

August 19, 2022

Lucas West
Colorado Division of Reclamation, Mining, and Safety
1313 Sherman St, Rm 215
Denver, CO 80203

Delivered Via Email

RE: Skelton Pit M-2022-019
Slope Stability Analysis for Rule 6.4.19

Mr. West

This document is to address the requirements of Rule 6.4.19 when structure agreements have not been securable with structure owners. Two sets of structures have been identified that this report may apply to: San Miguel County structures on the west side and BLM fences to the east. See Map C-1 within the Skelton Pit permit file for a map of these structures. All neighbor owned structures are at or beyond the property line. Disturbance is maintained at a setback of at least 20 feet from all mining.

In the event that an agreement is put in place between San Miguel County Pit and the Skelton Pit to allow direct connection of the pit floors, structure agreements and slope stability along the shared west property line will be moot.

1. Slope Stability Analysis

A slope stability analysis was performed using GALENA Slope Stability Software, assuming the ground conditions described in the DRMS permit. The model assumes an average 54 inches of overburden and topsoil overlying a 45-foot-thick sand and gravel deposit for a total mining depth of ~50 feet. The material used in the slope stability analysis are sand and gravel - mixed grain size for the aggregate deposit. The material properties is shown in Table 2 below.

Table 2 – Material Properties

Aggregate Deposit	
Description	sand and gravel, mixed grain size
Unit Weight (lbs/ft3)	110
Friction Angle (°)	45
Cohesion	0

*Material information is from the SME Mining Reference Handbook (2002 Edition)¹

Using these conditions, the failure slopes for the active mining and reclaimed slopes were determined using Bishop's Method of Slices to identify the circular failure at various factors of safety (FOS). The inputs and results of this analysis are depicted in the attached *Slope Stability Map* and summarized in Table 3. More information on each slope condition is provided below.

Table 3 – Slope Stability Analysis Results

Active Slope Status	Slope	Lowest Calc. FOS	FOS = 1.5 Slope Failure Distance from Mining Crest (ft)	Distance to Nearest Structure (ft)	Sufficiency (Y/N)
Active Mining	Vertical	<1.0	28	>20	Yes
Reclaimed	3H:1V	3.03	--	48.0	Yes

1.1. Active Mining Slope

The active mining slope is proposed to range from 0.5H:1V to vertical. An analysis of the worst-case vertical slope resulted in a failure circle with a minimum Factor of Safety (FOS) < 1.5; the minimum DRMS requirement for slopes near critical structures using general inputs. Further analysis was conducted to determine the location of the failure slope with a FOS = 1.5. The FOS = 1.5 failure circle was identified creating a crest roughly 28 feet from the permit boundary. As described above, the minimum setback between the permit boundary and mining is 20 feet. All structures are outside of the permit boundary. The active highwall will stop at the halfway point of the reclaimed slope to allow the final reclaimed slope to be installed with a dozer knocking the highwall done.

It should be noted that if the San Miguel County Pit floor is connected to the Skelton Pit floor in the future, as intended, this slope stability analysis will be moot.

1.2. Reclaimed Slope

The reclaimed slopes are proposed to be 3H:1V, obtained by knocking down the highwall and grading the final mining slope before topsoiling. An analysis of these slopes resulted in a FOS = 2.84, which is more than sufficient to meet DRMS standards regarding slope stability. Additionally, this circular failure scenario was contained entirely on the reclaimed slope face. Therefore, the permanent slope conditions following mine reclamation pose no risk of failure outside the property or to any nearby structures.

¹ Table 2.5; Originally from *Houk and Bray*, 1977

2. Conclusion

During the active mining conditions, the $FOS = 1.5$ failure slope will be contained within the property and isolated from nearby structures. This is sufficient to satisfy the DRMS requirements for slope stability. The permanent reclaimed condition of 3H:1V backfilled slopes will have a $FOS = 2.84$, which is also sufficient for DRMS requirements.

Regards,



Ben Langenfeld, P.E.
Lewicki & Associates, PLLC

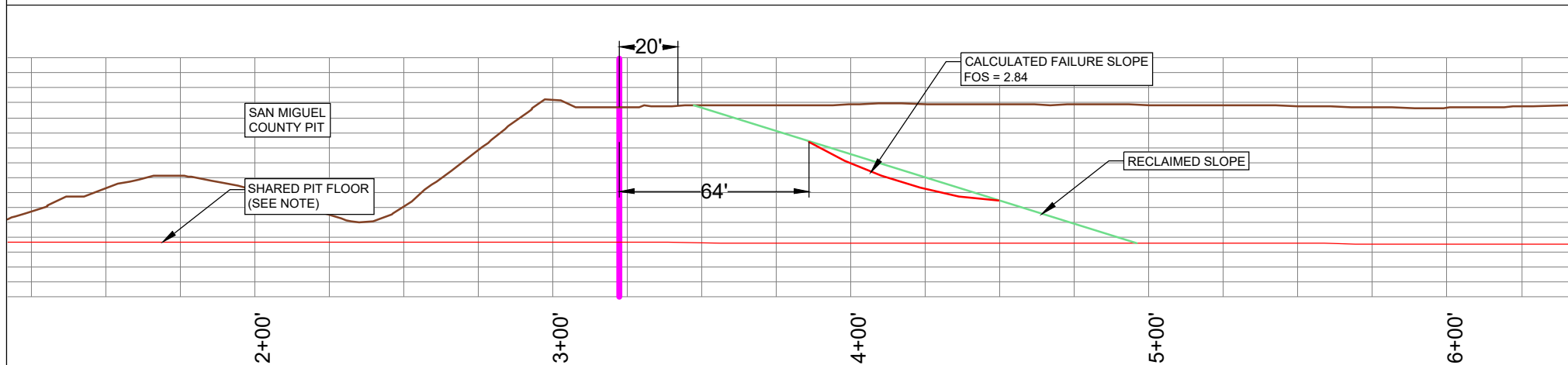
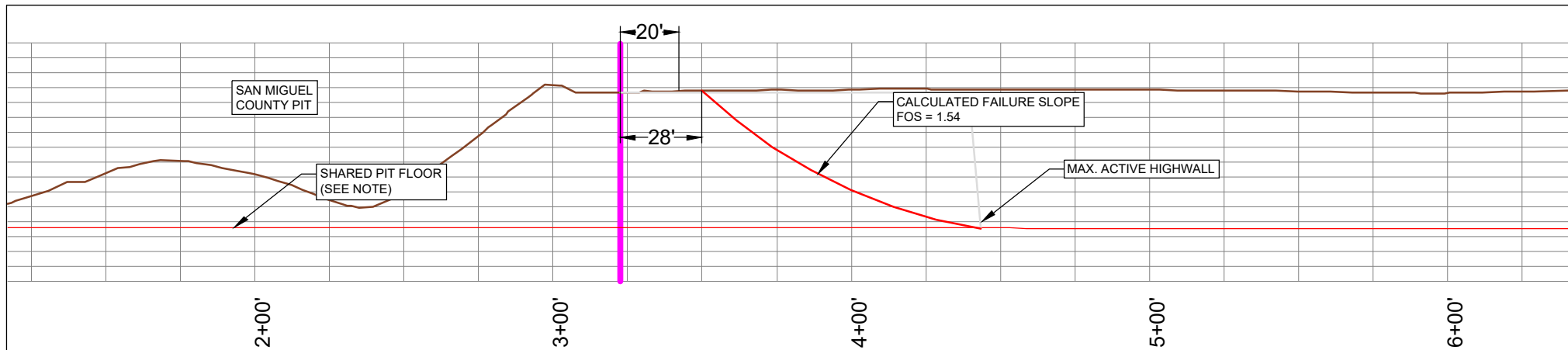
Attachments

Slope Stability figure

GALENA Analysis Result – Active Highwall

GALENA Analysis Result – Reclaimed Slope

GALENA Analysis Data Output



LEGEND

Baseline Topography
Final Mining Extents
Reclamation Slope
Limit of Active Highwall

NOTE: RECLAIMED SLOPES WILL NOT BE PLACED ALONG THE WEST PERMIT BOUNDARY IF SAN MIGUEL COUNTY AGREES TO CONNECT THE FLOOR OF THE ADJACENT PIT.

Slope Stability

Skelton Pit

File Name: Norwood Pit 220819

DRMS Permit Number: M-1988-037

United Companies

Map Geo. Info.:

Datum: NAD83

Projection: CO SOUTH

Mine Entry Location: Latitude: 38.1544 Longitude: -108.2533

State: CO County: Montrose Nearest Town: Norwood

Section: 13 Township: 45N Range: 13W PM: 10

Major Watershed: San Miguel River

Map Scale: 1"=50'



Survey Source: Drone Flight

Imagery Source: Google

Drawn by: SC

Checked by: BEL

Approved by: BEL

Survey Date: 2020

Imagery Date: 06/14/14

Date: 03/01/22

Date: 03/15/22

Date: 03/15/22

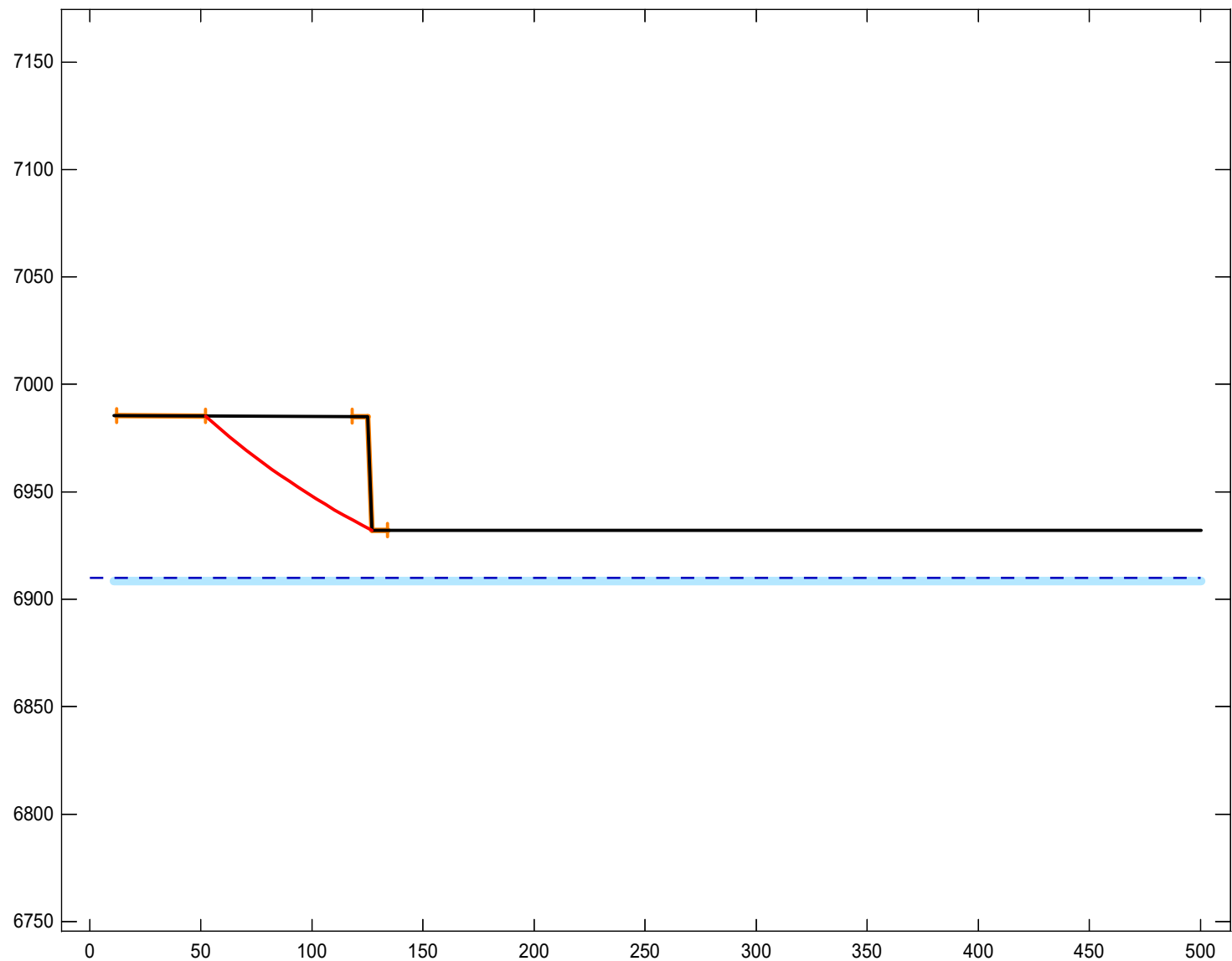


Lewicki & Associates

3375 West Powers Circle
Littleton, CO USA 80123

(303)-346-5196

info@lewicki.biz



GALENA Version 7.2

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Material Keys

1: Sand and gravel, mixed grain size

Analysis 1

Multiple Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

Critical Factor of Safety: 1.55

Project Skelton Pit
Mining Highwall Slope Stability

File: E:\Work\GLA Dropbox\Ben Langenfeld\United Companies\Norwood\DRMS\Adequacy\Slope Stability.1.gmf

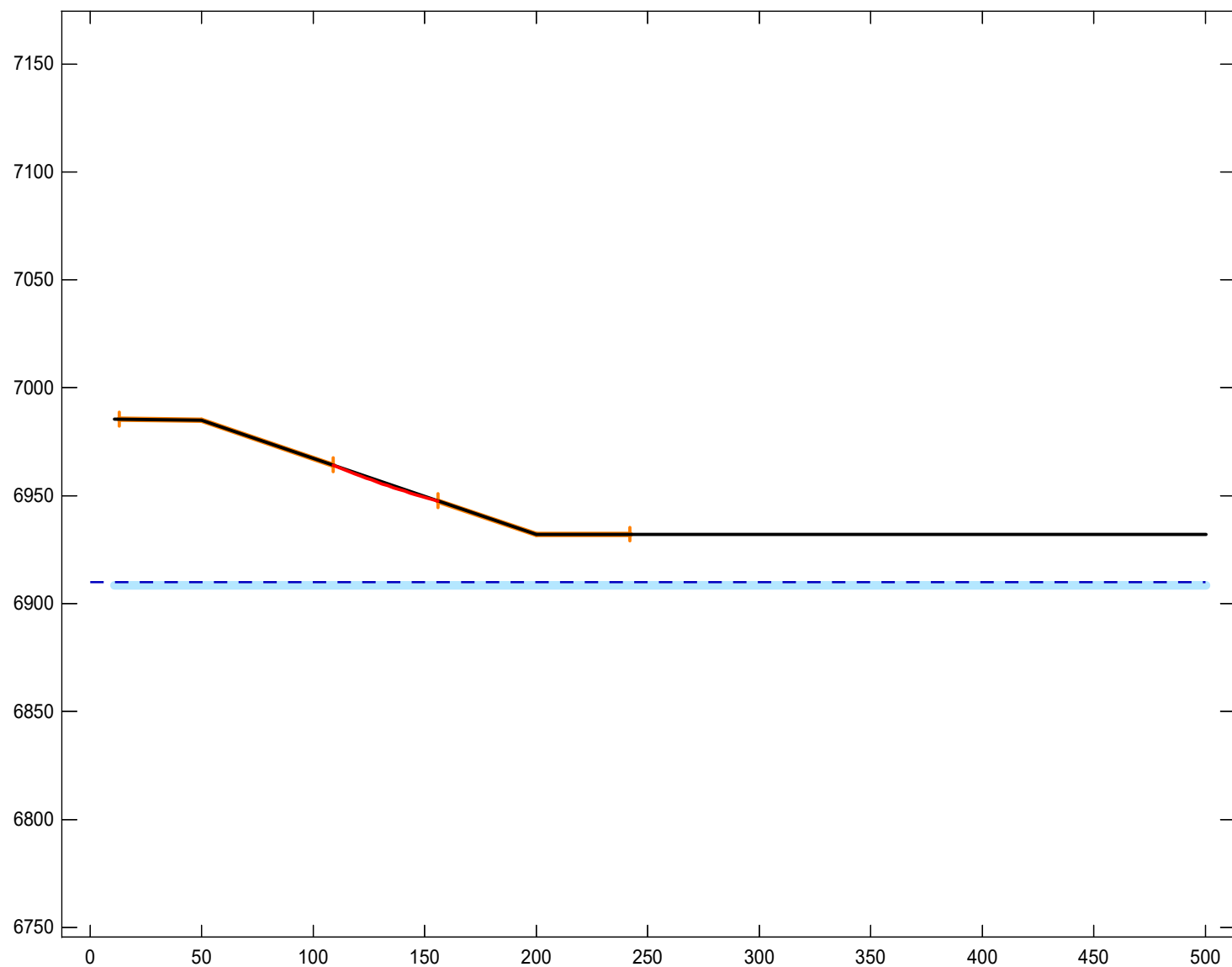
Edited: 19 Aug 2022

Processed: 19 Aug 2022



Material Keys

1: Sand and gravel, mixed grain size



GALENA Version 7.2

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Analysis 2

Multiple Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

Critical Factor of Safety: 2.84

Edited: 19 Aug 2022

Processed: 19 Aug 2022

Project Skelton Pit
Reclaimed Slope Stability

File: E:\Work\GLA Dropbox\Ben Langenfeld\United Companies\Norwood\DRMS\Adequacy\Slope Stability.1.gmf



Project: Skelton Pit
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 Processed: 19 Aug 2022 16:28:05

DATA: Analysis 1 - Mining Highwall Slope Stability

Material Properties (2 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Sand and gravel, mixed grain size
 Cohesion Phi UnitWeight Ru
 0.00 45.0 110.00 Auto
 Material: 2 (Mohr-Coulomb Isotropic) - Loose sand, mixed grain size
 Cohesion Phi UnitWeight Ru
 0.00 34.0 99.00 Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 0.000

Material Profiles (1 profile)

Profile: 1 (7 points) Material beneath: 1 - Sand and gravel, mixed grain size
 0.80 6987.86 6.20 6987.62 10.93 6985.35 71.09 6985.31 180.35
 6986.19
 203.44 6986.15 500.00 6986.00

Slope Surface (4 points)

10.93 6985.35 125.00 6985.00 127.00 6932.00 500.00 6932.00

Phreatic Surface (3 points)

0.00 6910.00 188.00 6910.00 500.00 6910.00

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects: XL: 32.00 YL: 6985.29 XR: 126.00 YR: 6958.50
 Centre: XC: 173.98 YC: 7305.20 Radius: R: 350.00

Variable Restraints

Parameter descriptor: XL XR R
 Range of variation: 40.00 16.00 25.00
 Trial positions within range: 15 15 25

RESULTS: Analysis 1 - Mining Highwall Slope Stability

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 4.156

Analysis Summary

There were: 3363 successful analyses from a total of 5625 trial failure surfaces
 2262 analyses terminated due to unacceptable geometry

Critical (minimum) Factor of Safety: 1.55

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	52.00	6985.22	127.14	6932.00	297.40	7252.03	362.50	1.547	<-- Critical Surface
2	52.00	6985.22	127.14	6932.00	296.79	7251.17	361.46	1.547	
3	52.00	6985.22	127.14	6932.00	296.19	7250.31	360.42	1.547	
4	52.00	6985.22	127.14	6932.00	295.58	7249.46	359.38	1.548	
5	52.00	6985.22	127.14	6932.00	294.97	7248.60	358.33	1.548	
6	52.00	6985.22	127.14	6932.00	294.37	7247.74	357.29	1.549	
7	52.00	6985.22	127.14	6932.00	293.76	7246.89	356.25	1.549	
8	52.00	6985.22	127.14	6932.00	293.15	7246.03	355.21	1.550	
9	52.00	6985.22	127.14	6932.00	292.54	7245.17	354.17	1.550	
10	52.00	6985.22	127.14	6932.00	291.94	7244.31	353.12	1.551	
11	52.00	6985.22	127.14	6932.00	291.33	7243.46	352.08	1.551	
12	52.00	6985.22	127.14	6932.00	290.72	7242.60	351.04	1.552	
13	52.00	6985.22	127.14	6932.00	290.11	7241.74	350.00	1.552	
14	52.00	6985.22	127.14	6932.00	289.51	7240.88	348.96	1.553	
15	52.00	6985.22	127.14	6932.00	288.90	7240.03	347.92	1.553	
16	52.00	6985.22	127.14	6932.00	288.29	7239.17	346.88	1.553	
17	52.00	6985.22	127.14	6932.00	287.68	7238.31	345.83	1.554	
18	52.00	6985.22	127.14	6932.00	287.08	7237.45	344.79	1.554	
19	52.00	6985.22	127.14	6932.00	286.47	7236.60	343.75	1.555	
20	52.00	6985.22	127.14	6932.00	285.86	7235.74	342.71	1.555	
21	52.00	6985.22	127.14	6932.00	285.25	7234.88	341.67	1.556	
22	52.00	6985.22	127.14	6932.00	284.65	7234.02	340.62	1.556	

23	52.00	6985.22	127.14	6932.00	284.04	7233.17	339.58	1.557
24	52.00	6985.22	127.14	6932.00	283.43	7232.31	338.54	1.557
25	52.00	6985.22	127.14	6932.00	282.82	7231.45	337.50	1.558
26	49.14	6985.23	127.14	6932.00	290.75	7255.48	362.50	1.611
27	49.14	6985.23	127.14	6932.00	290.15	7254.61	361.46	1.611
28	49.14	6985.23	127.14	6932.00	289.56	7253.75	360.42	1.612
29	49.14	6985.23	127.14	6932.00	288.97	7252.88	359.38	1.612
30	49.14	6985.23	127.14	6932.00	288.38	7252.01	358.33	1.613
31	49.14	6985.23	127.14	6932.00	287.78	7251.14	357.29	1.613
32	49.14	6985.23	127.14	6932.00	287.19	7250.27	356.25	1.614
33	49.14	6985.23	127.14	6932.00	286.60	7249.41	355.21	1.614
34	49.14	6985.23	127.14	6932.00	286.01	7248.54	354.17	1.615
35	49.14	6985.23	127.14	6932.00	285.41	7247.67	353.12	1.615
36	49.14	6985.23	127.14	6932.00	284.82	7246.80	352.08	1.616
37	49.14	6985.23	127.14	6932.00	284.23	7245.93	351.04	1.616
38	49.14	6985.23	127.14	6932.00	283.64	7245.06	350.00	1.617
39	49.14	6985.23	127.14	6932.00	283.04	7244.20	348.96	1.617
40	49.14	6985.23	127.14	6932.00	282.45	7243.33	347.92	1.618
41	49.14	6985.23	127.14	6932.00	281.86	7242.46	346.88	1.618
42	49.14	6985.23	127.14	6932.00	281.27	7241.59	345.83	1.619
43	49.14	6985.23	127.14	6932.00	280.67	7240.72	344.79	1.619
44	49.14	6985.23	127.14	6932.00	280.08	7239.85	343.75	1.620
45	49.14	6985.23	127.14	6932.00	279.49	7238.99	342.71	1.620
46	49.14	6985.23	127.14	6932.00	278.89	7238.12	341.67	1.621
47	49.14	6985.23	127.14	6932.00	278.30	7237.25	340.62	1.622
48	49.14	6985.23	127.14	6932.00	277.71	7236.38	339.58	1.622
49	49.14	6985.23	127.14	6932.00	277.12	7235.51	338.54	1.623
50	49.14	6985.23	127.14	6932.00	276.52	7234.64	337.50	1.623
51	46.29	6985.24	127.14	6932.00	284.29	7258.67	362.50	1.676
52	46.29	6985.24	127.14	6932.00	283.71	7257.79	361.46	1.676
53	46.29	6985.24	127.14	6932.00	283.13	7256.91	360.42	1.677
54	46.29	6985.24	127.14	6932.00	282.55	7256.03	359.38	1.677
55	46.29	6985.24	127.14	6932.00	281.97	7255.16	358.33	1.678
56	46.29	6985.24	127.14	6932.00	281.40	7254.28	357.29	1.678
57	46.29	6985.24	127.14	6932.00	280.82	7253.40	356.25	1.679
58	46.29	6985.24	127.14	6932.00	280.24	7252.52	355.21	1.680
59	46.29	6985.24	127.14	6932.00	279.66	7251.64	354.17	1.680
60	46.29	6985.24	127.14	6932.00	279.08	7250.77	353.12	1.681
61	46.29	6985.24	127.14	6932.00	278.50	7249.89	352.08	1.681
62	46.29	6985.24	127.14	6932.00	277.93	7249.01	351.04	1.682
63	46.29	6985.24	127.14	6932.00	277.35	7248.13	350.00	1.682
64	46.29	6985.24	127.14	6932.00	276.77	7247.25	348.96	1.683
65	46.29	6985.24	127.14	6932.00	276.19	7246.37	347.92	1.683
66	46.29	6985.24	127.14	6932.00	275.61	7245.50	346.88	1.684
67	46.29	6985.24	127.14	6932.00	275.03	7244.62	345.83	1.685
68	46.29	6985.24	127.14	6932.00	274.45	7243.74	344.79	1.685
69	46.29	6985.24	127.14	6932.00	273.88	7242.86	343.75	1.686
70	46.29	6985.24	127.14	6932.00	273.30	7241.98	342.71	1.686
71	46.29	6985.24	127.14	6932.00	272.72	7241.10	341.67	1.687
72	46.29	6985.24	127.14	6932.00	272.14	7240.22	340.62	1.687
73	46.29	6985.24	127.14	6932.00	271.56	7239.34	339.58	1.688
74	46.29	6985.24	127.14	6932.00	270.98	7238.46	338.54	1.689
75	46.29	6985.24	127.14	6932.00	270.40	7237.59	337.50	1.689
76	43.43	6985.25	127.14	6932.00	278.01	7261.61	362.50	1.742
77	43.43	6985.25	127.14	6932.00	277.45	7260.72	361.46	1.742
78	43.43	6985.25	127.14	6932.00	276.89	7259.84	360.42	1.743
79	43.43	6985.25	127.14	6932.00	276.32	7258.95	359.38	1.743
80	43.43	6985.25	127.14	6932.00	275.76	7258.06	358.33	1.744
81	43.43	6985.25	127.14	6932.00	275.19	7257.17	357.29	1.744
82	43.43	6985.25	127.14	6932.00	274.63	7256.29	356.25	1.745
83	43.43	6985.25	127.14	6932.00	274.06	7255.40	355.21	1.746
84	43.43	6985.25	127.14	6932.00	273.50	7254.51	354.17	1.746
85	43.43	6985.25	127.14	6932.00	272.93	7253.62	353.12	1.747
86	43.43	6985.25	127.14	6932.00	272.37	7252.74	352.08	1.747
87	43.43	6985.25	127.14	6932.00	271.80	7251.85	351.04	1.748
88	43.43	6985.25	127.14	6932.00	271.24	7250.96	350.00	1.748
89	43.43	6985.25	127.14	6932.00	270.68	7250.07	348.96	1.749
90	43.43	6985.25	127.14	6932.00	270.11	7249.19	347.92	1.750
91	43.43	6985.25	127.14	6932.00	269.55	7248.30	346.88	1.750
92	43.43	6985.25	127.14	6932.00	268.98	7247.41	345.83	1.751
93	43.43	6985.25	127.14	6932.00	268.42	7246.52	344.79	1.751
94	43.43	6985.25	127.14	6932.00	267.85	7245.63	343.75	1.752
95	43.43	6985.25	127.14	6932.00	267.29	7244.74	342.71	1.753
96	43.43	6985.25	127.14	6932.00	266.72	7243.86	341.67	1.753
97	43.43	6985.25	127.14	6932.00	266.16	7242.97	340.62	1.754
98	43.43	6985.25	127.14	6932.00	265.59	7242.08	339.58	1.755
99	43.43	6985.25	127.14	6932.00	265.03	7241.19	338.54	1.755

Critical Failure Surface (circle 1)

Intersects: XL: 52.00 YL: 6985.22 XR: 127.14 YR: 6932.00
Centre: XC: 297.40 YC: 7252.03 Radius: R: 362.50

Generated failure surface: (20 points)									
52.00	6985.22	55.60	6981.96	59.24	6978.74	62.93	6975.57	66.65	6972.46
70.42	6969.39	74.23	6966.37	78.08	6963.40	81.97	6960.49	85.90	6957.63
89.86	6954.82	93.87	6952.06	97.90	6949.36	101.98	6946.71	106.09	6944.12
110.24	6941.59	114.41	6939.10	118.62	6936.68	122.87	6934.31	127.14	6932.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 38 slices)

Slice	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	PoreWater Force	Normal Stress	Test Factor
1	52.00	1.46	42.2	1.80	2.43	1	0.00	45.0	161.02	0.00	56.39	0.85
2	53.80	4.39	42.2	1.80	2.43	1	0.00	45.0	483.15	0.00	169.22	0.85
3	55.60	7.39	41.5	1.82	2.43	1	0.00	45.0	812.52	0.00	283.96	0.85

4	57.42	10.31	41.5	1.82	2.43	1	0.00	45.0	1133.63	0.00	396.23	0.85
5	59.24	13.36	40.7	1.84	2.43	1	0.00	45.0	1469.37	0.00	512.57	0.85
6	61.08	16.27	40.7	1.84	2.43	1	0.00	45.0	1789.21	0.00	624.14	0.85
7	62.93	19.37	39.9	1.86	2.43	1	0.00	45.0	2130.56	0.00	741.93	0.85
8	64.79	22.27	39.9	1.86	2.43	1	0.00	45.0	2449.15	0.00	852.87	0.85
9	66.65	25.42	39.2	1.88	2.43	1	0.00	45.0	2795.71	0.00	971.98	0.84
10	68.54	28.30	39.2	1.88	2.43	1	0.00	45.0	3112.49	0.00	1082.12	0.84
11	70.42	31.49	38.4	1.90	2.43	1	0.00	45.0	3463.72	0.00	1202.57	0.84
12	72.33	34.35	38.4	1.90	2.43	1	0.00	45.0	3778.60	0.00	1311.89	0.84
13	74.23	37.58	37.6	1.92	2.43	1	0.00	45.0	4133.81	0.00	1433.56	0.84
14	76.16	40.42	37.6	1.92	2.43	1	0.00	45.0	4446.64	0.00	1542.04	0.84
15	78.08	43.68	36.8	1.94	2.43	1	0.00	45.0	4805.21	0.00	1664.69	0.84
16	80.02	46.51	36.8	1.94	2.43	1	0.00	45.0	5115.60	0.00	1772.22	0.84
17	81.97	49.79	36.1	1.96	2.43	1	0.00	45.0	5477.11	0.00	1895.93	0.84
18	83.93	52.59	36.1	1.96	2.43	1	0.00	45.0	5784.99	0.00	2002.29	0.84
19	85.90	55.90	35.3	1.98	2.43	1	0.00	45.0	6148.60	0.00	2126.99	0.84
20	87.88	58.67	35.3	1.98	2.43	1	0.00	45.0	6453.49	0.00	2232.46	0.84
21	89.86	61.99	34.5	2.00	2.43	1	0.00	45.0	6819.43	0.00	2357.94	0.84
22	91.86	64.74	34.5	2.00	2.43	1	0.00	45.0	7121.29	0.00	2462.04	0.84
23	93.87	68.07	33.8	2.02	2.43	1	0.00	45.0	7488.05	0.00	2588.30	0.84
24	95.88	70.79	33.8	2.02	2.43	1	0.00	45.0	7786.92	0.00	2691.31	0.84
25	97.90	74.13	33.0	2.04	2.43	1	0.00	45.0	8154.25	0.00	2818.03	0.84
26	99.94	76.81	33.0	2.04	2.43	1	0.00	45.0	8449.53	0.00	2920.40	0.84
27	101.98	80.15	32.2	2.06	2.43	1	0.00	45.0	8816.98	0.00	3047.52	0.84
28	104.04	82.81	32.2	2.06	2.43	1	0.00	45.0	9108.62	0.00	3147.98	0.84
29	106.09	86.14	31.5	2.07	2.43	1	0.00	45.0	9475.66	0.00	3275.75	0.84
30	108.16	88.76	31.5	2.07	2.43	1	0.00	45.0	9763.40	0.00	3375.22	0.84
31	110.24	92.09	30.7	2.09	2.43	1	0.00	45.0	10129.43	0.00	3503.19	0.84
32	112.32	94.66	30.7	2.09	2.43	1	0.00	45.0	10413.11	0.00	3601.69	0.84
33	114.41	97.98	29.9	2.11	2.43	1	0.00	45.0	10777.57	0.00	3729.76	0.84
34	116.52	100.52	29.9	2.11	2.43	1	0.00	45.0	11057.04	0.00	3826.47	0.84
35	118.62	103.81	29.2	2.12	2.43	1	0.00	45.0	11419.47	0.00	3954.54	0.84
36	120.75	106.31	29.2	2.12	2.43	1	0.00	45.0	11694.34	0.00	4050.17	0.84
37	122.87	109.29	28.4	2.13	2.42	1	0.00	45.0	12022.06	0.00	4178.87	0.84
38	125.00	51.49	28.4	2.14	2.44	1	0.00	45.0	5663.81	0.00	1958.39	0.84

X-S Area:		2110.05	Path Length:		92.33	X-S Weight:		232105.55				

DATA: Analysis 2 - Reclaimed Slope Stability

Material Properties (2 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Sand and gravel, mixed grain size

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Loose sand, mixed grain size

Cohesion	Phi	UnitWeight	Ru
0.00	34.0	99.00	Auto

Water Properties

Unit weight of water:	62.400	Unit weight of water/medium above ground:	0.000
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Material Profiles (1 profile)

Profile: 1 (7 points) Material beneath: 1 - Sand and gravel, mixed grain size

0.80	6987.86	6.20	6987.62	10.93	6985.35	71.09	6985.31	180.35
6986.19								
203.44	6986.15	500.00	6986.00					

Slope Surface (4 points)

10.93	6985.35	50.00	6985.00	200.00	6932.00	500.00	6932.00
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Phreatic Surface (3 points)

0.00	6910.00	188.00	6910.00	500.00	6910.00
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Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects: XL:	61.00	YL:	6981.11	XR:	199.00	YR:	6932.35
Centre: XC:	244.02	YC:	7279.45	Radius:	R:	350.00	

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	96.00	86.00	25.00
Trial positions within range:	15	15	25

RESULTS: Analysis 2 - Reclaimed Slope Stability

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 2.887

Analysis Summary

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There were: 3382 successful analyses from a total of 5625 trial failure surfaces
2243 analyses terminated due to unacceptable geometry

Critical (minimum) Factor of Safety: 2.84

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Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	109.00	6964.15	156.00	6947.55	252.98	7296.83	362.50	2.836	<-- Critical Surface
2	109.00	6964.15	156.00	6947.55	252.63	7295.85	361.46	2.836	
3	109.00	6964.15	156.00	6947.55	252.28	7294.86	360.42	2.836	
4	109.00	6964.15	156.00	6947.55	251.94	7293.88	359.38	2.836	
5	109.00	6964.15	156.00	6947.55	251.59	7292.90	358.33	2.836	
6	109.00	6964.15	156.00	6947.55	251.24	7291.91	357.29	2.836	
7	109.00	6964.15	156.00	6947.55	250.89	7290.93	356.25	2.836	
8	109.00	6964.15	156.00	6947.55	250.54	7289.94	355.21	2.836	
9	109.00	6964.15	156.00	6947.55	250.20	7288.96	354.17	2.836	
10	109.00	6964.15	156.00	6947.55	249.85	7287.97	353.12	2.836	
11	109.00	6964.15	156.00	6947.55	249.50	7286.99	352.08	2.837	
12	109.00	6964.15	156.00	6947.55	249.15	7286.00	351.04	2.837	
13	109.00	6964.15	156.00	6947.55	248.80	7285.02	350.00	2.837	
14	109.00	6964.15	156.00	6947.55	248.46	7284.03	348.96	2.837	
15	109.00	6964.15	156.00	6947.55	248.11	7283.05	347.92	2.837	
16	109.00	6964.15	156.00	6947.55	247.76	7282.06	346.88	2.837	
17	109.00	6964.15	156.00	6947.55	247.41	7281.08	345.83	2.837	
18	109.00	6964.15	156.00	6947.55	247.07	7280.10	344.79	2.837	
19	109.00	6964.15	156.00	6947.55	246.72	7279.11	343.75	2.837	
20	109.00	6964.15	156.00	6947.55	246.37	7278.13	342.71	2.837	
21	109.00	6964.15	156.00	6947.55	246.02	7277.14	341.67	2.837	
22	109.00	6964.15	156.00	6947.55	245.67	7276.16	340.62	2.837	
23	109.00	6964.15	156.00	6947.55	245.33	7275.17	339.58	2.837	
24	109.00	6964.15	156.00	6947.55	244.98	7274.19	338.54	2.837	
25	109.00	6964.15	156.00	6947.55	244.63	7273.20	337.50	2.837	
26	109.00	6964.15	162.14	6945.38	255.97	7295.52	362.50	2.838	
27	109.00	6964.15	162.14	6945.38	255.63	7294.54	361.46	2.838	
28	109.00	6964.15	162.14	6945.38	255.28	7293.55	360.42	2.838	
29	109.00	6964.15	162.14	6945.38	254.93	7292.57	359.38	2.838	
30	109.00	6964.15	162.14	6945.38	254.58	7291.58	358.33	2.838	
31	102.14	6966.58	156.00	6947.55	249.46	7297.79	362.50	2.838	
32	102.14	6966.58	156.00	6947.55	249.11	7296.81	361.46	2.838	
33	109.00	6964.15	162.14	6945.38	254.23	7290.60	357.29	2.838	
34	109.00	6964.15	162.14	6945.38	253.88	7289.61	356.25	2.838	
35	102.14	6966.58	156.00	6947.55	248.77	7295.82	360.42	2.838	
36	109.00	6964.15	162.14	6945.38	253.54	7288.63	355.21	2.838	
37	102.14	6966.58	156.00	6947.55	248.42	7294.84	359.38	2.838	
38	109.00	6964.15	162.14	6945.38	253.19	7287.64	354.17	2.838	
39	102.14	6966.58	156.00	6947.55	248.07	7293.85	358.33	2.838	
40	102.14	6966.58	156.00	6947.55	247.72	7292.87	357.29	2.838	
41	109.00	6964.15	162.14	6945.38	252.84	7286.65	353.12	2.838	
42	109.00	6964.15	162.14	6945.38	252.49	7285.67	352.08	2.838	
43	102.14	6966.58	156.00	6947.55	247.37	7291.88	356.25	2.838	
44	109.00	6964.15	162.14	6945.38	252.14	7284.68	351.04	2.838	
45	109.00	6964.15	162.14	6945.38	251.80	7283.70	350.00	2.838	
46	102.14	6966.58	156.00	6947.55	247.02	7290.89	355.21	2.838	
47	102.14	6966.58	156.00	6947.55	246.68	7289.91	354.17	2.838	
48	109.00	6964.15	162.14	6945.38	251.45	7282.71	348.96	2.838	
49	109.00	6964.15	162.14	6945.38	251.10	7281.73	347.92	2.838	
50	102.14	6966.58	156.00	6947.55	246.33	7288.92	353.12	2.838	
51	102.14	6966.58	156.00	6947.55	245.98	7287.94	352.08	2.839	
52	109.00	6964.15	162.14	6945.38	250.75	7280.74	346.88	2.839	
53	102.14	6966.58	156.00	6947.55	245.63	7286.95	351.04	2.839	
54	109.00	6964.15	162.14	6945.38	250.40	7279.76	345.83	2.839	
55	102.14	6966.58	156.00	6947.55	245.28	7285.97	350.00	2.839	
56	109.00	6964.15	162.14	6945.38	250.06	7278.77	344.79	2.839	
57	102.14	6966.58	156.00	6947.55	244.94	7284.98	348.96	2.839	
58	109.00	6964.15	162.14	6945.38	249.71	7277.79	343.75	2.839	
59	102.14	6966.58	156.00	6947.55	244.59	7284.00	347.92	2.839	
60	109.00	6964.15	162.14	6945.38	249.36	7276.80	342.71	2.839	
61	102.14	6966.58	156.00	6947.55	244.24	7283.01	346.88	2.839	
62	109.00	6964.15	162.14	6945.38	249.01	7275.82	341.67	2.839	
63	102.14	6966.58	156.00	6947.55	243.89	7282.03	345.83	2.839	
64	109.00	6964.15	162.14	6945.38	248.66	7274.83	340.62	2.839	
65	102.14	6966.58	156.00	6947.55	243.54	7281.04	344.79	2.839	
66	102.14	6966.58	156.00	6947.55	243.19	7280.05	343.75	2.839	
67	109.00	6964.15	162.14	6945.38	248.31	7273.84	339.58	2.839	
68	109.00	6964.15	162.14	6945.38	247.97	7272.86	338.54	2.839	
69	102.14	6966.58	156.00	6947.55	242.85	7279.07	342.71	2.839	
70	109.00	6964.15	162.14	6945.38	247.62	7271.87	337.50	2.839	
71	102.14	6966.58	156.00	6947.55	242.50	7278.08	341.67	2.839	
72	102.14	6966.58	156.00	6947.55	242.15	7277.10	340.62	2.839	
73	102.14	6966.58	156.00	6947.55	241.80	7276.11	339.58	2.839	
74	102.14	6966.58	156.00	6947.55	241.45	7275.13	338.54	2.839	
75	102.14	6966.58	156.00	6947.55	241.10	7274.14	337.50	2.839	
76	109.00	6964.15	168.29	6943.21	258.95	7294.18	362.50	2.840	
77	109.00	6964.15	168.29	6943.21	258.61	7293.20	361.46	2.840	
78	109.00	6964.15	168.29	6943.21	258.26	7292.21	360.42	2.840	
79	109.00	6964.15	168.29	6943.21	257.91	7291.23	359.38	2.840	
80	109.00	6964.15	168.29	6943.21	257.56	7290.24	358.33	2.840	
81	102.14	6966.58	162.14	6945.38	252.44	7296.45	362.50	2.840	
82	109.00	6964.15	168.29	6943.21	257.21	7289.25	357.29	2.840	
83	102.14	6966.58	162.14	6945.38	252.10	7295.46	361.46	2.840	
84	102.14	6966.58	162.14	6945.38	251.75	7294.48	360.42	2.840	
85	109.00	6964.15	168.29	6943.21	256.86	7288.27	356.25	2.840	

86	109.00	6964.15	168.29	6943.21	256.52	7287.28	355.21	2.840
87	102.14	6966.58	162.14	6945.38	251.40	7293.49	359.38	2.840
88	109.00	6964.15	168.29	6943.21	256.17	7286.30	354.17	2.840
89	102.14	6966.58	162.14	6945.38	251.05	7292.50	358.33	2.840
90	95.29	6969.00	156.00	6947.55	245.93	7298.71	362.50	2.840
91	109.00	6964.15	168.29	6943.21	255.82	7285.31	353.12	2.840
92	102.14	6966.58	162.14	6945.38	250.70	7291.52	357.29	2.840
93	95.29	6969.00	156.00	6947.55	245.58	7297.73	361.46	2.840
94	109.00	6964.15	168.29	6943.21	255.47	7284.32	352.08	2.840
95	95.29	6969.00	156.00	6947.55	245.23	7296.74	360.42	2.840
96	102.14	6966.58	162.14	6945.38	250.35	7290.53	356.25	2.840
97	109.00	6964.15	168.29	6943.21	255.12	7283.34	351.04	2.840
98	95.29	6969.00	156.00	6947.55	244.89	7295.76	359.38	2.840
99	102.14	6966.58	162.14	6945.38	250.01	7289.55	355.21	2.840

Critical Failure Surface (circle 1)

Intersects: XL: 109.00 YL: 6964.15 XR: 156.00 YR: 6947.55
Centre: XC: 252.98 YC: 7296.83 Radius: R: 362.50

Generated failure surface: (20 points)

109.00	6964.15	111.41	6963.12	113.83	6962.10	116.26	6961.10	118.70	6960.12
121.14	6959.16	123.59	6958.21	126.05	6957.28	128.51	6956.37	130.98	6955.48
133.45	6954.61	135.93	6953.75	138.42	6952.91	140.92	6952.09	143.42	6951.29
145.92	6950.50	148.43	6949.74	150.95	6948.99	153.47	6948.26	156.00	6947.55

Slice Geometry and Properties - Critical Failure Surface (circle 1, 38 slices)

Slice	X-S		Base						PoreWater		Normal		Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor	
1	109.00	0.05	23.2	1.21	1.31	1	0.00	45.0	5.96	0.00	4.29	0.95	
2	110.21	0.16	23.2	1.21	1.31	1	0.00	45.0	18.02	0.00	12.97	0.95	
3	111.41	0.27	22.8	1.21	1.31	1	0.00	45.0	29.52	0.00	21.24	0.94	
4	112.62	0.37	22.8	1.21	1.31	1	0.00	45.0	40.31	0.00	29.01	0.94	
5	113.83	0.46	22.4	1.21	1.31	1	0.00	45.0	50.47	0.00	36.31	0.94	
6	115.05	0.54	22.4	1.21	1.31	1	0.00	45.0	59.86	0.00	43.06	0.94	
7	116.26	0.63	21.9	1.22	1.31	1	0.00	45.0	68.80	0.00	49.47	0.94	
8	117.48	0.70	21.9	1.22	1.31	1	0.00	45.0	76.98	0.00	55.35	0.94	
9	118.70	0.77	21.5	1.22	1.31	1	0.00	45.0	84.67	0.00	60.87	0.94	
10	119.92	0.83	21.5	1.22	1.31	1	0.00	45.0	91.36	0.00	65.68	0.94	
11	121.14	0.89	21.1	1.22	1.31	1	0.00	45.0	97.74	0.00	70.25	0.94	
12	122.36	0.94	21.1	1.22	1.31	1	0.00	45.0	103.27	0.00	74.22	0.94	
13	123.59	0.98	20.7	1.23	1.31	1	0.00	45.0	108.30	0.00	77.83	0.94	
14	124.82	1.02	20.7	1.23	1.31	1	0.00	45.0	112.39	0.00	80.76	0.94	
15	126.05	1.06	20.3	1.23	1.31	1	0.00	45.0	116.07	0.00	83.39	0.94	
16	127.28	1.08	20.3	1.23	1.31	1	0.00	45.0	118.85	0.00	85.39	0.94	
17	128.51	1.10	19.9	1.23	1.31	1	0.00	45.0	121.22	0.00	87.08	0.94	
18	129.74	1.11	19.9	1.23	1.31	1	0.00	45.0	122.55	0.00	88.04	0.94	
19	130.98	1.12	19.5	1.24	1.31	1	0.00	45.0	123.59	0.00	88.78	0.94	
20	132.22	1.12	19.4	1.24	1.31	1	0.00	45.0	123.53	0.00	88.75	0.94	
21	133.45	1.12	19.0	1.24	1.31	1	0.00	45.0	123.18	0.00	88.49	0.94	
22	134.69	1.11	19.1	1.24	1.31	1	0.00	45.0	121.78	0.00	87.47	0.94	
23	135.93	1.09	18.6	1.24	1.31	1	0.00	45.0	120.01	0.00	86.22	0.94	
24	137.18	1.07	18.6	1.24	1.31	1	0.00	45.0	117.33	0.00	84.30	0.94	
25	138.42	1.04	18.2	1.25	1.31	1	0.00	45.0	114.13	0.00	82.01	0.94	
26	139.67	1.00	18.2	1.25	1.31	1	0.00	45.0	109.91	0.00	78.98	0.94	
27	140.92	0.96	17.8	1.25	1.31	1	0.00	45.0	105.34	0.00	75.70	0.94	
28	142.17	0.91	17.8	1.25	1.31	1	0.00	45.0	99.77	0.00	71.70	0.94	
29	143.42	0.85	17.4	1.25	1.31	1	0.00	45.0	93.80	0.00	67.42	0.94	
30	144.67	0.79	17.4	1.25	1.31	1	0.00	45.0	86.80	0.00	62.40	0.94	
31	145.92	0.72	17.0	1.26	1.31	1	0.00	45.0	79.38	0.00	57.07	0.94	
32	147.18	0.65	17.0	1.26	1.31	1	0.00	45.0	71.02	0.00	51.07	0.94	
33	148.43	0.56	16.6	1.26	1.31	1	0.00	45.0	62.05	0.00	44.63	0.94	
34	149.69	0.48	16.6	1.26	1.31	1	0.00	45.0	52.31	0.00	37.63	0.94	
35	150.95	0.38	16.2	1.26	1.31	1	0.00	45.0	41.93	0.00	30.17	0.94	
36	152.21	0.28	16.1	1.26	1.31	1	0.00	45.0	30.75	0.00	22.13	0.94	
37	153.47	0.17	15.7	1.26	1.31	1	0.00	45.0	18.87	0.00	13.58	0.95	
38	154.74	0.06	15.7	1.26	1.31	1	0.00	45.0	6.31	0.00	4.54	0.95	
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	X-S Area:	28.44	Path Length:	49.89			X-S Weight:	3128.13					