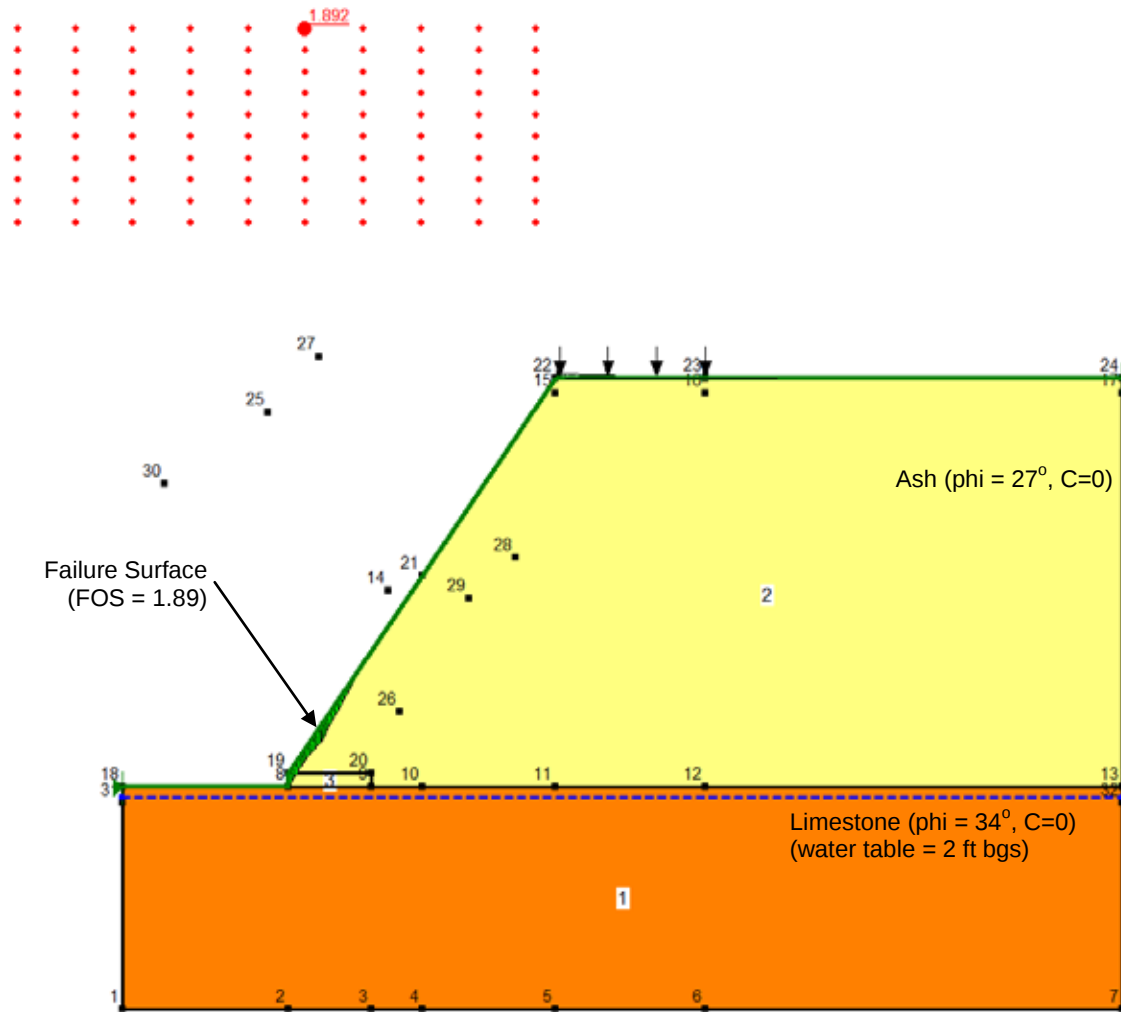




Condition 1 - 80 ft Ash, 4H:1V, No GCL, Circular Failure – $FOS_{min} = 1.89$

Condition 1 – Circular Failure

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File Information

Revision Number: 40
Last Edited By: [Stafford, Sam](#)
Date: [7/12/2011](#)
Time: [2:27:59 PM](#)
File Name: [Condition 1.gsz](#)
Directory: [G:\Projects\083\083-82\083-82671\083-82671.1 \(Vertical Expansion\)\Calculations\Revised Slope Stability\](#)
Last Solved Date: [7/12/2011](#)
Last Solved Time: [2:28:10 PM](#)

Project Settings

Length(L) Units: [feet](#)
Time(t) Units: [Seconds](#)
Force(F) Units: [lbf](#)
Pressure(p) Units: [psf](#)
Strength Units: [psf](#)
Unit Weight of Water: [62.4 pcf](#)
View: [2D](#)

Analysis Settings

Circular

Kind: [SLOPE/W](#)
Method: [Spencer](#)
Settings
 Apply Phreatic Correction: [Yes](#)
 PWP Conditions Source: [Piezometric Line](#)
 Use Staged Rapid Drawdown: [No](#)
SlipSurface
 Direction of movement: [Right to Left](#)
 Use Passive Mode: [No](#)
 Slip Surface Option: [Grid and Radius](#)
 Critical slip surfaces saved: [1](#)
 Optimize Critical Slip Surface Location: [Yes](#)
 Tension Crack
 Tension Crack Option: [\(none\)](#)
FOS Distribution
 FOS Calculation Option: [Constant](#)
Advanced
 Number of Slices: [30](#)
 Optimization Tolerance: [0.01](#)
 Minimum Slip Surface Depth: [0.1 ft](#)
 Optimization Maximum Iterations: [2000](#)
 Optimization Convergence Tolerance: [1e-007](#)
 Starting Optimization Points: [8](#)

Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Material 1

Model: Mohr-Coulomb
Unit Weight: 95 pcf
Cohesion: 0 psf
Phi: 27 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Limestone

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Grid

Upper Left: (-324.8032, 248.89272) ft
Lower Left: (-324.8032, 209.47343) ft
Lower Right: (297.2441, 209.47343) ft
Grid Horizontal Increment: 9
Grid Vertical Increment: 9
Left Projection Angle: 0 °
Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (60.3675, 105.83169) ft
Upper Right Coordinate: (60.3675, 105.83169) ft
Lower Left Coordinate: (60.3675, 105.83169) ft
Lower Right Coordinate: (60.3675, 105.83169) ft
Number of Increments: 0
Left Projection: No
Left Projection Angle: 0 °
Right Projection: No
Right Projection Angle: 0 °
UsePoints: 0

Slip Surface Limits

Left Coordinate: (-200, 95) ft
Right Coordinate: (1000, 178) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	-200	93
	1000	93

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 753 pcf

Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	325	178
	325	179
	500	178
	500	179

Seismic Loads

Horz Seismic Load: 0

Vert Seismic Load: 0

Regions

	Material	Points	Area (ft²)
Region 1	Limestone	18,1,2,3,4,5,6,7,13,12,11,10,9,8	54000
Region 2	Material 1	19,21,22,23,24,13,12,11,10,9,20	69900
Region 3	Material 1	8,9,20,19	300

Points

	X (ft)	Y (ft)
Point 1	-200	50
Point 2	0	50
Point 3	100	50
Point 4	160	50
Point 5	320	50
Point 6	500	50
Point 7	1000	50

Point 8	0	95
Point 9	100	95
Point 10	160	95
Point 11	320	95
Point 12	500	95
Point 13	1000	95
Point 14	120	135
Point 15	320	175
Point 16	500	175
Point 17	1000	175
Point 18	-200	95
Point 19	0	98
Point 20	100	98
Point 21	160	138
Point 22	320	178
Point 23	500	178
Point 24	1000	178
Point 25	-25.0262	171.14911
Point 26	133.5802	110.34695
Point 27	36.2791	182.34498
Point 28	272.5015	141.60925
Point 29	216.8205	133.42766
Point 30	-148.1994	156.50837
Point 31	-200	92
Point 32	1000	92

Critical Slip Surfaces

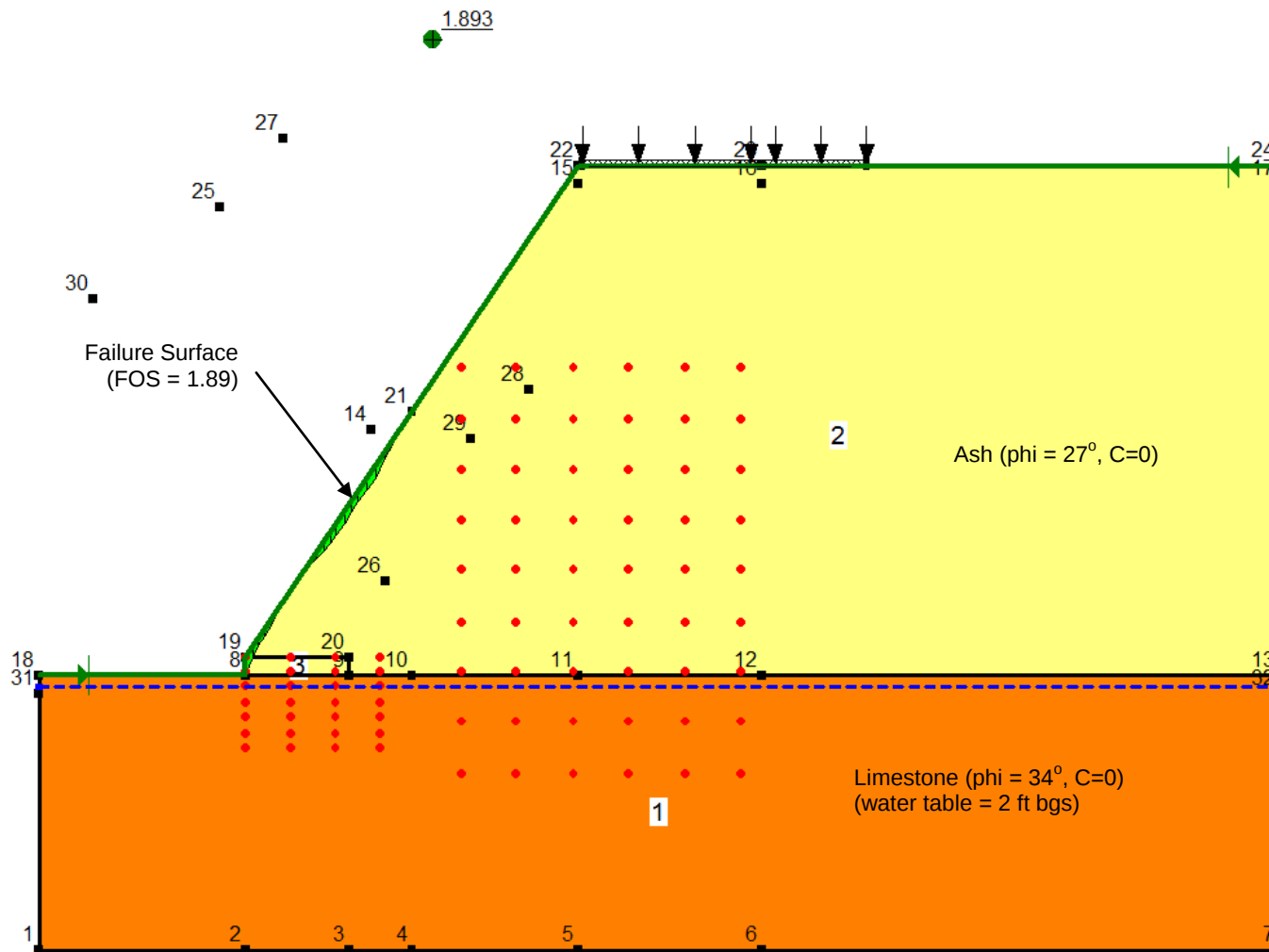
	Number	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	1.892	(20.779, 248.893)	47.04531	(104.045, 124.011)	(0, 98)
2	96	2.123	(20.779, 248.893)	148.438	(99.0339, 122.759)	(11.0871, 100.772)

Slices of Slip Surface: **Optimized**

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimized	1.6693525	95.56656	-160.15461	249.68499	127.22086	0
2	Optimized	5.0080575	96.539935	-220.89299	237.53617	121.03072	0
3	Optimized	8.34676	97.51331	-281.63138	225.38734	114.84059	0
4	Optimized	10.423805	98.11886	-319.41584	217.83009	110.98997	0
5	Optimized	12.56095	98.71529	-356.62591	214.048	109.0629	0
6	Optimized	15.859415	99.581215	-410.67495	213.50396	108.7857	0
7	Optimized	18.99745	100.35794	-459.14796	214.20306	109.14191	0
8	Optimized	22.135485	101.13465	-507.59003	214.90216	109.49812	0
9	Optimized	25.3147	101.8462	-551.99537	227.85222	116.0965	0
10	Optimized	28.5351	102.49255	-592.33478	242.41703	123.51765	0
11	Optimized	32.11535	103.1137	-631.10521	274.73617	139.98507	0
12	Optimized	36.05545	103.70965	-668.29548	311.39944	158.66594	0
13	Optimized	38.71295	104.1873	-698.09025	310.47579	158.19531	0
14	Optimized	40.50775	104.7414	-732.67704	289.73016	147.62489	0
15	Optimized	43.23945	105.6397	-788.7238	273.39476	139.30159	0
16	Optimized	46.48815	106.68745	-854.11144	253.07537	128.94834	0
17	Optimized	49.73685	107.7352	-919.46979	232.75599	118.5951	0
18	Optimized	53.453825	108.8868	-991.33327	216.00107	110.05804	0
19	Optimized	57.639075	110.1422	-1069.6723	197.76774	100.7677	0
20	Optimized	61.593675	111.36835	-1146.1815	175.16631	89.251691	0
21	Optimized	65.317625	112.5653	-1220.8824	152.21404	77.556929	0
22	Optimized	68.646615	113.6024	-1285.5784	136.05207	69.321991	0
23	Optimized	71.58065	114.4796	-1340.3401	123.51597	62.934531	0
24	Optimized	74.514685	115.3568	-1395.0692	110.97661	56.545407	0
25	Optimized	78.45845	116.5507	-1469.5617	92.55821	47.160764	0
26	Optimized	82.551825	117.79395	-1547.1361	73.54315	37.472106	0
27	Optimized	85.785075	118.7699	-1608.0421	58.934006	30.028376	0
28	Optimized	89.380885	119.83295	-1674.3808	44.892591	22.873918	0
29	Optimized	93.33925	120.98305	-1746.1411	30.826812	15.707045	0
30	Optimized	97.297615	122.13315	-1817.9013	16.762731	8.5410381	0
31	Optimized	101.66075	123.3597	-1894.435	4.9077515	2.5006243	0

Slices of Slip Surface: 96

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	96	12.55292	100.69045	-479.89286	46.534962	23.710748	0
2	96	15.48448	100.55675	-471.53056	135.16959	68.872348	0
3	96	18.41604	100.4811	-466.82545	216.07262	110.0945	0
4	96	21.3476	100.4634	-465.7214	289.49908	147.50715	0
5	96	24.27916	100.5036	-468.22115	355.65028	181.21287	0
6	96	27.210715	100.60175	-474.35246	414.7815	211.34173	0
7	96	30.14227	100.75795	-484.09994	467.0441	237.97085	0
8	96	33.07383	100.97245	-497.47269	512.63415	261.20015	0
9	96	36.00539	101.24545	-514.50439	551.69339	281.10182	0
10	96	38.93695	101.5773	-535.21867	584.37658	297.75474	0
11	96	41.86851	101.9684	-559.62861	610.78327	311.20962	0
12	96	44.80007	102.4192	-587.76977	631.12625	321.57489	0
13	96	47.73163	102.93025	-619.63268	645.42835	328.86217	0
14	96	50.66319	103.5022	-655.32919	653.8256	333.14079	0
15	96	53.59475	104.13575	-694.85636	656.39924	334.45212	0
16	96	56.52631	104.83175	-738.29667	653.27668	332.86109	0
17	96	59.45787	105.59115	-785.68206	644.49838	328.38833	0
18	96	62.38943	106.41485	-837.09258	630.11968	321.06201	0
19	96	65.32099	107.30405	-892.58724	610.2432	310.93444	0
20	96	68.25255	108.26	-952.23505	584.88945	298.01606	0
21	96	71.18411	109.284	-1016.1125	554.16149	282.35938	0
22	96	74.11567	110.3776	-1084.3618	518.05142	263.96038	0
23	96	77.04723	111.5425	-1157.0608	476.60579	242.84278	0
24	96	79.97879	112.78055	-1234.3134	429.89354	219.0417	0
25	96	82.91035	114.0937	-1316.2427	377.91483	192.55722	0
26	96	85.841905	115.48415	-1403.0162	320.69992	163.40477	0
27	96	88.77346	116.9544	-1494.7436	258.29324	131.60698	0
28	96	91.70502	118.50715	-1591.6508	190.68826	97.16052	0
29	96	94.63658	120.14535	-1693.8556	117.91628	60.081345	0
30	96	97.56814	121.87235	-1801.6248	39.989725	20.375782	0



Condition 1 - 80 ft Ash, 4H:1V, No GCL, Block Failure – $FOS_{min} = 1.89$

Condition 1 – Block Failure

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File Information

Revision Number: 40
Last Edited By: [Stafford, Sam](#)
Date: [7/12/2011](#)
Time: [2:27:59 PM](#)
File Name: [Condition 1.gsz](#)
Directory: [G:\Projects\083\083-82\083-82671\083-82671.1 \(Vertical Expansion\)\Calculations\Revised Slope Stability\](#)
Last Solved Date: [7/12/2011](#)
Last Solved Time: [2:28:32 PM](#)

Project Settings

Length(L) Units: [feet](#)
Time(t) Units: [Seconds](#)
Force(F) Units: [lbf](#)
Pressure(p) Units: [psf](#)
Strength Units: [psf](#)
Unit Weight of Water: [62.4 pcf](#)
View: [2D](#)

Analysis Settings

Block

Kind: [SLOPE/W](#)
Method: [Spencer](#)
Settings
 Apply Phreatic Correction: [Yes](#)
 PWP Conditions Source: [Piezometric Line](#)
 Use Staged Rapid Drawdown: [No](#)
SlipSurface
 Direction of movement: [Right to Left](#)
 Use Passive Mode: [No](#)
 Slip Surface Option: [Block](#)
 Critical slip surfaces saved: [1](#)
 Optimize Critical Slip Surface Location: [Yes](#)
 Tension Crack
 Tension Crack Option: [\(none\)](#)
FOS Distribution
 FOS Calculation Option: [Constant](#)
Restrict Block Crossing: [No](#)
Advanced
 Number of Slices: [30](#)
 Optimization Tolerance: [0.01](#)
 Minimum Slip Surface Depth: [0.1 ft](#)
 Optimization Maximum Iterations: [2000](#)
 Optimization Convergence Tolerance: [1e-007](#)

Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Material 1

Model: Mohr-Coulomb
Unit Weight: 95 pcf
Cohesion: 0 psf
Phi: 27 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Limestone

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Limits

Left Coordinate: (-152.23097, 95) ft
Right Coordinate: (950.13123, 178) ft

Slip Surface Block

Left Grid

Upper Left: (0, 98) ft
Lower Left: (0, 83) ft
Lower Right: (130.3704, 83) ft
X Increments: 3
Y Increments: 6
Starting Angle: 135 °
Ending Angle: 180 °
Angle Increments: 2

Right Grid

Upper Left: (207.4074, 145) ft
Lower Left: (207.4074, 79) ft
Lower Right: (480, 79) ft
X Increments: 5
Y Increments: 8
Starting Angle: 45 °
Ending Angle: 65 °
Angle Increments: 2

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	-200	93
	1000	93

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 753 pcf
Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	325	178
	325	179
	600	179
	600	178

Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

Regions

	Material	Points	Area (ft²)
Region 1	Limestone	18,1,2,3,4,5,6,7,13,12,11,10,9,8	54000
Region 2	Material 1	19,21,22,23,24,13,12,11,10,9,20	69900
Region 3	Material 1	8,9,20,19	300

Points

	X (ft)	Y (ft)
Point 1	-200	50
Point 2	0	50
Point 3	100	50
Point 4	160	50
Point 5	320	50
Point 6	500	50
Point 7	1000	50

Point 8	0	95
Point 9	100	95
Point 10	160	95
Point 11	320	95
Point 12	500	95
Point 13	1000	95
Point 14	120	135
Point 15	320	175
Point 16	500	175
Point 17	1000	175
Point 18	-200	95
Point 19	0	98
Point 20	100	98
Point 21	160	138
Point 22	320	178
Point 23	500	178
Point 24	1000	178
Point 25	-25.0262	171.14911
Point 26	133.5802	110.34695
Point 27	36.2791	182.34498
Point 28	272.5015	141.60925
Point 29	216.8205	133.42766
Point 30	-148.1994	156.50837
Point 31	-200	92
Point 32	1000	92

Critical Slip Surfaces

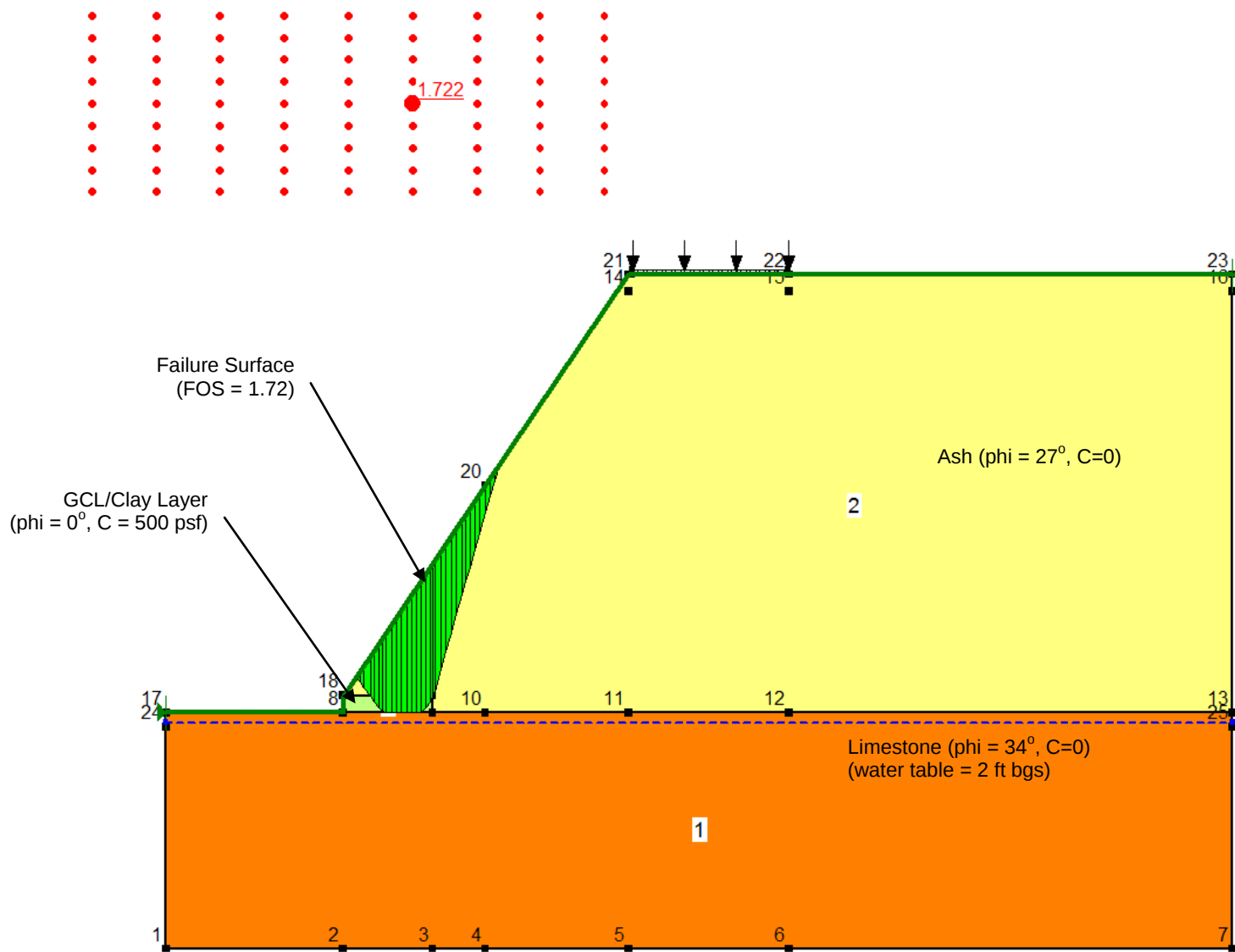
	Number	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	1.893	(95.953, 165.461)	88.9513	(202.318, 148.58)	(0, 98)
2	10189	2.041	(95.953, 165.461)	94.86	(213.876, 151.469)	(0, 98)

Slices of Slip Surface: **Optimized**

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimized	3.566166	96.668595	-228.91844	188.93521	96.267296	0
2	Optimized	9.539916	98.898855	-368.08782	126.31021	64.358269	0
3	Optimized	14.861675	100.61206	-474.99615	97.315962	49.584959	0
4	Optimized	20.690025	102.2407	-576.6217	82.182844	41.874251	0
5	Optimized	27.661925	104.2539	-702.24839	57.977502	29.541013	0
6	Optimized	35.777375	106.65165	-851.86584	25.652758	13.070733	0
7	Optimized	43.33115	108.747	-982.60819	7.6361047	3.8907897	0
8	Optimized	50.32325	110.54005	-1094.5037	3.6293663	1.8492545	0
9	Optimized	57.4231	112.08035	-1190.6123	25.319274	12.900814	0
10	Optimized	64.6307	113.36785	-1270.9489	72.599309	36.991196	0
11	Optimized	71.8383	114.65535	-1351.2991	119.87934	61.081577	0
12	Optimized	78.310625	115.9316	-1430.9304	148.69659	75.764696	0
13	Optimized	84.047675	117.1966	-1509.8601	163.9923	83.55825	0
14	Optimized	91.4805	118.78245	-1608.7942	189.49951	96.554821	0
15	Optimized	99.10205	120.64895	-1725.3281	186.11918	94.832458	0
16	Optimized	105.21655	122.4752	-1839.253	160.07472	81.562142	0
17	Optimized	112.4647	124.31735	-1954.1465	162.41651	82.755346	0
18	Optimized	120.84655	126.17545	-2070.1582	183.84841	93.675443	0
19	Optimized	130.03655	128.7242	-2229.1554	154.65551	78.800917	0
20	Optimized	137.63135	131.28245	-2388.7619	96.084854	48.957679	0
21	Optimized	142.82285	133.15955	-2505.9628	46.628589	23.758453	0
22	Optimized	149.65505	135.2847	-2638.6019	11.377458	5.7971042	0
23	Optimized	156.94575	137.2328	-2760.0733	0.32539193	0.16579547	0
24	Optimized	163.95355	138.97995	-2869.1547	0.7534829	0.38391872	0
25	Optimized	171.8606	140.9513	-2992.1132	1.2364571	0.63000635	0
26	Optimized	179.84825	142.94925	-3116.8336	1.1434561	0.58261998	0
27	Optimized	187.9165	144.9738	-3243.1803	0.47631882	0.24269656	0
28	Optimized	194.5424	146.63445	-3346.7681	0.10709733	0.054568814	0
29	Optimized	199.72605	147.93115	-3427.616	0.035698485	0.018189287	0

Slices of Slip Surface: **10189**

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	10189	5.23756	96.75	-233.99806	230.08881	117.2361	0
2	10189	14.035235	98.84966	-365.0171	239.05068	121.80241	0
3	10189	21.15547	100.54896	-471.05238	246.31824	125.50541	0
4	10189	28.275705	102.2483	-577.08766	253.57213	129.20146	0
5	10189	35.395935	103.94765	-683.13661	260.82603	132.8975	0
6	10189	42.516165	105.64695	-789.17189	268.09358	136.6005	0
7	10189	49.6364	107.34625	-895.20717	275.34748	140.29655	0
8	10189	56.756635	109.04555	-1001.2425	282.60138	143.99259	0
9	10189	63.876865	110.7449	-1107.2777	289.86893	147.6956	0
10	10189	70.997095	112.44425	-1213.313	297.12283	151.39164	0
11	10189	78.117325	114.14355	-1319.362	304.37672	155.08769	0
12	10189	85.23756	115.84285	-1425.3699	311.64428	158.79069	0
13	10189	92.357795	117.54215	-1531.3779	318.89817	162.48673	0
14	10189	99.478005	119.2415	-1637.5224	326.15207	166.18278	0
15	10189	106.59825	120.94085	-1743.5304	333.41962	169.88578	0
16	10189	113.7185	122.64015	-1849.5384	340.67352	173.58183	0
17	10189	120.8387	124.33945	-1955.5463	347.92741	177.27787	0
18	10189	127.95895	126.03875	-2061.5543	355.19497	180.98088	0
19	10189	135.0792	127.7381	-2167.6989	362.44887	184.67692	0
20	10189	142.1994	129.43745	-2273.7068	369.70276	188.37297	0
21	10189	149.31965	131.13675	-2379.7148	376.97032	192.07597	0
22	10189	156.4399	132.83605	-2485.7227	384.22421	195.77201	0
23	10189	163.38625	134.49385	-2589.2284	391.2998	199.37721	0
24	10189	170.15875	136.1102	-2690.0515	398.20805	202.89714	0
25	10189	176.93125	137.72655	-2790.8746	405.1163	206.41706	0
26	10189	183.7037	139.34285	-2891.8413	412.01018	209.92967	0
27	10189	190.47615	140.95915	-2992.6643	418.91843	213.4496	0
28	10189	197.24865	142.5755	-3093.4874	425.82668	216.96953	0
29	10189	204.02115	144.19185	-3194.3105	432.72056	220.48214	0
30	10189	210.64195	148.23455	-3446.5963	160.44839	81.75254	0



Condition 2 - 80 ft ash, 4H:1V, GCL, Circular Failure – $FOS_{min} = 1.72$

Condition 2 – Circular Failure

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File Information

Revision Number: 30
Last Edited By: [Stafford, Sam](#)
Date: [7/12/2011](#)
Time: [2:43:34 PM](#)
File Name: [Condition 2.gsz](#)
Directory: [G:\Projects\083\083-82\083-82671\083-82671.1 \(Vertical Expansion\)\Calculations\Revised Slope Stability\](#)
Last Solved Date: [7/12/2011](#)
Last Solved Time: [2:43:40 PM](#)

Project Settings

Length(L) Units: [feet](#)
Time(t) Units: [Seconds](#)
Force(F) Units: [lbf](#)
Pressure(p) Units: [psf](#)
Strength Units: [psf](#)
Unit Weight of Water: [62.4 pcf](#)
View: [2D](#)

Analysis Settings

Circular

Kind: [SLOPE/W](#)
Method: [Spencer](#)
Settings
 Apply Phreatic Correction: [Yes](#)
 PWP Conditions Source: [Piezometric Line](#)
 Use Staged Rapid Drawdown: [No](#)
SlipSurface
 Direction of movement: [Right to Left](#)
 Use Passive Mode: [No](#)
 Slip Surface Option: [Grid and Radius](#)
 Critical slip surfaces saved: [1](#)
 Optimize Critical Slip Surface Location: [Yes](#)
 Tension Crack
 Tension Crack Option: [\(none\)](#)
FOS Distribution
 FOS Calculation Option: [Constant](#)
Advanced
 Number of Slices: [30](#)
 Optimization Tolerance: [0.01](#)
 Minimum Slip Surface Depth: [0.1 ft](#)
 Optimization Maximum Iterations: [2000](#)
 Optimization Convergence Tolerance: [1e-007](#)
 Starting Optimization Points: [8](#)

Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Material 1

Model: Mohr-Coulomb
Unit Weight: 95 pcf
Cohesion: 0 psf
Phi: 27 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Material 2

Model: Mohr-Coulomb
Unit Weight: 95 pcf
Cohesion: 500 psf
Phi: 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Limestone

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Grid

Upper Left: (-283.4646, 227.30069) ft
Lower Left: (-283.4646, 193.75) ft
Lower Right: (293.9633, 193.75) ft
Grid Horizontal Increment: 8
Grid Vertical Increment: 8
Left Projection Angle: 0 °
Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (134.5144, 110.59301) ft
Upper Right Coordinate: (134.5144, 110.59301) ft
Lower Left Coordinate: (134.5144, 110.59301) ft
Lower Right Coordinate: (134.5144, 110.59301) ft
Number of Increments: 0
Left Projection: No
Left Projection Angle: 0 °

Right Projection: No
Right Projection Angle: 0 °
UsePoints: 0

Slip Surface Limits

Left Coordinate: (-200, 95) ft
Right Coordinate: (1000, 178) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	-200	93
	1000	93

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 753 pcf
Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	325	178
	325	179
	500	179
	500	178

Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

Regions

	Material	Points	Area (ft²)
Region 1	Limestone	17,1,2,3,4,5,6,7,13,12,11,10,9,8	54000
Region 2	Material 1	18,20,21,22,23,13,12,11,10,9,19	69900
Region 3	Material 2	8,9,19,18	300

Points

	X (ft)	Y (ft)
Point 1	-200	50
Point 2	0	50
Point 3	100	50
Point 4	160	50
Point 5	320	50
Point 6	500	50
Point 7	1000	50
Point 8	0	95
Point 9	100	95
Point 10	160	95
Point 11	320	95
Point 12	500	95
Point 13	1000	95
Point 14	320	175
Point 15	500	175
Point 16	1000	175
Point 17	-200	95
Point 18	0	98
Point 19	100	98
Point 20	160	138
Point 21	320	178
Point 22	500	178
Point 23	1000	178
Point 24	-200	92
Point 25	1000	92

Critical Slip Surfaces

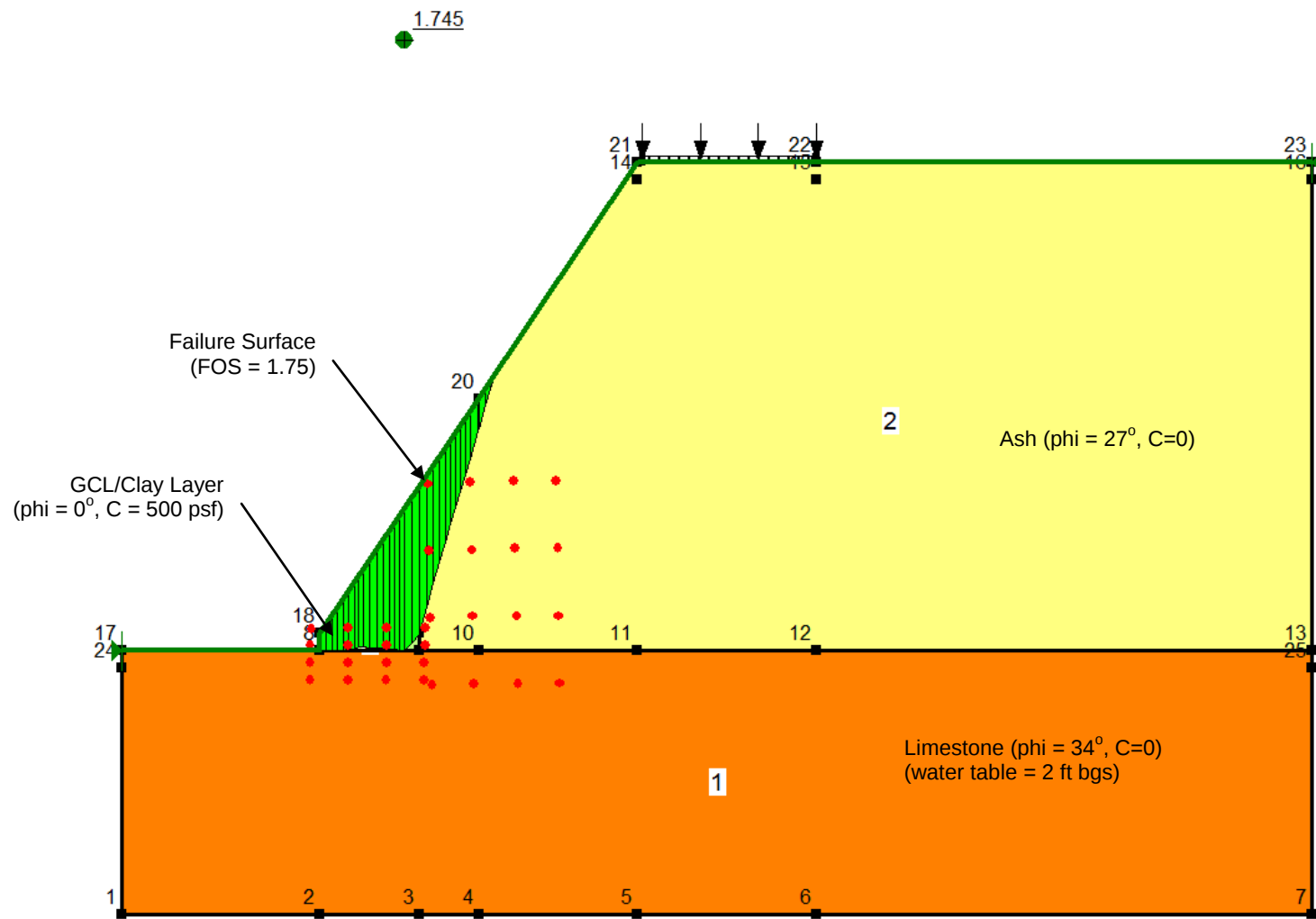
	Number	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	1.722	(77.428, 210.525)	77.4065	(175.186, 141.797)	(14.4927, 101.623)
2	42	1.914	(77.428, 210.525)	115.088	(168.466, 140.117)	(30.2337, 105.558)

Slices of Slip Surface: **Optimized**

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimized	16.546605	101.1341	-507.56421	116.00588	59.107948	0
2	Optimized	20.65447	100.15593	-446.53715	348.02238	177.32626	0
3	Optimized	26.27814	98.833425	-364.00588	661.85863	337.23382	0
4	Optimized	32.286785	97.43059	-276.46309	994.93171	0	500
5	Optimized	37.164595	96.29177	-205.41079	1230.109	0	500
6	Optimized	41.89175	95.436915	-152.063	1368.374	0	500
7	Optimized	45.43205	95.08079	-129.83999	1448.3947	0	500
8	Optimized	50.47655	95.00781	-125.28707	1542.5383	0	500
9	Optimized	56.96971	95.005685	-125.1542	1696.5178	0	500
10	Optimized	62.371125	95.006035	-125.17641	1824.7619	0	500
11	Optimized	67.77254	95.00638	-125.19863	1953.006	0	500
12	Optimized	73.17396	95.006725	-125.21899	2081.3057	0	500
13	Optimized	78.575375	95.007075	-125.24121	2209.6054	0	500
14	Optimized	83.97679	95.007425	-125.26343	2337.7199	0	500
15	Optimized	89.300825	95.463245	-153.70682	2289.678	0	500
16	Optimized	94.547475	96.374535	-210.56474	2326.4841	0	500
17	Optimized	98.5854	97.41461	-275.47227	2155.2734	0	500
18	Optimized	101.155	98.476215	-341.71702	2057.0318	1048.11	0
19	Optimized	105.66705	101.01434	-500.0898	1784.122	909.05556	0
20	Optimized	111.96205	104.81215	-737.07648	1629.3855	830.2134	0
21	Optimized	117.83795	108.2858	-953.83955	1475.2664	751.68576	0
22	Optimized	123.7749	111.8282	-1174.8877	1311.0933	668.03539	0
23	Optimized	129.7729	115.4394	-1400.2211	1149.3348	585.61534	0
24	Optimized	135.0737	118.5638	-1595.1759	1023.494	521.49622	0
25	Optimized	139.67735	121.20145	-1759.7711	908.26042	462.7818	0
26	Optimized	144.7902	124.1569	-1944.2205	775.33631	395.05358	0
27	Optimized	150.4122	127.4301	-2148.5112	631.10307	321.56308	0
28	Optimized	156.5609	131.0232	-2372.66	471.5854	240.28476	0
29	Optimized	159.9493	133.00895	-2496.5978	385.27944	196.30968	0
30	Optimized	162.53105	134.4979	-2589.4943	320.00756	163.05199	0
31	Optimized	167.5931	137.41735	-2771.5735	192.00453	97.831197	0
32	Optimized	172.65515	140.33685	-2953.8238	63.9998	32.609527	0

Slices of Slip Surface: 42

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	42	32.53772	104.58215	-722.71703	198.8321	101.31002	0
2	42	37.145845	102.74475	-608.0766	563.6407	287.18928	0
3	42	41.753975	101.13225	-507.45167	880.59247	448.68427	0
4	42	46.3621	99.73483	-420.25928	1155.9063	588.96368	0
5	42	50.970225	98.54438	-345.97684	1394.3826	710.4734	0
6	42	55.610575	97.54883	-283.84711	1531.6565	0	500
7	42	60.283145	96.745625	-233.71962	1699.4616	0	500
8	42	64.955715	96.13885	-195.86347	1845.6197	0	500
9	42	69.628285	95.725385	-170.06442	1970.9212	0	500
10	42	74.300855	95.503145	-156.19672	2075.9909	0	500
11	42	78.97343	95.471015	-154.19026	2161.3557	0	500
12	42	83.646005	95.62884	-164.03995	2227.418	0	500
13	42	88.318575	95.9774	-185.78963	2274.3533	0	500
14	42	92.991145	96.518455	-219.55475	2302.4198	0	500
15	42	97.663715	97.25477	-265.49804	2311.5732	0	500
16	42	102.3077	98.18322	-323.4251	2298.605	1171.1977	0
17	42	106.9231	99.30629	-393.5137	2256.3686	1149.6772	0
18	42	111.5385	100.63459	-476.40814	2196.7375	1119.2937	0
19	42	116.15385	102.1757	-572.55911	2119.4256	1079.9013	0
20	42	120.7692	103.9389	-682.58694	2024.7396	1031.6564	0
21	42	125.3846	105.93545	-807.17969	1912.7583	974.59901	0
22	42	130	108.17895	-947.15859	1783.3448	908.65955	0
23	42	134.6154	110.68615	-1103.6096	1636.3691	833.7717	0
24	42	139.2308	113.4776	-1277.8025	1471.5955	749.81538	0
25	42	143.84615	116.5787	-1471.305	1288.7431	656.64741	0
26	42	148.4615	120.02145	-1686.1353	1087.4686	554.09292	0
27	42	153.0769	123.84675	-1924.7611	867.37496	441.94962	0
28	42	157.6923	128.1082	-2190.7777	628.08296	320.02425	0
29	42	162.1165	132.6575	-2474.5664	381.2105	194.23645	0
30	42	166.3495	137.53795	-2779.1305	127.60289	65.016918	0



Condition 2 - 80 ft ash, 4H:1V, GCL, Block Failure – FOS_{min} = 1.75

Condition 2 – Block Failure

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File Information

Revision Number: 30
Last Edited By: Stafford, Sam
Date: 7/12/2011
Time: 2:43:34 PM
File Name: Condition 2.gsz
Directory: G:\Projects\083\083-82\083-82671\083-82671.1 (Vertical Expansion)\Calculations\Revised Slope Stability\
Last Solved Date: 7/12/2011
Last Solved Time: 2:43:51 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Block

Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions Source: (none)
SlipSurface
Direction of movement: Right to Left
Use Passive Mode: No
Slip Surface Option: Block
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: Yes
Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Restrict Block Crossing: No
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000

Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Material 1

Model: Mohr-Coulomb
Unit Weight: 95 pcf
Cohesion: 0 psf
Phi: 27 °
Phi-B: 0 °

Material 2

Model: Mohr-Coulomb
Unit Weight: 95 pcf
Cohesion: 500 psf
Phi: 0 °
Phi-B: 0 °

Limestone

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Slip Surface Limits

Left Coordinate: (-200, 95) ft
Right Coordinate: (1000, 178) ft

Slip Surface Block

Left Grid

Upper Left: (-9.2042, 98.69388) ft
Lower Left: (-10.0138, 89.88886) ft
Lower Right: (105.3074, 89.98821) ft
X Increments: 3
Y Increments: 3
Starting Angle: 135 °
Ending Angle: 180 °
Angle Increments: 2

Right Grid

Upper Left: (108.7056, 123.45457) ft
Lower Left: (112.6611, 89.04182) ft
Lower Right: (242.0935, 89.44973) ft

X Increments: 3
Y Increments: 3
Starting Angle: 45 °
Ending Angle: 65 °
Angle Increments: 2

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 753 pcf
Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	325	178
	325	179
	500	179
	500	178

Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

Regions

	Material	Points	Area (ft²)
Region 1	Limestone	17,1,2,3,4,5,6,7,13,12,11,10,9,8	54000
Region 2	Material 1	18,20,21,22,23,13,12,11,10,9,19	69900
Region 3	Material 2	8,9,19,18	300

Points

	X (ft)	Y (ft)
Point 1	-200	50
Point 2	0	50
Point 3	100	50
Point 4	160	50
Point 5	320	50
Point 6	500	50
Point 7	1000	50
Point 8	0	95

Point 9	100	95
Point 10	160	95
Point 11	320	95
Point 12	500	95
Point 13	1000	95
Point 14	320	175
Point 15	500	175
Point 16	1000	175
Point 17	-200	95
Point 18	0	98
Point 19	100	98
Point 20	160	138
Point 21	320	178
Point 22	500	178
Point 23	1000	178
Point 24	-200	92
Point 25	1000	92

Critical Slip Surfaces

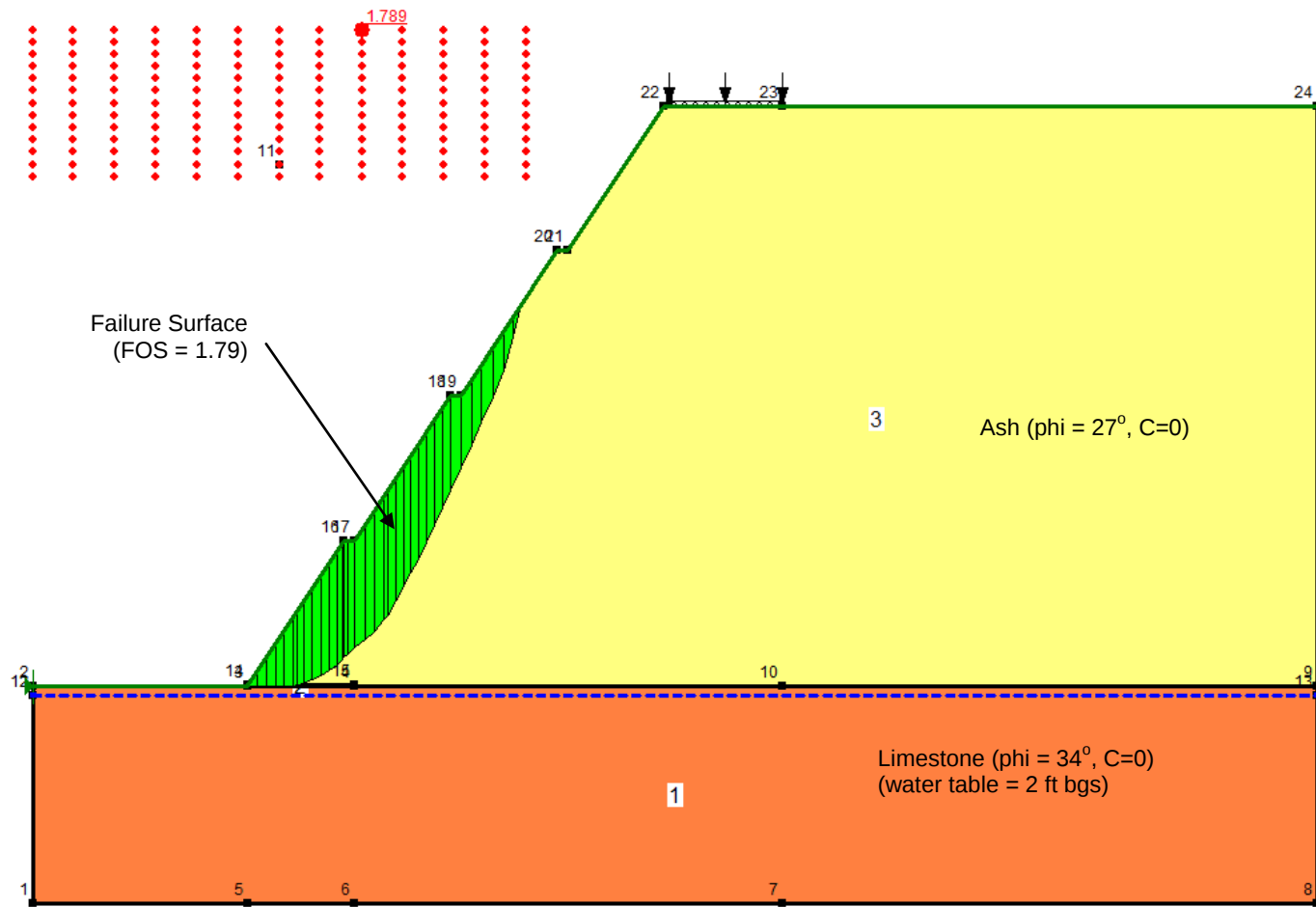
	Number	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	1.745	(75.458, 151.143)	85.35349	(176.234, 142.059)	(-0.451214, 95)
2	1720	1.958	(75.458, 151.143)	80.977	(168.346, 140.086)	(0, 98)

Slices of Slip Surface: **Optimized**

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimized	-0.22560705	94.999055	0	0.1337402	0.090208906	0
2	Optimized	3.186925	94.98477	0	395.07956	266.48453	0
3	Optimized	9.560775	94.95809	0	563.76734	380.26587	0
4	Optimized	14.911645	94.972375	0	692.61409	467.1741	0
5	Optimized	20.012805	95.037495	0	809.93498	0	500
6	Optimized	25.88724	95.11249	0	941.98794	0	500
7	Optimized	31.76168	95.187485	0	1074.0239	0	500
8	Optimized	36.9891	95.395345	0	1146.0779	0	500
9	Optimized	41.3948	95.5755	0	1269.899	0	500
10	Optimized	46.942385	95.54163	0	1414.7405	0	500
11	Optimized	53.80655	95.454305	0	1586.5173	0	500
12	Optimized	60.670715	95.36698	0	1758.2649	0	500
13	Optimized	66.78198	95.282905	0	1913.4267	0	500
14	Optimized	72.140345	95.202075	0	2048.7138	0	500
15	Optimized	77.49871	95.121245	0	2184.1876	0	500
16	Optimized	82.926345	95.03937	0	2321.2209	0	500
17	Optimized	89.154265	95.68625	0	2248.1607	0	500
18	Optimized	96.107915	97.061885	0	2281.2271	0	500
19	Optimized	99.79105	97.870735	0	2031.7771	0	500
20	Optimized	103.88115	100.2501	0	1833.2546	934.08986	0
21	Optimized	111.0332	104.418	0	1647.7918	839.59186	0
22	Optimized	117.57505	108.2382	0	1479.0921	753.63508	0
23	Optimized	123.6557	111.7517	0	1332.3452	678.86378	0
24	Optimized	129.2751	114.9585	0	1192.4538	607.58556	0
25	Optimized	134.45445	117.9507	0	1054.0804	537.0808	0
26	Optimized	139.19375	120.72835	0	931.18568	474.4628	0
27	Optimized	144.04075	123.5067	0	818.67394	417.13521	0
28	Optimized	148.9954	126.2857	0	698.60223	355.95562	0
29	Optimized	155.48305	130.0216	0	528.61776	269.3442	0
30	Optimized	159.7467	132.51655	0	418.10639	213.03584	0
31	Optimized	163.4715	134.70065	0	321.46175	163.79294	0
32	Optimized	169.2658	138.0668	0	174.49266	88.908449	0
33	Optimized	173.9114	140.72795	0	58.164218	29.63615	0

Slices of Slip Surface: 1720

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	1720	2.777778	95.85822	0	322.95597	0	500
2	1720	8.333333	95.85822	0	454.89596	0	500
3	1720	13.88889	95.85822	0	586.83595	0	500
4	1720	19.444445	95.85822	0	718.77594	0	500
5	1720	25	95.85822	0	850.73393	0	500
6	1720	30.555555	95.85822	0	982.67392	0	500
7	1720	36.11111	95.85822	0	1114.6139	0	500
8	1720	41.666665	95.85822	0	1246.5539	0	500
9	1720	47.22222	95.85822	0	1378.5119	0	500
10	1720	52.77778	95.85822	0	1510.4519	0	500
11	1720	58.333335	95.85822	0	1642.3919	0	500
12	1720	63.88889	95.85822	0	1774.3319	0	500
13	1720	69.444445	95.85822	0	1906.1998	0	500
14	1720	75	95.85822	0	2038.1398	0	500
15	1720	80.555555	95.85822	0	2170.2598	0	500
16	1720	86.11111	95.85822	0	2302.1998	0	500
17	1720	91.666665	95.85822	0	2434.1398	0	500
18	1720	97.22222	95.85822	0	2566.0798	0	500
19	1720	102.92355	95.85822	0	2800.6888	1427.0222	0
20	1720	108.7223	97.59149	0	2134.3686	1087.5151	0
21	1720	114.47265	101.05803	0	1977.3925	1007.5318	0
22	1720	120.22295	104.52455	0	1820.4164	927.54847	0
23	1720	125.97325	107.9911	0	1663.4403	847.56515	0
24	1720	131.7236	111.45765	0	1506.4642	767.58183	0
25	1720	137.47395	114.9242	0	1349.5625	687.63646	0
26	1720	143.22425	118.39075	0	1192.5864	607.65314	0
27	1720	148.97455	121.85725	0	1035.6252	527.67741	0
28	1720	155.92485	127.66565	0	625.83397	318.87833	0
29	1720	164.1728	135.9136	0	210.25296	107.12923	0



Condition 3 - 120 ft ash, 4H:1V, No GCL, Circular Failure – FOS_{min} = 1.79

Condition 3 – Circular Failure

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File Information

Revision Number: 28
Last Edited By: Stafford, Sam
Date: 7/12/2011
Time: 2:53:43 PM
File Name: Condition 3.gsz
Directory: G:\Projects\083\083-82\083-82671\083-82671.1 (Vertical Expansion)\Calculations\Revised Slope Stability\
Last Solved Date: 7/12/2011
Last Solved Time: 2:53:54 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Circular

Kind: SLOPE/W
Method: Spencer
Settings
 Apply Phreatic Correction: Yes
 PWP Conditions Source: Piezometric Line
 Use Staged Rapid Drawdown: No
SlipSurface
 Direction of movement: Right to Left
 Use Passive Mode: No
 Slip Surface Option: Grid and Radius
 Critical slip surfaces saved: 1
 Optimize Critical Slip Surface Location: Yes
Tension Crack
 Tension Crack Option: (none)
FOS Distribution
 FOS Calculation Option: Constant
Advanced
 Number of Slices: 30
 Optimization Tolerance: 0.01
 Minimum Slip Surface Depth: 0.1 ft

Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Ash

Model: Mohr-Coulomb
Unit Weight: 95 pcf
Cohesion: 0 psf
Phi: 27 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Limestone

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Grid

Upper Left: (-200.9901, 231.01648) ft
Lower Left: (-200.9901, 200.47699) ft
Lower Right: (260.7058, 200.47699) ft
Grid Horizontal Increment: 12
Grid Vertical Increment: 12
Left Projection Angle: 0 °
Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (98.7364, 95.14885) ft
Upper Right Coordinate: (98.7364, 95.14885) ft
Lower Left Coordinate: (98.7364, 95.14885) ft
Lower Right Coordinate: (98.7364, 95.14885) ft
Number of Increments: 0
Left Projection: No
Left Projection Angle: 0 °
Right Projection: No
Right Projection Angle: 0 °
UsePoints: 0

Slip Surface Limits

Left Coordinate: (-200, 95) ft
Right Coordinate: (1000, 215.2) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	-200	93
	1000	93

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 753 pcf
Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	395	215.2
	395	216.2
	500	216.2
	500	215.2

Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

Regions

	Material	Points	Area (ft²)
Region 1	Limestone	1,2,3,4,10,9,8,7,6,5	54000
Region 2	Ash	3,14,15,4	20
Region 3	Ash	14,16,17,18,19,20,21,22,23,24,9,10,4,15	96780

Points

	X (ft)	Y (ft)
Point 1	-200	50
Point 2	-200	95
Point 3	0	95
Point 4	100	95
Point 5	0	50
Point 6	100	50
Point 7	500	50
Point 8	1000	50
Point 9	1000	95
Point 10	500	95
Point 11	30.6932	203.06299
Point 12	-200	93
Point 13	1000	93
Point 14	0	95.2
Point 15	100	95.2
Point 16	90	125.2
Point 17	100	125.2
Point 18	190	155.2
Point 19	200	155.2
Point 20	290	185.2
Point 21	300	185.2
Point 22	390	215.2
Point 23	500	215.2
Point 24	1000	215.2

Critical Slip Surfaces

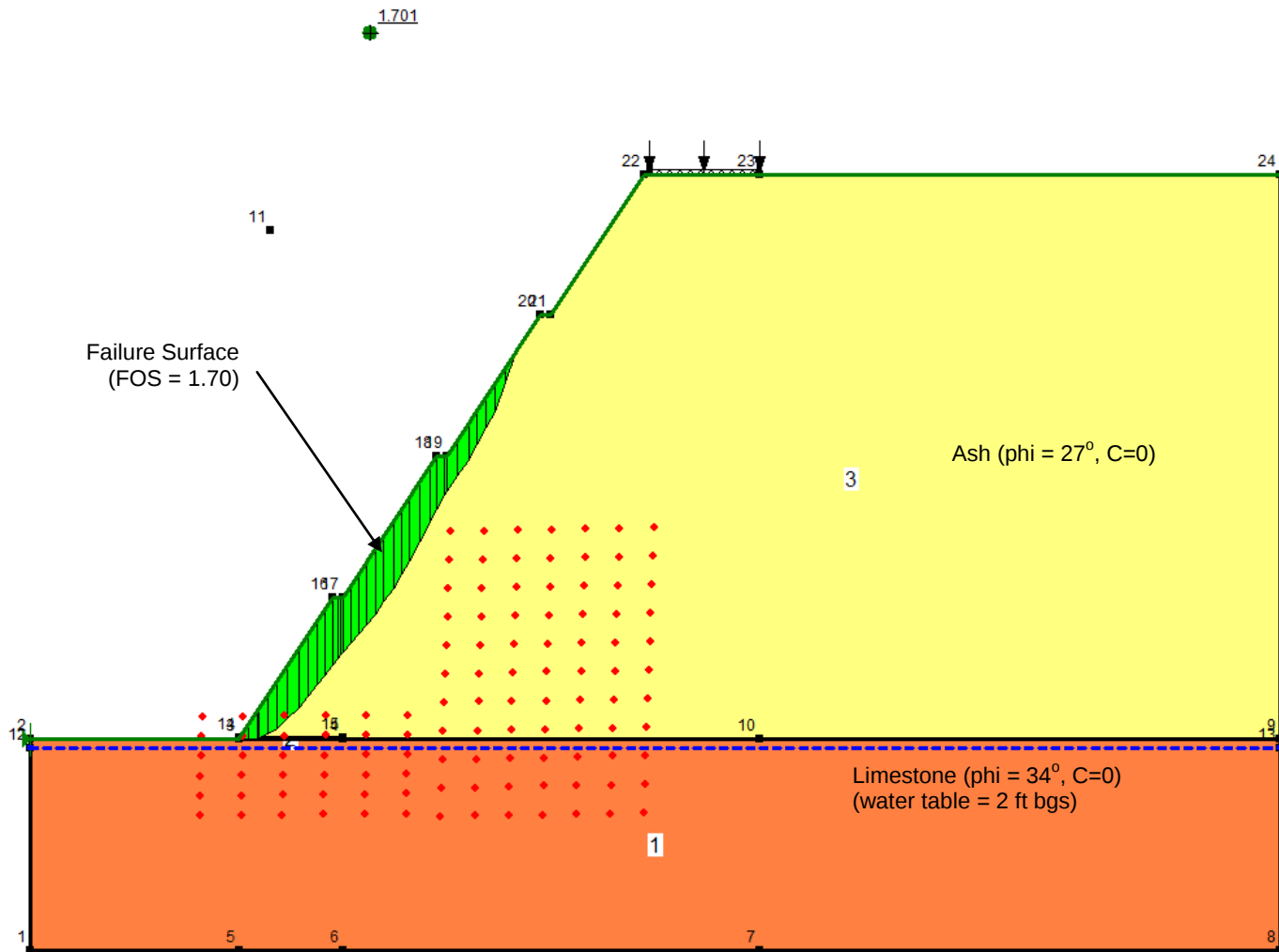
	Number	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	1.789	(106.807, 231.016)	127.5837	(256.563, 174.054)	(0, 95.2)
2	165	2.280	(106.807, 231.016)	136.107	(225.009, 163.536)	(44.4706, 110.024)

Slices of Slip Surface: **Optimized**

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimized	4.32668	95.00508	-125.11899	169.39079	86.308919	0
2	Optimized	12.98004	95.012025	-125.54656	467.11319	238.00606	0
3	Optimized	21.6334	95.018975	-125.9857	764.83559	389.7032	0
4	Optimized	30.28676	95.02592	-126.41328	1062.5695	541.40623	0
5	Optimized	38.94012	95.032865	-126.85242	1360.2804	693.09748	0
6	Optimized	44.89436	95.11817	-132.17531	1510.2024	769.48656	0
7	Optimized	49.65651	95.3576	-147.11416	1645.5056	838.42699	0
8	Optimized	56.669925	95.94305	-183.64573	1757.5305	895.50651	0
9	Optimized	64.427575	96.79875	-237.03663	1925.1218	980.89855	0
10	Optimized	72.11705	97.80921	-300.09624	2025.1989	1031.8904	0
11	Optimized	79.73835	98.974425	-372.80833	2155.1624	1098.1101	0
12	Optimized	86.18205	100.11117	-443.74558	2179.1476	1110.3312	0
13	Optimized	89.40755	100.8135	-487.55886	2165.9731	1103.6184	0
14	Optimized	91.6836	101.3827	-523.09229	2132.6758	1086.6526	0
15	Optimized	96.6836	102.3911	-585.99807	2126.1785	1083.3421	0
16	Optimized	104.84705	103.83695	-676.22329	2142.0069	1091.407	0
17	Optimized	114.54115	105.5539	-783.36426	2283.0941	1163.2946	0
18	Optimized	123.74055	107.56565	-908.89708	2269.3832	1156.3085	0
19	Optimized	129.34785	109.2231	-1012.308	2132.0134	1086.3151	0
20	Optimized	134.49265	111.21575	-1136.6605	2129.3551	1084.9606	0
21	Optimized	142.2723	114.19265	-1322.3683	2097.3013	1068.6284	0
22	Optimized	149.5546	117.07415	-1502.1605	2030.7388	1034.7131	0
23	Optimized	156.3396	119.86025	-1676.1264	1987.52	1012.692	0
24	Optimized	163.5004	123.02695	-1873.6655	1867.5428	951.56057	0
25	Optimized	171.037	126.5742	-2095.043	1784.7063	909.35326	0
26	Optimized	178.5736	130.12145	-2316.4205	1701.8698	867.14596	0
27	Optimized	186.17095	133.7333	-2541.772	1608.2665	819.45269	0
28	Optimized	195	137.97185	-2806.2726	1372.3502	699.24733	0
29	Optimized	204.80255	142.67775	-3099.8817	1124.9601	573.19581	0
30	Optimized	214.40765	147.2889	-3387.6448	1012.7081	516.00056	0
31	Optimized	224.3233	152.31915	-3701.5046	853.65633	434.95962	0
32	Optimized	234.54945	157.76845	-4041.5277	695.13137	354.18712	0
33	Optimized	243.88765	163.8834	-4423.1337	410.11962	208.96638	0
34	Optimized	252.33795	170.66405	-4846.2305	136.70346	69.653893	0

Slices of Slip Surface: **165**

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	165	47.31614	108.6402	-975.94339	312.00859	158.97631	0
2	165	53.007325	106.032	-813.19629	881.75617	449.27721	0
3	165	58.69851	103.73155	-669.64491	1376.1727	701.19503	0
4	165	64.38969	101.72245	-544.27438	1806.6237	920.52073	0
5	165	70.08087	99.991295	-436.25559	2181.8701	1111.7183	0
6	165	75.77205	98.52712	-344.89619	2508.3671	1278.0769	0
7	165	81.46323	97.32113	-269.6402	2791.3518	1422.2648	0
8	165	87.15441	96.36638	-210.06767	3034.871	1546.344	0
9	165	93.95853	95.575525	-160.71455	3136.2035	1597.9755	0
10	165	98.95853	95.13984	-133.52614	3120.4827	1589.9653	0
11	165	100.92025	95.03984	-127.28862	3138.8993	1599.3491	0
12	165	104.32385	94.954675	-121.97209	3294.2469	2221.9976	0
13	165	109.2905	94.954675	-121.97209	3391.4799	2287.5821	0
14	165	114.7825	95.176645	-135.82319	3419.5107	1742.3277	0
15	165	120.7999	95.66433	-166.24594	3491.0491	1778.7783	0
16	165	126.8173	96.422675	-213.57634	3533.1408	1800.2252	0
17	165	132.8347	97.4563	-278.08068	3546.6378	1807.1022	0
18	165	138.8521	98.771675	-360.15261	3532.3995	1799.8475	0
19	165	144.8695	100.37732	-460.35158	3490.8093	1778.6562	0
20	165	150.8869	102.28415	-579.33573	3422.1183	1743.6564	0
21	165	156.9043	104.5058	-717.96761	3326.319	1694.8442	0
22	165	162.9217	107.0592	-877.30069	3203.507	1632.2684	0
23	165	168.9391	109.9655	-1058.6437	3053.1884	1555.6772	0
24	165	174.9565	113.2509	-1263.6503	2875.0119	1464.8917	0
25	165	180.9739	116.94825	-1494.3895	2668.1944	1359.513	0
26	165	186.9913	121.0993	-1753.4021	2431.9392	1239.1349	0
27	165	192.5	125.321	-2016.8263	2131.168	1085.8843	0
28	165	197.5	129.5832	-2282.7854	1773.7769	903.78446	0
29	165	203.12605	134.95285	-2617.8055	1419.9875	723.51977	0
30	165	209.3782	141.6762	-3037.3673	1058.3985	539.28097	0
31	165	215.63035	149.43515	-3521.5808	658.16892	335.35382	0
32	165	221.88245	158.57065	-4091.6148	218.30013	111.22947	0



Condition 3 - 120 ft ash, 4H:1V, No GCL, Block Failure – $FOS_{min} = 1.70$

Condition 3 – Block Failure

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File Information

Revision Number: 28
Last Edited By: [Stafford, Sam](#)
Date: [7/12/2011](#)
Time: [2:53:43 PM](#)
File Name: [Condition 3.gsz](#)
Directory: [G:\Projects\083\083-82\083-82671\083-82671.1 \(Vertical Expansion\)\Calculations\Revised Slope Stability\](#)
Last Solved Date: [7/12/2011](#)
Last Solved Time: [2:54:23 PM](#)

Project Settings

Length(L) Units: [feet](#)
Time(t) Units: [Seconds](#)
Force(F) Units: [lbf](#)
Pressure(p) Units: [psf](#)
Strength Units: [psf](#)
Unit Weight of Water: [62.4 pcf](#)
View: [2D](#)

Analysis Settings

Block

Kind: [SLOPE/W](#)
Method: [Spencer](#)
Settings
 Apply Phreatic Correction: [Yes](#)
 PWP Conditions Source: [Piezometric Line](#)
 Use Staged Rapid Drawdown: [No](#)
SlipSurface
 Direction of movement: [Right to Left](#)
 Use Passive Mode: [No](#)
 Slip Surface Option: [Block](#)
 Critical slip surfaces saved: [1](#)
 Optimize Critical Slip Surface Location: [Yes](#)
 Tension Crack
 Tension Crack Option: [\(none\)](#)
FOS Distribution
 FOS Calculation Option: [Constant](#)
Restrict Block Crossing: [No](#)
Advanced
 Number of Slices: [30](#)
 Optimization Tolerance: [0.01](#)

Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Ash

Model: Mohr-Coulomb
Unit Weight: 95 pcf
Cohesion: 0 psf
Phi: 27 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Limestone

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Limits

Left Coordinate: (-200, 95) ft
Right Coordinate: (1000, 215.2) ft

Slip Surface Block

Left Grid

Upper Left: (-35.2284, 99.69606) ft
Lower Left: (-37.073, 78.71968) ft
Lower Right: (160.8331, 79.12756) ft
X Increments: 5
Y Increments: 5
Starting Angle: 135 °
Ending Angle: 180 °
Angle Increments: 2

Right Grid

Upper Left: (203.4712, 139.11534) ft
Lower Left: (193.9843, 78.45165) ft
Lower Right: (389.4133, 79.29071) ft
X Increments: 6

Y Increments: 10
Starting Angle: 45 °
Ending Angle: 65 °
Angle Increments: 2

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	-200	93
	1000	93

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 753 pcf
Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	395	215.2
	395	216.2
	500	216.2
	500	215.2

Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

Regions

	Material	Points	Area (ft²)
Region 1	Limestone	1,2,3,4,10,9,8,7,6,5	54000
Region 2	Ash	3,14,15,4	20
Region 3	Ash	14,16,17,18,19,20,21,22,23,24,9,10,4,15	96780

Points

	X (ft)	Y (ft)
Point 1	-200	50
Point 2	-200	95
Point 3	0	95
Point 4	100	95
Point 5	0	50
Point 6	100	50
Point 7	500	50
Point 8	1000	50
Point 9	1000	95
Point 10	500	95
Point 11	30.6932	203.06299
Point 12	-200	93
Point 13	1000	93
Point 14	0	95.2
Point 15	100	95.2
Point 16	90	125.2
Point 17	100	125.2
Point 18	190	155.2
Point 19	200	155.2
Point 20	290	185.2
Point 21	300	185.2
Point 22	390	215.2
Point 23	500	215.2
Point 24	1000	215.2

Critical Slip Surfaces

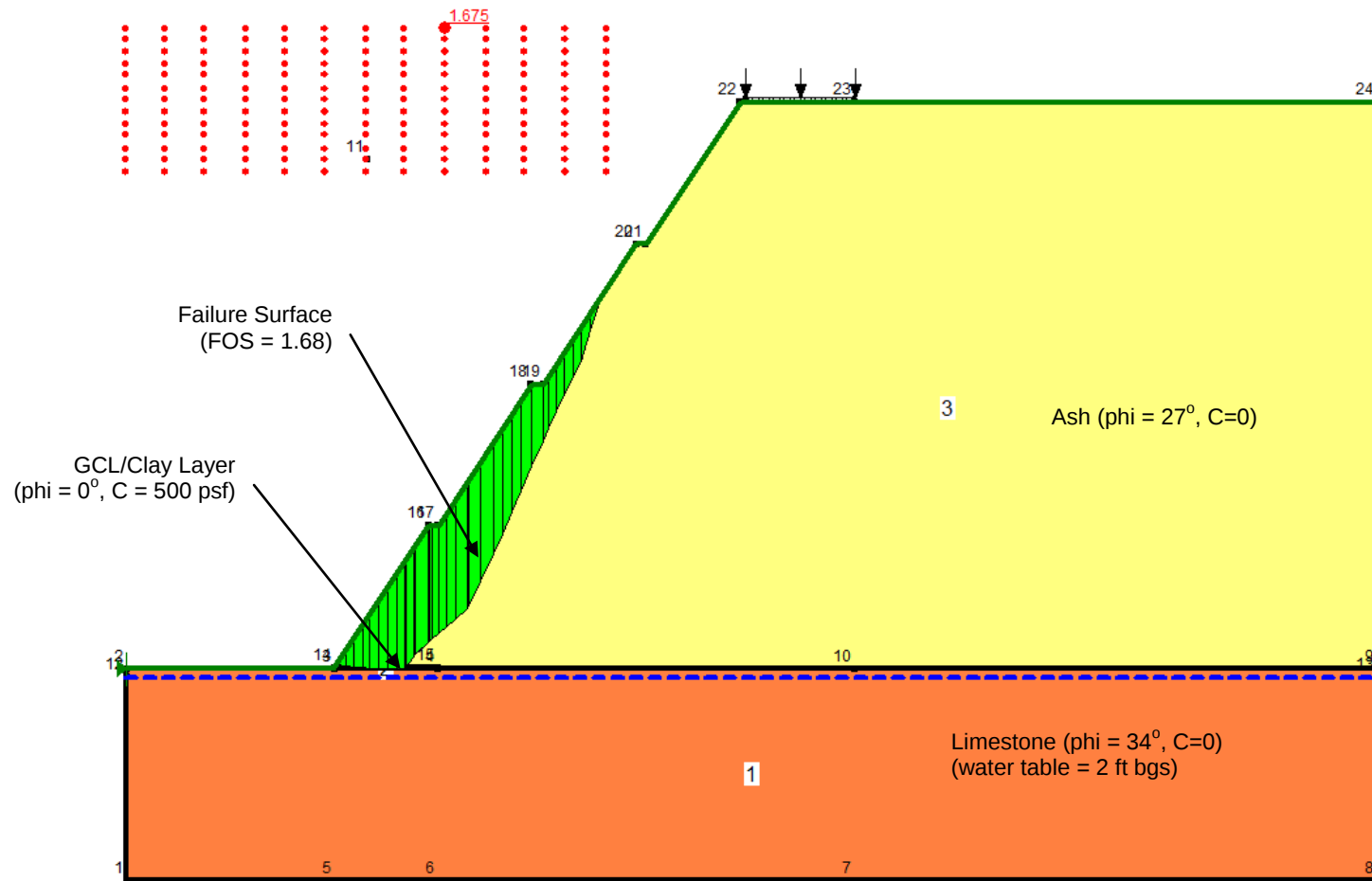
	Number	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	1.701	(99.555, 182.306)	128.4831	(266.303, 177.301)	(0, 95.2)
2	18691	1.830	(99.555, 182.306)	110.325	(229.334, 164.978)	(1.39181, 95.6639)

Slices of Slip Surface: Optimized

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimized	4.522425	95.001885	-124.9219	177.80282	90.595061	0
2	Optimized	13.567275	95.00558	-125.14302	491.72728	250.54756	0
3	Optimized	18.86848	95.103715	-131.27117	616.05444	313.89541	0
4	Optimized	23.69497	95.70044	-168.50444	713.70121	363.64893	0
5	Optimized	31.79039	96.70132	-230.96571	877.47355	447.0951	0
6	Optimized	41.355725	98.31766	-331.82427	982.35404	500.53439	0
7	Optimized	52.390975	100.54948	-471.08584	1115.5847	568.4188	0
8	Optimized	62.373775	102.88375	-616.74468	1159.7924	590.94375	0
9	Optimized	71.304125	105.3205	-768.79458	1207.5409	615.27284	0
10	Optimized	79.326975	107.5728	-909.34549	1232.7313	628.10797	0
11	Optimized	86.442325	109.6406	-1038.3651	1259.3585	641.67519	0
12	Optimized	92.4313	111.38105	-1146.9704	1210.7765	616.92146	0
13	Optimized	96.2078	112.4872	-1215.987	1109.9159	565.53041	0
14	Optimized	98.7765	113.1875	-1259.7027	1079.1328	549.84564	0
15	Optimized	103.8404	114.4319	-1337.4107	1082.3317	551.47553	0
16	Optimized	111.5212	116.31935	-1455.1201	1142.7668	582.26875	0
17	Optimized	119.1816	118.30345	-1578.8918	1176.2757	599.34238	0
18	Optimized	126.82155	120.38415	-1708.7191	1217.5223	620.35862	0
19	Optimized	135.06085	122.8632	-1863.4313	1205.5661	614.26662	0
20	Optimized	143.8995	125.74055	-2042.986	1211.4832	617.2815	0
21	Optimized	152.19275	128.6123	-2222.2489	1174.1434	598.25596	0
22	Optimized	159.9406	131.4785	-2401.0407	1150.3328	586.12381	0
23	Optimized	168.7517	134.9544	-2617.9387	1080.1711	550.37466	0
24	Optimized	178.6261	139.04005	-2872.9388	1014.9472	517.14144	0
25	Optimized	186.78165	142.4322	-3084.6054	957.00279	487.61728	0
26	Optimized	193.74335	145.3509	-3266.6732	805.95759	410.6559	0
27	Optimized	198.74335	147.32435	-3389.8555	678.51656	345.72145	0
28	Optimized	205.13175	149.3784	-3518.0573	648.91313	330.63775	0
29	Optimized	215.3952	152.67845	-3723.9761	659.3482	335.95469	0
30	Optimized	224.7539	156.0509	-3934.4246	609.2514	310.42909	0
31	Optimized	233.2079	159.49575	-4149.3462	557.64611	284.13488	0
32	Optimized	241.6619	162.9406	-4364.2679	506.04081	257.84067	0
33	Optimized	250.9923	167.82245	-4668.9236	324.68712	165.43635	0
34	Optimized	261.1991	174.14135	-5063.1931	108.22626	55.144035	0

Slices of Slip Surface: **18691**

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	18691	4.9062505	95.66394	-166.22836	120.84562	61.573921	0
2	18691	11.935136	95.66394	-166.22836	362.53261	184.71959	0
3	18691	18.96402	95.66394	-166.22836	604.22101	307.86598	0
4	18691	25.992905	95.66394	-166.22836	845.90942	431.01238	0
5	18691	33.02179	95.66394	-166.22836	1087.612	554.16602	0
6	18691	40.050675	95.66394	-166.22836	1329.3005	677.31241	0
7	18691	47.434695	96.71542	-231.83931	1265.2468	644.67546	0
8	18691	55.17384	98.81838	-363.06487	1307.3926	666.14982	0
9	18691	62.912985	100.92133	-494.29043	1349.5384	687.62418	0
10	18691	70.652135	103.0243	-625.51599	1391.8089	709.16207	0
11	18691	78.39128	105.1273	-756.74155	1433.9547	730.63643	0
12	18691	86.130425	107.23025	-887.96711	1476.1005	752.11078	0
13	18691	95	109.64035	-1038.3484	1376.9697	701.60111	0
14	18691	103.75	112.018	-1186.7277	1277.2196	650.77591	0
15	18691	111.25	114.056	-1313.9543	1318.0716	671.59104	0
16	18691	118.75	116.094	-1441.0779	1358.988	692.43895	0
17	18691	126.25	118.132	-1568.2016	1399.9043	713.28685	0
18	18691	133.75	120.16995	-1695.4539	1440.8206	734.13476	0
19	18691	141.25	122.2079	-1822.5776	1481.6082	754.91711	0
20	18691	148.75	124.2459	-1949.7012	1522.5246	775.76501	0
21	18691	156.25	126.2839	-2076.9536	1563.4409	796.61292	0
22	18691	163.75	128.3219	-2204.0772	1604.3572	817.46082	0
23	18691	171.25	130.35985	-2331.2009	1645.2735	838.30873	0
24	18691	178.75	132.3978	-2458.4532	1686.0612	859.09108	0
25	18691	186.25	134.4358	-2585.5769	1726.9775	879.93898	0
26	18691	195	136.81345	-2733.9637	1627.1962	829.09789	0
27	18691	201.7356	138.6437	-2848.1514	1516.4286	772.65899	0
28	18691	207.78165	143.42575	-3146.5566	920.78735	469.16459	0
29	18691	216.4025	152.04665	-3684.5438	552.46421	281.49457	0
30	18691	225.02335	160.6675	-4222.449	184.15747	93.832918	0



Condition 4 - 120 ft ash, 3H:1V, GCL, Circular Failure – $FOS_{min} = 1.68$

Condition 4 – Circular Failure

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File Information

Revision Number: 30
Last Edited By: [Stafford, Sam](#)
Date: [7/12/2011](#)
Time: [3:21:30 PM](#)
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Last Solved Date: [7/12/2011](#)
Last Solved Time: [3:21:37 PM](#)

Project Settings

Length(L) Units: [feet](#)
Time(t) Units: [Seconds](#)
Force(F) Units: [lbf](#)
Pressure(p) Units: [psf](#)
Strength Units: [psf](#)
Unit Weight of Water: [62.4 pcf](#)
View: [2D](#)

Analysis Settings

Circular

Kind: [SLOPE/W](#)
Method: [Spencer](#)
Settings
 Apply Phreatic Correction: [Yes](#)
 PWP Conditions Source: [Piezometric Line](#)
 Use Staged Rapid Drawdown: [No](#)
SlipSurface
 Direction of movement: [Right to Left](#)
 Use Passive Mode: [No](#)
 Slip Surface Option: [Grid and Radius](#)
 Critical slip surfaces saved: [1](#)
 Optimize Critical Slip Surface Location: [Yes](#)
 Tension Crack
 Tension Crack Option: [\(none\)](#)
FOS Distribution
 FOS Calculation Option: [Constant](#)
Advanced
 Number of Slices: [30](#)
 Optimization Tolerance: [0.01](#)
 Minimum Slip Surface Depth: [0.1 ft](#)
 Optimization Maximum Iterations: [2000](#)
 Optimization Convergence Tolerance: [1e-007](#)
 Starting Optimization Points: [8](#)

Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Ash

Model: Mohr-Coulomb
Unit Weight: 95 pcf
Cohesion: 0 psf
Phi: 27 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Clay Material

Model: Mohr-Coulomb
Unit Weight: 95 pcf
Cohesion: 500 psf
Phi: 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Limestone

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Grid

Upper Left: (-200.9901, 231.01648) ft
Lower Left: (-200.9901, 200.47699) ft
Lower Right: (260.7058, 200.47699) ft
Grid Horizontal Increment: 12
Grid Vertical Increment: 12
Left Projection Angle: 0 °
Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (98.7364, 95.1488) ft
Upper Right Coordinate: (98.7364, 95.1488) ft
Lower Left Coordinate: (98.7364, 95.1488) ft
Lower Right Coordinate: (98.7364, 95.1488) ft
Number of Increments: 0
Left Projection: No
Left Projection Angle: 0 °

Right Projection: No
Right Projection Angle: 0 °
UsePoints: 0

Slip Surface Limits

Left Coordinate: (-200, 95) ft
Right Coordinate: (1000, 215.2) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	-200	93
	1000	93

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 753 pcf
Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	395	215.2
	395	216.2
	500	216.2
	500	215.2

Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

Regions

	Material	Points	Area (ft²)
Region 1	Limestone	1,2,3,4,10,9,8,7,6,5	54000
Region 2	Clay Material	3,14,15,4	20
Region 3	Ash	14,16,17,18,19,20,21,22,23,24,9,10,4,15	96780

Points

	X (ft)	Y (ft)
Point 1	-200	50
Point 2	-200	95
Point 3	0	95
Point 4	100	95
Point 5	0	50
Point 6	100	50
Point 7	500	50
Point 8	1000	50
Point 9	1000	95
Point 10	500	95
Point 11	30.6932	203.06299
Point 12	-200	93
Point 13	1000	93
Point 14	0	95.2
Point 15	100	95.2
Point 16	90	125.2
Point 17	100	125.2
Point 18	190	155.2
Point 19	200	155.2
Point 20	290	185.2
Point 21	300	185.2
Point 22	390	215.2
Point 23	500	215.2
Point 24	1000	215.2

Critical Slip Surfaces

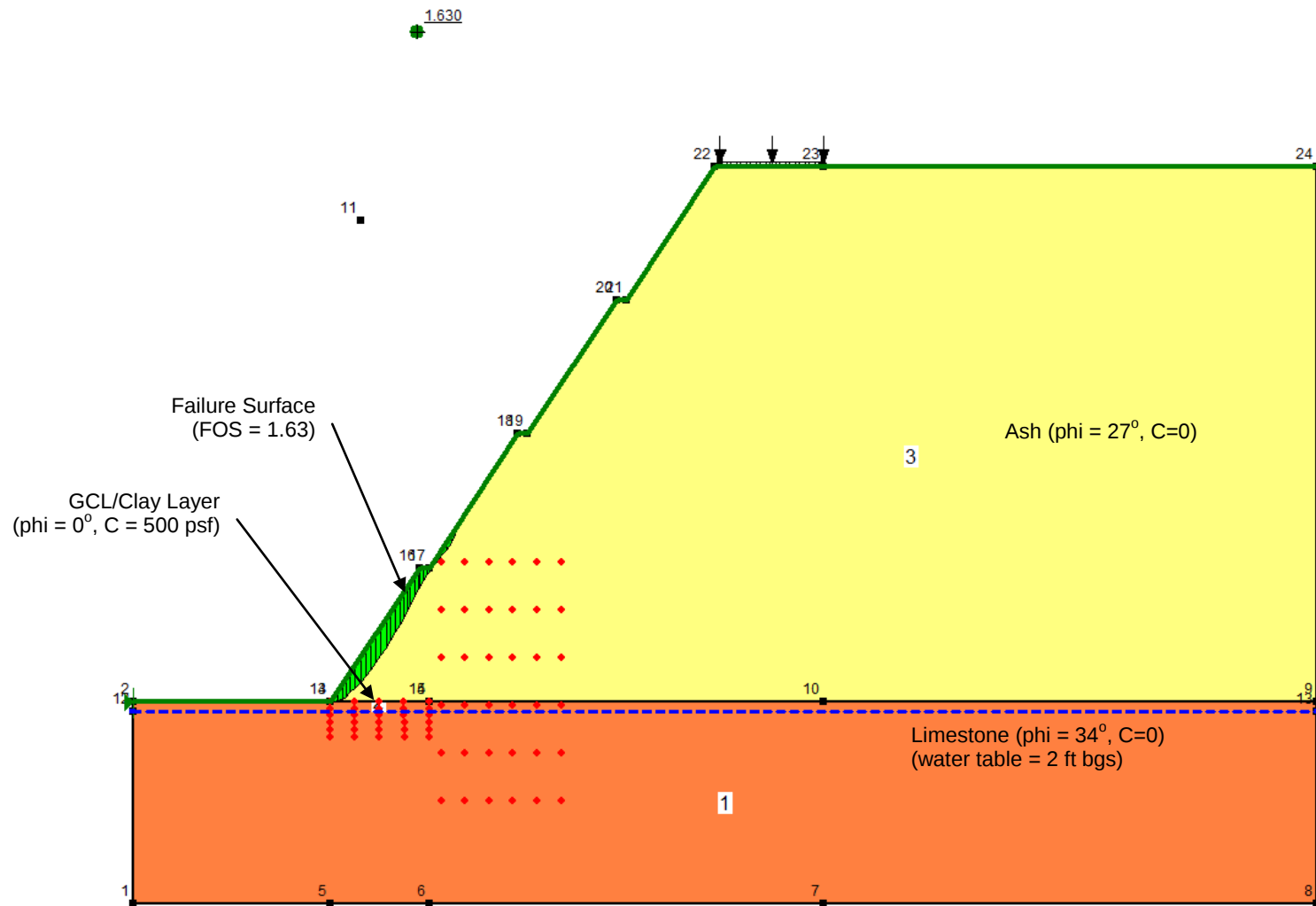
	Number	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	1.675	(106.807, 231.016)	126.4084	(255.45, 173.683)	(2.29715, 95.9657)
2	165	2.260	(106.807, 231.016)	136.107	(225.009, 163.536)	(44.4705, 110.024)

Slices of Slip Surface: **Optimized**

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimized	6.522116	95.8381	-177.09244	163.42991	83.271697	0
2	Optimized	14.97204	95.58286	-161.17056	490.2779	249.80907	0
3	Optimized	23.42196	95.32762	-145.24869	817.13771	416.35246	0
4	Optimized	30.86316	95.10285	-131.21771	1092.7195	0	500
5	Optimized	38.321985	95.007505	-125.26552	1319.0062	0	500
6	Optimized	46.80716	95.011115	-125.48944	1587.3566	0	500
7	Optimized	55.29234	95.01472	-125.71336	1855.7069	0	500
8	Optimized	63.777515	95.018325	-125.94907	2123.9394	0	500
9	Optimized	68.317735	95.110065	-131.66725	1993.2527	0	500
10	Optimized	72.414685	96.34803	-208.92031	2001.901	1020.0195	0
11	Optimized	77.39285	97.76703	-297.46406	2106.0002	1073.0607	0
12	Optimized	84.28585	99.2862	-392.25425	2190.8449	1116.2912	0
13	Optimized	90.7823	100.70525	-480.8076	2235.1643	1138.8731	0
14	Optimized	92.56115	101.10535	-505.78395	2184.1515	1112.8808	0
15	Optimized	96.77885	101.9411	-557.92795	2159.7112	1100.4278	0
16	Optimized	104.026	103.30565	-643.07135	2157.566	1099.3348	0
17	Optimized	112.078	104.82175	-737.68303	2266.0668	1154.6187	0
18	Optimized	121.7909	106.76915	-859.19992	2357.1672	1201.0367	0
19	Optimized	128.3977	108.1786	-947.12498	2388.455	1216.9786	0
20	Optimized	134.95785	111.05545	-1126.689	2056.494	1047.836	0
21	Optimized	146.8202	116.51775	-1467.5395	1955.9379	996.60015	0
22	Optimized	157.44965	121.5621	-1782.29	1783.6049	908.79207	0
23	Optimized	166.2643	126.0397	-2061.6546	1663.1402	847.41227	0
24	Optimized	175.07895	130.5173	-2341.1204	1542.6756	786.03247	0
25	Optimized	184.74315	135.45065	-2648.8816	1405.4858	716.1308	0
26	Optimized	195	140.70815	-2976.9977	1131.6916	576.62569	0
27	Optimized	202.75345	144.68245	-3225.012	893.03923	455.02621	0
28	Optimized	209.4209	147.8737	-3424.1733	841.21679	428.62136	0
29	Optimized	217.24895	151.43355	-3646.2806	764.82816	389.69941	0
30	Optimized	225.077	154.9934	-3868.3878	688.42791	350.77154	0
31	Optimized	232.905	158.55325	-4090.4951	612.03928	311.84959	0
32	Optimized	241.47665	163.6707	-4409.8642	380.16613	193.70432	0
33	Optimized	250.792	170.3457	-4826.3567	126.71913	64.566623	0

Slices of Slip Surface: **165**

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	165	47.316085	108.64015	-975.94184	312.56119	159.25788	0
2	165	53.007275	106.0319	-813.19498	883.175	450.00014	0
3	165	58.69846	103.7315	-669.64392	1378.143	702.19895	0
4	165	64.389645	101.72245	-544.27357	1808.9583	921.7103	0
5	165	70.080835	99.991275	-436.25492	2184.4046	1113.0097	0
6	165	75.772025	98.52708	-344.89572	2510.9298	1279.3826	0
7	165	81.463215	97.321085	-269.63978	2793.937	1423.582	0
8	165	87.154405	96.36633	-210.06738	3037.301	1547.5821	0
9	165	93.95815	95.5755	-160.71744	3138.3915	1599.0904	0
10	165	98.95815	95.139815	-133.52511	2968.8962	0	500
11	165	100.9196	95.039815	-127.2855	3140.6903	1600.2617	0
12	165	104.3232	94.95465	-121.97068	3296.5593	2223.5573	0
13	165	109.2912	94.95465	-121.97068	3393.5643	2288.988	0
14	165	114.78385	95.17667	-135.82383	3420.7299	1742.9489	0
15	165	120.8011	95.6644	-166.26522	3491.9333	1779.2289	0
16	165	126.81835	96.422785	-213.57982	3533.8558	1800.5895	0
17	165	132.83565	97.45644	-278.08512	3547.0207	1807.2973	0
18	165	138.85295	98.771835	-360.15831	3532.4554	1799.8759	0
19	165	144.87025	100.3775	-460.35885	3490.5454	1778.5217	0
20	165	150.88755	102.2843	-579.34483	3421.7004	1743.4434	0
21	165	156.90485	104.50595	-717.97892	3325.5989	1694.4773	0
22	165	162.92215	107.0594	-877.29949	3202.4982	1631.7543	0
23	165	168.93945	109.96565	-1058.6607	3052.0548	1555.0996	0
24	165	174.95675	113.25095	-1263.6565	2873.7641	1464.2559	0
25	165	180.97405	116.94825	-1494.4145	2666.8457	1358.8258	0
26	165	186.99135	121.0993	-1753.4327	2430.5048	1238.404	0
27	165	192.5	125.32095	-2016.8269	2129.6151	1085.0931	0
28	165	197.5	129.5831	-2282.7861	1772.2865	903.02506	0
29	165	203.12605	134.9528	-2617.7987	1418.7414	722.88485	0
30	165	209.3782	141.6762	-3037.3593	1057.3452	538.74428	0
31	165	215.63035	149.43515	-3521.5707	657.4187	334.97156	0
32	165	221.8825	158.57065	-4091.6009	218.01818	111.08581	0



Condition 4 - 120 ft ash, 3H:1V, GCL, Block Failure – $FOS_{min} = 1.63$

Condition 4 – Block Failure

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File Information

Revision Number: 26
Last Edited By: [Stafford, Sam](#)
Date: [7/12/2011](#)
Time: [3:05:35 PM](#)
File Name: [Condition 4.gsz](#)
Directory: [G:\Projects\083\083-82\083-82671\083-82671.1 \(Vertical Expansion\)\Calculations\Revised Slope Stability\](#)
Last Solved Date: [7/12/2011](#)
Last Solved Time: [3:05:49 PM](#)

Project Settings

Length(L) Units: [feet](#)
Time(t) Units: [Seconds](#)
Force(F) Units: [lbf](#)
Pressure(p) Units: [psf](#)
Strength Units: [psf](#)
Unit Weight of Water: [62.4 pcf](#)
View: [2D](#)

Analysis Settings

Block

Kind: [SLOPE/W](#)
Method: [Spencer](#)
Settings
 Apply Phreatic Correction: [Yes](#)
 PWP Conditions Source: [Piezometric Line](#)
 Use Staged Rapid Drawdown: [No](#)
SlipSurface
 Direction of movement: [Right to Left](#)
 Use Passive Mode: [No](#)
 Slip Surface Option: [Block](#)
 Critical slip surfaces saved: [1](#)
 Optimize Critical Slip Surface Location: [Yes](#)
 Tension Crack
 Tension Crack Option: [\(none\)](#)
FOS Distribution
 FOS Calculation Option: [Constant](#)
Restrict Block Crossing: [No](#)
Advanced
 Number of Slices: [30](#)
 Optimization Tolerance: [0.01](#)
 Minimum Slip Surface Depth: [0.1 ft](#)
 Optimization Maximum Iterations: [2000](#)
 Optimization Convergence Tolerance: [1e-007](#)

Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Ash

Model: Mohr-Coulomb
Unit Weight: 95 pcf
Cohesion: 0 psf
Phi: 27 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Clay Material

Model: Mohr-Coulomb
Unit Weight: 95 pcf
Cohesion: 500 psf
Phi: 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Limestone

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Limits

Left Coordinate: (-200, 95) ft
Right Coordinate: (1000, 215.2) ft

Slip Surface Block

Left Grid

Upper Left: (-0.0064, 95.2025) ft
Lower Left: (0.0783, 87.20194) ft
Lower Right: (100.2114, 87.21217) ft
X Increments: 4
Y Increments: 5
Starting Angle: 135 °
Ending Angle: 180 °
Angle Increments: 2

Right Grid

Upper Left: (112.3975, 126.3617) ft

Lower Left: (112.3975, 72.82998) ft
Lower Right: (234.2086, 72.82998) ft
X Increments: 5
Y Increments: 5
Starting Angle: 45 °
Ending Angle: 65 °
Angle Increments: 2

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	-200	93
	1000	93

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 753 pcf
Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	395	215.2
	395	216.2
	500	216.2
	500	215.2

Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

Regions

	Material	Points	Area (ft²)
Region 1	Limestone	1,2,3,4,10,9,8,7,6,5	54000
Region 2	Clay Material	3,14,15,4	20
Region 3	Ash	14,16,17,18,19,20,21,22,23,24,9,10,4,15	96780

Points

	X (ft)	Y (ft)
Point 1	-200	50
Point 2	-200	95
Point 3	0	95
Point 4	100	95
Point 5	0	50
Point 6	100	50
Point 7	500	50
Point 8	1000	50
Point 9	1000	95
Point 10	500	95
Point 11	30.6932	203.06299
Point 12	-200	93
Point 13	1000	93
Point 14	0	95.2
Point 15	100	95.2
Point 16	90	125.2
Point 17	100	125.2
Point 18	190	155.2
Point 19	200	155.2
Point 20	290	185.2
Point 21	300	185.2
Point 22	390	215.2
Point 23	500	215.2
Point 24	1000	215.2

Critical Slip Surfaces

	Number	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	1.630	(50.293, 139.721)	64.54184	(135.198, 136.933)	(0.0129823, 95.2043)
2	8731	1.716	(50.293, 139.721)	55.933	(116.854, 130.818)	(0.0151725, 95.2051)

Slices of Slip Surface: **Optimized**

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimized	1.9621367	95.22227	-138.66964	65.951447	33.60394	0
2	Optimized	5.8604455	95.258155	-140.90898	197.85177	100.81051	0
3	Optimized	9.79875	95.5297	-157.8531	283.75507	144.58043	0
4	Optimized	13.77705	96.036895	-189.50251	362.87237	184.89271	0
5	Optimized	18.011225	96.74749	-233.84311	410.92225	209.37535	0
6	Optimized	22.501275	97.661485	-290.86897	464.6527	236.75238	0
7	Optimized	27.926	98.904495	-368.44242	503.58581	256.58979	0
8	Optimized	33.547025	100.37546	-460.22819	529.44285	269.76461	0
9	Optimized	38.429675	101.74535	-545.71125	552.13974	281.32925	0
10	Optimized	43.5652	103.2076	-636.96198	571.53974	291.21404	0
11	Optimized	48.857425	104.8064	-736.72892	576.9199	293.95537	0
12	Optimized	54.053475	106.44945	-839.24964	584.59015	297.86356	0
13	Optimized	59.06465	108.1281	-943.98436	571.35382	291.11931	0
14	Optimized	63.89095	109.8423	-1050.9607	562.45052	286.58285	0
15	Optimized	68.34825	111.5067	-1154.8176	535.62824	272.91622	0
16	Optimized	72.43655	113.12135	-1255.5778	514.8119	262.30977	0
17	Optimized	76.1726	114.63245	-1349.8757	487.30428	248.29393	0
18	Optimized	79.5564	116.03995	-1437.6827	464.43844	236.6432	0
19	Optimized	83.38575	117.73465	-1543.4419	419.5882	213.79086	0
20	Optimized	87.66065	119.7166	-1667.1261	375.1697	191.15851	0
21	Optimized	89.89905	120.7455	-1731.3277	369.54343	188.29178	0
22	Optimized	91.973625	121.52425	-1779.908	307.26918	156.56146	0
23	Optimized	95.920875	123.0059	-1872.3615	183.40803	93.451061	0
24	Optimized	98.94725	124.04035	-1936.9387	102.30242	52.125688	0
25	Optimized	102.17675	124.94115	-1993.1372	86.846299	44.2504	0
26	Optimized	106.5303	126.1555	-2068.8943	107.74145	54.897011	0
27	Optimized	110.88385	127.36985	-2144.6735	128.6366	65.543622	0
28	Optimized	115.23735	128.58415	-2220.4969	149.53175	76.190233	0
29	Optimized	119.78805	130.0525	-2312.157	146.75208	74.77392	0
30	Optimized	124.536	131.77485	-2419.469	134.9933	68.782523	0
31	Optimized	128.98195	133.71015	-2540.2276	89.22611	45.462974	0
32	Optimized	133.1259	135.85845	-2674.341	29.742751	15.154688	0

Slices of Slip Surface: **8731**

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	8731	2.0994813	95.20506	-137.59479	72.477275	36.929016	0
2	8731	6.2680985	95.20506	-137.59479	217.43182	110.78705	0
3	8731	10.436714	95.20506	-137.59479	362.37438	184.63897	0
4	8731	14.60533	95.20506	-137.59479	507.33852	258.50189	0
5	8731	18.77395	95.20506	-137.59479	652.30267	332.36481	0
6	8731	22.94257	95.20506	-137.59479	797.24283	406.21551	0
7	8731	26.93785	95.88652	-180.11977	701.01479	357.18488	0
8	8731	30.759795	97.24944	-265.17557	693.4982	353.35498	0
9	8731	34.581745	98.612355	-350.19934	685.9816	349.52508	0
10	8731	38.403695	99.975255	-435.24775	678.46501	345.69519	0
11	8731	42.225645	101.3382	-520.29616	670.94841	341.86529	0
12	8731	46.047595	102.70115	-605.34457	663.43182	338.0354	0
13	8731	49.86954	104.06405	-690.39298	655.91523	334.2055	0
14	8731	53.691485	105.42695	-775.44139	648.39863	330.3756	0
15	8731	57.513435	106.78985	-860.4898	640.88204	326.54571	0
16	8731	61.335385	108.15275	-945.53821	633.36545	322.71581	0
17	8731	65.157335	109.5157	-1030.5866	625.84885	318.88592	0
18	8731	68.979285	110.87865	-1115.635	618.33226	315.05602	0
19	8731	72.801235	112.24155	-1200.6834	610.79102	311.21357	0
20	8731	76.62318	113.60445	-1285.7072	603.27443	307.38367	0
21	8731	80.445125	114.96735	-1370.7556	595.75783	303.55378	0
22	8731	84.267075	116.3303	-1455.804	588.24124	299.72388	0
23	8731	88.089025	117.69325	-1540.8524	580.72464	295.89399	0
24	8731	91.666665	118.96905	-1620.4588	526.74024	268.38756	0
25	8731	95	120.1577	-1694.6336	426.25806	217.18933	0
26	8731	98.333335	121.34635	-1768.8085	325.77588	165.9911	0
27	8731	102.06625	122.67755	-1851.8734	271.45949	138.31552	0
28	8731	106.19875	124.1512	-1943.8414	263.32254	134.16954	0
29	8731	110.33125	125.62485	-2035.7866	255.20839	130.03517	0
30	8731	114.6256	128.5898	-2220.8759	93.531945	47.656906	0

Caterpillar Performance Handbook (Edition 32, October 2001)

Model	Unit	D3K LGP	D4G LGP Hystat	D6R	D6R LGP	D6N LGP	D7R LGP Series II	D8R	D9R	D10R
Weight of Equipment, W_b	lb	17842	17877	40400	45600	42454	60300	82850	107670	144200
Length of Equipment Track, w	in	83	80.9	103	128	123	125	126	137	153
	ft	6.9	6.7	8.6	10.7	10.3	10.4	10.5	11.4	12.8
Width of Equipment Track, b	in	25	25	22	36	33	36	22	24	24
	ft	2.1	2.1	1.8	3.0	2.75	3.0	1.8	2.0	2.0
Ground contact area, calculated	in ²	4150	4045	4532	9216	8118	9000	5544	6576	7344
	ft ²	28.8	28.1	31.5	64.0	56.4	62.5	38.5	45.7	51.0
Ground contact area, from book	in ²	4124	4045	4518	9194	8122	9029	5565	6569	7321
	ft ²	28.6	28.1	31.4	63.8	56.4	62.7	38.6	45.6	50.8
Ground pressures, from book	psi	4.3	4.11	8.82	4.94	5.23	6.55	14.67	16.08	19.63
	psf	619	592	1270	711	753	943	2112	2316	2827
Ground pressures, calculated	psi	4.30	4.42	8.91	4.95	5.23	6.70	14.94	16.37	19.64
	psf	619	636	1284	713	753	965	2152	2358	2827