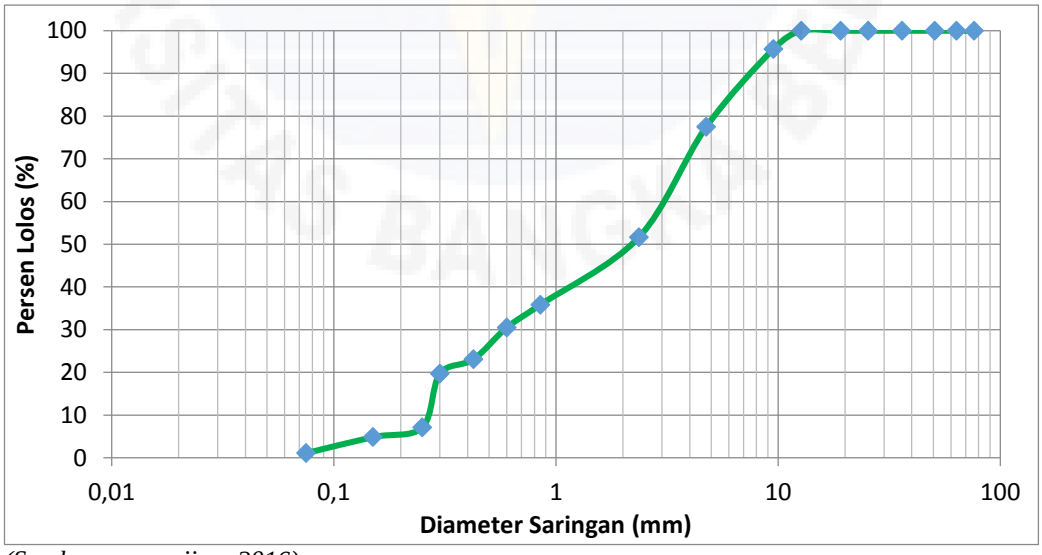
LAMPIRAN I

Data Hasil Pengujian Laboratorium

1. Pengujian Gradasi Tanah

Tabel 1.1 Data Pengujian Analaisis Saringan Tanah

Standar Ukuran Saringan (mm)	saringan	Berat Tertahan	Jumlah Berat Tertahan	Jumlah Persen (%)	
				Tertahan	Lewat
76,2	3”	0	0	0	100
83,5	2 1/9 “	0	0	0	100
50,8	2 “	0	0	0	100
36,1	1 1/2 “	0	0	0	100
25,4	1”	0	0	0	100
19,1	3/4”	0	0	0	100
12,7	1/2”	0	0	0	100
9,52	3/8”	63,3	63,3	4,294	95,706
4,75	No. 4	268,3	331,6	22,495	77,505
2,36	No. 8	381,4	713	48,368	51,632
0,85	No. 20	232,6	945,6	64,148	35,852
0,6	No. 30	78,6	1024,2	69,480	30,520
0,425	No. 40	109,7	1133,9	76,922	23,078
0,3	No. 50	49,6	1183,5	80,286	19,714
0,25	No. 80	185,5	1369	92,870	7,130
0,15	No. 100	33,3	1402,3	95,129	4,871
0,075	No. 200	55,3	1457,6	98,881	1,119
	pan	16,5	1474,1	100	0,000



(Sumber : pengujian, 2016)

2. Pengujian Berat Jenis

Tabel 2.1 Pemeriksaan Berat Jenis

No. Piknometer		1	2
Berat piknometer + contoh (W_2)	Gram	73,6	73,6
Berat piknometer (W_1)	Gram	38,6	38,6
Berat tanah ($W_t = W_2 - W_1$)	gram	35	35
Temperatur ^oC		29	28
Berat piknometer + air + tanah pada temperatur 20 ^oC (W_3)	Gram	109,3	109,2
Berat piknometer + air 20^oC (W_4)	gram	87,6	87,6
$W_5 = W_t + W_4$	Gram	122,6	122,6
Isi tanah ($W_5 – W_3$)	Cm^3	13,3	13,4
Berat jenis (Gs) ($W_t / W_5 – W_3$)		2,63	2,62
Rata – rata		2,63	

(Sumber : pengujian, 2016)

3. Pengujian Pemadatan

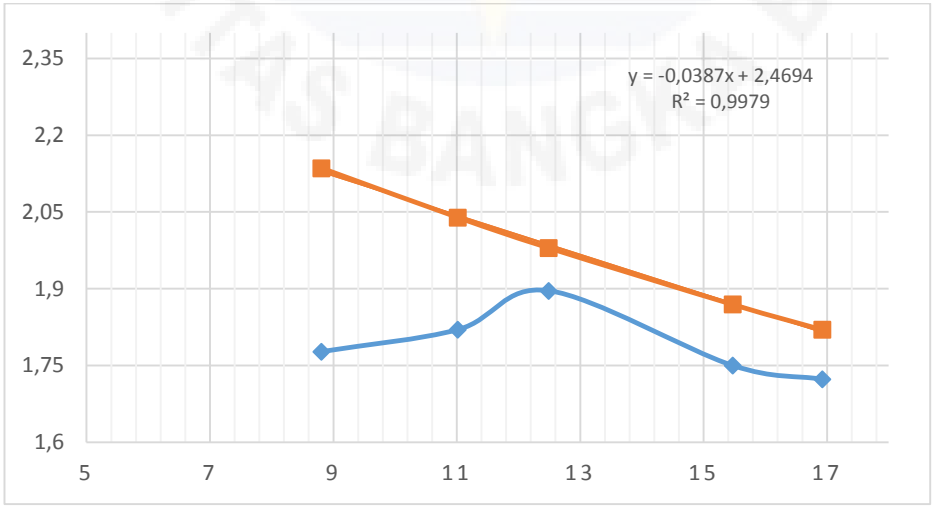
Tabel 3.1 Pengujian Pemadatan

Nomor cawan		**8%**	**10%**	**12%**	**14%**	**16%**
Massa tanah basah + cawan	(gr)	68,6	53,010	70,557	60,26	59,59
Massa tanah kering + cawan	(gr)	64,7667	49,8333	65,26667	55	54,00
Massa air	(gr)	3,83333	3,700	6,400	5,967	7,067
Massa Cawan	(gr)	21,23	21	22,9	21	20,97
Massa tanah kering	(gr)	43,5333	28,8333	42,36667	34	33,033
Kadar air	(%)	8,80551	11,0173	12,4863	15,4706	16,922
Massa tanah basah + cetakan (gr)		13708	13873,563	13490,05	13532,181	13111,2
Massa cetakan	(gr)	7240	7239	6504	6913	6530
Massa tanah basah	(gr)	6044	6931	6986,05	6809	6837
Isi cetakan	(cm^3)	3345,28	3283,6	3275,63	3275,63	3266,49
Kepadatan Basah	(gr/cm^3)	1,933	2,021	2,133	2,021	2,0147
Kepadatan Kering	(gr/cm^3)	1,777	1,82	1,89599	1,75	1,72317

(*Sumber : pengujian, 2016)*

GS	**Kadar air**	**Kep.Kering**	**zav Line**
2,63	8,806	1,777	2,135
2,63	11,017	1,820	2,039
2,63	12,486	1,896	1,980
2,63	15,471	1,750	1,869
2,63	16,922	1,723	1,820

(Sumber : pengujian ,2016)



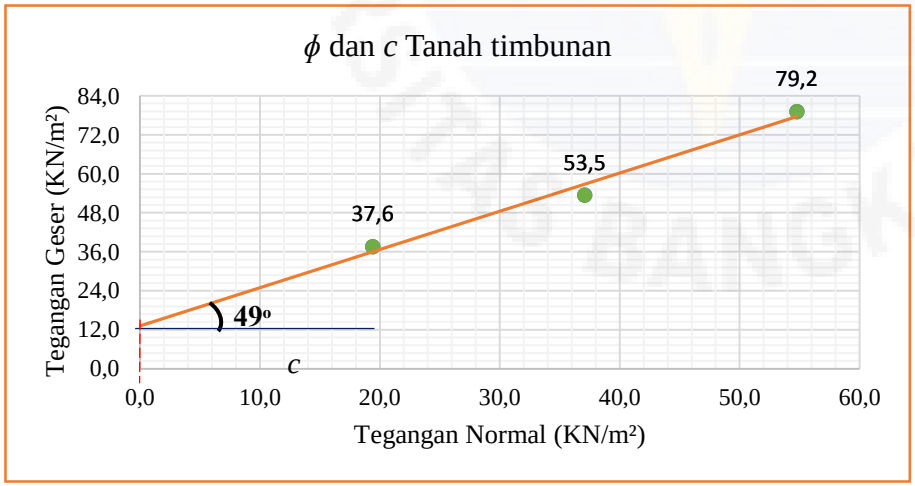
Gambar 3.1 Hubungan Kepadatan Kering Maksimum dan Kadar Air Optimum

4. Pengujian Direct Shear

Diameter ring *(D)*	:	6	cm
Tinggi sample *(H)*	:	2	cm
Kalibrasi (K)	:	0,56	kgf/Div
Luas sample *(A)*	:	28,274	cm^2
Berat tutup *(B)*	:	483,3	gr

Tabel Hasil Analisis Pengujian Tanah Timbunan

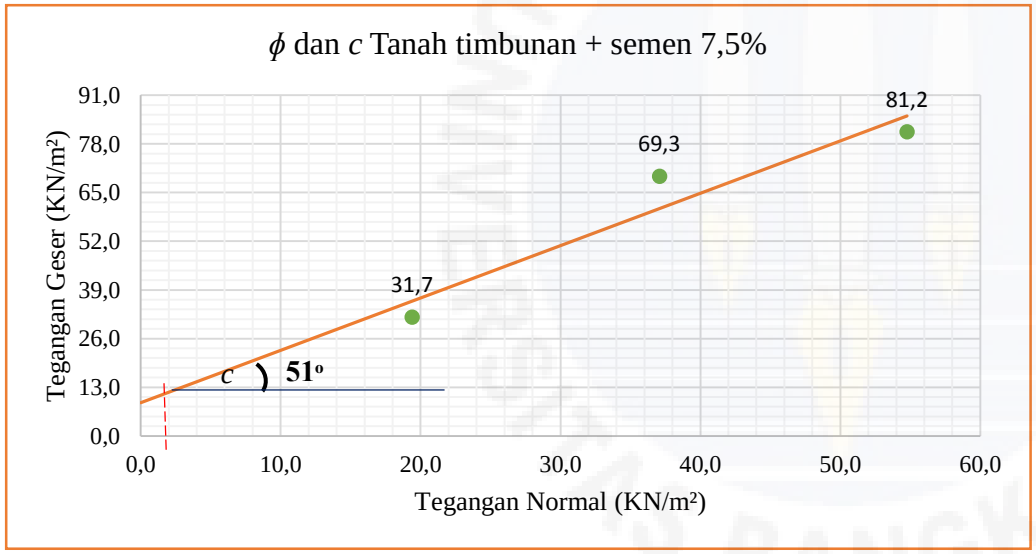
No	Kode Sampel	Berat Sempel	Beban Tetap	Beban Tambahan	Total Beban	Pembacaan Dial	Tegangan Normal	Tegangan Geser	Tegangan Normal	Tegangan Geser	Sudut Geser (ϕ)	Kohesi (c)
		gr	gr	gr	gr		kg/cm²	kg/cm²	KN/m²	KN/m²	derajad (°)	KN/m²
1	1A	118,5	483,3	5000	5483,3	19	0,19	0,38	19,4	37,63	49,62	14,82
2	1B	119,2	483,3	10000	10483,3	27	0,37	0,53	37,1	53,48	41,86	20,25
3	1C	121,8	483,3	15000	15483,3	40	0,55	0,79	54,8	79,22	55,52	-0,51
Rata-Rata											49	12



Gambar 4.1 Grafik Hubungan C dan ø

Tabel 4.2 Hasil Analisis Tanah Timbunan + Semen 7,5%

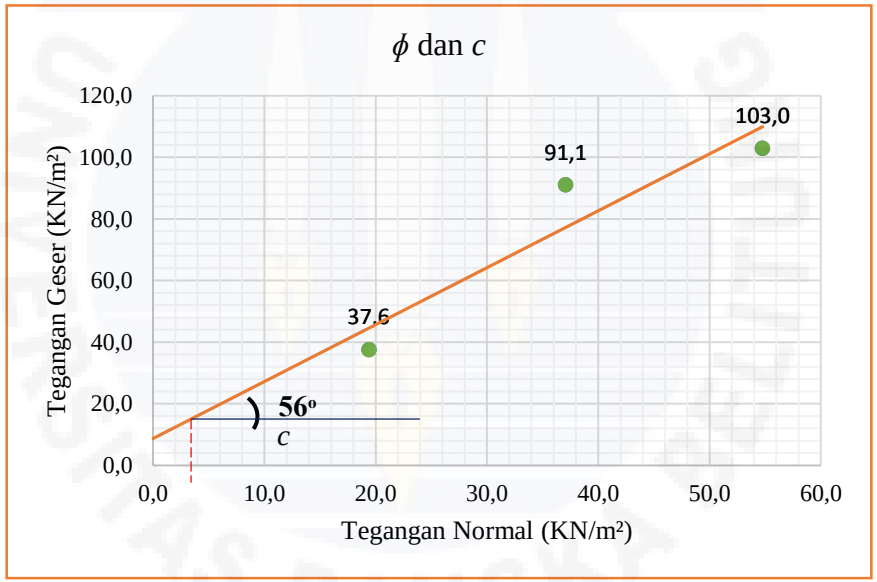
No	Tanah asli+semen 7,5%	Berat Sempel	Beban Tetap	Beban Tambahan	Total Beban	Pembacaan Dial	Tegangan Normal	Tegangan Geser	Tegangan Normal	Tegangan Geser	Sudut Geser (ϕ)	Kohesi (c)
		gr	gr	gr	gr		Kg/cm^2	Kg/cm^2	kN/m^2	kN/m^2	Derajat(^{o})	kN/m^2
1.	1A	120,4	483,3	5000	5483	16	0,19	0,32	19,4	31,69	54,46	4,54
2.	1B	121,6	483,3	10000	10483	35	0,37	0,69	37,1	69,32	64,83	-9,58
3.	1C	124,7	483,3	15000	15483	41	0,55	0,81	54,8	81,20	33,90	44,41
Rata-Rata											51	13



Grafik 4.2 Hubungan c dan ø

Tabel 4.3 Hasil Analisis Tanah Timbunan + Semen 10%

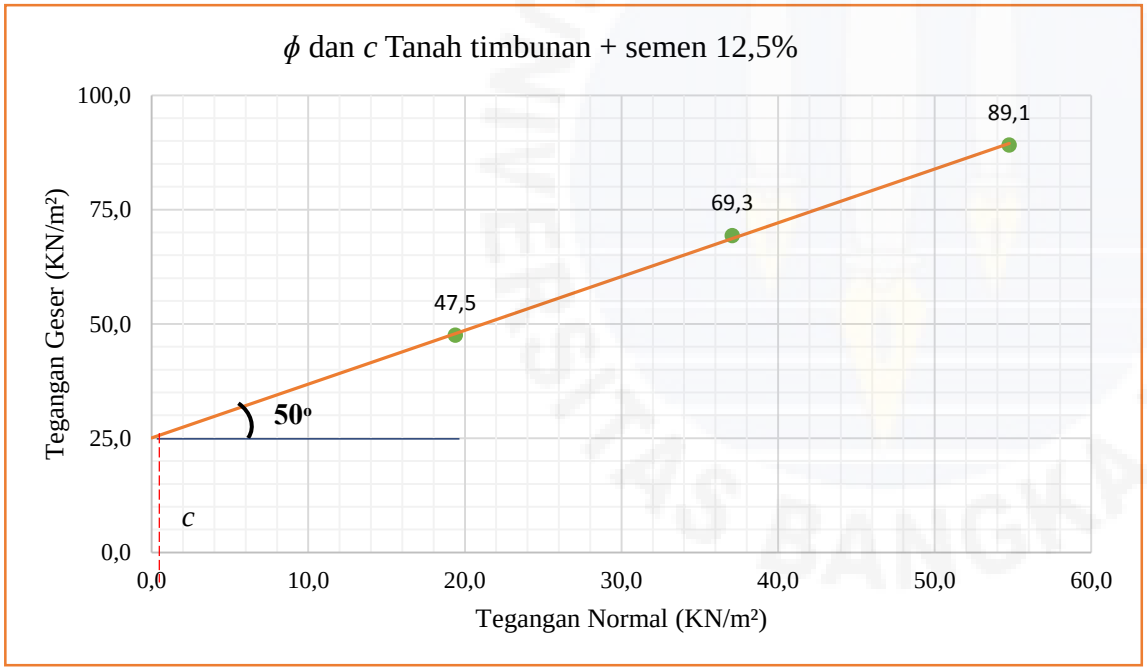
No	Kode Sampel	Berat Sempel	Beban Tetap	Beban Tambahan	Total Beban	Pembacaan Dial	Tegangan Normal	Tegangan Geser	Tegangan Normal	Tegangan Geser	Sudut Geser (ϕ)	Kohesi (c)
		gr	gr	gr	gr		kg/cm²	kg/cm²	KN/m²	KN/m²	derajad (°)	KN/m²
1	1A 10%	115,2	483,3	5000	5483,3	19	0,19	0,38	19,4	37,63	61,58	1,79
2	1B	118,3	483,3	10000	10483,3	46	0,37	0,91	37,1	91,11	71,70	-21,01
3	1C	119	483,3	15000	15483,3	52	0,55	1,03	54,8	102,99	33,90	66,19
Rata-Rata											56	16



Gambar 4.3 Grafik Hubungan C dan ø

No	Kode Sampel	Berat Sempel	Beban Tetap	Beban Tambahan	Total Beban	Pembacaan Dial	Tegangan Normal	Tegangan Geser	Tegangan Normal	Tegangan Geser	Sudut Geser (ϕ)	Kohesi (c)
		gr	gr	gr	gr		kg/cm²	kg/cm²	KN/m²	KN/m²	derajad (°)	KN/m²
1	1A	120,4	483,3	5000	5483,3	24	0,19	0,48	19,4	47,53	49,62	24,73
2	1B	121,6	483,3	10000	10483,3	35	0,37	0,69	37,1	69,32	50,93	23,64
3	1C	124,7	483,3	15000	15483,3	45	0,55	0,89	54,8	89,13	48,24	27,79
Rata-Rata											50	25

Tabel 4.4 Hasil Analisis Tanah Timbunan + Semen 12,5%



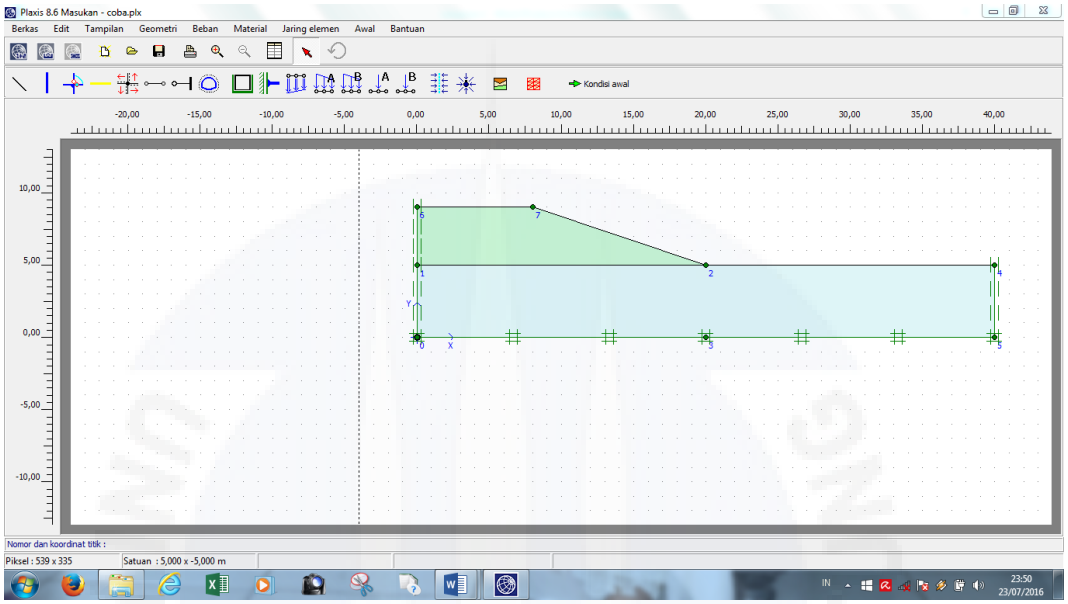
Gambar 4.4 Grafik Hubungan C dan ø

LAMPIRAN II

Tahapan Analisis dan Hasil Analisis Program *Plaxis* 2D-Versi 8

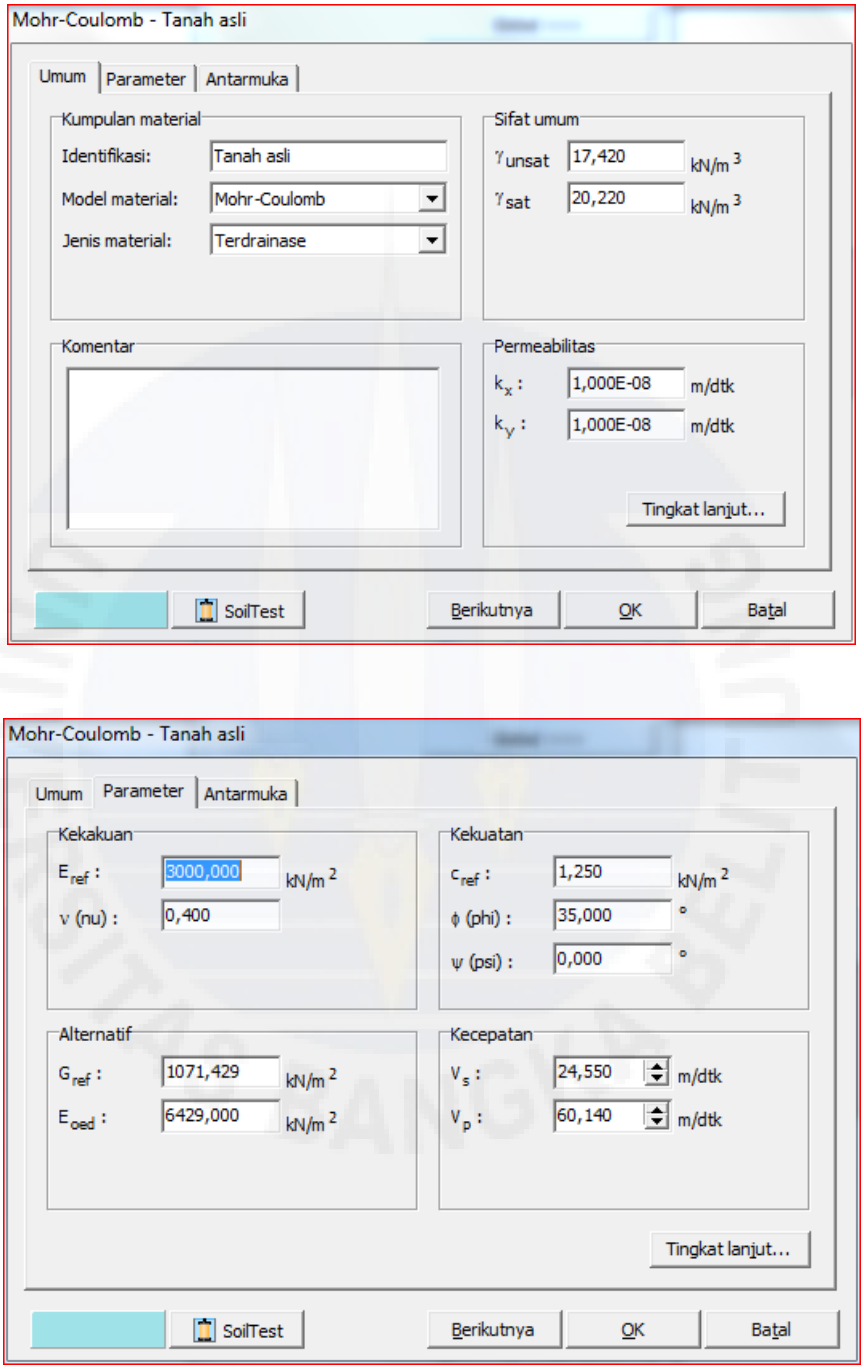
1. **Tahapan analisis angka keamanan tanah timbunan**

Dalam analisis angka keamanan tanah timbunan dengan plaxis tahap pertama dengan memodelkan geometri tanah timbunan, dapat dilihat pada Gambar 1.1

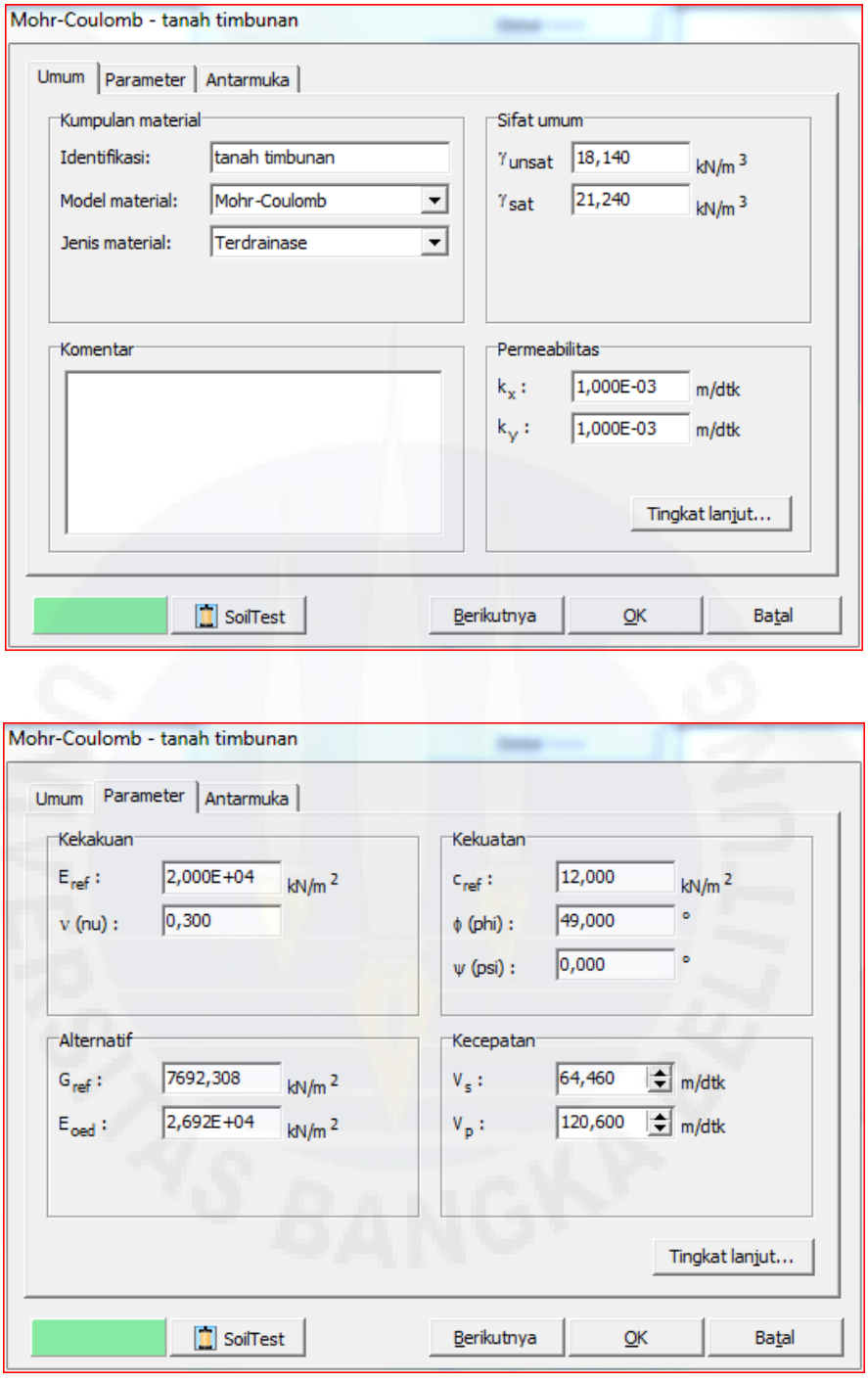


Gambar 1.1 Bentuk Geometri Lereng

Tahap kedua yaitu memasukkan parameter tanah. Adapun masukkan dapat dilihat pada Gambar 1.2 untuk tanah asli dan Gambar 1.3 untuk tanah timbunan.

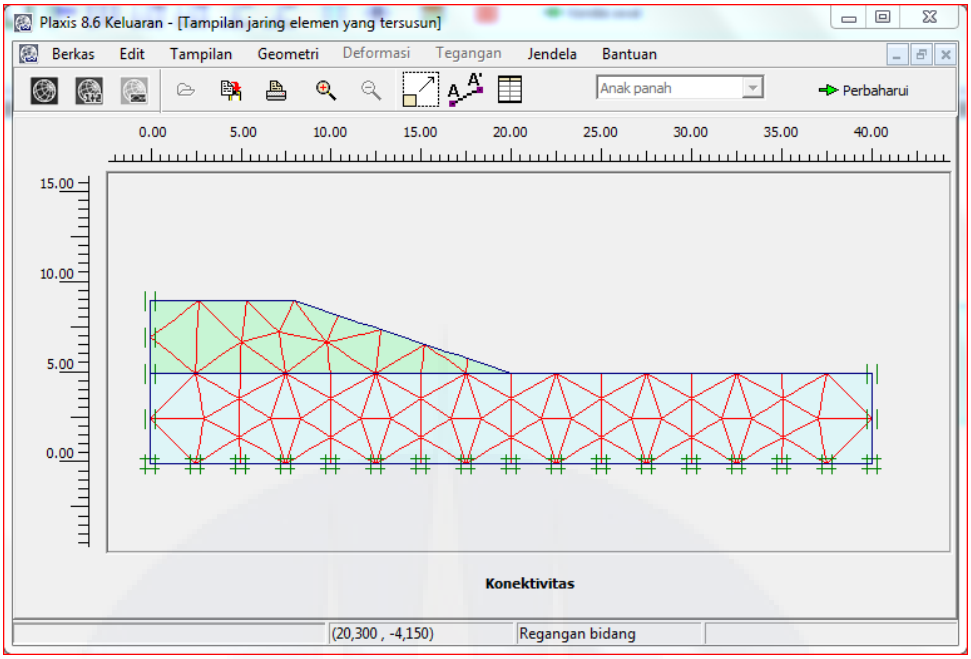


Gambar 1.2 Masukan Parameter Tanah asli



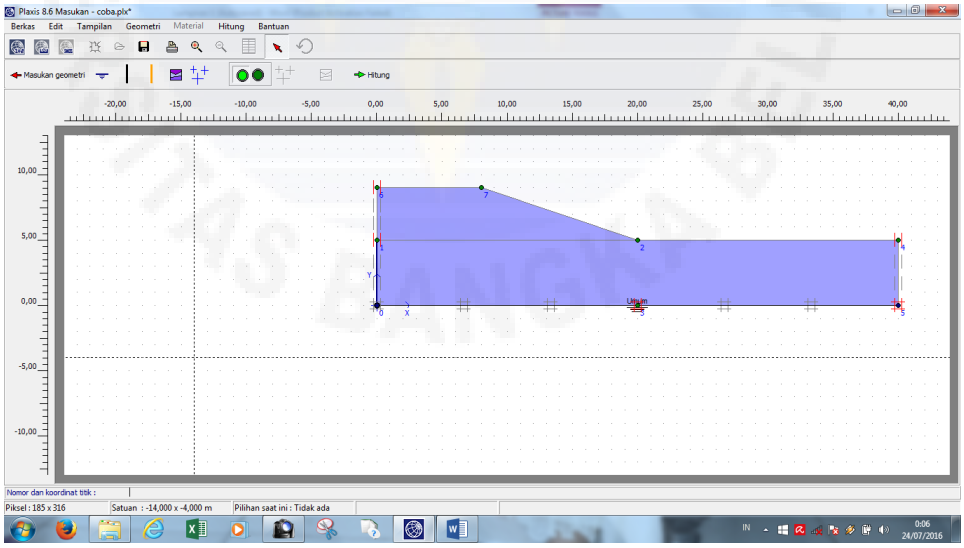
Gambar 1.3 Masukan Parameter Tanah timbunan

Setelah parameter tanah dimasukkan selanjutnya penyusunan jaring elemen dapat dilihat pada Gambar 1.4.



Gambar 1.4 Penyusunan Jaring Elemen

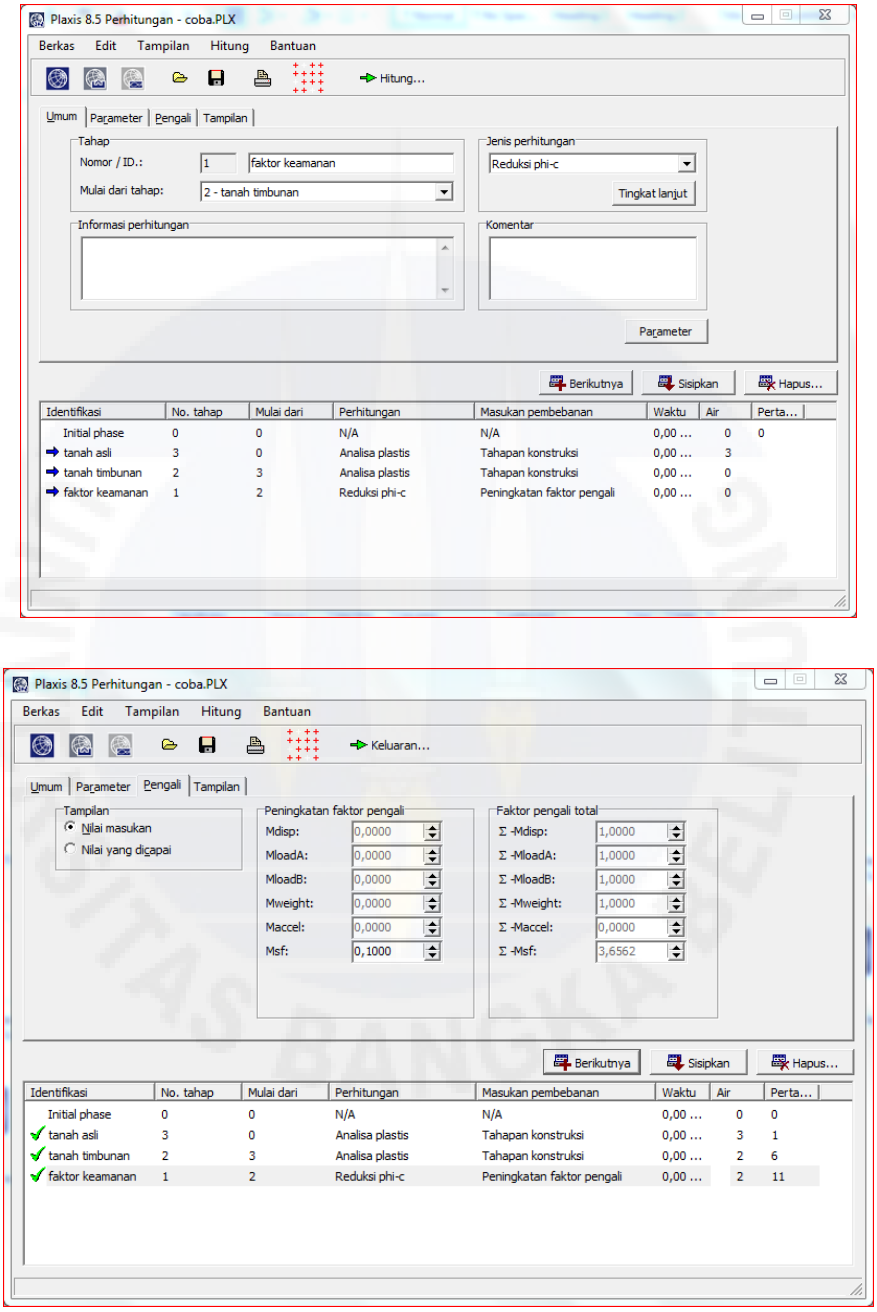
Setelah jaring elemen tersusun dilakukan penetapan muka air tanah karena dipermodelan ini muka air tanahnya jauh dari tanah permodelan maka muka air tanah terdapat dibawah tanah dasar, dapat dillihat pada Gambar 1.5.



Gambar 1.5 Penggambaran Muka Air Tanah

Selanjutnya tahap perhitungan, untuk analisis *FS* pada tanah asli digunakan jenis perhitungan analisa plastis selanjutnya matikan perhitungan faktor keamanan

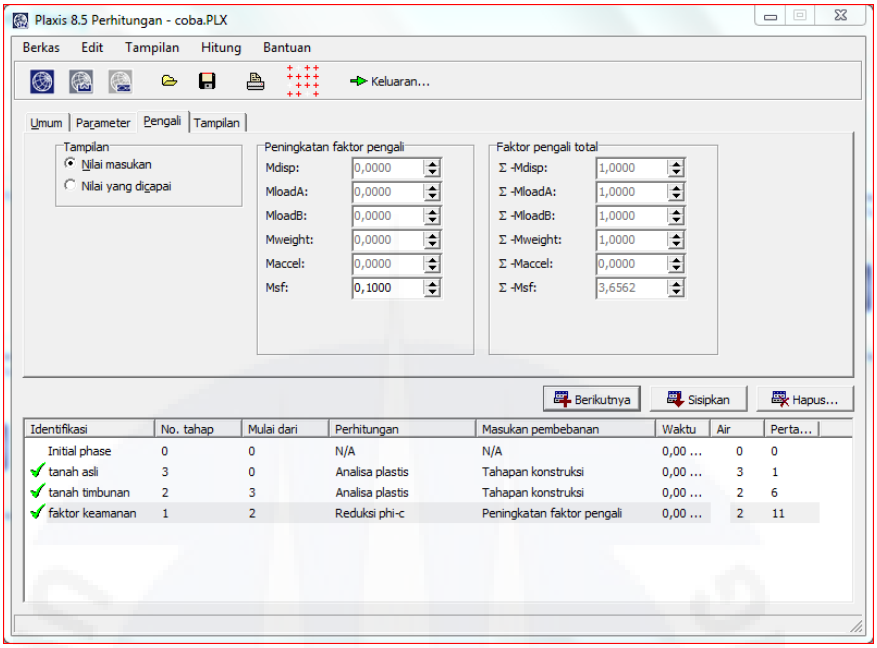
tanah timbunan, setelah itu untuk perhitungan tanah timbunan aktifkan tanah asli dan tanah timbunan dan pada perhitungan faktor keamanan tanah asli dan tanah timbunnan dapat dipilih p*hi/c reduction* (Gambar 1.6) pada jenis perhitungan.



Gambar 1.6 Tahap Perhitungan Nilai Faktor Keamanan

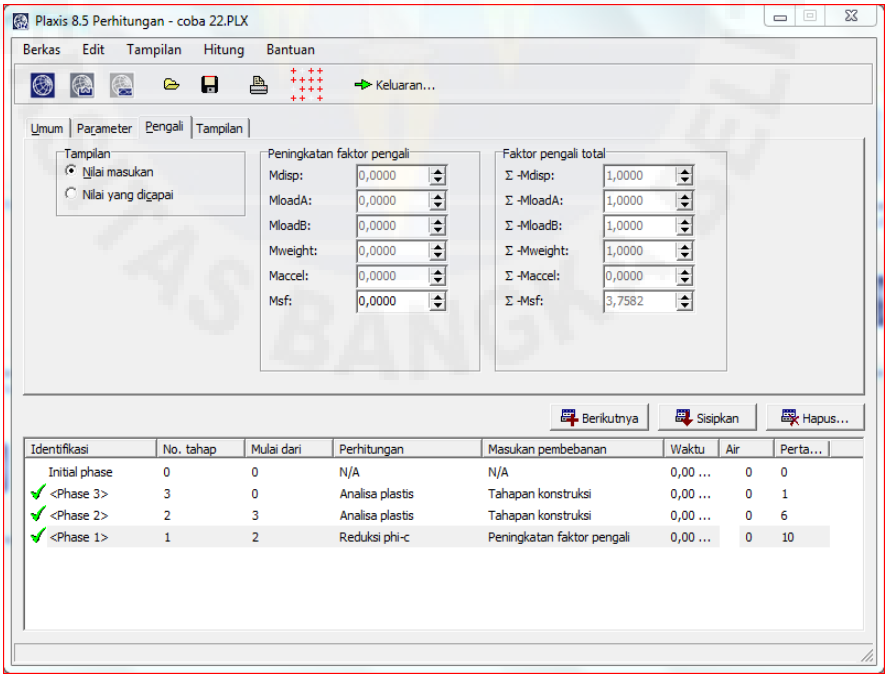
2. Hasil Analisis Angka Keamanan Tanah Timbunan dengan Software Plaxis

1. Permodelan 1 (tanah timbunan)



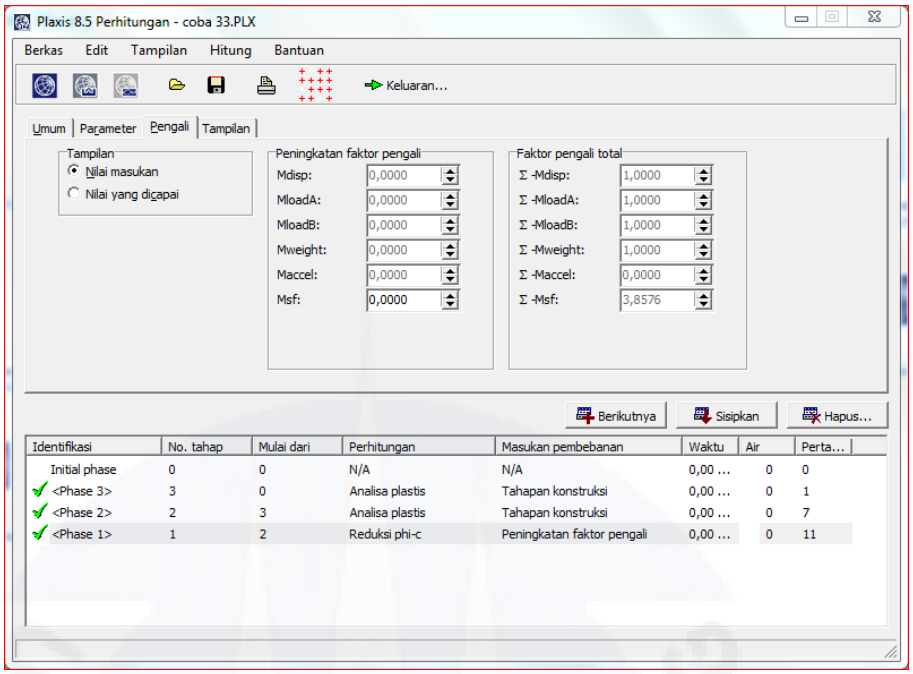
Gambar 2.1 Hasil Tanah Timbunan

2. Permodelan 2 (tanah timbunan + semen 7,5 %)



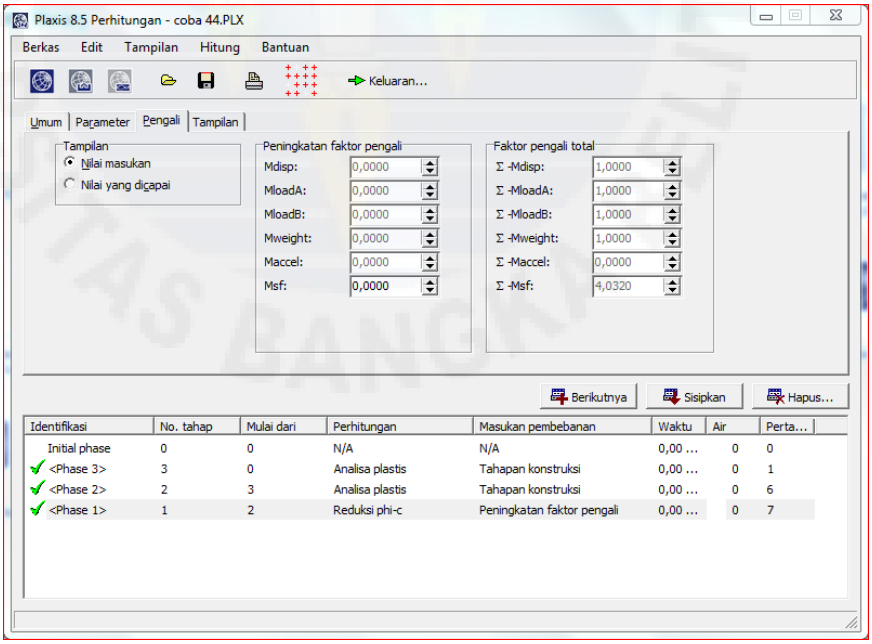
Gambar 2.2 Hasil Tanah Timbunan + Semen 7,5%

3. Permodelan 3 (tanah timbunan + semen 10%)



Gambar 3.1 Hasil Tanah Timbunan + Semen 10%

4. Permodelan 4 (tanah timbunan + semen 12,5%)



Gambar 4.1 Hasil Tanah Timbunan + Semen 12,5%

LAMPIRAN III

Data Hasil Perhitungan Manual (Fellinius)

3.1 Perhitungan Manual

3.1.1 Permodelan 3 irisan

lapisan	C KN/m²	ø	γd (kN/m2)	A (m2)	w (kN)	bi	tg φ	θ	sin θ	cos θ	αi	w sin θ	w cos θ	c.αi	Mr	SF
1	3,68	44,33	20,08	14,6	293,168	3	0,977	45	0,707	0,707	4,243	207,301	207,301	15,613	218,122	2,278
2	1,68	38,11	18,36	21,6	396,576	3	0,784	15	0,259	0,966	3,106	102,641	383,063	5,218	305,686	
3	1,68	38,11	18,36	5,8	106,488	2,1	0,784	-25	-0,423	0,906	2,317	-45,004	96,511	3,893	79,594	
												264,939			603,401	

3.1.2 Permodelan 5 irisan

lapisan	c	ø	γn (kN/m2)	A (m2)	w (kN)	bi	tg φ	θ	sin θ	cos θ	αi	w sin θ	w cos θ	c.αi	Mr	SF
1	12	49	21,24	2,4	50,976	2	1,150	55	0,819	0,574	3,487	41,757	29,239	41,843	75,478	3,327
2	3,541	44,1	20,0205	12	240,246	4	0,969	38	0,616	0,788	5,076	147,910	189,316	17,974	201,434	
3	2,056	40	18,9077	12,92	244,287	4	0,839	15	0,259	0,966	4,141	63,226	235,964	8,513	206,510	
4	2,056	40	18,9077	10	189,077	4	0,839	-10	-0,174	0,985	4,062	-32,833	186,204	8,350	164,594	
5	1,25	35	17,42	2,24	39,0208	3,2	0,700	-25	-0,423	0,906	3,531	-16,491	35,365	4,414	29,176	
												203,570			677,192	

3.1.3 Permodelan 8 irisan

lapisan	c	ø	γn (kN/m2)	A (m2)	w (kN)	bi	tg φ	θ	sin θ	cos θ	αi	w sin θ	w cos θ	c.αi	Mr	SF
1	12	49	21,24	2,6	55,224	2	1,150	50	0,766	0,643	3,111	42,304	35,497	37,337	78,172	3,425
2	12	49	21,24	5,8	123,192	2	1,150	40	0,643	0,766	2,611	79,186	94,371	31,330	139,891	
3	3,54	44,1	20,02	6,8	136,136	2	0,969	35	0,574	0,819	2,442	78,084	111,516	8,643	116,710	
4	5,3	41,19	19,24	7,4	142,376	2	0,875	20	0,342	0,940	2,128	48,695	133,790	11,280	128,363	
5	1,88	39,2	18,68	7,2	134,496	2	0,816	10	0,174	0,985	2,031	23,355	132,453	3,818	111,844	
6	1,58	37,47	18,17	5,8	105,386	2	0,766	-10	-0,174	0,985	2,031	-18,300	103,785	3,209	82,759	
7	1,58	37,47	18,17	4,6	83,582	2	0,766	-9	-0,156	0,988	2,025	-13,075	82,553	3,199	66,476	
8	1,25	35	17,42	2,72	47,3824	9	0,700	-20	-0,342	0,940	9,578	-16,206	44,525	11,972	43,149	
												224,044			767,364	

1. Perhitungan permodelan 3 irisan :

- $c1 = \frac{H}{(H1/c1)+(H2/c2)} = \frac{3{,}8}{(2{,}8/12)+(1/1{,}25)} = 3{,}68\ \text{kN/m}^2$

  $c2 = \frac{H}{(H1/c1)+(H2/c2)} = \frac{2{,}8}{(0{,}8/12)+(2/1{,}25)} = 1{,}68\ \text{kN/m}^2$

  $c3 = \frac{H}{(H1/c1)+(H2/c2)} = \frac{2{,}8}{(0{,}8/12)+(1/1{,}25)} = 1{,}68\ \text{kN/m}^2$

- $ø = \frac{H}{(H1/ø)+(H2/ø)} = \frac{3{,}8}{(2{,}8/49)+(1/35)} = 44{,}33$

  $ø = \frac{H}{(H1/ø)+(H2/ø)} = \frac{2{,}8}{(0{,}8/49)+(1/35)} = 38{,}11$

  $ø = \frac{H}{(H1/ø)+(H2/ø)} = \frac{2{,}8}{(0{,}8/49)+(2/35)} = 38{,}11$

- $\gamma d = \frac{H}{(H1/\gamma d)+(H2/\gamma d)} = \frac{3{,}8}{(2{,}8/21{,}24)+(1/17{,}42)} = 20{,}08\ \text{kN/m}^2$

  $\gamma d = \frac{H}{(H1/\gamma d)+(H2/\gamma d)} = \frac{2{,}8}{(0{,}8/21{,}24)+(2/17{,}42)} = 18{,}36\ \text{kN/m}^2$

  $\gamma d = \frac{H}{(H1/\gamma d)+(H2/\gamma d)} = \frac{2{,}8}{(0{,}8/21{,}24)+(2/17{,}42)} = 18{,}36\ \text{kN/m}^2$

- A = $(\frac{atas+bawah}{2} xt)$+(1/2 x a x t) + (1/2 x a x t) = $(\frac{1{,}2+3{,}6}{2} x4)$ + (1/2 x 2,6 x 2) + (½ x 4 x 1,4) = 15 m^2
  A = (1/2 x a x t) + (P x L)= (1/2 x 6 x 2) + (6 x 2,6) = 21,6 m^2
  A = (1/2 x a x t) + (1/2 x a x t) = (1/2 x 2 x 0,8) + (½ x 5 x 2) = 5,8 m^2

- bi = 3 m
  bi = 3 m
  bi = 2,1 m

- w = γd x A = 20,08 x 15 = 301,2 kN
  w = γd x A = 18,36 x 21,6 = 396,576 kN
  w = γd x A = 18,36 x 5,8 = 106,488 kN

- tg Ø = tg 44,33 = 0,977
  tg Ø = tg 38,11 = 0,784
  tg Ø = tg 38,11 = 0,784

- $\theta = 45^o$
  $\theta = 15^o$
  $\theta = -25^o$

- $\sin\theta = \sin 45^o = 0{,}707$
  $\sin\theta = \sin 15^o = 0{,}259$
  $\sin\theta = \sin -25^o = -0{,}423$

- $\text{Cos}\ \theta = \cos 45^o = 0{,}707$
  $\text{Cos}\ \theta = \cos 15^o = 0{,}966$
  $\text{Cos}\ \theta = \cos -25^o = 0{,}906$

- ai = bi / Cos θ = 3 / 0,707 = 4,243 m
  ai = bi / Cos θ = 3 / 0,966 = 3,106 m
  ai = bi / Cos θ = 3 / 0,906 = 2,317 m

- w cos θ = 301,2 cos 45^o = 212,981 kN
  w cos θ = 396,576 cos 45^o = 383,063 kN
  w cos θ = 106,488 cos 45^o = 96,511 kN

- w sin θ = 301,2 sin 45^o = 207,269 kN
  w sin θ = 396,576 sin 45^o = 207,269 kN
  w sin θ = 106,488 sin 45^o = 207,269 kN

- c. ai = 3,68 x 4,243 = 15,613 kN/m
  c. ai = 1,68 x 3,106= 5,218 kN/m
  c. ai = 1,68 x 2,317= 3,893 kN/m

- Mr = c. ai +(w cos θ x tg ∅) = 15,613+ (212,981x 0,977) = 218,1158 kN
  Mr = c. ai +(w cos θ x tg ∅) = 5,218 + (383,063x 0,784) = 218,1158 kN
  Mr = c. ai +(w cos θ x tg ∅) = 3,893 + (96,511 x 0,784) = 218,1158 kN

$$SF = \frac{\sum c.a_i + (W_i \cos\theta) tg\,\varphi}{\sum W_i \, Sin\,\theta}$$

$$SF = \frac{(15{,}613 + (207{,}301 \text{ x } 0{,}977)) + (5{,}218 + (383{,}063 \text{ x } 0{,}784)) + (3{,}893 + (96{,}511 \text{ x } 0{,}784)}{207{,}301 + 102{,}641 - 45{,}004}$$

SF = 2,250

2. Hitungan Permodelan 5 irisan

- $C1$ = 12 kN/m^2

$$c2 = \frac{H}{(H1/c1)+(H2/c2)} = \frac{3,6}{(2,6/12)+(1/1,25)} = 3,5409 \text{ kN/m}^2$$

$$c3 = \frac{H}{(H1/c1)+(H2/c2)} = \frac{3,2}{(1,4/12)+(1,8/1,25)} = 2,0557 \text{ kN/m}^2$$

$$c3 = \frac{H}{(H1/c1)+(H2/c2)} = \frac{3,2}{(1,4/12)+(1,8/1,25)} = 2,0557 \text{ kN/m}^2$$

$C5$ = 1,25 kN/m^2

- ø = 49

$$ø = \frac{H}{(H1/ø)+(H2/ø)} = \frac{3,6}{(2,6/49)+(1/35)} = 44,1$$

$$ø = \frac{H}{(H1/ø)+(H2/ø)} = \frac{3,2}{(1,4/49)+(1,8/35)} = 40$$

$$ø = \frac{H}{(H1/ø)+(H2/ø)} = \frac{3,2}{(1,4/49)+(1,8/35)} = 40$$

ø = 49

- γd = 21,24 kN/m^2

$$\gamma d = \frac{H}{(H1/\gamma d)+(H2/\gamma d)} = \frac{3,6}{(2,6/21,24)+(1/17,42)} = 20,0205 \text{ kN/m}^2$$

$$\gamma d = \frac{H}{(H1/\gamma d)+(H2/\gamma d)} = \frac{3,2}{(1,4/21,24)+(1,8/17,42)} = 18,9077 \text{ kN/m}^2$$

$$\gamma d = \frac{H}{(H1/\gamma d)+(H2/\gamma d)} = \frac{3,2}{(1,4/21,24)+(1,8/17,42)} = 18,9077 \text{ kN/m}^2$$

γd = 17,42 kN/m^2

- A = 1/2 x a x t = ½ x 2 x 2,4) = 2,4 m^2

A = (1/2 x a x t) + ($\frac{atas + bawah}{2} xt$) = (1/2 x 4 x 1,4) + ($\frac{1+3,6}{2} x4$) = 12 m^2

A = (1/2 x a x t)+($\frac{atas + bawah}{2} xt$) = (1/2 x 3,8 x 1,2)+($\frac{2,4+3,2}{2} x3,8$)

= 12,92 m^2

A = (1/2 x a x t) + (P x L) = (1/2 x 4 x 1,4) + (4 x 1,8) = 10 m^2

A = 1/2 x a x t = ½ x 3,2 x 1,4 = 2,24 m^2

- bi = 2 m
  bi = 4 m
  bi = 4 m
  bi = 4 m
  bi = 3,2 m

- w = γd x A = 21,24 x 2,4 = 50,976 kN
  w = γd x A = 20,0205 x 12= 240,246 kN
  w = γd x A = 18,9077 x 12,92 = 244,2875 kN
  w = γd x A = 18,9077 x 10 = 189,077 kN
  w = γd x A = 17,42 x 2,24 = 39,0208 kN

- tg Ø = tg 49 = 1,1504
  tg Ø = tg 44,1 = 0,9691
  tg Ø = tg 40 = 0,839
  tg Ø = tg 40 = 0,839
  tg Ø = tg 35 = 0,700

- $\theta = 55^o$
  $\theta = 38^o$
  $\theta = 15^o$
  $\theta = -10^o$
  $\theta = -25^o$

- sin θ = sin 55^o = 0,819
  sin θ = sin 38^o = 0,616
  sin θ = sin 15^o = 0,259
  sin θ = sin -10^o = -0,174
  sin θ = sin -25^o = -0,423

- Cos θ = cos 55^o = 0,574
  Cos θ = cos 38^o = 0,788
  Cos θ = cos 15^o = 0,966
  Cos θ = cos -10^o = 0,985
  Cos θ = cos -25^o = 0,906

- ai = bi / Cos θ = 2 / 0,574= 3,487 m
  ai = bi / Cos θ = 4 / 0,788= 5,076 m
  ai = bi / Cos θ = 4 / 0,966= 4,141 m
  ai = bi / Cos θ = 4 / 00,985= 4,062 m
  ai = bi / Cos θ = 3,2 / 0,906= 3,531 m

- w cos θ = 50,976 cos 55^o = 29,239 kN
  w cos θ = 240,246 cos 38^o = 189,316 kN
  w cos θ = 244,2875 cos 15^o = 235,964 kN
  w cos θ = 189,077 cos -10^o = 186,204 kN
  w cos θ = 39,0208 cos -25^o = 35,365 kN

- w sin θ = 50,976 sin 55^o = 41,757 kN
  w sin θ = 240,246 sin 38^o = 147,910 kN
  w sin θ = 244,2875 sin 15^o = 63,226 kN
  w sin θ = 189,077 sin -10^o = -32,833 kN
  w sin θ = 39,0208 sin -25^o = -16,491 kN

- c. ai = 12 x 3,487 = 41,843 kN/m
  c. ai = 3,541 x 5,076= 17,974 kN/m
  c. ai = 2,056 x 4,141 = 8,513 kN/m
  c. ai = 2,056 x 4,062= 8,350 kN/m
  c. ai = 1,25 x 3,531 = 4,414 kN/m

- Mr = c. ai +(w cos θ x tg $\emptyset$) = 41,843+ (29,239x 1,150) = 75,478 kN
  Mr = c. ai +(w cos θ x tg $\emptyset$) = 17,974 + (189,316x 0,969) = 201,434 kN
  Mr = c. ai +(w cos θ x tg $\emptyset$) = 8,513+ (235,964 x 0,839) = 206,510 kN
  Mr = c. ai +(w cos θ x tg $\emptyset$) = 8,350+ (186,204 x 0,839) = 164,594 kN
  Mr = c. ai +(w cos θ x tg $\emptyset$) = 4,414+ (35,365x 0,700) = 29,176 kN

$$SF = \frac{\sum c.a_i + (W_i \cos\theta) tg\,\varphi}{\sum W_i \, Sin\,\theta}$$

$$SF = \frac{(41{,}843 + (29{,}239x1{,}150)) + (17{,}974 + (189{,}316x0{,}969)) + (8{,}513 + (235{,}964x0{,}839))}{41{,}757 + 147{,}910 + 63{,}226}$$

$$+ \frac{(8{,}350 + (186{,}204x0{,}839) + (4{,}414 + (35{,}365x0{,}700))}{-32{,}833 - 16{,}491}$$

SF = 3,
327

3. Permodelan 8 irisan

- $C1$ = 12 kN/m^2
  $C2$ = 3,5409 kN/m^2

$$c3 = \frac{H}{(H1/c1) + (H2/c2)} = \frac{3{,}6}{(2{,}6/12) + (1/1{,}25)} = 3{,}54 \text{ kN/m}^2$$

$$c4 = \frac{H}{(H1/c1) + (H2/c2)} = \frac{3{,}8}{(2/12) + (1{,}8/1{,}25)} = 5{,}30 \text{ kN/m}^2$$

$$c5 = \frac{H}{(H1/c1) + (H2/c2)} = \frac{3{,}2}{(1{,}2/12) + (2/1{,}25)} = 1{,}88 \text{ kN/m}^2$$

$$c6 = \frac{H}{(H1/c1) + (H2/c2)} = \frac{2{,}6}{(0{,}6/12) + (2/1{,}25)} = 1{,}58 \text{ kN/m}^2$$

$$c7 = \frac{H}{(H1/c1) + (H2/c2)} = \frac{2{,}6}{(0{,}6/12) + (2/1{,}25)} = 1{,}58 \text{ kN/m}^2$$

$C8$ = 1,25 kN/m^2

- ø = 49

  ø = 49

  $$ø = \frac{H}{(H1/ø)+(H2/ø)} = \frac{3,6}{(2,6/49)+(1/35)} = 44,1$$

  $$ø = \frac{H}{(H1/ø)+(H2/ø)} = \frac{3,8}{(2/12)+(1,8/1,25)} = 41,19$$

  $$ø = \frac{H}{(H1/ø)+(H2/ø)} = \frac{3,2}{(1,2/12)+(2/1,25)} = 39,2$$

  $$ø = \frac{H}{(H1/ø)+(H2/ø)} = \frac{2,6}{(0,6/12)+(2/1,25)} = 37,47$$

  $$ø = \frac{H}{(H1/ø)+(H2/ø)} = \frac{2,6}{(0,6/12)+(2/1,25)} = 37,47$$

  ø = 35

- γd = 21,24 kN/m^2

  γd = 21,24 kN/m^2

  $$γd = \frac{H}{(H1/γd)+(H2/γd)} = \frac{3,6}{(2,6/21,24)+(1/17,42)} = 20,0205 \text{ kN/m}^2$$

  $$γd = \frac{H}{(H1/γd)+(H2/γd)} = \frac{3,8}{(2/12)+(1,8/1,25)} = 19,24 \text{ kN/m}^2$$

  $$γd = \frac{H}{(H1/γd)+(H2/γd)} = \frac{3,2}{(1,2/12)+(2/1,25)} = 18,68 \text{ kN/m}^2$$

  $$γd = \frac{H}{(H1/γd)+(H2/γd)} = \frac{2,6}{(0,6/12)+(2/1,25)} = 18,17 \text{ kN/m}^2$$

  $$γd = \frac{H}{(H1/γd)+(H2/γd)} = \frac{2,6}{(0,6/12)+(2/1,25)} = 18,17 \text{ kN/m}^2$$

  γd = 17,42 kN/m^2

- A = 1/2 x a x t = ½ x 2 x 2,6) = 2,6 m^2

  A = (1/2 x a x t) + ($\frac{atas+bawah}{2} xt$) = (1/2 x 2 x 0,8) + ($\frac{1,8+3,2}{2} x2$)

  = 5,8 m^2

  A = (1/2 x a x t)+($\frac{atas+bawah}{2} xt$) = (1/2 x 2 x 0,6)+($\frac{2,6+3,6}{2} x2$)

  = 6,8 m^2

  A = (1/2 x a x t)+($\frac{atas+bawah}{2} xt$) = (1/2 x 2 x 0,6)+($\frac{3+3,8}{2} x2$)

  = 7,4 m^2

  A = (1/2 x a x t) + (P x L) = (1/2 x 2 x 0,8) + (3,2 x 2) = 7,2 m^2

A = (1/2 x a x t) + (P x L) = (1/2 x 2 x 0,6) + (2,6 x 2) = 5,8 m^2
A = (1/2 x a x t) + (s x s) = (½ x 2 x 0,6) + (2 x 2) = 4,6 m^2
A = 1/2 x a x t = ½ x 3,4 x 1,6 = 2,72 m^2

- bi = 2 m
  bi = 2 m
  bi = 2 m
  bi = 2 m
  bi = 2 m

  bi = 2 m
  bi = 2 m
  bi = 9 m

- w = γd x A = 21,24 x 2,6 = 55,224 kN
  w = γd x A = 21,24 x 5,8 = 123,192 kN
  w = γd x A = 20,02 x 6,8 = 136,136 kN
  w = γd x A = 19,24 x 7,4 = 142,376 kN
  w = γd x A = 18,68 x 7,2 = 134,396 kN
  w = γd x A = 18,17 x 5,8 = 105,386 kN
  w = γd x A = 18,17 x 4,6 = 83,582 kN
  w = γd x A = 17,42 x 2,72 = 47,3824 kN

- tg Ø = tg 49 = 1,150
  tg Ø = tg 49 = 1,150
  tg Ø = tg 44,1 = 0,969
  tg Ø = tg 41,19 = 0,875
  tg Ø = tg 39,2 = 0,816
  tg Ø = tg 37,47 = 0,766
  tg Ø = tg 37,47 = 0,766
  tg Ø = tg 35 = 0,700

- $\theta = 50^o$
  $\theta = 40^o$
  $\theta = 35^o$
  $\theta = 20^o$
  $\theta = 10^o$
  $\theta = -10^o$
  $\theta = -9^o$
  $\theta = -20^o$

- sin θ = sin 50^o = 0,766
  sin θ = sin 40^o = 0,643
  sin θ = sin 35^o = 0,574
  sin θ = sin 20^o = 0,342

sin θ = sin 10^o = 0,174
sin θ = sin -10^o = -0,174
sin θ = sin -9^o = -0,156
sin θ = sin -20^o = -0,342

- Cos θ = cos 50^o = 0,643
  Cos θ = cos 40^o = 0,766
  Cos θ = cos 35^o = 0,819
  Cos θ = cos 20^o = 0,940
  Cos θ = cos 10^o = 0,985
  Cos θ = cos -10^o = 0,985
  Cos θ = cos -9^o = 0,988
  Cos θ = cos -20^o = 0,940

- ai = bi / Cos θ = 2 / 0,643= 3,111 m
  ai = bi / Cos θ = 2 / 0,766= 2,611 m
  ai = bi / Cos θ = 2 / 0,819= 2,442 m
  ai = bi / Cos θ = 2 / 0,940= 2,128 m
  ai = bi / Cos θ = 2 / 0,985= 2,031 m
  ai = bi / Cos θ = 2 / 0,985= 2,031 m
  ai = bi / Cos θ = 2 / 0,988= 2,025 m
  ai = bi / Cos θ = 2 / 0,940= 9,578 m

- w cos θ = 55,224 cos 50^o = 35,497 kN
  w cos θ = 123,192 cos 40^o = 94,371 kN
  w cos θ = 136,136 cos 35^o = 111,516 kN
  w cos θ = 142,376 cos 20^o = 133,790 kN
  w cos θ = 134,496 cos 10^o = 132,453 kN
  w cos θ = 105,386 cos -10^o = 103,785 kN
  w cos θ = 83,582 cos -9^o = 82,553 kN
  w cos θ = 47,3824 cos -20^o = 44,525 kN

- w sin θ = 55,224 cos 50^o = 42,304 kN
  w sin θ = 123,192 cos 40^o = 79,186 kN
  w sin θ = 136,136 cos 35^o = 78,084 kN
  w sin θ = 142,376 cos 20^o = 48,695 kN
  w sin θ = 134,496 cos 10^o = 23,355 kN
  w sin θ = 105,386 cos -10^o = -18,300 kN
  w sin θ = 83,582 cos -9^o = -13,075 kN
  w sin θ = 47,3824 cos -20^o = -16,206 kN

- c. ai = 12 x 3,111 = 37,337 kN/m
  c. ai = 12 x 2,611= 31,330 kN/m
  c. ai = 3,54 x 2,442 = 8,643 kN/m
  c. ai = 5,3 x 2,128 = 11,280 kN/m
  c. ai = 1,88 x 2,031 = 3,818 kN/m
  c. ai = 1,58 x 2,031 = 3,209 kN/m
  c. ai = 1,58 x 2,025 = 3,199 kN/m

c. ai = 1,25 x 9,578 = 11,972 kN/m

- Mr = c. ai +(w cos θ x tg $\emptyset$) = 37,337+ (29,239x 1,150) = 78,172 kN
  Mr = c. ai +(w cos θ x tg $\emptyset$) = 31,330 + (189,316x 0,969) = 139,891 kN
  Mr = c. ai +(w cos θ x tg $\emptyset$) = 8,643+ (235,964 x 0,839) = 116,710 kN
  Mr = c. ai +(w cos θ x tg $\emptyset$) = 11,280+ (186,204 x 0,839) = 128,363 kN
  Mr = c. ai +(w cos θ x tg $\emptyset$) = 3,818+ (35,365x 0,700) = 111,844 kN
  Mr = c. ai +(w cos θ x tg $\emptyset$) = 3,209+ (35,365x 0,700) = 82,759 kN
  Mr = c. ai +(w cos θ x tg $\emptyset$) = 3,199+ (35,365x 0,700) = 66,476 kN
  Mr = c. ai +(w cos θ x tg $\emptyset$) =11,972+ (35,365x 0,700) = 43,149 kN

$$SF = \frac{\sum c.a_i + (W_i \cos\theta) tg\,\varphi}{\sum W_i \, Sin\,\theta}$$

$$SF = \frac{(37{,}337 + (35{,}497 x 1{,}15)) + (31{,}330 + (94{,}371 x 1{,}15)) + (8{,}643 + (111{,}516 X\, 0{,}969))}{42{,}304 + 79{,}186 + 78{,}084}$$

$$+ \frac{(11{,}280 + (133{,}79 x 0{,}875)) + (3{,}818 + (132{,}453 x 0{,}816)) + (3{,}209 + (103{,}785 x 0{,}766))}{48{,}695 + 23{,}355 - 18{,}300}$$

$$+ \frac{(3{,}199 + (82{,}553 x 0{,}766)) + (11{,}972 + (44{,}525 x 0{,}700))}{-13{,}075 - 16{,}206}$$

SF = 3,4255

LAMPIRAN IV

Foto Dokumentasi Laboratorium

Bahan uji setelah di keringkan

Penghalusan bahan uji

Pengayakan/penyaringan benda uji

Piknometer

Pemanasan Piknometer

Mol Pemadatan

Perendaman Tanah dengan air

Penumbukan

Pengambilan tanah

Sampel tanah pemadatan

Pengovenan bahan uji

Pengmabilan sampel tanah pengujian Direct Shear

Bahan uji Direct Shear

Proses pengujian *direct shear*

Proses pengujian *direct shear*

Bahan uji setelah dilakukan pengujian *direct shear*

LAMPIRAN V

Lembar Asistensi

KARTU ASISTENSI
TUGAS AKHIR

NAMA : RENI ANZELLA

NIM : 104 11 11 004

DOSEN PEMBIMBING : 1. FERRA FAHRIANI, S.T., M.T

2. YAYUK APRIYANTI, S.T., M.T

JUDUL TA : ANALISIS ANGKA KEAMANAN ~~LERENG~~ Geser TIMBUNAN DENGAN PENAMBAHAN ~~KAPUR~~

NO	TANGGAL	KETERANGAN	PARAF
1.		Perbaiki latar belakang - Tinjauan pustaka diurutkan sesuai tahun paling muda - Tambahkan teori PLAXIS - Perbaiki sesuai petunjuk	
2		- Perbaiki latar belakang tujuan & rumusan masalah - Pada BAB IV tambah teori korelasi nilai C & Ø pada tanah lempung - Perbaiki BAB IV	
3.	4/2/2016	- Perbaiki BAB I - Perbaiki BAB IV sesuai petunjuk	
4.	5/2/2016	- Bisa diajukan ke Pembimbing II	

KARTU ASISTENSI
TUGAS AKHIR

NAMA : RENI ANZELLA

NIM : 104 11 11 004

DOSEN PEMBIMBING : 1. FERRA FAHRIANI, S.T., M.T

2. YAYUK APRIYANTI, S.T., M.T

JUDUL TA : ANALISIS ANGKA KEAMANAN LERENG TIMBUNAN DENGAN PENAMBAHAN ~~KAPUR~~ Semen

NO	TANGGAL	KETERANGAN	PARAF
	15/2 - 2016	- Teori yang di buat di lanjutkan teori sesuai dengan apa yang mau di laksanakan - ~~Kata~~ kemiringan untuk lereng timbunan	
	17/3 - 2016	- Tambahkan teori pemadatan dan jelaskan garis pemadatan yang digunakan - Perbaiki diagram alir penelitian	
	7/4 - 2016	lengkapi penjelasan di bahasan masalah.	
	14/4 - 2016	Lengkapi daftar isi dan daftar pustaka Acc untuk seminar proposal Langsung ke Pembimbing I	

KARTU ASISTENSI
TUGAS AKHIR

NAMA : RENI ANZELLA

NIM : 104 11 11 004

DOSEN PEMBIMBING : 1. FERRA FAHRIANI, S.T., M.T

2. YAYUK APRIYANTI, S.T., M.T

JUDUL TA : ANALISIS ANGKA KEAMANAN TANAH TIMBUNAN DENGAN PENAMBAHAN SEMEN

NO	TANGGAL	KETERANGAN	PARAF
	18/4/2015	Lanjutkan Seminar Proposal, dgn dosen Penguji: 1) Endang S. Hidayat, M.Eng 2) Indra Gunawan, M.T	

KARTU ASISTENSI
TUGAS AKHIR

NAMA : RENI ANZELLA

NIM : 104 11 11 004

DOSEN PEMBIMBING : 1. FERRA FAHRIANI, S.T., M.T

2. YAYUK APRIYANTI, S.T., M.T

JUDUL TA : ANALISIS ANGKA KEAMANAN TANAH TIMBUNAN DENGAN PENAMBAHAN SEMEN

NO	TANGGAL	KETERANGAN	PARAF
	25/7-2016	- Perbaiki grafik (dilengkapi keterangan sb x dan sumbu y).	
		- Perbaiki penjelasan. Pada bab fibrasi tanah lengkapi satuan ?.	
	27/7-2016	- Perbaiki semua catatan. Lanjutkan ke pembimbing I	
	27/7-2016	Acc seminar hasil	
	28/7-2016	Acc seminar hasil	
	4/8-2016	Acc Sidang	
	4/8-2016	Acc sidang	

LAMPIRAN VI

Revisi Tugas Akhir

SURAT PERSETUJUAN REVISI TUGAS AKHIR

Nama : Reni Anzella
Nim : 1041111004
Judul TA : Analisis Angka Keamanan Tanah Timbunan dengan Campuran Semen pada Tanah Lempung Lunak

Dosen Pembimbing I : Ferra Fahriani, S. T., M. T.
Dosen Pembimbing II : Yayuk Apriyanti, S. T., M. T.

Mahasiswa yang namanya tersebut diatas memang benar telah menyelesaikan revisi tugas akhir

Balunijuk, 06 Agustus 2016

Disetujui oleh,

Majelis Penguji

Penguji I

Endang Setyawati Hisyam, S. T., M. Eng.

Penguji II

Indra Gunawan, S. T., M. T.

Ketua Majelis Penguji,

Ferra Fahriani, S. T., M. T.

Sekretaris,

Yayuk Apriyanti, S. T., M. T.