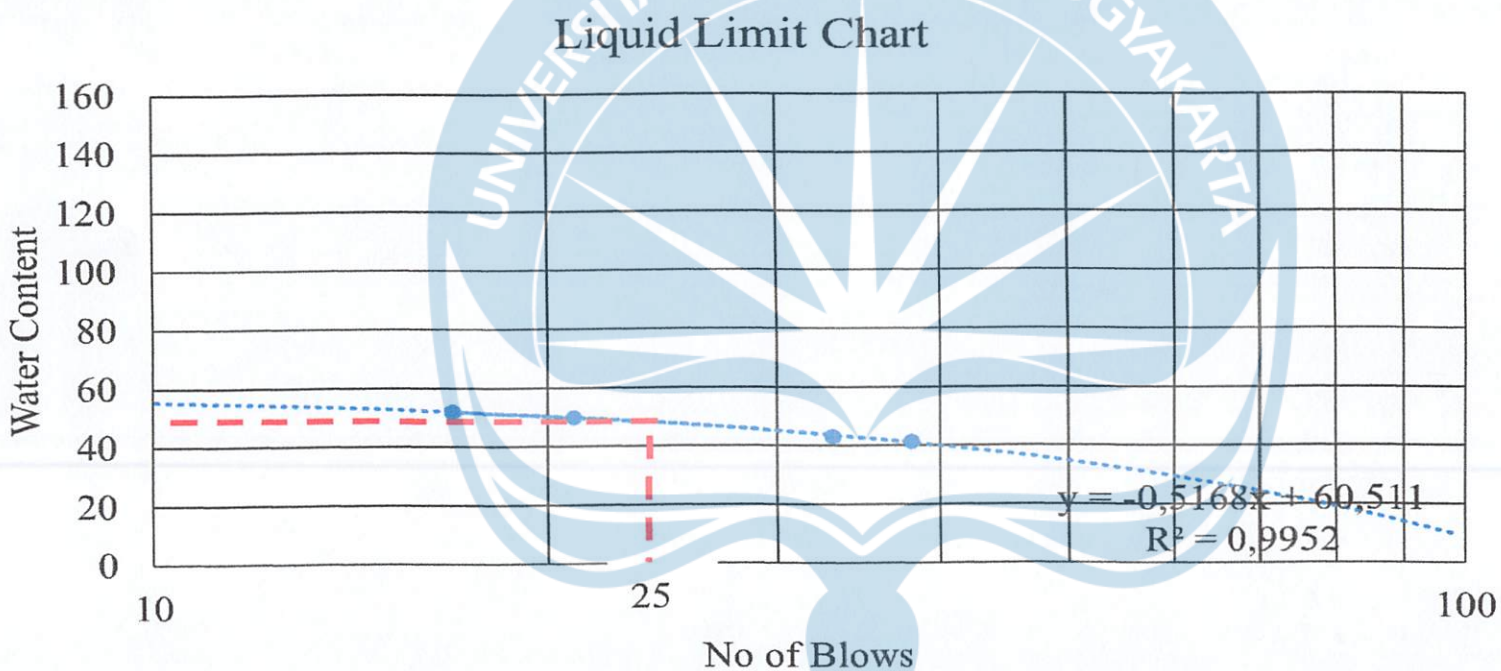

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APPENDIX III

SOIL + 20 % CKD + RHA

I. SOIL + 20 % CKD + 10 % RHA (7-day curing time)

A. PLASTIC LIMIT TEST

Project : **Final Project**

Location : **Kasongan, Bantul, D.I. Yogyakarta**

Date : **20th March 2018**

Tin Box		A	B
Tin Box (empty)	w1 gram	9,23	13,87
Tin Box (wet soil)	w2 gram	12,37	15,89
Tin Box (dried soil)	w3 gram	11,45	15,32
Water Weight	w4 = (w2-w3) gram	0,92	0,57
Dried Soil Weight	w5 = (w3-w1) gram	2,22	1,45
Water Content	w4/w5 x 100%	41,441	39,310
Average Water Content		40,375	
Plastic Limit		40,375	

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B. LIQUID LIMIT TEST

Project : **Final Project**

Location : **Kasongan, Bantul, D.I. Yogyakarta**

Date : **20th March 2018**

Test No.		1		2		3		4	
No. of Blows		12		18		31		35	
Tin Box		1-Left	1-Right	2-Left	2-Right	3-Left	3-Right	4-Left	4-Right
Tin Box Weight (empty)	wt (gram)	10,45	9,68	10,44	10,55	13,62	13,7	13,62	13,7
Tin Box Weight (wet soil)	w1 (gram)	53,07	50,25	46,66	54,11	29,44	29,61	29,44	29,61
Tin Box Weight (dry soil)	w2 (gram)	37,62	35,73	33,87	38,81	24,15	24,28	24,27	24,44
Water Weight	Ww = w1 - w2	15,45	14,52	12,79	15,3	5,29	5,33	5,17	5,17
Dried Soil Weight	Ws = w2 - wt	27,17	26,05	23,43	28,26	10,53	10,58	10,65	10,74
Water Content	w = (Ww / Ws) x 100%	56,864	55,73	54,588	54,140	50,237	50,378	48,544	48,137
Average Water Content		56,301		54,364		50,307		48,341	

Liquid Limit (LL) = 51.993 %

$w100$ = 26.733 %

$w10$ = 57.045 %

Flow Index (I_f) = $w10 - w100$ = 30.312 %

Plasticity Index (PI) = LL – PL = 11.617 %

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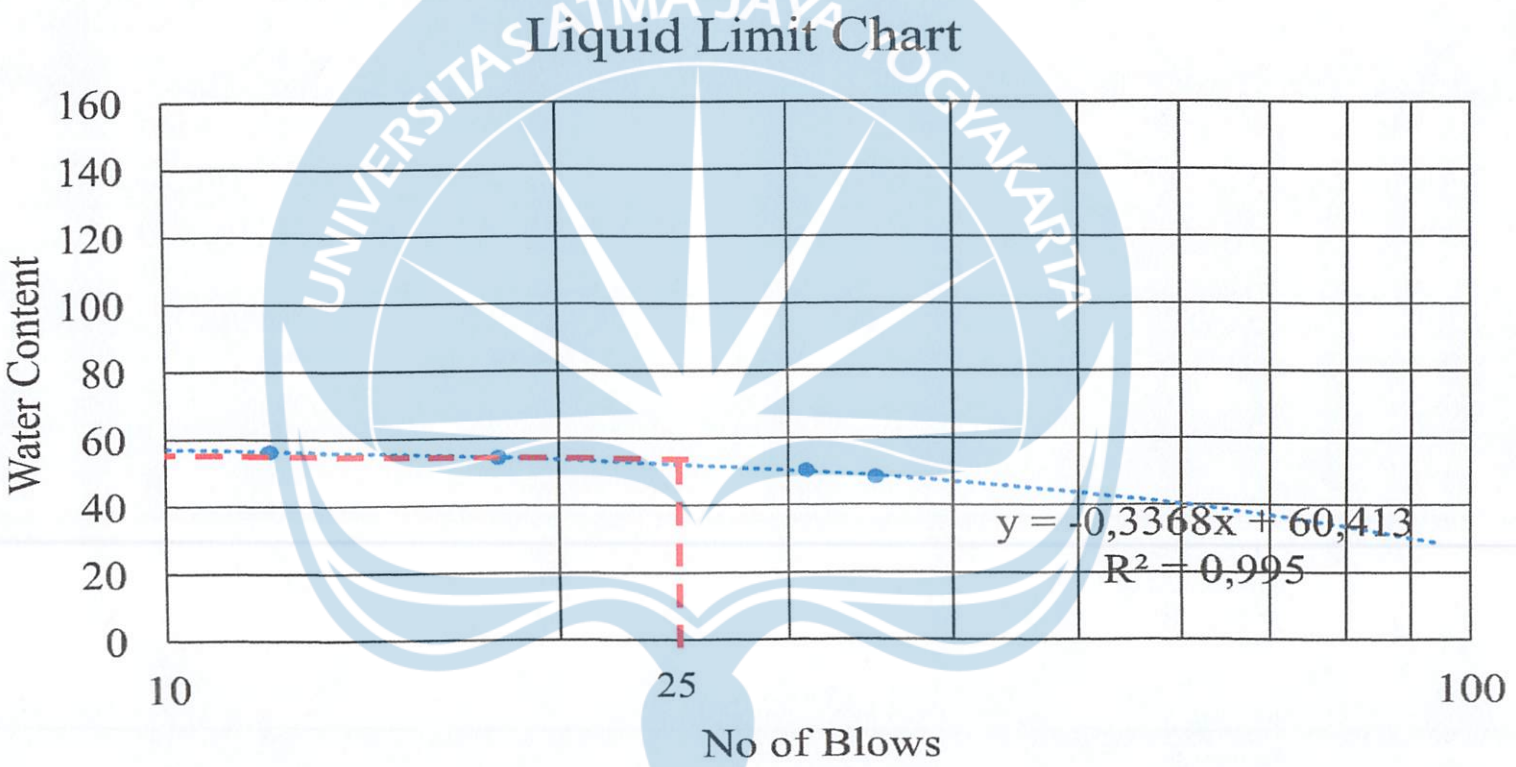

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C. DIRECT SHEAR TEST

SOIL + 20 % CKD + 10 % RHA (7-day curing time)

Project : Final Project

Location: Kasongan, Bantul, D. I. Yogyakarta

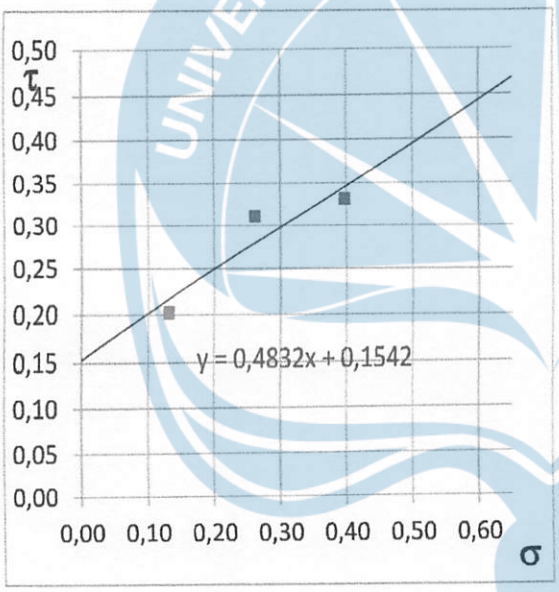
Date : 20th March 2018

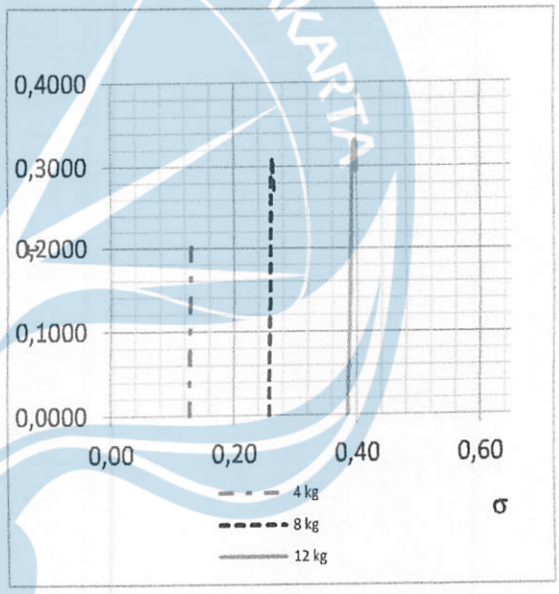
Load (kg)	τ (kg/cm²)	σ (kg/cm²)
4	0,2021	0,1314
8	0,3113	0,2618
12	0,3313	0,3976

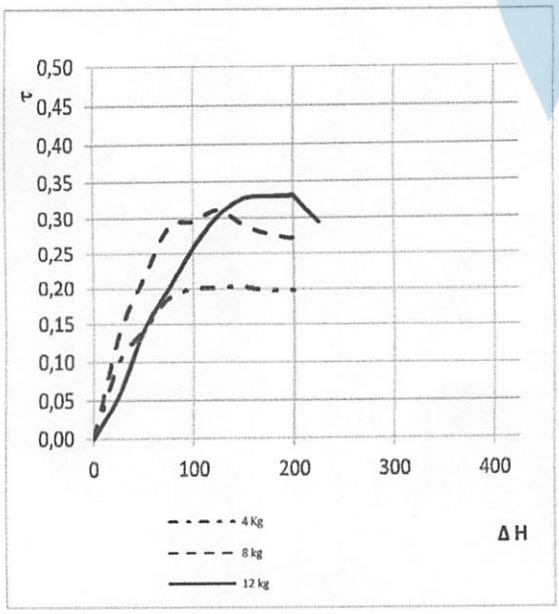
c = 0.1542 kg/cm²

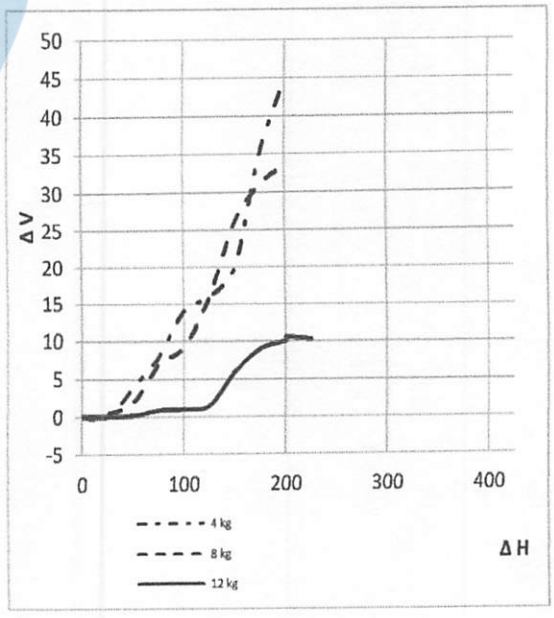
tan ϕ = 0.4832

ϕ = 25.79 °









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Sample Data

Load : 4 kg

Diameter : 6.3 cm

Height : 2.1 cm

Area : 31.1725 cm^2

Weight : 91 gr

ΔH	ΔV	ε	Load		τ	σ
0	0	0,0000	0	0,00	0,0000	0,1283
25	0	0,0040	70	3,10	0,0998	0,1288
50	4	0,0079	100	4,42	0,1429	0,1293
75	8	0,0119	130	5,75	0,1867	0,1299
100	14	0,0159	138	6,11	0,1992	0,1304
125	16	0,0198	139	6,15	0,2013	0,1309
150	20	0,0238	139	6,15	0,2021	0,1314
175	35	0,0278	135	5,97	0,1970	0,1320
200	45	0,0317	135	5,97	0,1978	0,1325

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Sample Data

Load : 8 kg

Diameter : 6.3 cm

Height : 2.1 cm

Area : 31.1725 cm^2

Weight : 98.35 gr

ΔH	ΔV	ε	Load		τ	σ
0	0	0,0000	0	0	0,0000	0,2566
25	0,5	0,0040	95	4,2	0,1353	0,2577
50	2	0,0079	150	6,64	0,2147	0,2587
75	7	0,0119	200	8,85	0,2873	0,2597
100	9,2	0,0159	205	9,07	0,2957	0,2608
125	16	0,0198	215	9,51	0,3113	0,2618
150	26	0,0238	200	8,85	0,2908	0,2629
175	31	0,0278	190	8,41	0,2775	0,2640
200	34	0,0317	185	8,19	0,2713	0,2651

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Sample Data

Load : 12 kg

Diameter : 6.3 cm

Height : 2.1 cm

Area : 31.1725 cm^2

Weight : 104.31 gr

ΔH	ΔV	ε	Load		τ	σ
0	0	0,0000	0	0	0,0000	0,3850
25	0	0,0040	40	1,77	0,0570	0,3865
50	0,2	0,0079	100	4,42	0,1429	0,3880
75	0,9	0,0119	140	6,19	0,2010	0,3896
100	1,0	0,0159	180	7,96	0,2595	0,3912
125	1,5	0,0198	210	9,29	0,3041	0,3927
150	6,0	0,0238	225	9,96	0,3273	0,3943
175	9,0	0,0278	226	10	0,3300	0,3960
200	10,0	0,0317	226	10	0,3313	0,3976
200	10,5	0,0317	225	9,96	0,3300	0,3976
225	10,2	0,0357	200	8,85	0,2944	0,3992

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II. SOIL + 20 % CKD + 15 % RHA (7-day curing time)

A. PLASTIC LIMIT TEST

Project : **Final Project**

Location : **Kasongan, Bantul, D.I. Yogyakarta**

Date : **20th March 2018**

Tin Box		A	B
Tin Box (empty)	w1 gram	9,98	10,34
Tin Box (wet soil)	w2 gram	12,63	13,69
Tin Box (dried soil)	w3 gram	11,85	12,7
Water Weight	w4 = (w2-w3) gram	0,78	0,99
Dried Soil Weight	w5 = (w3-w1) gram	1,87	2,36
Water Content	w4/w5 x 100%	41,7112	41,949153
Average Water Content		41,83019124	
Plastic Limit		41,83019124	

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B. LIQUID LIMIT TEST

Project : **Final Project**

Location : **Kasongan, Bantul, D.I. Yogyakarta**

Date : **20th March 2018**

Test No.		1		2		3		4	
No. of Blows		12		14		28		40	
Tin Box		1-Left	1-Right	2-Left	2-Right	3-Left	3-Right	4-Left	4-Right
Tin Box Weight (empty)	wt (gram)	14,41	13,81	17,56	17,42	15,32	15,11	14,74	16,84
Tin Box Weight (wet soil)	w1 (gram)	31,72	34,21	34,04	34,77	30,74	31,55	27,74	31,43
Tin Box Weight (dry soil)	w2 (gram)	25,65	27,04	28,32	28,75	25,59	26,03	23,68	26,89
Water Weight	Ww = w1 - w2	6,07	7,17	5,72	6,02	5,15	5,52	4,06	4,54
Dried Soil Weight	Ws = w2 - wt	11,24	13,23	10,76	11,33	10,27	10,92	8,94	10,05
Water Content	w = (Ww / Ws) x 100%	54,0036	54,195	53,1599	53,1333	50,1461	50,5495	45,4139	45,1741
Average Water Content		54,09928503		53,1465629		50,34775351		45,2939998	

Liquid Limit (LL) = 50.2765 %

$w100$ = 27.979 %

$w10$ = 54.736 %

Flow Index (I_f) = $w10 - w100$ = 26.757 %

Plasticity Index (PI) = LL – PL = 8.44631 %

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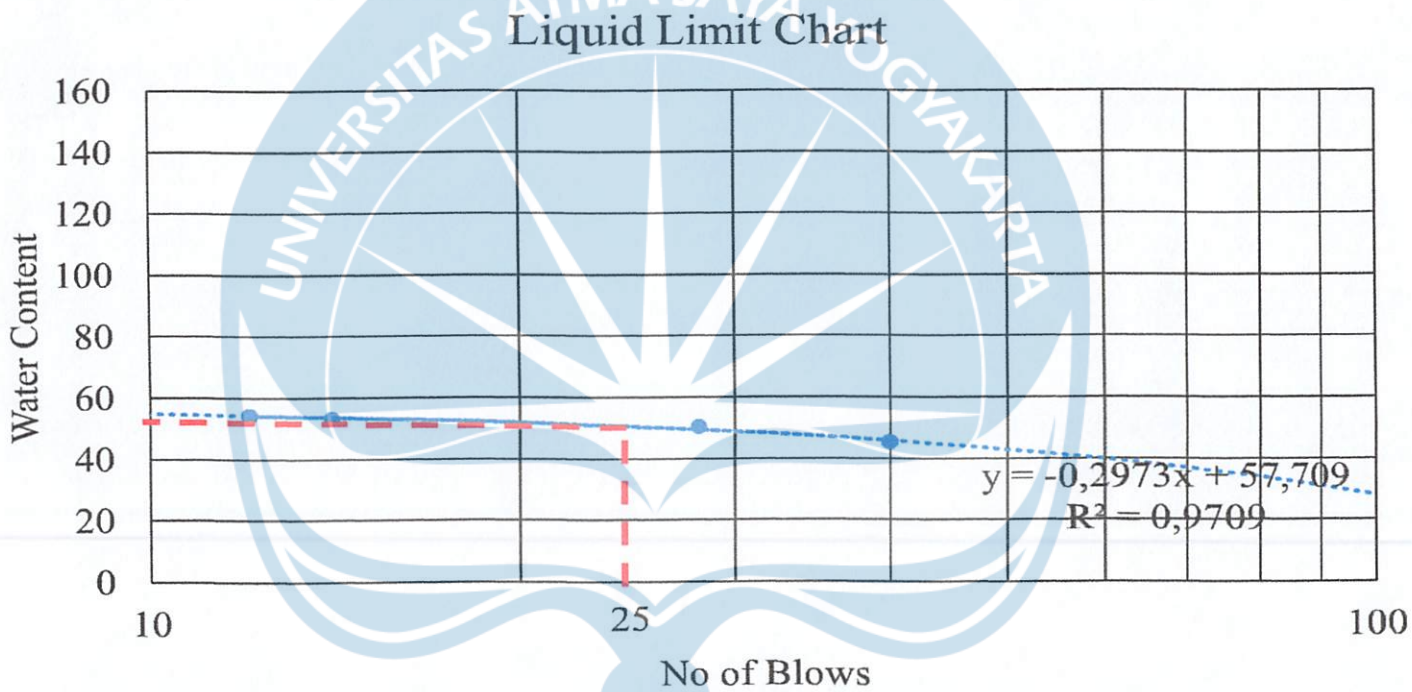

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C. DIRECT SHEAR TEST

SOIL + 20 % CKD + 15 % RHA (7-day curing time)

Project : Final Project

Location: Kasongan, Bantul, D. I. Yogyakarta

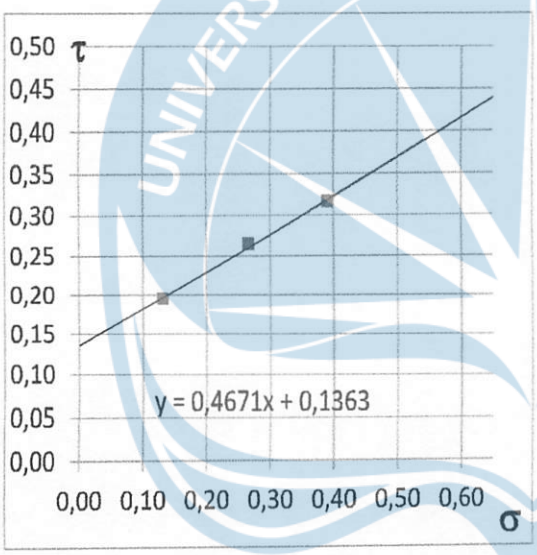
Date : 20th March 2018

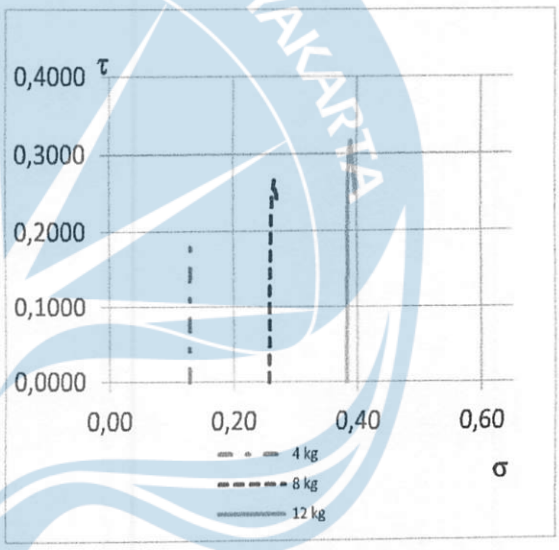
Load (kg)	τ (kg/cm²)	σ (kg/cm²)
4	0,1954	0,1309
8	0,2648	0,2661
12	0,3162	0,3900

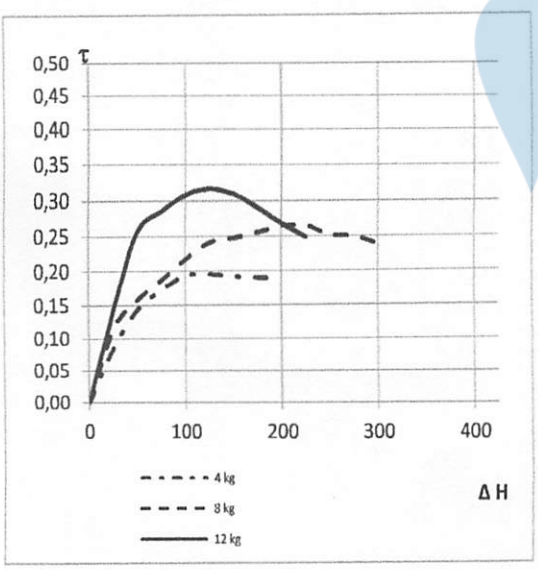
c = 0.1363 kg/cm²

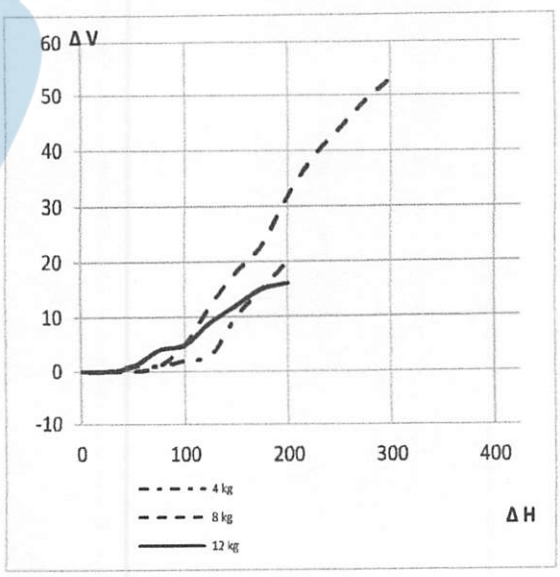
tan ϕ = 0.4671

ϕ = 26.73 °









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Sample Data

Load : 4 kg

Diameter : 6.3 cm

Height : 2.1 cm

Area : 31.1725 cm^2

Weight : 88.83 gr

ΔH	ΔV	ε	Load		τ	σ
0	0	0,0000	0	0,00	0,0000	0,1283
25	0	0,0040	60	2,61	0,0841	0,1288
50	1	0,0079	100	4,42	0,1429	0,1293
75	1	0,0119	120	5,31	0,1724	0,1299
100	2	0,0159	134	5,93	0,1933	0,1304
125	3	0,0198	135	5,97	0,1954	0,1309
150	10	0,0238	132	5,84	0,1919	0,1314
175	15	0,0278	130	5,75	0,1897	0,1320
200	20	0,0317	129	5,71	0,1892	0,1325

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Sample Data

Load : 8 kg

Diameter : 6.3 cm

Height : 2.1 cm

Area : 31.1725 cm^2

Weight : 89.71 gr

ΔH	ΔV	ε	Load		τ	σ
0	0	0,0000	0	0	0,0000	0,2566
25	0	0,0040	80	3,54	0,1140	0,2577
50	0	0,0079	110	4,87	0,1575	0,2587
75	1	0,0119	130	5,75	0,1867	0,2597
100	5	0,0159	150	6,64	0,2164	0,2608
125	12	0,0198	166	7,35	0,2406	0,2618
150	18	0,0238	170	7,52	0,2471	0,2629
175	23	0,0278	175	7,74	0,2554	0,2640
200	32	0,0317	180	7,96	0,2637	0,2651
225	39	0,0357	180	7,96	0,2648	0,2661
250	44	0,0397	170	7,52	0,2512	0,2672
275	49	0,0437	168	7,43	0,2492	0,2684
300	53	0,0476	160	7,08	0,2385	0,2695

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Sample Data

Load : 12 kg

Diameter : 6.3 cm

Height : 2.1 cm

Area : 31.1725 cm^2

Weight : 90.64 gr

ΔH	ΔV	ε	Load		τ	σ
0	0	0,0000	0	0	0,0000	0,3823
25	0,0	0,0040	100	4,42	0,1414	0,3838
50	0,0	0,0079	180	7,96	0,2556	0,3853
75	1,0	0,0119	200	8,85	0,2853	0,3869
100	4,0	0,0159	215	9,51	0,3078	0,3884
125	5,0	0,0198	220	9,73	0,3162	0,3900
150	9,0	0,0238	214	9,47	0,3090	0,3916
175	12,0	0,0278	200	8,85	0,2900	0,3932
200	15,0	0,0317	184	8,14	0,2678	0,3948
225	16,0	0,0357	170	7,52	0,2484	0,3964

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III. SOIL + 20 % CKD + 20 % RHA (7-day curing time)

A. PLASTIC LIMIT TEST

Project : **Final Project**

Location : **Kasongan, Bantul, D.I. Yogyakarta**

Date : **20th March 2018**

Tin Box		A	B
Tin Box (empty)	w1 gram	10,83	10,72
Tin Box (wet soil)	w2 gram	14,36	15,67
Tin Box (dried soil)	w3 gram	13,29	14,15
Water Weight	w4 = (w2-w3) gram	1,07	1,52
Dried Soil Weight	w5 = (w3-w1) gram	2,46	3,43
Water Content	w4/w5 x 100%	43,495	44,314
Average Water Content		43,905	
Plastic Limit		43,905	

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B. LIQUID LIMIT TEST

Project : **Final Project**

Location : **Kasongan, Bantul, D.I. Yogyakarta**

Date : **20th March 2018**

Test No.		1		2		3		4	
No. of Blows		17		23		32		38	
Tin Box		1-Left	1-Right	2-Left	2-Right	3-Left	3-Right	4-Left	4-Right
Tin Box Weight (empty)	wt (gram)	15,36	13,85	17,09	17,52	15,49	14,85	9,7	9,22
Tin Box Weight (wet soil)	w1 (gram)	40,17	41,43	46,67	52,4	41,42	44,16	37,94	38,55
Tin Box Weight (dry soil)	w2 (gram)	31,45	31,89	36,53	40,59	32,66	34,32	28,59	29,81
Water Weight	Ww = w1 - w2	8,72	9,54	10,14	11,81	8,76	9,84	9,35	8,74
Dried Soil Weight	Ws = w2 - wt	16,09	18,04	19,44	23,07	17,17	19,47	18,89	20,59
Water Content	w = (Ww / Ws) x 100%	54,1952	52,8825	52,1605	51,192	51,0192	50,5393	49,4971	42,4478
Average Water Content		53,53881782		51,67625905		50,77925539		45,9724393	

Liquid Limit (LL) = 48.998 %

$w100$ = 34.883 %

$w10$ = 51.821 %

Flow Index (I_f) = $w10 - w100$ = 16.938 %

Plasticity Index (PI) = LL – PL = 5.0926 %

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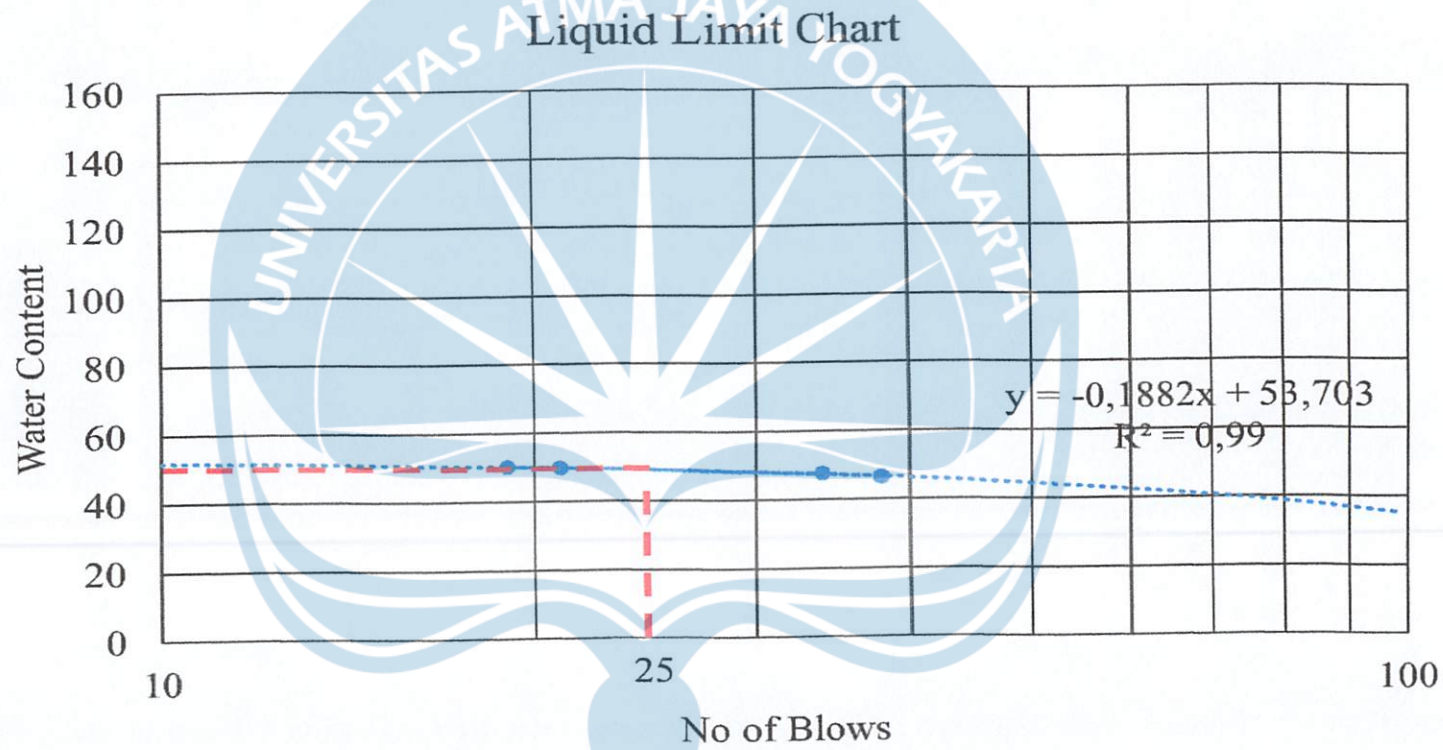

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C. DIRECT SHEAR TEST

SOIL + 20 % CKD + 20 % RHA (7-day curing time)

Project : Final Project

Location: Kasongan, Bantul, D. I. Yogyakarta

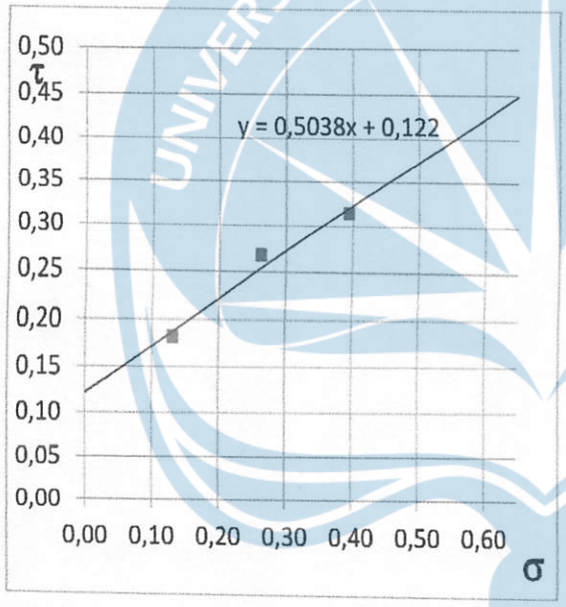
Date : 20th March 2018

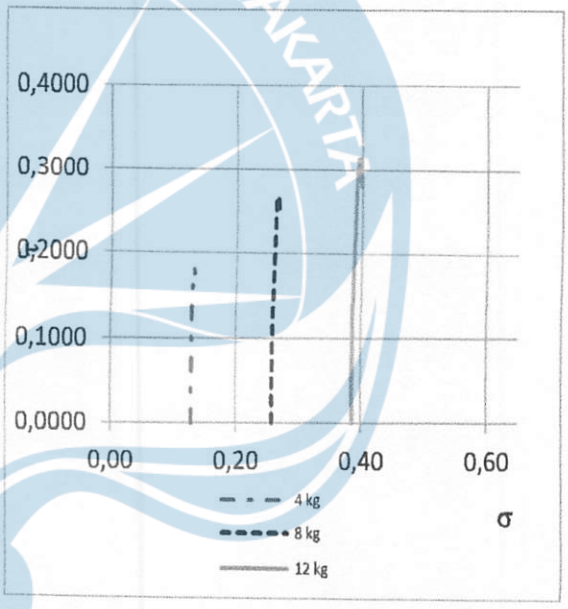
Load (kg)	τ (kg/cm²)	σ (kg/cm²)
4	0,1817	0,1314
8	0,2675	0,2629
12	0,3142	0,3943

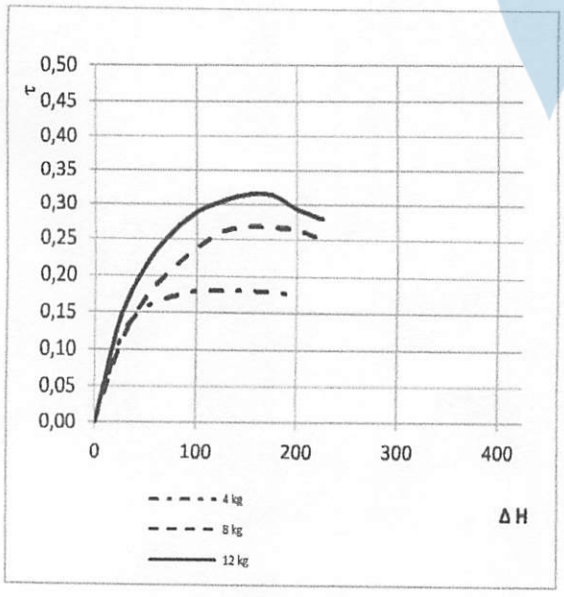
c = 0.122 kg/cm²

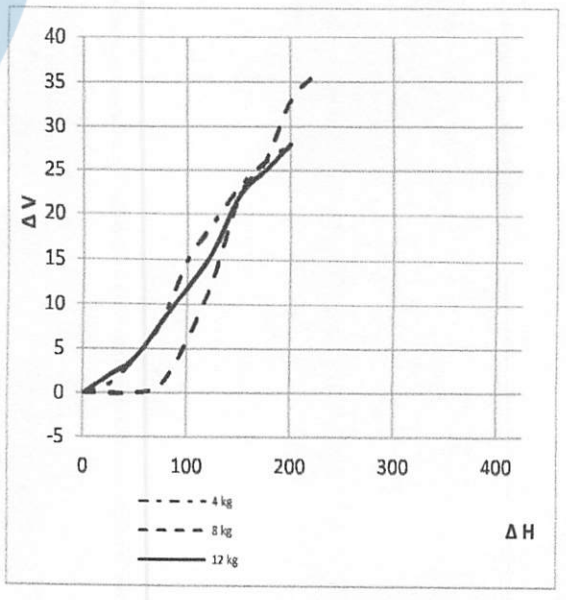
tan ϕ = 0.5038

ϕ = 26.74 °









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Sample Data

Load : 4 kg

Diameter : 6.3 cm

Height : 2.1 cm

Area : 31.1725 cm^2

Weight : 95.61 gr

ΔH	ΔV	ε	Load		τ	σ
0	0	0,0000	0	0,00	0,0000	0,1283
25	1	0,0040	80	3,54	0,1140	0,1288
50	4	0,0079	110	4,87	0,1575	0,1293
75	8	0,0119	120	5,31	0,1724	0,1299
100	15	0,0159	125	5,53	0,1803	0,1304
125	19	0,0198	125	5,53	0,1810	0,1309
150	23	0,0238	125	5,53	0,1817	0,1314
175	26	0,0278	123	5,44	0,1795	0,1320
200	28	0,0317	120	5,31	0,1759	0,1325

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Sample Data

Load : 8 kg

Diameter : 6.3 cm

Height : 2.1 cm

Area : 31.1725 cm^2

Weight : 99.73 gr

ΔH	ΔV	ε	Load		τ	σ
0	0	0,0000	0	0	0,0000	0,2566
25	0	0,0040	75	3,32	0,1069	0,2577
50	0	0,0079	120	5,31	0,1717	0,2587
75	1	0,0119	145	6,42	0,2084	0,2597
100	6	0,0159	165	7,3	0,2380	0,2608
125	13	0,0198	180	7,96	0,2605	0,2618
150	22	0,0238	184	8,14	0,2675	0,2629
175	26	0,0278	183	8,1	0,2673	0,2640
200	33	0,0317	180	7,96	0,2637	0,2651
225	36	0,0357	170	7,52	0,2502	0,2661

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Sample Data

Load : 12 kg

Diameter : 6.3 cm

Height : 2.1 cm

Area : 31.1725 cm^2

Weight : 99.99 gr

ΔH	ΔV	ε	Load		τ	σ
0	0,0	0,0000	0	0	0,0000	0,3850
25	0,0	0,0040	100	4,42	0,1424	0,3865
50	2,0	0,0079	150	6,64	0,2147	0,3880
75	4,0	0,0119	180	7,96	0,2584	0,3896
100	8,0	0,0159	200	8,85	0,2885	0,3912
125	12,0	0,0198	210	9,29	0,3041	0,3927
150	16,0	0,0238	216	9,56	0,3142	0,3943
175	22,0	0,0278	215	9,51	0,3138	0,3960
200	25,0	0,0317	200	8,85	0,2932	0,3976
225	28,0	0,0357	190	8,41	0,2798	0,3992

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IV. SOIL + 20 % CKD + 10 % RHA (28-day curing time)

A. PLASTIC LIMIT TEST

Project : **Final Project**

Location : **Kasongan, Bantul, D.I. Yogyakarta**

Date : **12th March 2018**

Tin Box		A	B
Tin Box (empty)	w1 gram	16.98	18.17
Tin Box (wet soil)	w2 gram	22.7	25.42
Tin Box (dried soil)	w3 gram	21.15	23.35
Water Weight	w4 = (w2-w3) gram	1.55	2.07
Dried Soil Weight	w5 = (w3-w1) gram	4.17	5.18
Water Content	w4/w5 x 100%	37.170	39.961
Average Water Content		38.566	
Plastic Limit		38.566	

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B. LIQUID LIMIT TEST

Project : Final Project

Location : Kasongan, Bantul, D.I. Yogyakarta

Date : 12th March 2018

Test No.		1		2		3		4	
No. of Blows		17		22		29		31	
Tin Box		1-Left	1-Right	2-Left	2-Right	3-Left	3-Right	4-Left	4-Right
Tin Box Weight (empty)	wt (gram)	10.44	10.46	10.46	10.57	13.56	13.86	13.61	13.49
Tin Box Weight (wet soil)	w1 (gram)	51.8	46.15	41.62	49.28	41.52	44	47.11	39.2
Tin Box Weight (dry soil)	w2 (gram)	39.59	35.65	32.53	38.02	33.73	35.62	37.82	32.03
Water Weight	Ww = w1 - w2	12.21	10.5	9.09	11.26	7.79	8.38	9.29	7.17
Dried Soil Weight	Ws = w2 - wt	29.15	25.19	22.07	27.45	20.17	21.76	24.21	18.54
Water Content	w = (Ww / Ws) x 100%	41.887	41.683	41.187	41.020	38.622	38.511	38.373	38.673
Average Water Content		41.785		41.104		38.566		38.523	

Liquid Limit (LL) = 39.9295 %

$w100$ = 43.801 %

$w10$ = 20.572 %

Flow Index (I_f) = $w10 - w100$ = 23.229 %

Plasticity Index (PI) = LL – PL = 1.363 %

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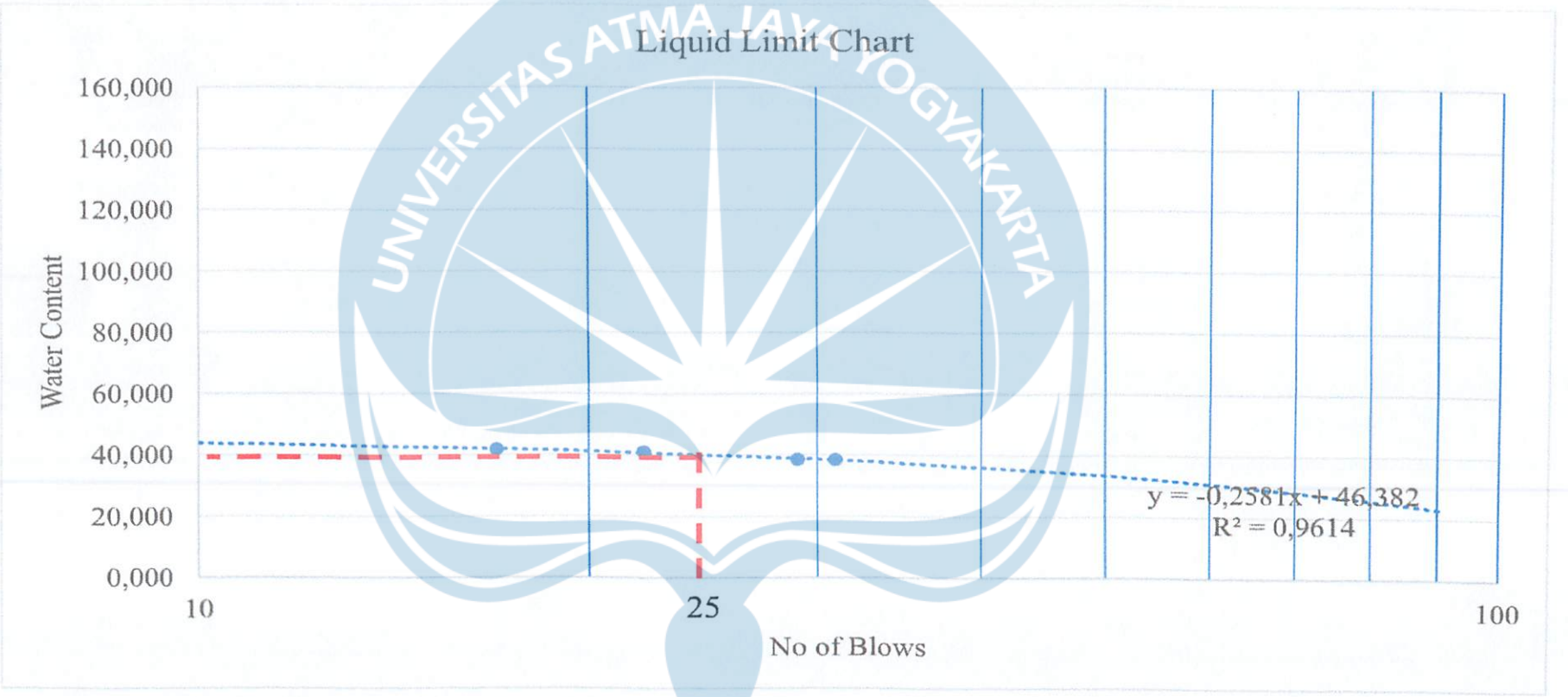

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C. DIRECT SHEAR TEST

SOIL + 20 % CKD + 10 % RHA (28-day curing time)

Project : Final Project

Location: Kasongan, Bantul, D. I. Yogyakarta

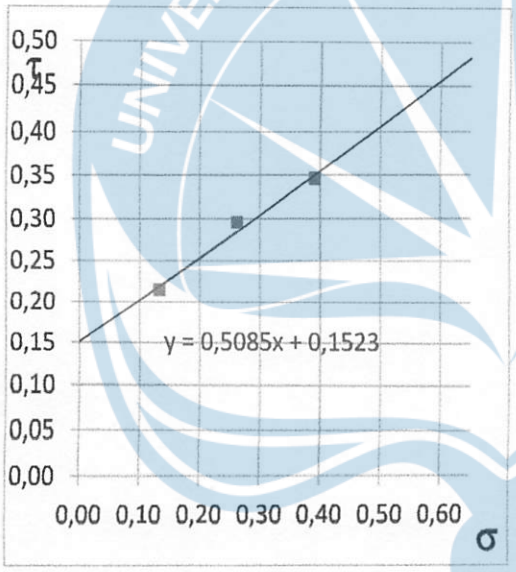
Date : 12th March 2018

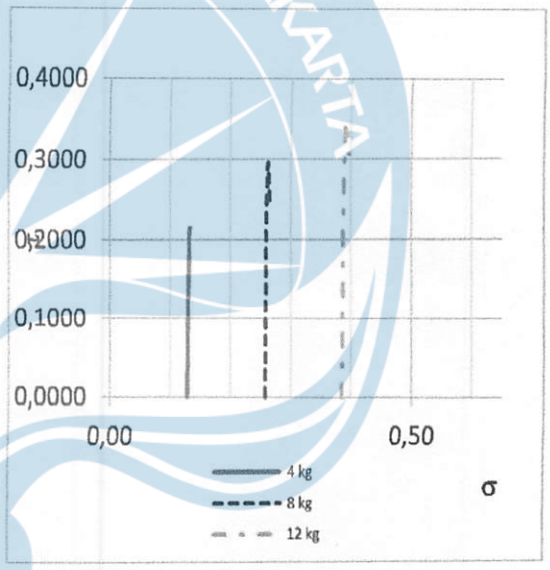
Load (kg)	τ (kg/cm²)	σ (kg/cm²)
4	0.2149	0.1331
8	0.2955	0.2618
12	0.3462	0.3912

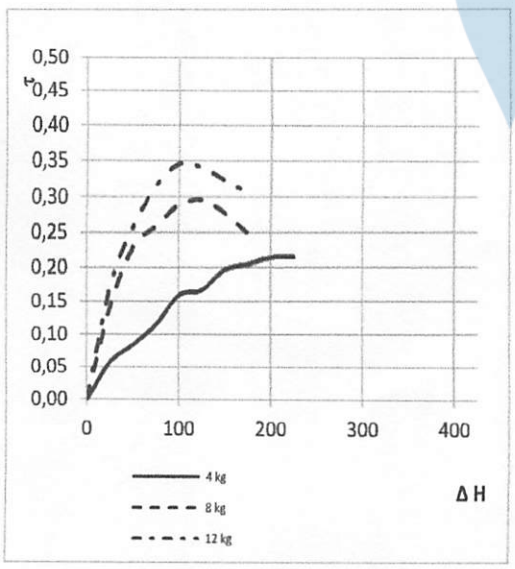
c = 0.1523 kg/cm²

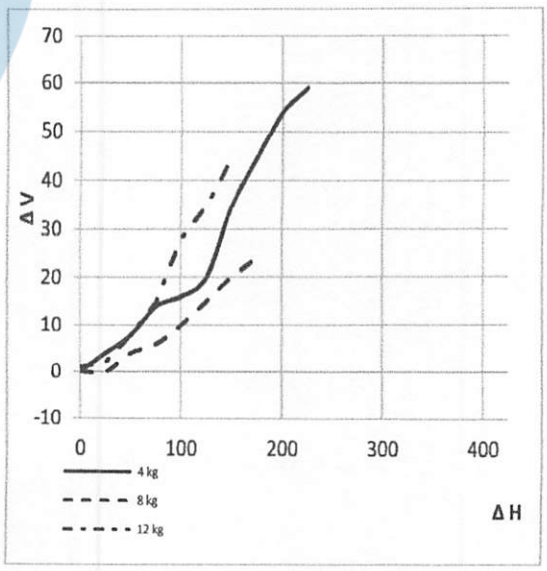
tan ϕ = 0.5085

ϕ = 26.95 °









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Sample Data

Load : 4 kg

Diameter : 6.3 cm

Height : 2.1 cm

Area : 31.1725 cm^2

Weight : 93.14 gr

ΔH	ΔV	ε	Load		τ	σ
0	0	0.0000	0	0.00	0.0000	0.1283
25	4	0.0040	40	1.77	0.0570	0.1288
50	8	0.0079	60	2.61	0.0844	0.1293
75	14	0.0119	80	3.54	0.1149	0.1299
100	16	0.0159	110	4.87	0.1587	0.1304
125	20	0.0198	115	5.09	0.1666	0.1309
150	35	0.0238	135	5.97	0.1962	0.1314
175	45	0.0278	140	6.19	0.2042	0.1320
200	54	0.0317	146	6.46	0.2140	0.1325
225	59	0.0357	146	6.46	0.2149	0.1331

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Sample Data

Load : 8 kg

Diameter : 6.3 cm

Height : 2.1 cm

Area : 31.1725 cm^2

Weight : 98.41 gr

ΔH	ΔV	ε	Load		τ	σ
0	0	0.0000	0	0	0.0000	0.2566
25	0	0.0040	100	4.42	0.1424	0.2577
50	4	0.0079	160	7.08	0.2289	0.2587
75	6	0.0119	180	7.96	0.2584	0.2597
100	10	0.0159	200	8.85	0.2885	0.2608
125	15	0.0198	204	9.03	0.2955	0.2618
150	20	0.0238	190	8.41	0.2764	0.2629
175	24	0.0278	170	7.52	0.2481	0.2640

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Sample Data

Load : 12 kg

Diameter : 6.3 cm

Height : 2.1 cm

Area : 31.1725 cm^2

Weight : 100.98 gr

ΔH	ΔV	ε	Load		τ	σ
0	0	0.0000	0	0	0.0000	0.3850
25	1.0	0.0040	120	5.31	0.1710	0.3865
50	2.0	0.0079	180	7.96	0.2574	0.3880
75	8.0	0.0119	220	9.73	0.3159	0.3896
100	15.0	0.0159	240	10.62	0.3462	0.3912
125	28.0	0.0198	235	10.4	0.3404	0.3927
150	35.0	0.0238	222	9.82	0.3227	0.3943
175	45.0	0.0278	210	9.29	0.3065	0.3960

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V. SOIL + 20 % CKD + 15 % RHA (28-day curing time)

A. PLASTIC LIMIT TEST

Project : **Final Project**

Location : **Kasongan, Bantul, D.I. Yogyakarta**

Date : **12th March 2018**

Tin Box		A	B
Tin Box (empty)	w1 gram	14.57	15.1
Tin Box (wet soil)	w2 gram	25.25	22.82
Tin Box (dried soil)	w3 gram	21.92	20.44
Water Weight	w4 = (w2-w3) gram	3.33	2.38
Dried Soil Weight	w5 = (w3-w1) gram	7.35	5.34
Water Content	w4/w5 x 100%	45.306	44.569
Average Water Content		44.938	
Plastic Limit		44.938	

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B. LIQUID LIMIT TEST

Project : Final Project

Location : Kasongan, Bantul, D.I. Yogyakarta

Date : 12th March 2018

Test No.		1		2		3		4	
No. of Blows		10		23		35		39	
Tin Box		1-Left	1-Right	2-Left	2-Right	3-Left	3-Right	4-Left	4-Right
Tin Box Weight (empty)	wt (gram)	15.41	13.91	16.95	17.35	15.76	16.16	14.2	14.21
Tin Box Weight (wet soil)	w1 (gram)	54.01	54.36	49.75	47.34	49.79	47.13	37.93	45.58
Tin Box Weight (dry soil)	w2 (gram)	41.33	41.35	39.53	37.93	39.36	37.83	30.99	36.43
Water Weight	Ww = w1 - w2	12.68	13.01	10.22	9.41	10.43	9.3	6.94	9.15
Dried Soil Weight	Ws = w2 - wt	25.92	27.44	22.58	20.58	23.6	21.67	16.79	22.22
Water Content	w = (Ww / Ws) x 100%	48.919	47.412	45.261	45.724	44.194	42.916	41.334	41.179
Average Water Content		48.166		45.493		43.556		41.257	

Liquid Limit (LL) = 45.003 %

$w100$ = 48.298 %

$w10$ = 28.525 %

Flow Index (I_f) = $w10 - w100$ = 19.773 %

Plasticity Index (PI) = LL – PL = 0.0648 %

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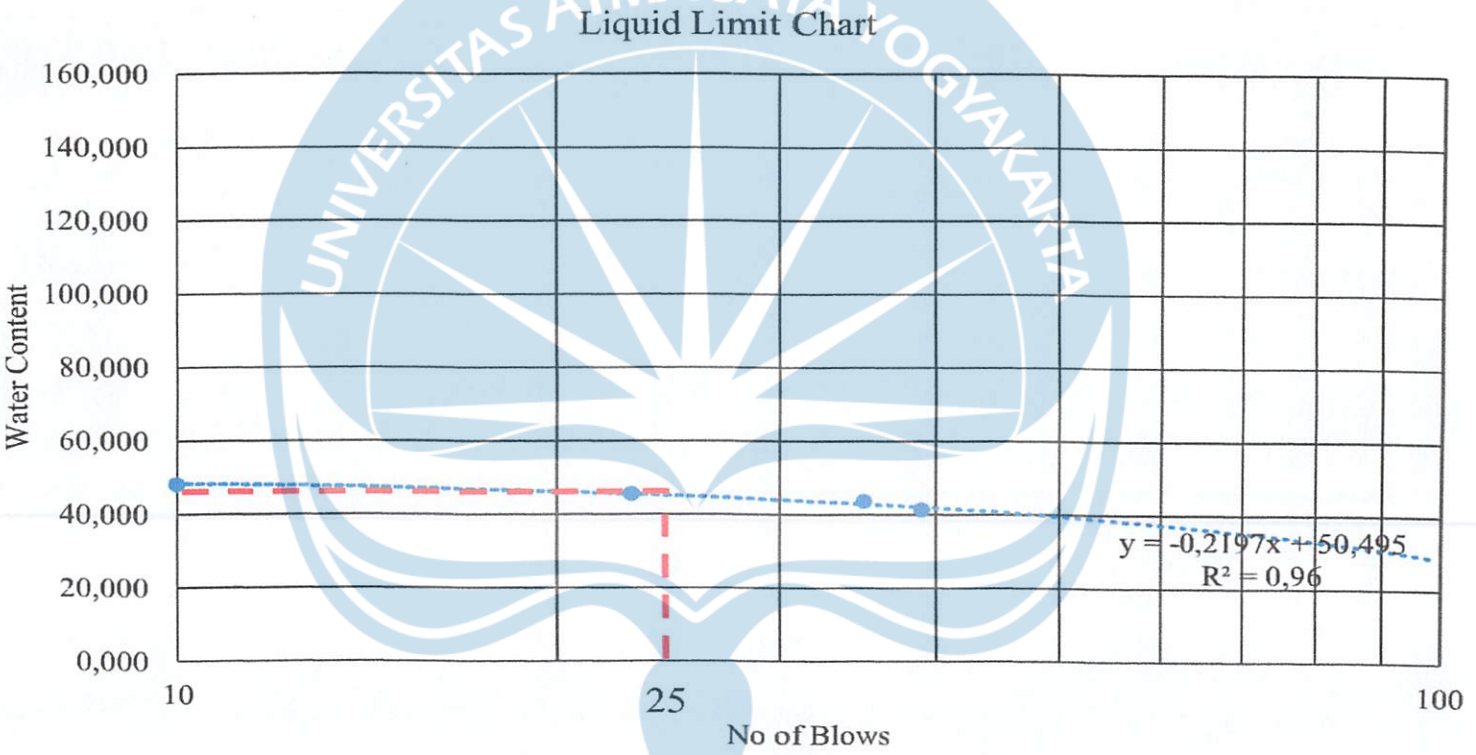

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C. DIRECT SHEAR TEST

SOIL + 20 % CKD + 15 % RHA (28-day curing time)

Project : Final Project

Location: Kasongan, Bantul, D. I. Yogyakarta

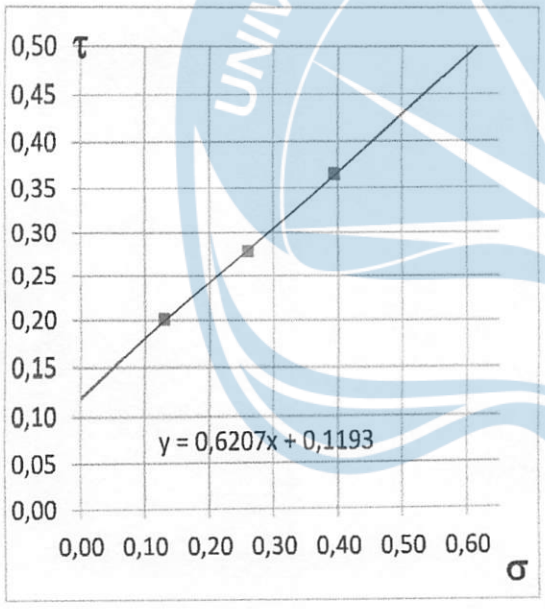
Date : 12th March 2018

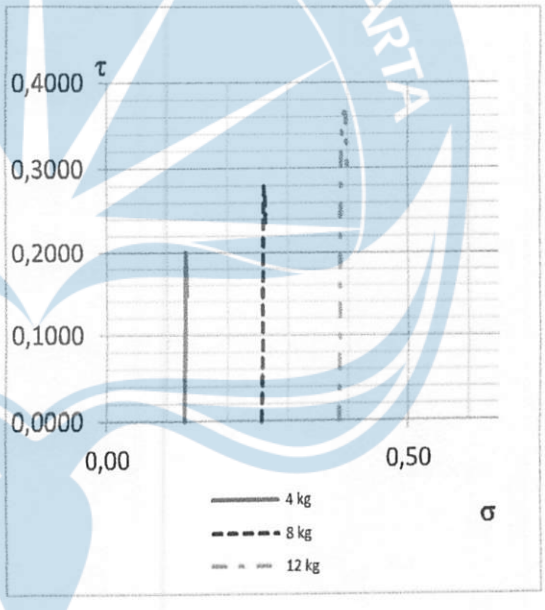
Load (kg)	τ (kg/cm²)	σ (kg/cm²)
4	0.2010	0.1299
8	0.2786	0.2597
12	0.3651	0.3943

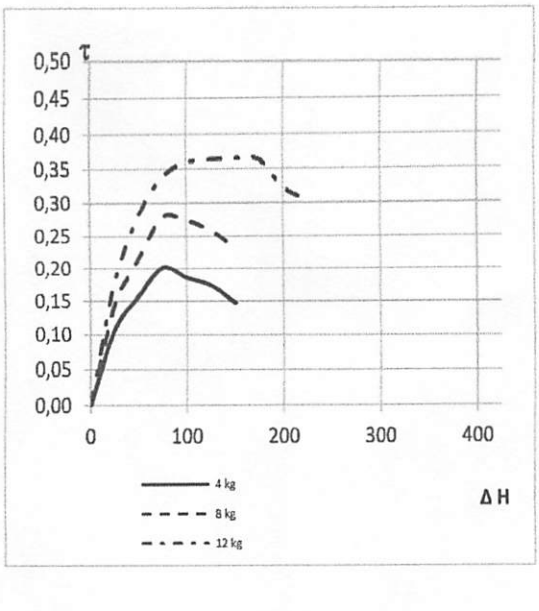
c = 0.1193 kg/cm²

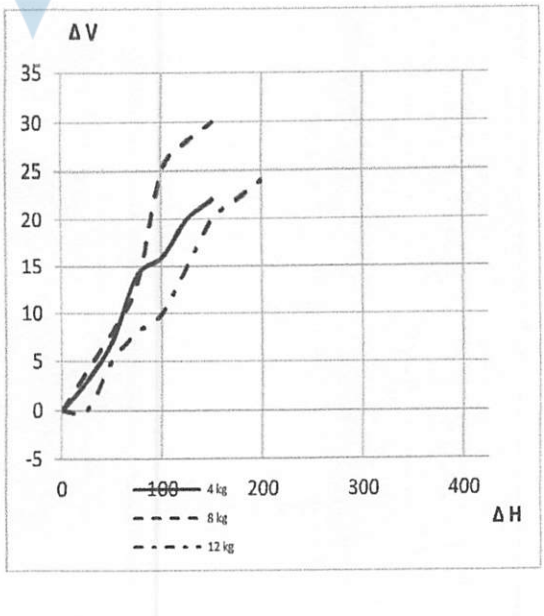
$\tan \phi$ = 0.6207

ϕ = 31.83 °









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Sample Data

Load : 4 kg

Diameter : 6.3 cm

Height : 2.1 cm

Area : 31.1725 cm^2

Weight : 93.82 gr

ΔH	ΔV	ε	Load		τ	σ
0	0	0.0000	0	0.00	0.0000	0.1283
25	3	0.0040	75	3.32	0.1069	0.1288
50	7	0.0079	110	4.87	0.1575	0.1293
75	14	0.0119	140	6.19	0.2010	0.1299
100	16	0.0159	129	5.71	0.1861	0.1304
125	20	0.0198	120	5.31	0.1738	0.1309
150	22	0.0238	101	4.47	0.1469	0.1314

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Sample Data

Load : 8 kg

Diameter : 6.3 cm

Height : 2.1 cm

Area : 31.1725 cm^2

Weight : 93.81 gr

ΔH	ΔV	ε	Load		τ	σ
0	0	0.0000	0	0	0.0000	0.2566
25	4	0.0040	100	4.42	0.1424	0.2577
50	8	0.0079	150	6.64	0.2147	0.2587
75	13	0.0119	194	8.58	0.2786	0.2597
100	25	0.0159	190	8.41	0.2741	0.2608
125	28	0.0198	178	7.88	0.2579	0.2618
150	30	0.0238	160	7.08	0.2327	0.2629

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Sample Data

Load : 12 kg

Diameter : 6.3 cm

Height : 2.1 cm

Area : 31.1725 cm^2

Weight : 93.2 gr

ΔH	ΔV	ε	Load		τ	σ
0	0	0.0000	0	0	0.0000	0.3850
25	0.0	0.0040	124	5.49	0.1768	0.3865
50	0.0	0.0079	196	8.67	0.2804	0.3880
75	5.0	0.0119	235	10.4	0.3376	0.3896
100	8.0	0.0159	249	11.02	0.3592	0.3912
125	10.0	0.0198	251	11.11	0.3636	0.3927
150	15.0	0.0238	251	11.11	0.3651	0.3943
175	20.0	0.0278	249	11.02	0.3636	0.3960
200	22.0	0.0317	220	9.73	0.3224	0.3976
225	24.0	0.0357	206	9.12	0.3034	0.3992

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VI. SOIL + 20 % CKD + 20 % RHA (28-day curing time)

A. PLASTIC LIMIT TEST

Project : Final Project

Location : Kasongan, Bantul, D.I. Yogyakarta

Date : 12th March 2018

Tin Box		A	B
Tin Box (empty)	w1 gram	15.34	14.24
Tin Box (wet soil)	w2 gram	19.82	19.47
Tin Box (dried soil)	w3 gram	18.31	17.74
Water Weight	w4 = (w2-w3) gram	1.51	1.73
Dried Soil Weight	w5 = (w3-w1) gram	2.97	3.5
Water Content	w4/w5 x 100%	50.8418	49.429
Average Water Content		50.135	
Plastic Limit		50.135	

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B. LIQUID LIMIT TEST

Project : Final Project

Location : Kasongan, Bantul, D.I. Yogyakarta

Date : 12th March 2018

Test No.		1		2		3		4	
No. of Blows		17		23		32		38	
Tin Box		1-Left	1-Right	2-Left	2-Right	3-Left	3-Right	4-Left	4-Right
Tin Box Weight (empty)	wt (gram)	15.36	13.85	17.09	17.52	15.49	14.85	9.7	9.22
Tin Box Weight (wet soil)	w1 (gram)	40.17	41.43	46.67	52.4	41.42	44.16	37.94	38.55
Tin Box Weight (dry soil)	w2 (gram)	31.45	31.89	36.53	40.59	32.66	34.32	28.59	29.81
Water Weight	Ww = w1 - w2	8.72	9.54	10.14	11.81	8.76	9.84	9.35	8.74
Dried Soil Weight	Ws = w2 - wt	16.09	18.04	19.44	23.07	17.17	19.47	18.89	20.59
Water Content	w = (Ww / Ws) x 100%	54.195	52.882	52.160	51.192	51.019	50.539	49.497	42.448
Average Water Content		53.539		51.676		50.779		45.972	

Liquid Limit (LL) = 51.2905 %

$w100$ = 56.089 %

$w10$ = 27.298 %

Flow Index (I_f) = $w10 - w100$ = 28.791 %

Plasticity Index (PI) = LL – PL = 1.155 %

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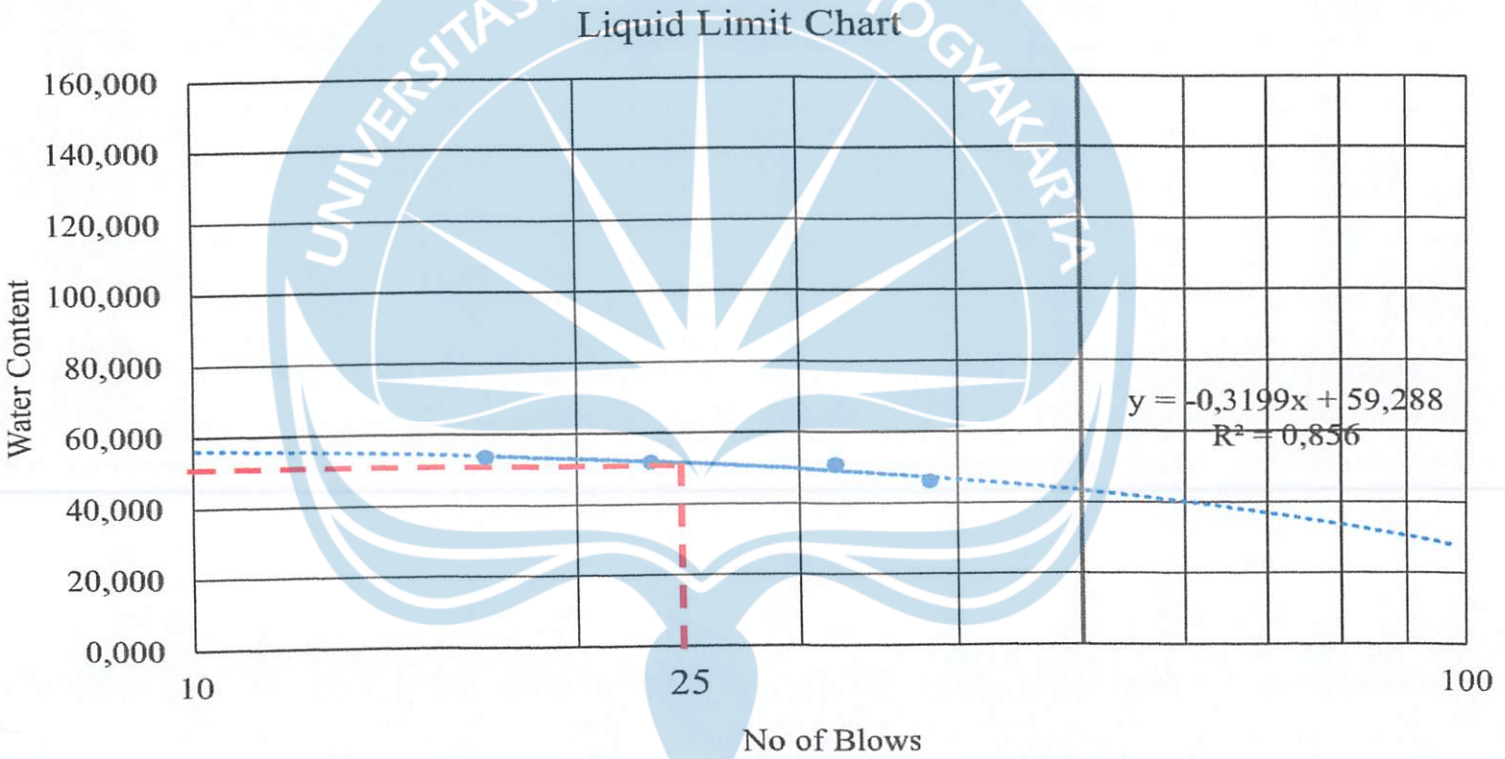

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C. DIRECT SHEAR TEST

SOIL + 20 % CKD + 20 % RHA (28-day curing time)

Project : Final Project

Location: Kasongan, Bantul, D. I. Yogyakarta

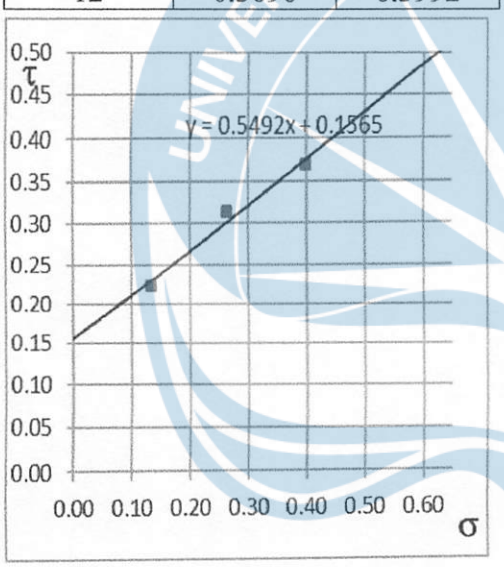
Date : 12th March 2018

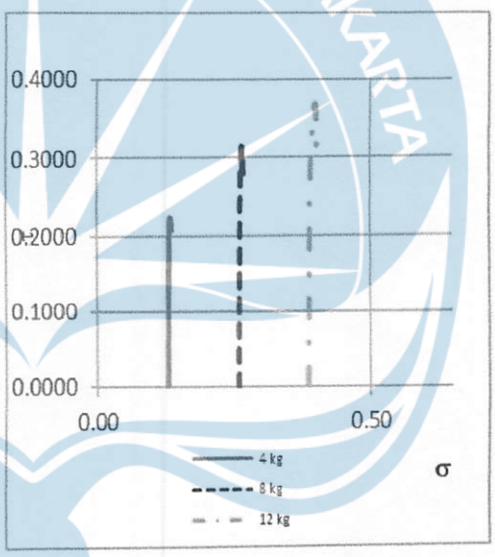
Load (kg)	τ (kg/cm²)	σ (kg/cm²)
4	0.2230	0.1325
8	0.3138	0.2640
12	0.3696	0.3992

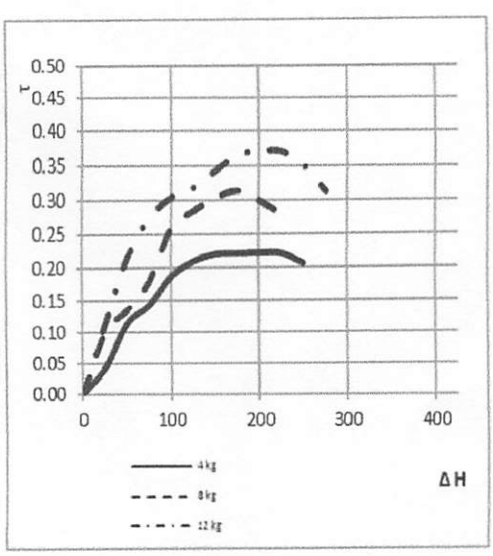
c = 0.1565 kg/cm²

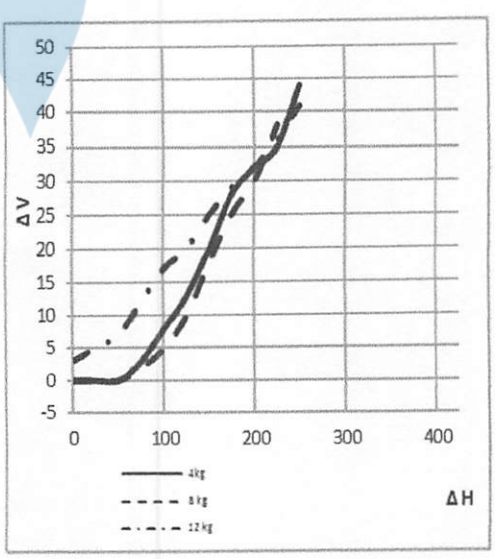
tan ϕ = 0.5492

ϕ = 28.78 °









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Sample Data

Load : 4 kg

Diameter : 6.3 cm

Height : 2.1 cm

Area : 31.1725 cm^2

Weight : 94.21 gr

ΔH	ΔV	ε	Load		τ	σ
0	0	0.0000	0	0.00	0.0000	0.1283
25	0	0.0040	30	1.33	0.0428	0.1288
50	0	0.0079	80	3.54	0.1145	0.1293
75	3	0.0119	100	4.42	0.1435	0.1299
100	8	0.0159	130	5.75	0.1874	0.1304
125	13	0.0198	145	6.42	0.2101	0.1309
150	20	0.0238	152	6.73	0.2212	0.1314
175	28	0.0278	152	6.73	0.2221	0.1320
200	32	0.0317	152	6.73	0.2230	0.1325
225	35	0.0357	151	6.68	0.2222	0.1331
250	44	0.0397	140	6.19	0.2068	0.1336

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Sample Data

Load : 8 kg

Diameter : 6.3 cm

Height : 2.1 cm

Area : 31.1725 cm^2

Weight : 94.09 gr

ΔH	ΔV	ε	Load		τ	σ
0	0	0.0000	0	0	0.0000	0.2566
25	0	0.0040	70	3.1	0.0998	0.2577
50	0	0.0079	95	4.2	0.1358	0.2587
75	2	0.0119	125	5.53	0.1795	0.2597
100	5	0.0159	180	7.96	0.2595	0.2608
125	10	0.0198	196	8.67	0.2838	0.2618
150	18	0.0238	208	9.2	0.3023	0.2629
175	25	0.0278	215	9.51	0.3138	0.2640
200	30	0.0317	204	9.03	0.2992	0.2651
225	38	0.0357	190	8.41	0.2798	0.2661

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Sample Data

Load : 12 kg

Diameter : 6.3 cm

Height : 2.1 cm

Area : 31.1725 cm^2

Weight : 98.2 gr

ΔH	ΔV	ε	Load		τ	σ
0	0.0	0.0000	0	0	0.0000	0.3850
25	3.0	0.0040	80	3.54	0.1140	0.3865
50	5.0	0.0079	150	6.64	0.2147	0.3880
75	7.0	0.0119	190	8.41	0.2730	0.3896
100	12.0	0.0159	210	9.29	0.3028	0.3912
125	17.0	0.0198	219	9.69	0.3171	0.3927
150	20.0	0.0238	235	10.4	0.3418	0.3943
175	25.0	0.0278	250	11.06	0.3649	0.3960
200	29.0	0.0317	252	11.15	0.3694	0.3976
225	32.0	0.0357	251	11.11	0.3696	0.3992
250	36.0	0.0397	236	10.44	0.3488	0.4009
275	41.0	0.0437	210	9.29	0.3116	0.4025

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VII. SOIL + 20 % CKD + 10 % RHA (36-day curing time)

A. PLASTIC LIMIT TEST

Project : **Final Project**

Location : **Kasongan, Bantul, D.I. Yogyakarta**

Date : **19th March 2018**

Tin Box		A	B
Tin Box (empty)	w1 gram	9,23	13,86
Tin Box (wet soil)	w2 gram	12,79	16,71
Tin Box (dried soil)	w3 gram	11,69	15,88
Water Weight	w4 = (w2-w3) gram	1,1	0,83
Dried Soil Weight	w5 = (w3-w1) gram	2,46	2,02
Water Content	w4/w5 x 100%	44,715	41,089
Average Water Content		42,902	
Plastic Limit		42,902	

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B. LIQUID LIMIT TEST

Project : Final Project

Location : Kasongan, Bantul, D.I. Yogyakarta

Date : 19th March 2018

Test No.		1		2		3		4	
No. of Blows		15		18		31		36	
Tin Box		1-Left	1-Right	2-Left	2-Right	3-Left	3-Right	4-Left	4-Right
Tin Box Weight (empty)	wt (gram)	10,43	9,67	13,62	13,69	10,46	10,56	13,56	13,87
Tin Box Weight (wet soil)	w1 (gram)	44,61	48,52	60,17	66,41	41,17	42,69	40,72	45,08
Tin Box Weight (dry soil)	w2 (gram)	34,28	36,43	47,13	50,13	32,19	33,48	33,84	36,85
Water Weight	Ww = w1 - w2	10,33	12,09	13,04	16,28	8,98	9,21	6,88	8,23
Dried Soil Weight	Ws = w2 - wt	23,85	26,76	33,51	36,44	21,73	22,92	20,28	22,98
Water Content	w = (Ww / Ws) x 100%	43,312	45,179	38,914	44,676	41,325	40,183	33,925	35,814
Average Water Content		44,246		41,795		40,754		34,869	

Liquid Limit (LL) = 42.9075 %

$w100$ = 45.801 %

$w10$ = 28.44 %

Flow Index (I_f) = $w10 - w100$ = 17.361 %

Plasticity Index (PI) = LL – PL = 0.005 %

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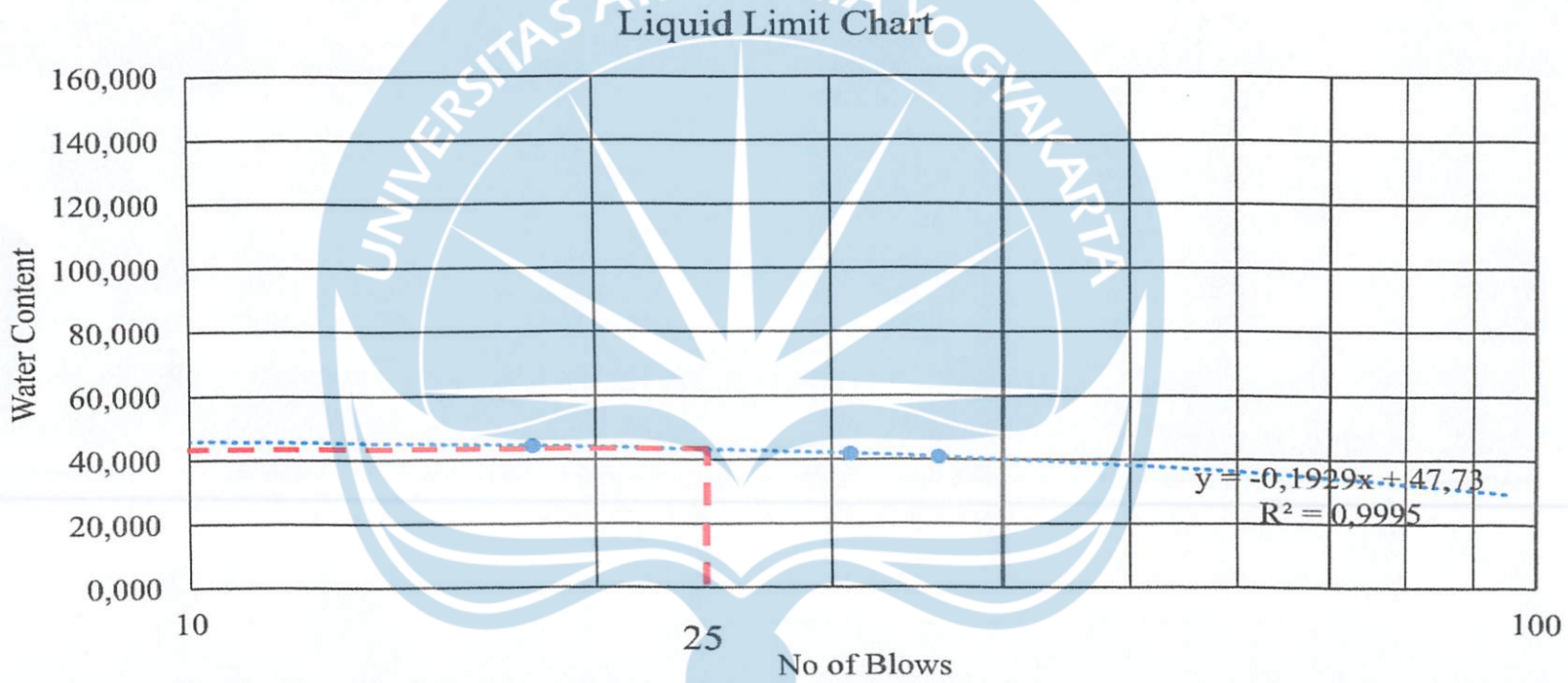

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C. DIRECT SHEAR TEST

SOIL + 20 % CKD + 10 % RHA (36-day curing time)

Project : Final Project

Location: Kasongan, Bantul, D. I. Yogyakarta

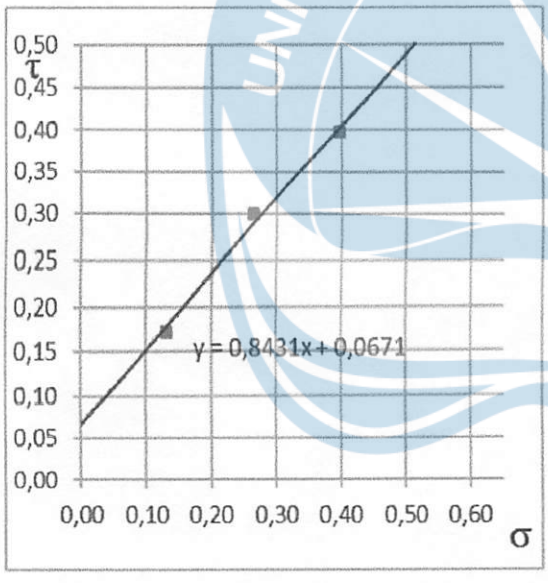
Date : 19th March 2018

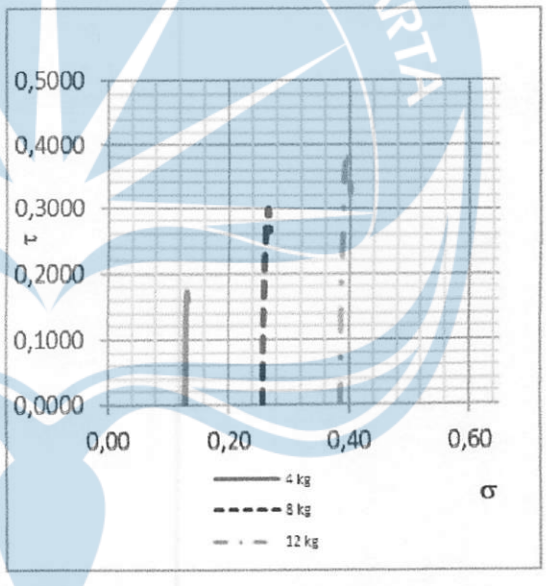
Load (kg)	τ (kg/cm²)	σ (kg/cm²)
4	0,1725	0,1309
8	0,3005	0,2651
12	0,3972	0,3976

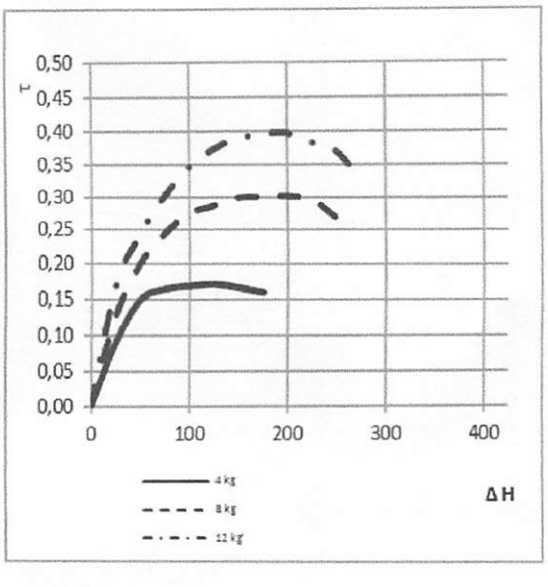
c = 0.0671 kg/cm²

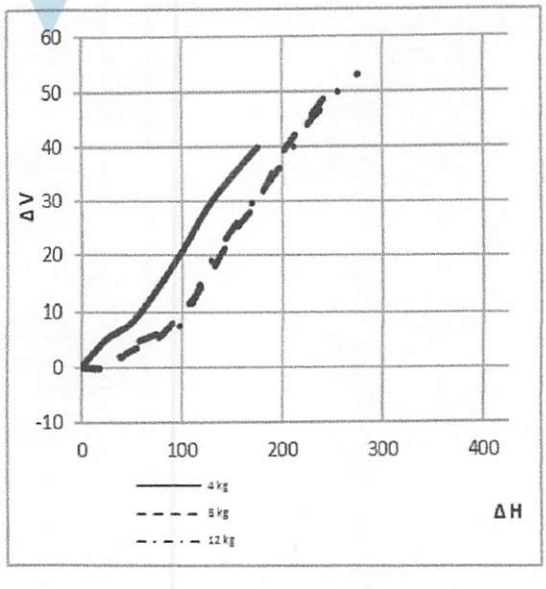
tan ϕ = 0.8431

ϕ = 40.13°









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Sample Data

Load : 4 kg

Diameter : 6.3 cm

Height : 2.1 cm

Area : 31.1725 cm^2

Weight : 96.70 gr

ΔH	ΔV	ε	Load		τ	σ
0	0	0,0000	0	0,00	0,0000	0,1283
25	5	0,0040	65	2,83	0,0911	0,1288
50	8	0,0079	105	4,65	0,1504	0,1293
75	14	0,0119	115	5,09	0,1653	0,1299
100	21	0,0159	118	5,22	0,1702	0,1304
125	29	0,0198	119	5,27	0,1725	0,1309
150	35	0,0238	115	5,09	0,1673	0,1314
175	40	0,0278	110	4,87	0,1607	0,1320

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Sample Data

Load : 8 kg

Diameter : 6.3 cm

Height : 2.1 cm

Area : 31.1725 cm^2

Weight : 93.93 gr

ΔH	ΔV	ε	Load		τ	σ
0	0	0,0000	0	0	0,0000	0,2566
25	0	0,0040	90	3,98	0,1282	0,2577
50	3	0,0079	140	6,19	0,2002	0,2587
75	5	0,0119	170	7,52	0,2441	0,2597
100	10	0,0159	190	8,41	0,2741	0,2608
125	16	0,0198	197	8,72	0,2854	0,2618
150	24	0,0238	205	9,07	0,2981	0,2629
175	30	0,0278	205	9,07	0,2993	0,2640
200	39	0,0317	205	9,07	0,3005	0,2651
225	45	0,0357	200	8,85	0,2944	0,2661
250	51	0,0397	180	7,96	0,2659	0,2672

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Sample Data

Load : 12 kg

Diameter : 6.3 cm

Height : 2.1 cm

Area : 31.1725 cm^2

Weight : 103.71 gr

ΔH	ΔV	ε	Load		τ	σ
0	0	0,0000	0	0	0,0000	0,3850
25	0	0,0040	120	5,31	0,1710	0,3865
50	4	0,0079	170	7,52	0,2432	0,3880
75	6	0,0119	210	9,29	0,3016	0,3896
100	8	0,0159	240	10,62	0,3462	0,3912
125	18	0,0198	258	11,42	0,3738	0,3927
150	25	0,0238	268	11,86	0,3897	0,3943
175	31	0,0278	271	11,99	0,3956	0,3960
200	37	0,0317	271	11,99	0,3972	0,3976
225	44	0,0357	260	11,51	0,3829	0,3992
250	49	0,0397	250	11,06	0,3695	0,4009
275	53	0,0437	220	9,73	0,3264	0,4025

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VIII. SOIL + 20 % CKD + 15 % RHA (36-day curing time)

A. PLASTIC LIMIT TEST

Project : **Final Project**

Location : **Kasongan, Bantul, D.I. Yogyakarta**

Date : **19th March 2018**

Tin Box		A	B
Tin Box (empty)	w1 gram	9,98	10,34
Tin Box (wet soil)	w2 gram	12,63	13,69
Tin Box (dried soil)	w3 gram	11,85	12,7
Water Weight	w4 = (w2-w3) gram	0,78	0,99
Dried Soil Weight	w5 = (w3-w1) gram	1,87	2,36
Water Content	w4/w5 x 100%	41,711	41,949
Average Water Content		41,830	
Plastic Limit		41,830	

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B. LIQUID LIMIT TEST

Project : Final Project

Location : Kasongan, Bantul, D.I. Yogyakarta

Date : 19th March 2018

Test No.		1		2		3		4	
No. of Blows		15		19		28		39	
Tin Box		1-Left	1-Right	2-Left	2-Right	3-Left	3-Right	4-Left	4-Right
Tin Box Weight (empty)	wt (gram)	14,68	16,91	15,32	15,13	17,6	17,47	14,44	13,84
Tin Box Weight (wet soil)	w1 (gram)	55,35	55,57	50,89	50,47	53,23	51,94	47,63	46,15
Tin Box Weight (dry soil)	w2 (gram)	40,91	41,98	38,59	38,24	41,31	40,38	36,91	35,66
Water Weight	Ww = w1 - w2	14,44	13,59	12,3	12,23	11,92	11,56	10,72	10,49
Dried Soil Weight	Ws = w2 - wt	26,23	25,07	23,27	23,11	23,71	22,91	22,47	21,82
Water Content	w = (Ww / Ws) x 100%	55,051	54,208	52,858	52,921	50,274	50,458	47,708	48,075
Average Water Content		54,630		52,889		50,366		47,892	

Liquid Limit (LL) = 51.512 %

$w100$ = 55.628 %

$w10$ = 30.932 %

Flow Index (I_f) = $w10 - w100$ = 24.696 %

Plasticity Index (PI) = LL – PL = 3.733 %

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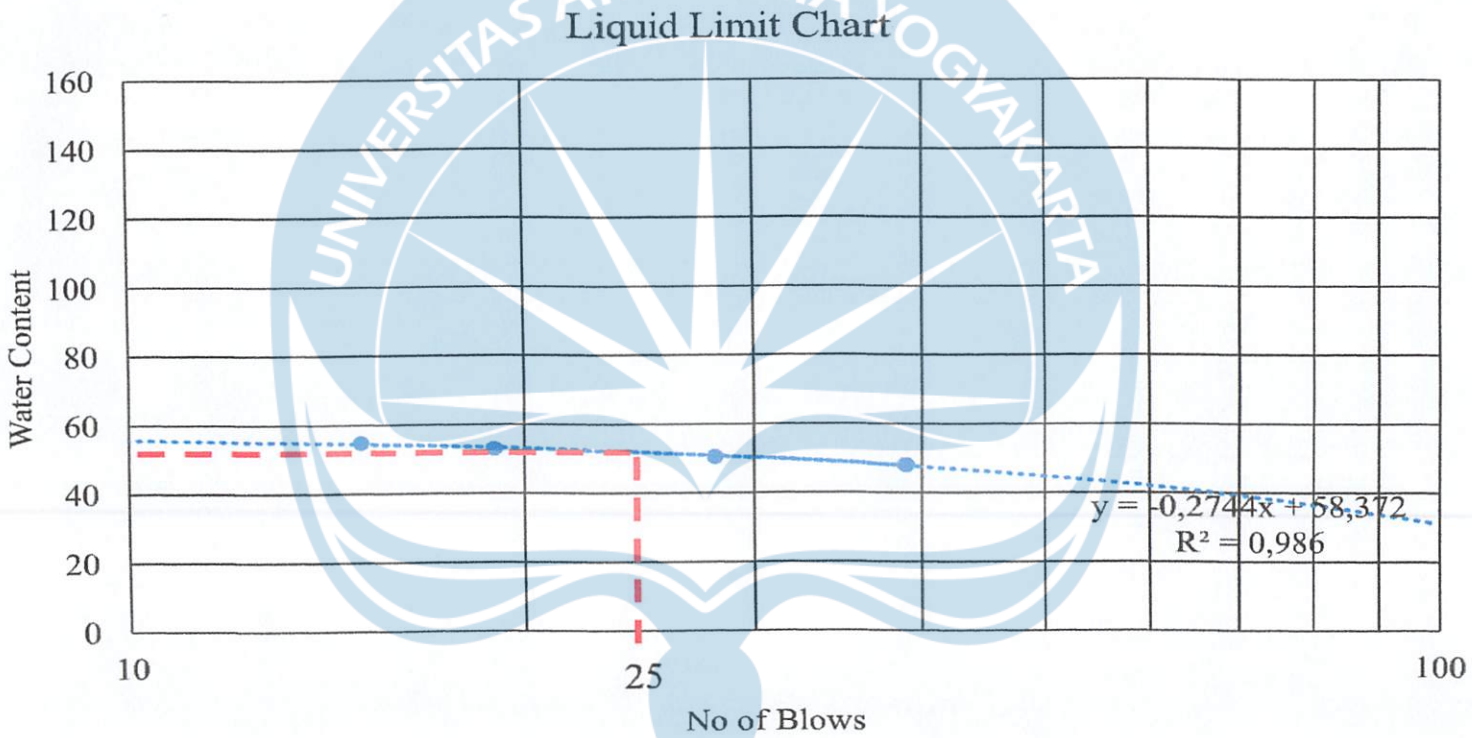

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C. DIRECT SHEAR TEST

SOIL + 20 % CKD + 15 % RHA (36-day curing time)

Project : Final Project

Location: Kasongan, Bantul, D. I. Yogyakarta

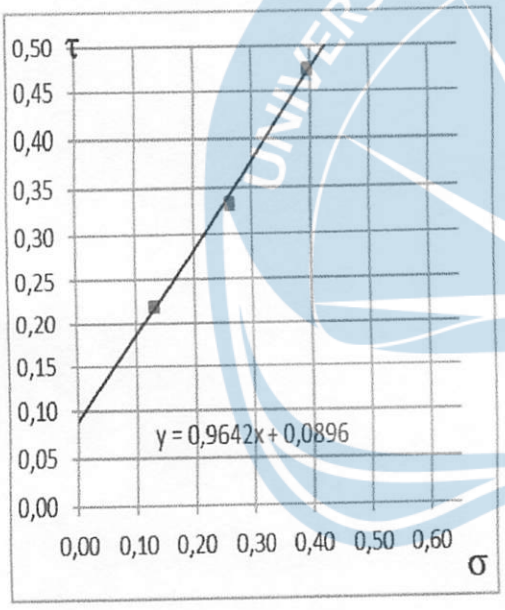
Date : 19th March 2018

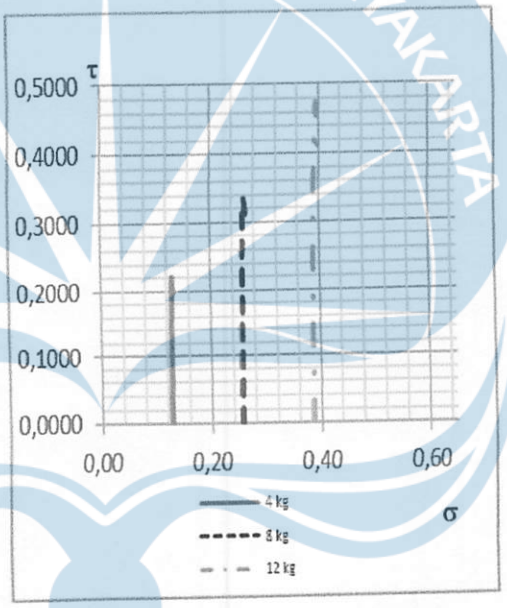
Load (kg)	τ (kg/cm²)	σ (kg/cm²)
4	0,2203	0,1309
8	0,3332	0,2618
12	0,4742	0,3943

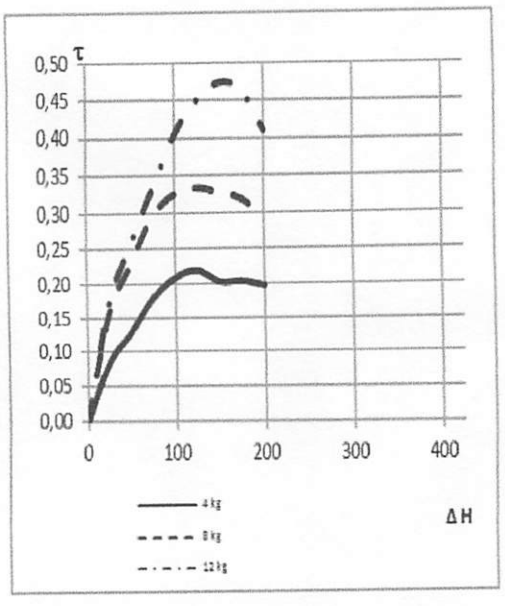
c = 0.0896 kg/cm²

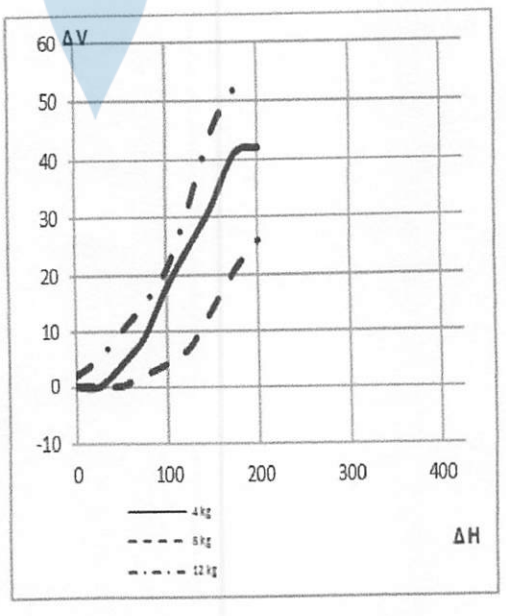
tan ϕ = 0.9642

ϕ = 43.96 °









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Sample Data

Load : 4 kg

Diameter : 6.3 cm

Height : 2.1 cm

Area : 31.1725 cm^2

Weight : 101.11 gr

ΔH	ΔV	ε	Load		τ	σ
0	0	0,0000	0	0,00	0,0000	0,1283
25	0	0,0040	60	2,61	0,0841	0,1288
50	4	0,0079	90	3,98	0,1287	0,1293
75	9	0,0119	125	5,53	0,1795	0,1299
100	18	0,0159	145	6,42	0,2093	0,1304
125	25	0,0198	152	6,73	0,2203	0,1309
150	32	0,0238	140	6,19	0,2034	0,1314
175	41	0,0278	140	6,19	0,2042	0,1320
200	42	0,0317	135	5,97	0,1978	0,1325

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Sample Data

Load : 8 kg

Diameter : 6.3 cm

Height : 2.1 cm

Area : 31.1725 cm^2

Weight : 110.11 gr

ΔH	ΔV	ε	Load		τ	σ
0	0	0,0000	0	0	0,0000	0,2566
25	0	0,0040	110	4,87	0,1569	0,2577
50	0	0,0079	160	7,08	0,2289	0,2587
75	2	0,0119	205	9,07	0,2945	0,2597
100	4	0,0159	225	9,96	0,3247	0,2608
125	7	0,0198	230	10,18	0,3332	0,2618
150	14	0,0238	225	9,96	0,3273	0,2629
175	21	0,0278	218	9,65	0,3184	0,2640
200	26	0,0317	200	8,85	0,2932	0,2651

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Sample Data

Load : 12 kg

Diameter : 6.3 cm

Height : 2.1 cm

Area : 31.1725 cm^2

Weight : 98.84 gr

ΔH	ΔV	ε	Load		τ	σ
0	0	0,0000	0	0	0,0000	0,3850
25	2	0,0040	120	5,31	0,1710	0,3865
50	5	0,0079	180	7,96	0,2574	0,3880
75	10	0,0119	230	10,18	0,3305	0,3896
100	15	0,0159	280	12,39	0,4039	0,3912
125	21	0,0198	310	13,72	0,4490	0,3927
150	32	0,0238	326	14,43	0,4742	0,3943
175	45	0,0278	318	14,08	0,4646	0,3960
200	52	0,0317	280	12,39	0,4105	0,3976

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IX. SOIL + 20 % CKD + 20 % RHA (36-day curing time)

A. PLASTIC LIMIT TEST

Project : **Final Project**

Location : **Kasongan, Bantul, D.I. Yogyakarta**

Date : **19th March 2018**

Tin Box		A	B
Tin Box (empty)	w1 gram	10,75	10,75
Tin Box (wet soil)	w2 gram	20,23	17,85
Tin Box (dried soil)	w3 gram	16,84	15,34
Water Weight	w4 = (w2-w3) gram	3,39	2,51
Dried Soil Weight	w5 = (w3-w1) gram	6,09	4,59
Water Content	w4/w5 x 100%	55,665	54,684
Average Water Content		55,175	
Plastic Limit		55,175	

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B. LIQUID LIMIT TEST

Project : **Final Project**

Location : **Kasongan, Bantul, D.I. Yogyakarta**

Date : **19th March 2018**

Test No.		1		2		3		4	
No. of Blows		17		23		30		35	
Tin Box		1-Left	1-Right	2-Left	2-Right	3-Left	3-Right	4-Left	4-Right
Tin Box Weight (empty)	wt (gram)	13,85	17,21	17,21	15,3	15,25	15,08	15,82	16,91
Tin Box Weight (wet soil)	w1 (gram)	56,77	50,22	48,9	46,13	50,07	49,55	51,79	47,2
Tin Box Weight (dry soil)	w2 (gram)	40,73	38,07	37,27	34,61	37,24	37,01	39,07	36,61
Water Weight	Ww = w1 - w2	16,04	12,15	11,63	11,52	12,83	12,54	12,72	10,59
Dried Soil Weight	Ws = w2 - wt	26,88	20,86	20,06	19,31	21,99	21,93	23,25	19,7
Water Content	w = (Ww / Ws) x 100%	59,673	58,245	57,976	59,658	58,345	57,182	54,710	53,756
Average Water Content		58,959		58,817		57,763		54,233	

Liquid Limit (LL) = 57.746 %

$w100$ = 61.391 %

$w10$ = 39.521 %

Flow Index (I_f) = $w10 - w100$ = 21.87 %

Plasticity Index (PI) = LL – PL = 2.571 %

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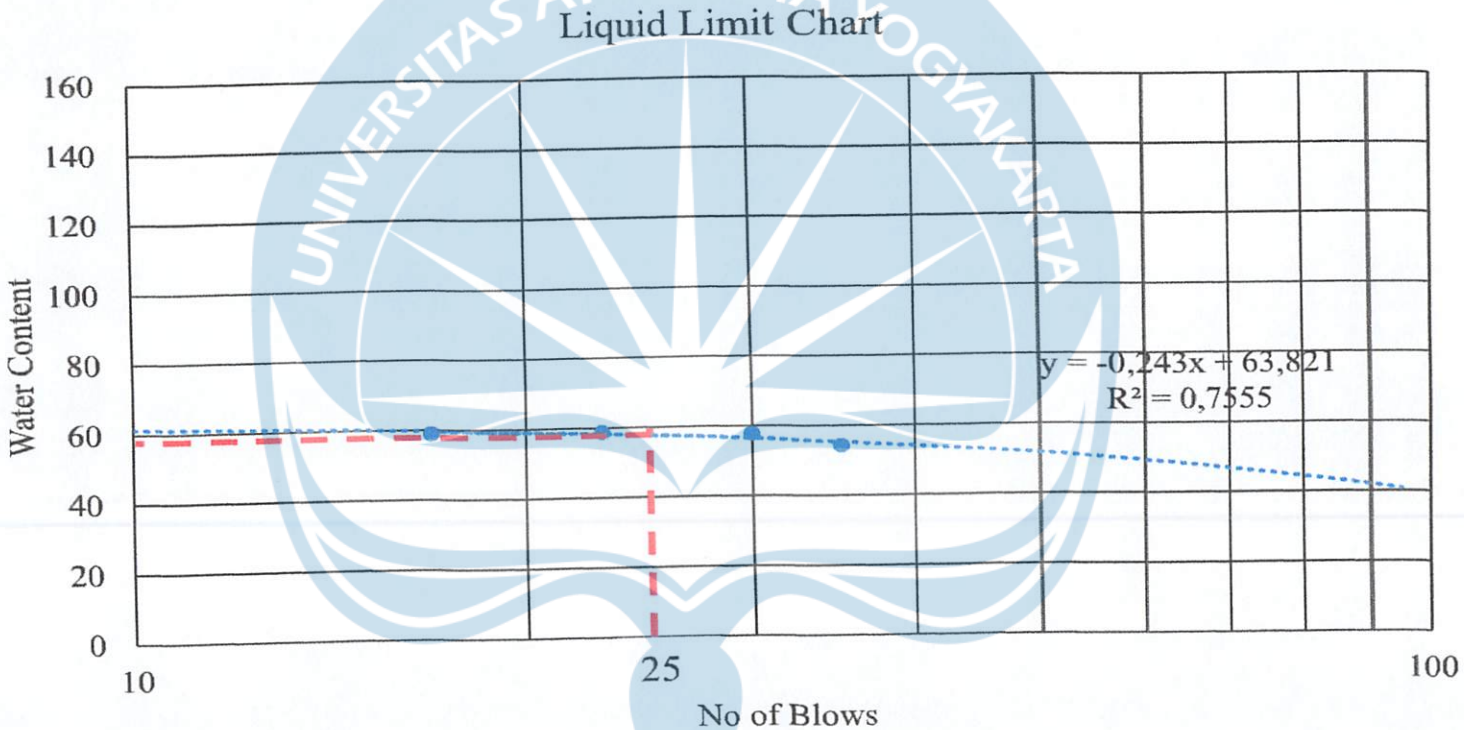

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C. DIRECT SHEAR TEST

SOIL + 20 % CKD + 20 % RHA (36-day curing time)

Project : Final Project

Location: Kasongan, Bantul, D. I. Yogyakarta

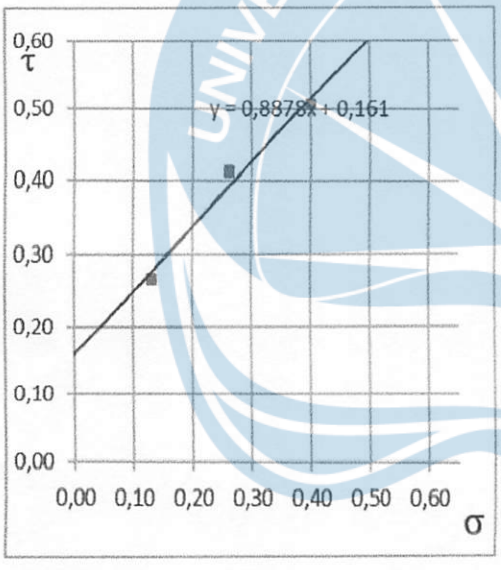
Date : 19th March 2018

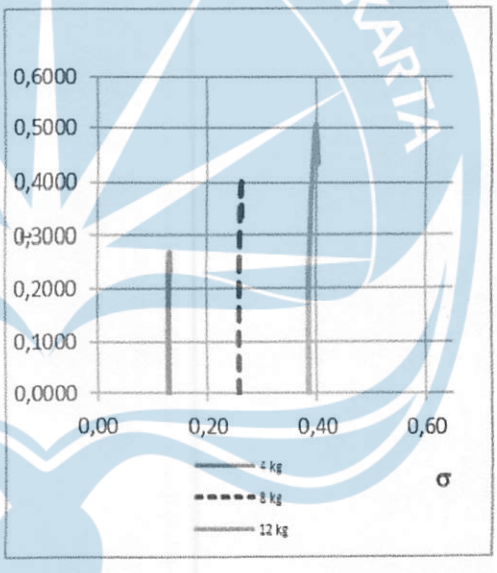
Load (kg)	τ (kg/cm²)	σ (kg/cm²)
4	0,2681	0,1309
8	0,4114	0,2618
12	0,5067	0,3992

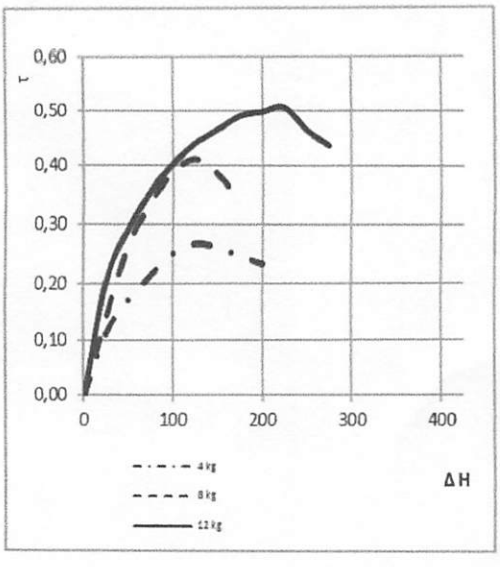
c = 0.161 kg/cm²

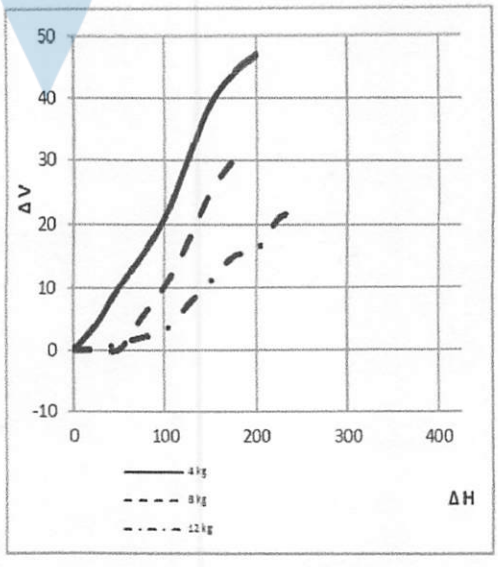
tan ϕ = 0.8878

ϕ = 41.60 °









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Sample Data

Load : 4 kg

Diameter : 6.3 cm

Height : 2.1 cm

Area : 31.1725 cm^2

Weight : 94.89 gr

ΔH	ΔV	ε	Load		τ	σ
0	0	0,0000	0	0,00	0,0000	0,1283
25	4	0,0040	80	3,54	0,1140	0,1288
50	10	0,0079	120	5,31	0,1717	0,1293
75	15	0,0119	150	6,64	0,2156	0,1299
100	21	0,0159	175	7,74	0,2523	0,1304
125	30	0,0198	185	8,19	0,2681	0,1309
150	39	0,0238	180	7,96	0,2616	0,1314
175	44	0,0278	170	7,52	0,2481	0,1320
200	47	0,0317	160	7,08	0,2346	0,1325

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Sample Data

Load : 8 kg

Diameter : 6.3 cm

Height : 2.1 cm

Area : 31.1725 cm^2

Weight : 99.3 gr

ΔH	ΔV	ε	Load		τ	σ
0	0	0,0000	0	0	0,0000	0,2566
25	0	0,0040	100	4,42	0,1424	0,2577
50	0	0,0079	185	8,19	0,2648	0,2587
75	5	0,0119	235	10,4	0,3376	0,2597
100	10	0,0159	270	11,95	0,3895	0,2608
125	17	0,0198	284	12,57	0,4114	0,2618
150	25	0,0238	264	11,68	0,3838	0,2629
175	30	0,0278	230	10,18	0,3359	0,2640

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Sample Data

Load : 12 kg

Diameter : 6.3 cm

Height : 2.1 cm

Area : 31.1725 cm^2

Weight : 102.35 gr

ΔH	ΔV	ε	Load		τ	σ
0	0	0,0000	0	0	0,0000	0,3850
25	0	0,0040	144	6,37	0,2052	0,3865
50	0	0,0079	204	9,03	0,2920	0,3880
75	1	0,0119	248	10,97	0,3562	0,3896
100	2	0,0159	280	12,39	0,4039	0,3912
125	3	0,0198	304	13,46	0,4405	0,3927
150	7	0,0238	320	14,17	0,4657	0,3943
175	11	0,0278	336	14,87	0,4907	0,3960
200	15	0,0317	340	15,05	0,4986	0,3976
225	16	0,0357	344	15,23	0,5067	0,3992
250	21	0,0397	314	13,9	0,4643	0,4009
275	22	0,0437	294	13,01	0,4364	0,4025

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X. DOCUMENTATION