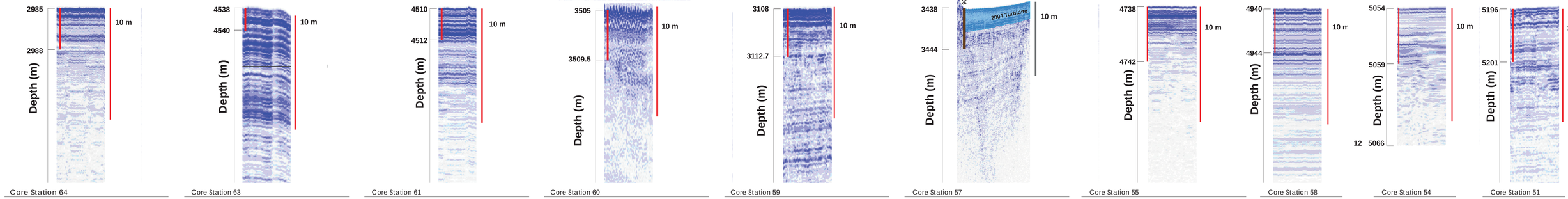
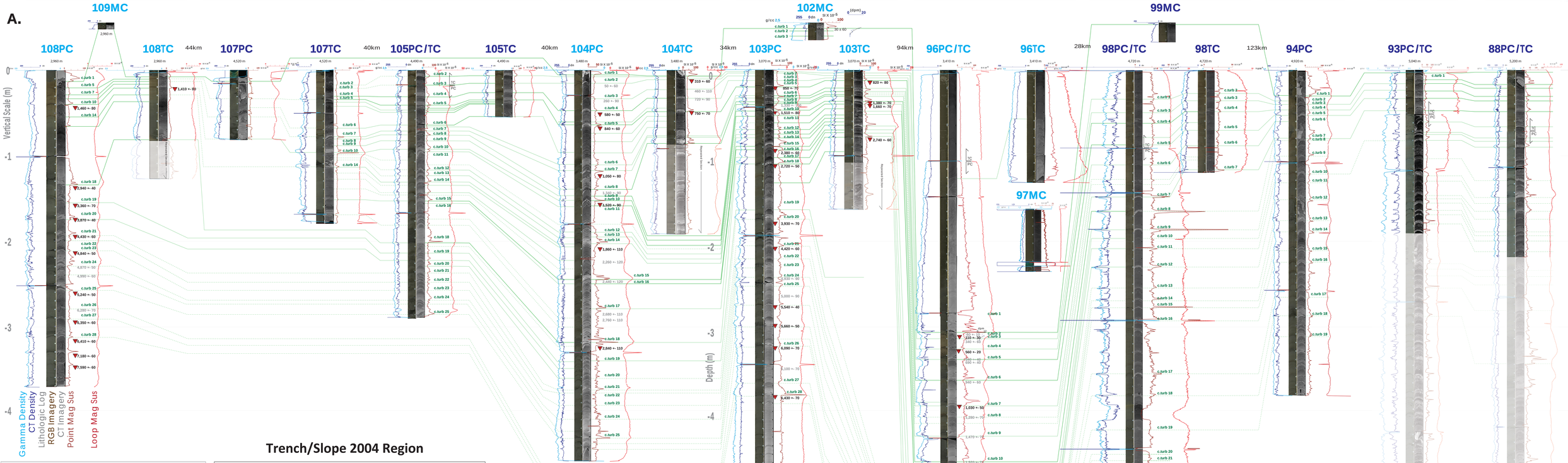
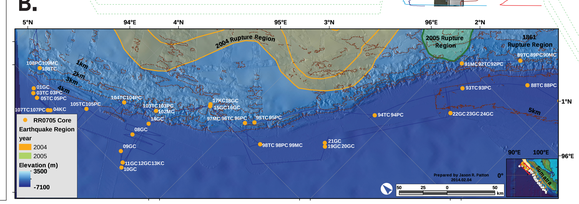
Appendix S 2-2 Stratigraphic Correlations







Correlation Ranking

- Most Certain (anchor points)
- Moderately Certain
- Least Certain

2,800 +- 60 cal yrs B.P.
14C Sample Location
c.turb 9 — Correlated Turbidite #
Core Section Break
Silt
Sand

Figure S2-2. A. Regional stratigraphic correlations for all cores plotted in Figs. 2-7, 2-10. Symbology is the same as used for Fig. 2-2 C. **B.** Core location map for cores plotted in A; cores are plotted as orange dots. Source areas for basin cores are outlined in orange. The 2004 SASZ EQ rupture region is outlined and shaded in tan. Inset map shows cores as they relate to historic ruptures and the Island of Sumatra.

Appendix S 2-4 Core Flattening

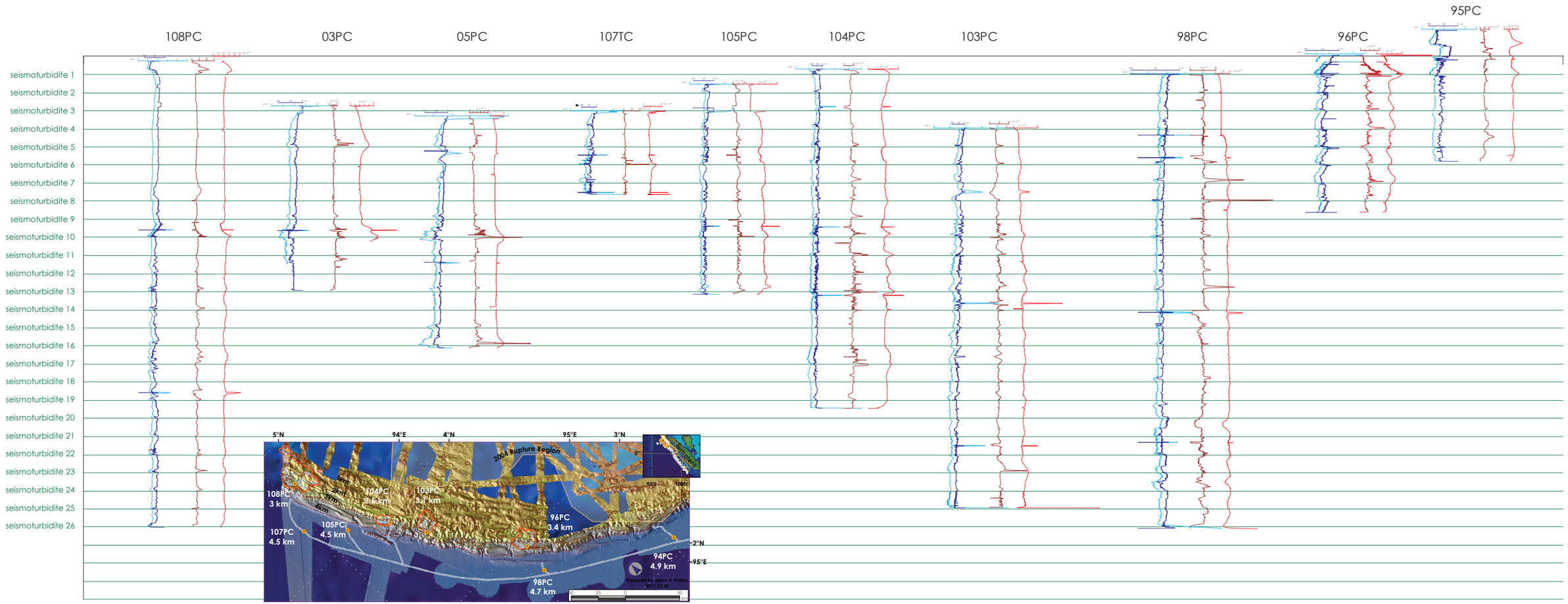


Figure S 2-4. Core Flattening. MSCL and CT data, as plotted in **Fig. 2-7**, for all cores in **Fig S 2-2**. Geophysical data are flattened to a regularly spaced horizontal lattice (green lines). These green lines represent the bases of the turbidite deposits. Evidence of missing upper section (possibly caused by erosion of seafloor during coring) is shown where core data do not reach the most upper horizon. This may also represent a recent hiatus. Core 95 has repeated section in the uppermost seismoturbidite.

Appendix S 2-5 Radiocarbon Age Modeling

Table S5. Radiocarbon Age Modeling. OxCal combinations (Bronk Ramsey, 2009) and single ages used to provide age control for timing of turbidite deposition (Fig. 3). Single ages are calibrated as discussed in text and **Fig S1**. Age results in this table are direct results from the OxCal code in **Fig S1**.

	Name	Unmodelled (BP)									Modelled (BP)									Amodel 106.3		Aoverall 106.9
		from	to	%	from	to	%	mu	sigma	median	from	to	%	from	to	%	mu	sigma	median	Acomb	A	C
	Curve Marine09																(mean)					
	Delta_R LocalMarine	4.5	27.5	68.2	-6.5	38.5	95.4	16	11	16	0.5	25	68.2	**-10**	**35.5**	95.4	13	11	12.5		96.4	99
T-2	**RR0705_104TC_011_013_SUM_176+N(55,6)**	320	230	68.2	360	210	95.4	280	40	280	320	230	68.2	**360**	**220**	95.4	**290**	40	280			99.5
	R_Date RR0705_104TC_011_013_SUM_176	370	280	68.2	420	270	95.4	340	40	330	380	290	68.2	420	270	95.4	340	40	340		99.4	99.1
	N(55,6)	49	61	68.2	43	67	95.4	55	6	55	48.22	60.4	68.2	42.82	66.7	95.4	55	6	54.82		99.8	98.1
T-4	**RR0705_104PC_049.5_051.5_SUM_060+N(10,1)**	650	580	68.2	660	540	95.4	610	30	610	650	590	68.2	**660**	**540**	95.4	**610**	30	620			99.5
	R_Date RR0705_104PC_049.5_051.5_SUM_060	660	590	68.2	670	550	95.4	620	30	620	660	600	68.2	670	550	95.4	620	30	630		101.3	99.2
	N(10,1)	9.0E+00	11	68.2	8	12	95.4	10	1	10	8.96	10.99	68.2	7.97	11.98	95.4	10	1	9.98		100	98.8
T-5	**Combine Sum-T-5**	770	720	68.2	790	710	95.4	750	20	750	770	720	68.2	**790**	**710**	95.4	**750**	20	750	126.9		99.3
	RR0705_104PC_067.5_069.5_SUM_062+N(10,1)	820	730	68.2	870	710	95.4	780	40	780	770	720	68.2	790	710	95.4	750	20	750		107.1	99.3
	R_Date RR0705_104PC_067.5_069.5_SUM_062	830	740	68.2	880	720	95.4	790	40	790												
	N(10,1)	9.0E+00	11	68.2	8	12	95.4	10	1	10												
	RR0705_104TC_047.5_049.5_SUM_175+N(0)	780	700	68.2	810	670	95.4	740	30	740	770	720	68.2	790	710	95.4	750	20	750		118.1	99.3
	R_Date RR0705_104TC_047.5_049.5_SUM_175	780	700	68.2	810	670	95.4	740	30	740												
	N(0)	-0.5	0.5	68.2	-0.5	0.5	95.4	0.0E+00	0	2.6E-16												
	RR0705_103PC_020_022_SUM_084+N(5)	780	700	68.2	820	670	95.4	740	40	740	770	720	68.2	790	710	95.4	750	20	750		119.3	99.3
	R_Date RR0705_103PC_020_022_SUM_084	780	700	68.2	820	670	95.4	750	40	740												
	N(5)	4.5	5.5	68.2	4.5	5.5	95.4	5	0	5												
T-6	**RR0705_96PC_287.5_289.5_SUM_089+N(4)**	1050	970	68.2	1090	930	95.4	1010	40	1010	1050	970	68.2	**1100**	**940**	95.4	**1020**	40	1010			98.8
	R_Date RR0705_96PC_287.5_289.5_SUM_089	1050	970	68.2	1090	940	95.4	1020	40	1010	1060	970	68.2	1100	940	95.4	1020	40	1020		98.6	98.9
	N(4)	3.5	4.5	68.2	3.5	4.5	95.4	4.0E+00	0	4.0E+00	3.5	4.5	68.2	3.5	4.5	95.4	4	0	4		100	100
T-7	**RR0705_104PC_122_124_SUM_061+N(19,2)**	1230	1110	68.2	1260	1040	95.4	1150	60	1160	1230	1110	68.2	**1260**	**1040**	95.4	**1160**	60	1160			98.9
	R_Date RR0705_104PC_122_124_SUM_061	1250	1120	68.2	1270	1060	95.4	1170	60	1180	1250	1130	68.2	1280	1060	95.4	1180	60	1180		100.5	98.3
	N(19,2)	17	21	68.2	15	23	95.4	19	2	19	17.02	21.02	68.2	14.92	22.98	95.4	19	2	19		100.1	97.2
T-8	**Combine Sum-T-8**	1450	1390	68.2	1480	1360	95.4	1420	30	1420	1460	1390	68.2	**1480**	**1360**	95.4	**1420**	30	1420	107.1		99
	RR0705_108TC_020_022_SUM_172+N(44,4)	1460	1370	68.2	1490	1330	95.4	1410	40	1410	1460	1390	68.2	1480	1360	95.4	1420	30	1420		113.8	99
	R_Date RR0705_108TC_020_022_SUM_172	1500	1410	68.2	1.5E+03	1380	95.4	1460	40	1460												
	N(44,4)	40	48	68.2	36	52	95.4	44	4	44												
	RR0705_103PC_049_051_SUM_054+N(15,1)	1500	1400	68.2	1540	1360	95.4	1450	40	1450	1460	1390	68.2	1480	1360	95.4	1420	30	1420		98.5	99
	R_Date RR0705_103PC_049_051_SUM_054	1520	1420	68.2	1550	1380	95.4	1470	40	1470												
	N(15,1)	14	16	68.2	13	17	95.4	15	1	15												
	RR0705_103TC_036_038_SUM_178+N(25,2)	1440	1340	68.2	1480	1310	95.4	1390	40	1390	1460	1390	68.2	1480	1360	95.4	1420	30	1420		100.3	99
	R_Date RR0705_103TC_036_038_SUM_178	1470	1370	68.2	1510	1340	95.4	1420	40	1420												
	N(25,2)	23	27	68.2	21	29	95.4	25	2	25												
T-9	**Combine Sum-T-9**	1660	1590	68.2	1680	1560	95.4	1620	30	1620	1660	1590	68.2	**1680**	**1560**	95.4	**1620**	30	1620	93.9		99.2
	RR0705_104PC_158_160_SUM_082+N(5)	1620	1530	68.2	**1680**	**1510**	95.4	1590	40	1580	1660	1590	68.2	1680	1560	95.4	1620	30	1620		83.1	99.2
	R_Date RR0705_104PC_158_160_SUM_082	1630	1530	68.2	1680	1510	95.4	1590	40	1590												
	N(5)	4.5	5.5	68.2	4.5	5.5	95.4	5	0	5												
	RR0705_103TC_039_041_SUM_179+N(0)	1670	1570	68.2	**1700**	**1530**	95.4	1620	40	1620	1660	1590	68.2	1680	1560	95.4	1620	30	1620		114.6	99.2
	R_Date RR0705_103TC_039_041_SUM_179	1670	1570	68.2	1700	1530	95.4	1620	40	1620												
	N(0)	-0.5	0.5	68.2	-0.5	0.5	95.4	0	0	2.6E-16												
	RR0705_96PC_374_376_SUM_090+N(15,1)	1710	1600	68.2	**1770**	**1570**	95.4	1660	50	1660	1660	1590	68.2	1680	1560	95.4	1620	30	1620		94.2	99.2
	R_Date RR0705_96PC_374_376_SUM_090	1720	1620	68.2	1780	1580	95.4	1680	50	1680												
	N(15,1)	14	16	68.2	13	17	95.4	1.5E+01	1	1.5E+01												
T-10	**RR0705_103PC_092_094_SUM_085+N(27,3)**	2390	2300	68.2	**2430**	**2280**	95.4	2350	40	2350	2390	2300	68.2	**2440**	**2280**	95.4	**2350**	40	2350			98.9
	R_Date RR0705_103PC_092_094_SUM_085	2410	2330	68.2	2460	2310	95.4	2380	40	2370	2420	2330	68.2	2460	2310	95.4	2380	40	2380		99.2	97.8
	N(27,3)	24	30	68.2	21	33	95.4	27	3	27	24	30.03	68.2	20.82	32.88	95.4	26.9498	3.00	26.94		100	98.6
T-11	**Combine Sum-T-11**	2750	2700	68.2	2770	2690	95.4	2730	20	2730	2750	2700	68.2	**2770**	**2690**	95.4	**2730**	20	2730	103.1		99.5
	RR0705_103PC_111_113_SUM_055+N(27,3)	2740	2680	68.2	2780	2660	95.4	2720	30	2710	2750	2700	68.2	2770	2690	95.4	2730	20	2730		99	99.5
	R_Date RR0705_103PC_111_113_SUM_055	2770	2710	68.2	2810	2690	95.4	2740	30	2740												
	N(27,3)	24	30	68.2	21	33	95.4	27	3	27												
	RR0705_103TC_079_081_SUM_180+N(0)	2770	2710	68.2	2810	2690	95.4	2740	30	2740	2750	2700	68.2	2770	2690	95.4	2730	20	2730		104.6	99.5
	R_Date RR0705_103TC_079_081_SUM_180	2770	2710	68.2	2810	2690	95.4	2740	30	2740												
	N(0)	-0.5	0.5	68.2	-0.5	0.5	95.4	0	0	2.6E-16												
T-12	**RR0705_108PC_156_158_SUM_083+N(57,6)**	3350	3270	68.2	3390	3250	95.4	3310	30	3310	3350	3270	68.2	**3390**	**3250**	95.4	**3310**	30	3310			99.5
	R_Date RR0705_108PC_156_158_SUM_083	3400	3330	68.2	3440	3310	95.4	3370	30	3370	3400	3330	68.2	3440	3310	95.4	3370	30	3370		99.4	99
	N(57,6)	51	63	68.2	45	69	95.4	5.7E+01	6	5.7E+01	51.06	63.06	68.2	44.88	68.64	95.4	56.8929	5.99	56.88		100.1	98.8
T-13	**RR0705_103PC_174_176_SUM_087+N(123,12)**	3810	3710	68.2	3860	3680	95.4	3760	40	3760	3810	3720	68.2	**3860**	**3680**	95.4	**3770**	40	3770			98.8
	R_Date RR0705_103PC_174_176_SUM_087	3930	3830	68.2	3980	3810	95.4	3890	40	3890	3930	3840	68.2	3980	3810	95.4	3890	40	3890		99.7	98.2
	N(123,12)	111	135	68.2	99	147	95.4	123	12	123	111	135	68.2	99	146.76	95.4	123	12	122.64		100	98.6
T-14	**Combine Sum-T-14**	4480	4420	68.2	4500	4390	95.4	4450	30	4450	4480	4420	68.2	**4500**	**4390**	95.4	**4450**	30	4450	110.4		99
	RR0705_108PC_194_196_SUM_194+N(23,2)	4470	4390	68.2	4510	4350	95.4	4430	40	4430	4480	4420	68.2	4500	4390	95.4	4450	30	4450		105.1	99
	R_Date RR0705_108PC_194_196_SUM_194	4500	4410	68.2	4530	4380	95.4	4460	40	4450												
	N(23,2)	21	25	68.2	19	27	95.4	23	2	23												
	RR0705_103PC_209_211_SUM_050+N(4)	4510	4420	68.2	4560	4390	95.4	4470	40	4470	4480	4420	68.2	4500	4390	95.4	4450	30	4450		108.9	99
	R_Date RR0705_103PC_209_211_SUM_050	4510	4420	68.2	4560	4400	95.4	4470	40	4470												
	N(4)	3.5	4.5	68.2	3.5	4.5	95.4	4	0	4												
T-16	**RR0705_108PC_212.5_214.5_SUM_045+N(48,5)**	4810	4750	68.2	4860	4720	95.4	4780	30	4780	4810	4750	68.2	**4860**	**4730**	95.4	**4780**	30	4780			99.2
	R_Date RR0705_108PC_212.5_214.5_SUM_045	4850	4800	68.2	4910	4770	95.4	4830	30	4830	4860	4800	68.2	4910	4780	95.4	4830	30	4830		99.1	98
	N(48,5)	43	53	68.2	38	58	95.4	48	5	48	43	53	68.2	37.85	57.95	95.4	47.9719	5.01	48		100	98.9
T-18	**RR0705_103PC_277_279_SUM_052+N(0)**	5490, 5370	5380, 5350	63.2, 5	5540	5320	95.4	5430	50	5440	5520	5390	68.2	**5540**	**5320**	95.4	**5440**	50	5450			98.3
	R_Date RR0705_103PC_277_279_SUM_052	5490, 5370	5380, 5350	63.6, 4.6	5540	5320	95.4	5430	50	5440	5510	5390	68.2	5550	5320	95.4	5440	50	5450		100.2	99.1
	N(0)	-0.5	0.5	68.2	-0.5	0.5	95.4	0	0	2.6E-16	-0.5	0.5	68.2	-0.5	0.5	95.4	0	0	1.37E-15		100	100
T-19	**RR0705_103PC_300.5_302.5_SUM_053+N(0)**	5740	5640	68.2	5830, 5810	5820, 5600	95.4	5700	50	5700	5740	5650	68.2	**5830**	**5610**	95.4	**5710**	50	5700			99
	R_Date RR0705_103PC_300.5_302.5_SUM_053	5740	5650	68.2	5810	5600	95.4	5700	50	5700	5740	5650	68.2	5830	5610	95.4	5710	50	5700		98.6	99
	N(0)	-0.5	0.5	68.2	-0.5	0.5	95.4	0.0E+00	0	2.6E-16	-0.5	0.5	68.2	-0.5	0.5	95.4	0.0E+00	0	1.4E-15		100	100
T-21	**RR0705_108PC_290.5_292.5_SUM_044+N(20,2)**	6360	6280	68.2	6390	6250	95.4	6320	30	6320	6370	6280	68.2	**6390**	**6260**	95.4	**6330**	30	6330			99.3
	R_Date RR0705_108PC_290.5_292.5_SUM_044	6380	6300	68.2	6410	6270	95.4	6340	30	6340	6380	6300	68.2	6410	6280	95.4	6350	30	6350		99.4	99.2
	N(20,2)	18	22	68.2	16	24	95.4	2.0E+01	2	2.0E+01	18.02	22.02	68.2	15.98	23.98	95.4	2.0E+01	2	20		100.2	97.8
T-22	**RR0705_108PC_312.5_314.5_SUM_043+N(41,4)**	6530	6430	68.2	6580	6400	95.4	6490	40	6480	6540	6440	68.2	**6580**	**6400**	95.4	**6490**	40	6490			99.1
	R_Date RR0705_108PC_312.5_314.5_SUM_043	6570	6470	68.2	6620	6440	95.4	6530	40	6530	6570	6480	68.2	6620	6440	95.4	6530	40	6530		99.9	98.4
	N(41,4)	37	45	**68.2**	33	49	95.4	41	4	41	36.96	45	68.2	33	48.92	95.4	41	4	40.92		100.2	98.5
T-23	**RR0705_108PC_330_332_SUM_041+N(31,3)**	7210	7130	68.2	7240	7100	95.4	7170	30	7170	7210	7130	68.2	**7250**	**7110**	95.4	**7170**	30	7180			99
	R_Date RR0705_108PC_330_332_SUM_041	7240	7160	68.2	7270	7140	95.4	7200	30	7200	7240	7160	68.2	7270	7140	95.4	7210	30	7210		99.7	98.6
	N(31,3)	28	34	68.2	25	37	95.4	31	3	31	28	34	68.2	25.03	37.03	95.4	31	3	30.91		100.2	98
T-24	**RR0705_108PC_345_347_SUM_195+N(49,5)**	7610	7540	**68.2**	7630	7510	95.4	7570	30	7570	7610	7540	68.2	**7640**	**7510**	95.4	**7580**	30	7580			99.4
	R_Date RR0705_108PC_345_347_SUM_195	7660	7590	68.2	7680	7560	95.4	7620	30	7620	7660	7590	68.2	7680	7560	95.4	7630	30	7630		99.5	99.4
	N(49,5)	44	54	68.2	39	59	95.4	49	5	49	43.9	53.9	68.2	38.95	58.95	95.4	49	5	49		100.1	98.8

Name	Unmodelled (BP) from	to	%	from	to	%	mu	sigma	median	Modelled (BP) from	to	%	from	to	%	mu	sigma	median	Indices Amodel 108.1 Aoverall 106.2 Acomb	A	L	P	C
Curve Marine																							
Delta_R LocalMarine		4.5	27.5	68.2	-6.5	38.5	95.4	16	11	16	5	26.5	68.2	-5.5	37	95.4	15.9112	10.4709	16		102		99.7
P_Sequence RR0705-96PC																							
Boundary Start								2059	1969	68.2	2099	1929	95.4	2013	43	2012					98.6		
RR0705_96PC_399_401_SUM-232+N(12,1)		2059	1969	68.2	2099	1929	95.4	2013	44	2013	2059	1969	68.2	2099	1929	95.4	2013	43	2012		100.3		98.6
R_Date RR0705_96PC_399_401_SUM-232		2072	1981	68.2	2111	1941	95.4	2025	44	2025	2073	1981	68.2	2111	1942	95.4	2025	43	2025		100.2		98.2
N(12,1)		11	13	68.2	10	14	95.4	12	1	12	10.9	12.98	68.2	9.92	14	95.4	11.9873	1.00095	11.99		99.8		98.7
RR0705_96PC_374_376_SUM-090+N(7,1)		1709	1618	68.2	1769	1579	95.4	1669	46	1670	1709	1619	68.2	1768	1581	95.4	1669	46	1670		100.1		98.9
R_Date RR0705_96PC_374_376_SUM-090		1715	1625	68.2	1775	1586	95.4	1676	46	1677	1716	1625	68.2	1775	1588	95.4	1676	46	1678		100		98.5
N(7,1)		6	8	68.2	5	9	95.4	7	1	7	6	8.01	68.2	5	9	95.4	7.00196	0.999251	7		99.9		98.5
RR0705_96PC_287.5_289.5_SUM-089+N(3)		1045	975	68.2	1090	940	95.4	1012	36	1012	1045	974	68.2	1088	943	95.4	1012	36	1012		100.2		99
R_Date RR0705_96PC_287.5_289.5_SUM-089		1049	976	68.2	1090	945	95.4	1015	36	1015	1049	976	68.2	1091	945	95.4	1015	36	1015		100.2		99.1
N(3)		2.5	3.5	68.2	2.5	3.5	95.4	3	0	3	2.5	3.5	68.2	2.5	3.5	95.4	3	0	3		100		100
RR0705_96PC_222_224_SUM-228+N(11,1)		686	643	68.2	714	629	95.4	669	22	666	685	642	68.2	713	629	95.4	668	22	666		100.5		99.4
R_Date RR0705_96PC_222_224_SUM-228		696	654	68.2	725	640	95.4	680	22	677	696	654	68.2	724	640	95.4	679	22	677		100.1		99.4
N(11,1)		10	12	68.2	9	13	95.4	11	1	11	9.99	12	68.2	9	13	95.4	10.9981	0.998283	11		100.1		98
RR0705_96PC_206_208_SUM-227+N(67,7)		13	...	68.2	61	...	95.4	-27	55	-30	-56	-61	68.2	-56	-61	95.4	-58	0	-58		112.8		100
R_Date RR0705_96PC_206_208_SUM-227		86	...	68.2	133	...	95.4	64	43	61	18	3	68.2	24	-2	95.4	11	7	11		116.5		99.6
N(67,7)		60	74	68.2	53	81	95.4	67	7	67	60.28	73.72	68.2	54.61	79.46	95.4	67.4304	6.40577	67.21		103.5		96.9
Boundary Revelle		-56	-57	68.2	-56	-57	95.4	-56	0	-56	-56	-57	68.2	-56	-57	95.4	-56	0	-56		100		100

Name	Unmodelled (BP)									Modelled (BP)									Amodel 12.4				
	from	to	%	from	to	%	mu	sigma	median	from	to	%	from	to	%	mu	sigma	median	Acomb	A	L	P	C
Curve Marine																							
Delta_R LocalMarine	4.5	27.5	68.2	-6.5	38.5	95.4	16	11	16	-9.5	13	68.2	-19.5	24.5	95.4	2.10652	10.1806	2		66.8			99.3
P_Sequence RR0705-103PC																							
Boundary Start							6464	6396	68.2	6504	6361	95.4	6431	34	6430					98.9			
R_Date RR0705_103PC_383_385_SUM-253	6461	6380	68.2	6495	6319	95.4	6415	43	6416	6464	6396	68.2	**6504**	**6361**	95.4	6431	34	**6430**		106.5			98.9
103PC-82.9							6131	6070	68.2	6131	6070	68.2	**6171**	**6038**	95.4	6100	32	**6101**		98.2			
R_Date RR0705_103PC_324_326_SUM-224	5974	5905	68.2	6024	5874	95.4	5944	38	5940	6115	6055	68.2	**6158**	**6026**	95.4	6086	31	**6086**		3.7			97.7
R_Date RR0705_103PC_300.5_302.5_SUM-053	5735	5650	68.2	5810	5609	95.4	5701	48	5698	5685	5636	68.2	**5710**	**5608**	95.4	5660	24	**5660**		98			98.7
R_Date RR0705_103PC_277_279_SUM-052	5486	5354	68.2	5534	5323	95.4	5434	54	5442	5561	5523	68.2	**5573**	**5491**	95.4	5535	21	**5539**		28.2			99.1
103PC-63							5042	4955	68.2	5042	4955	68.2	**5084**	**4910**	95.4	4996	43	**4997**		98			
103PC-62							4977	4891	68.2	4977	4891	68.2	**5020**	**4846**	95.4	4933	43	**4934**		97.5			
R_Date RR0705_103PC_209_211_SUM-050	4509	4429	68.2	4556	4404	95.4	4474	40	4472	4448	4404	68.2	**4476**	**4350**	95.4	4421	29	**4424**		75.3			99
R_Date RR0705_103PC_174_176_SUM-087	3924	3838	68.2	3972	3811	95.4	3887	43	3886	3964	3894	68.2	**3995**	**3850**	95.4	3928	35	**3929**		80.5			97.7
103PC-39							3514	3410	68.2	3514	3410	68.2	**3565**	**3360**	95.4	3462	51	**3462**		97			
R_Date RR0705_103PC_111_113_SUM-055	2762	2715	68.2	2803	2694	95.4	2743	26	2741	2745	2705	68.2	**2768**	**2679**	95.4	2723	24	**2724**		93.4			98.6
R_Date RR0705_103PC_092_094_SUM-085	2410	2331	68.2	2458	2316	95.4	2380	39	2374	2410	2341	68.2	**2451**	**2326**	95.4	2383	33	**2380**		103			98.8
103PC-23.2							2160	2045	68.2	2160	2045	68.2	**2213**	**1987**	95.4	2101	56	**2102**		97.9			
R_Date RR0705_103PC_049_051_SUM-054	1512	1422	68.2	1549	1381	95.4	1466	43	1467	1550	1476	68.2	**1595**	**1434**	95.4	1512	38	**1513**		80.1			98.6
103PC-16.9							1385	1285	68.2	1385	1285	68.2	**1429**	**1234**	95.4	1333	49	**1334**		98.4			
R_Date RR0705_103PC_020_022_SUM-084	777	709	68.2	820	675	95.4	745	36	743	885	811	68.2	**895**	**763**	95.4	838	36	**846**		19.2			99.4
Boundary Revelle	-56	-57	68.2	-56	-57	95.4	-56	0	-56	-56	-57	68.2	-56	-57	95.4	-56	0	-56		100			100
Page(2007)																							

Name	Unmodelled (BP)									Modelled (BP)									Amodel 21.9 Aoverall 23.4			
	from		to	%	from	to	%	mu	sigma	median	from		to	%	**from**	**to**	%	mu	sigma	**median**	Acomb	A	L P	C
Curve Marine																								
Delta_R LocalMarine		4.5	27.5	68.2	-6.5	38.5	95.4	16	11	16		9	33	68.2	**-2**	**44.5**	95.4	21.2361	11.3569	**21**		93		99.3
P_Sequence RR0705-104PC																								
Boundary Start								2914	2785	68.2		2914	2785	68.2	**2945**	**2738**	95.4	2841	53	**2837**		96.9		
R_Date RR0705_104PC_326_328_SUM-235		2790	2715	68.2	2843	2695	95.4	2761	38	2756		2914	2785	68.2	**2945**	**2738**	95.4	2841	53	**2837**		36.9		96.9
104PC-40.1								2816	2703	68.2		2816	2703	68.2	**2870**	**2654**	95.4	2761	54	**2758**		98.2		
104PC-38.6								2733	2620	68.2		2733	2620	68.2	**2792**	**2570**	95.4	2679	56	**2678**		97.4		
104PC-34.1								2496	2378	68.2		2496	2378	68.2	**2555**	**2323**	95.4	2437	58	**2437**		97.4		
104PC-30.8								2319	2201	68.2		2319	2201	68.2	**2376**	**2143**	95.4	2259	58	**2259**		97.4		
R_Date RR0705_104PC_207_209_SUM-115		2320	1789	68.2	2650	1546	95.4	2063	271	2056		1917	1811	68.2	**1962**	**1747**	95.4	1859	53	**1861**		110		97.6
R_Date RR0705_104PC_158_160_SUM-082		1625	1536	68.2	1677	1518	95.4	1590	42	1587		1560	1480	68.2	**1573**	**1411**	95.4	1507	43	**1518**		**44.2**		98.6
104PC-14.8								1391	1298	68.2		1391	1298	68.2	**1424**	**1240**	95.4	1338	46	**1341**		98.1		
R_Date RR0705_104PC_122_124_SUM-061		1242	1129	68.2	1270	1060	95.4	1173	56	1178		1090	999	68.2	**1119**	**965**	95.4	1045	40	**1050**		**22.8**		97.9
R_Date RR0705_104PC_067.5_069.5_SUM-062		825	740	68.2	875	723	95.4	792	40	788		875	807	68.2	**891**	**771**	95.4	835	32	**839**		72.7		98.7
R_Date RR0705_104PC_049.5_051.5_SUM-060		656	599	68.2	664	553	95.4	617	30	624		601	545	68.2	**640**	**536**	95.4	580	27	**575**		59.9		99.1
104PC-2.9								305	215	68.2		305	215	68.2	**351**	**176**	95.4	262	44	**261**		99.1		
104PC-1								81	16	68.2		81	16	68.2	**118**	**-6**	95.4	53	32	**51**		99		
Boundary Revelle		-56	-57	68.2	-56	-57	95.4	-56	0	-56		-56	-57	68.2	**-56**	**-57**	95.4	-56	0	**-56**		100		100
Page(2007)																								

Name	Unmodelled (BP) from	to	%	from	to	%	mu	sigma	median	Modelled (BP) from	to	%	from	to	%	mu	sigma	median	Indices Amodel 101.3 Aoverall 97.8 Acomb	A	L	P	C
Curve Marine																						
Delta_R LocalMarine	4.5	27.5	68.2	-6.5	38.5	95.4	16	11	16	0	24	68.2	-11	34.5	95.4	11.84	10.8684	12		96.8		98.9
P_Sequence RR0705-108PC																						
Boundary Start							7460	7389	68.2	7497	7355	95.4	7425	36	7425					98.9		
RR0705_108PC_345_347_SUM-195+N(201,20)	7457	7386	68.2	7492	7353	95.4	7422	35	7422	7460	7389	68.2	7497	7355	95.4	7425	36	7425		99.2		98.9
R_Date RR0705_108PC_345_347_SUM-195	7653	7593	68.2	7678	7568	95.4	7623	29	7623	7657	7597	68.2	7681	7570	95.4	7626	29	7626		98.9		98.5
N(201,20)	181	221	68.2	161	241	95.4	201	20	201	180.2	220.8	68.2	160.8	241	95.4	201.199	20.0677	201.2		99.7		97.4
RR0705_108PC_330_332_SUM-041+N(47,5)	7190	7121	68.2	7223	7093	95.4	7156	34	7157	7195	7123	68.2	7226	7095	95.4	7160	34	7161		99		98.1
R_Date RR0705_108PC_330_332_SUM-041	7236	7169	68.2	7269	7140	95.4	7203	34	7204	7240	7170	68.2	7271	7143	95.4	7207	34	7208		98.9		98
N(47,5)	42	52	68.2	37	57	95.4	47	5	47	41.85	51.95	68.2	37	57	95.4	46.9783	4.9974	46.95		99.9		97.8
RR0705_108PC_312.5_314.5_SUM-043+N(46,5)	6523	6431	68.2	6571	6396	95.4	6480	45	6479	6527	6436	68.2	6575	6402	95.4	6485	44	6484		99.9		98.6
R_Date RR0705_108PC_312.5_314.5_SUM-043	6570	6475	68.2	6616	6444	95.4	6526	44	6525	6575	6483	68.2	6620	6447	95.4	6531	44	6530		99.8		96.5
N(46,5)	41	51	68.2	36	56	95.4	46	5	46	40.65	50.9	68.2	36.05	56.15	95.4	45.9845	5.02261	46		99.8		97.4
RR0705_108PC_290.5_292.5_SUM-044+N(15,2)	6362	6291	68.2	6390	6264	95.4	6328	34	6327	6366	6296	68.2	6393	6266	95.4	6331	34	6331		99.6		98.7
R_Date RR0705_108PC_290.5_292.5_SUM-044	6378	6306	68.2	6405	6280	95.4	6343	34	6342	6381	6311	68.2	6409	6280	95.4	6346	34	6346		99.5		98.3
N(15,2)	13	17	68.2	11	19	95.4	15	2	15	13.02	17.02	68.2	10.98	18.98	95.4	14.9812	1.99321	14.98		100		96.4
RR0705_108PC_257_259_SUM-042+N(50,5)	5145	5006	68.2	5201	4964	95.4	5076	64	5075	5149	5011	68.2	5202	4971	95.4	5081	63	5081		100.1		98.5
R_Date RR0705_108PC_257_259_SUM-042	5196	5055	68.2	5251	5016	95.4	5126	64	5125	5201	5058	68.2	5253	5023	95.4	5131	63	5131		100.1		96.8
N(50,5)	45	55	68.2	40	60	95.4	50	5	50	44.8	54.9	68.2	39.9	59.7	95.4	49.9848	4.98651	49.95		100.1		97
RR0705_108PC_212.5_214.5_SUM-045+N(44,4)	4804	4760	68.2	4858	4733	95.4	4785	29	4783	4807	4762	68.2	4860	4737	95.4	4789	29	4786		98.8		98.6
R_Date RR0705_108PC_212.5_214.5_SUM-045	4848	4805	68.2	4902	4778	95.4	4829	28	4828	4851	4806	68.2	4906	4781	95.4	4833	29	4830		98.5		97.7
N(44,4)	40	48	68.2	36	52	95.4	44	4	44	40	48.12	68.2	35.68	51.92	95.4	43.9898	4.0231	43.96		99.5		97
RR0705_108PC_194_196_SUM-194+N(45,5)	4448	4370	68.2	4486	4337	95.4	4410	38	4410	4448	4373	68.2	4490	4343	95.4	4413	38	4412		100.1		97.9
R_Date RR0705_108PC_194_196_SUM-194	4491	4415	68.2	4530	4382	95.4	4455	38	4455	4494	4417	68.2	4535	4388	95.4	4459	38	4457		99.9		98
N(45,5)	40	50	68.2	35	55	95.4	45	5	45	40	50	68.2	34.7	54.95	95.4	45.0039	5.038	45		99.7		97.8
RR0705_108PC_175_177_SUM-046+N(342,34)	3801	3683	68.2	3853	3618	95.4	3739	58	3741	3806	3690	68.2	3860	3624	95.4	3745	58	3747		100.1		97.6
R_Date RR0705_108PC_175_177_SUM-046	4139	4045	68.2	4163	3978	95.4	4080	47	4084	4141	4055	68.2	4174	3981	95.4	4087	47	4090		100.7		98.2
N(342,34)	308	376	68.2	274	410	95.4	342	34	342	308	376	68.2	272.98	410	95.4	341.412	33.8575	341.32		100.1		97.9
RR0705_108PC_156_158_SUM-083+N(113,11)	3286	3221	68.2	3326	3193	95.4	3255	33	3254	3290	3224	68.2	3328	3197	95.4	3259	33	3258		99.6		98.9
R_Date RR0705_108PC_156_158_SUM-083	3396.00	3336.00	68.20	3436.00	3311.00	95.40	3368.00	31.00	3367.00	3399.00	3338.00	68.20	3437.00	3315.00	95.40	3372.00	31.00	3371.00		99.30		98.20
N(113,11)	102.00	124.00	68.20	91.00	135.00	95.40	113.00	11.00	113.00	101.45	123.78	68.20	90.34	135.00	95.40	112.74	11.02	112.78		99.60		97.80
RR0705_108PC_132.5_134.5_SUM-081+N(0)	2808.00	2747.00	68.20	2846.00	2733.00	95.40	2785.00	30.00	2781.00	2811.00	2751.00	68.20	2847.00	2735.00	95.40	2788.00	30.00	2785.00		99.30		97.10
R_Date RR0705_108PC_132.5_134.5_SUM-081	2810.00	2746.00	68.20	2845.00	2733.00	95.40	2785.00	30.00	2781.00	2811.00	2750.00	68.20	2848.00	2735.00	95.40	2787.00	30.00	2785.00		99.20		96.90
N(0)	-0.50	0.50	68.20	-0.50	0.50	95.40	0.00	0.00	0.00	-0.50	0.50	68.20	-0.50	0.50	95.40	0.00	0.00	0.00		100.00		100.00
RR0705_108PC_039_041_SUM-080+N(40,4)	1551.00	1481.00	68.20	1607.00	1451.00	95.40	1521.00	38.00	1518.00	1557.00	1483.00	68.20	1612.00	1455.00	95.40	1525.00	38.00	1522.00		99.30		97.40
R_Date RR0705_108PC_039_041_SUM-080	1593	1521	68.2	1649	1492	95.4	1561	37	1559	1595	1525	68.2	1653	1496	95.4	1565	38	1562		99.2		98.1
N(40,4)	36	44	68.2	32	48	95.4	40	4	40	36.04	44.2	68.2	32.04	48.04	95.4	40.0093	4.02204	40		99.7		97
Boundary Revelle 2007	-56	-57	68.2	-56	-57	95.4	-56	0	-56	-56	-57	68.2	-56	-57	95.4	-56	0	-56		100		100

Appendix S 2-6 Core Map and Core Table

Site	Core Name	Core Type	Date (GMT)	Time (GMT)	Latitude (dd)	Longitude (dd)	Depth (m)	Length (m)
1	RR0705-01GC	Gravity	5/8/07	22:36	4.5658	92.9687	4434	0.18
2	RR0705-02GC	Gravity	5/9/07	1:34	4.5365	92.9339	4483	0.00
2	RR0705-03TC	Trigger	5/9/07	4:30	4.5365	92.9339	4483	1.91
2	RR0705-03PC	Piston	5/9/07	4:30	4.5365	92.9339	4483	2.73
3	RR0705-04KC	Kasten	5/9/07	15:00	4.3074	92.9337	4540	0.00
4	RR0705-05TC	Trigger	5/10/07	0:49	4.4804	92.9267	4498	0.91
4	RR0705-05PC	Piston	5/10/07	0:49	4.4804	92.9267	4498	3.08
4	RR0705-06KC	Kasten	5/10/07	18:21	4.4804	92.9267	4498	0.00
4	RR0705-07MC	Multicore	5/11/07	0:18	4.4804	92.9267	4498	0.00
5	RR0705-08GC	Gravity (BB)	5/11/07	19:10	3.6047	93.3179	4502	0.00
6	RR0705-09GC	Gravity	5/12/07	7:20	3.5700	93.1300	4541	0.00
7	RR0705-10GC	Gravity	5/12/07	11:14	3.4566	93.0247	4481	0.23
8	RR0705-11GC	Gravity (BB)	5/12/07	15:26	3.4821	93.0654	4515	0.00
8	RR0705-12GC	Gravity (BB)	5/12/07	20:40	3.4821	93.0654	4516	0.55
8	RR0705-13KC	Kasten	5/13/07	4:17	3.4821	93.0654	4523	0.00
9	RR0705-14GC	Gravity	5/13/07	11:01	3.5692	93.4964	4414	0.00
10	RR0705-15GC	Gravity	5/13/07	16:45	3.2866	94.0353	1912	0.34
10	RR0705-16GC	Gravity (BB)	5/13/07	19:20	3.2866	94.0353	1911	1.95
10	RR0705-17KC	Kasten	5/13/07	23:50	3.2866	94.0353	1911	0.00
11	RR0705-18GC	Gravity (BB)	5/14/07	3:31	3.2761	94.0198	1820	3.14
12	RR0705-19GC	Gravity	5/14/07	14:14	2.2475	94.5145	4816	0.68
12	RR0705-20GC	Gravity (BB)	5/14/07	17:10	2.2475	94.5145	4816	2.21
13	RR0705-21GC	Gravity	5/14/07	22:20	2.2732	94.5387	4834	0.40
14	RR0705-22GC	Gravity	5/15/07	9:26	1.6356	95.5681	4985	0.94
14	RR0705-23GC	Gravity (BB)	5/15/07	11:50	1.6356	95.5681	4973	2.09
15	RR0705-24GC	Gravity	5/15/07	17:10	1.6364	95.5683	4975	0.99
16	RR0705-25GC	Gravity	5/16/07	2:27	1.0672	96.4672	5224	0.00
17	RR0705-26GC	Gravity	5/16/07	6:10	0.9955	96.3720	5220	0.45
17	RR0705-27GC	Gravity (BB)	5/16/07	9:01	0.9955	96.3720	5214	2.32
18	RR0705-28GC	Gravity (BB)	5/16/07	21:25	0.0800	97.0450	5238	0.00
19	RR0705-29GC	Gravity	5/17/07	2:49	0.0076	97.0078	5303	1.39
19	RR0705-30GC	Gravity (BB)	5/17/07	5:25	0.0076	97.0078	5303	1.70
20	RR0705-31GC	Gravity	5/17/07	16:45	-0.8595	97.4296	5420	1.37
21	RR0705-32GC	Gravity (BB)	5/17/07	19:31	-0.8595	97.4417	5435	1.83
22	RR0705-33GC	Gravity	5/18/07	4:45	-1.2833	97.6780	5489	0.00
23	RR0705-34GC	Gravity	5/18/07	8:13	-1.2879	97.6635	5463	0.81
24	RR0705-35GC	Gravity (BB)	5/18/07	11:27	-1.2879	97.6500	5455	1.99
24	RR0705-36KC	Kasten	5/18/07	17:15	-1.2879	97.6500	5455	1.85
25	RR0705-37GC	Gravity	5/19/07	4:26	-1.7075	97.9212	5492	0.88
26	RR0705-38GC	Gravity (BB)	5/19/07	7:30	-1.6989	97.9377	5511	1.87
26	RR0705-39KC	Kasten	5/19/07	14:00	-1.6989	97.9377	5510	2.30
27	RR0705-40GC	Gravity	5/19/07	23:40	-2.1344	98.2211	5529	1.22
28	RR0705-41GC	Gravity (BB)	5/20/07	2:45	-2.1287	98.2437	5540	1.62
29	RR0705-42GC	Gravity	5/22/07	2:26	-2.0157	98.7732	1152	0.16
30	RR0705-43GC	Gravity	5/22/07	9:40	-2.2321	98.3563	5555	0.84
30	RR0705-44MC	Multicore	5/22/07	11:55	-2.2321	98.3563	5557	0.00
30	RR0705-45TC	Trigger	5/22/07	20:21	-2.2321	98.3563	5561	1.37
30	RR0705-45PC	Piston	5/22/07	20:21	-2.2321	98.3563	5561	4.70
31	RR0705-46GC	Gravity	5/23/07	9:20	-2.9424	98.8677	5813	1.47
31	RR0705-47TC	Trigger	5/23/07	13:01	-2.9424	98.8677	5726	1.51
31	RR0705-47PC	Piston	5/23/07	13:01	-2.9424	98.8677	5726	2.72
32	RR0705-48GC	Gravity	5/23/07	23:56	-3.2683	99.2745	5790	1.70
32	RR0705-49TC	Trigger	5/24/07	4:08	-3.2683	99.2745	5797	2.58
32	RR0705-49PC	Piston	5/24/07	4:08	-3.2683	99.2745	5797	3.97
33	RR0705-50GC	Gravity	5/24/07	14:20	-3.6581	99.6043	5806	1.07
34	RR0705-51GC	Gravity	5/24/07	21:35	-4.1484	99.9531	5987	0.00
35	RR0705-52GC	Gravity	5/25/07	3:41	-4.3127	100.0973	5991	0.14
36	RR0705-53GC	Gravity	5/25/07	8:30	-4.5915	100.2570	6063	0.17
36	RR0705-54GC	Gravity	5/25/07	12:20	-4.5915	100.2570	6061	0.43
37	RR0705-55TC	Trigger	5/25/07	16:36	-4.5197	100.2131	6046	0.00
37	RR0705-55PC	Piston	5/25/07	16:36	-4.5197	100.2131	6046	2.61
38	RR0705-56GC	Gravity	5/26/07	7:45	-5.4402	100.7988	6069	0.00
38	RR0705-57TC	Trigger	5/26/07	11:32	-5.4402	100.7988	6069	0.00
38	RR0705-57PC	Piston	5/26/07	11:32	-5.4402	100.7988	6069	4.86
39	RR0705-58GC	Gravity	5/26/07	5:13	-6.5455	101.8861	6278	1.49
39	RR0705-59TC	Trigger	5/27/07	8:18	-6.5455	101.8861	6275	1.94
39	RR0705-59PC	Piston	5/27/07	8:18	-6.5455	101.8861	6275	0.00
40	RR0705-60GC	Gravity	5/27/07	19:00	-6.1390	101.8886	4184	1.73
40	RR0705-61TC	Trigger	5/28/07	0:09	-6.1390	101.8886	4187	2.75
40	RR0705-61PC	Piston	5/28/07	0:09	-6.1390	101.8886	4187	4.28
41	RR0705-62GC	Gravity	5/28/07	10:24	-5.6095	101.4768	3392	1.19
41	RR0705-63TC	Trigger	5/28/07	15:30	-5.6095	101.4768	3397	1.10
41	RR0705-63PC	Piston	5/28/07	15:30	-5.6095	101.4768	3397	2.60
42	RR0705-64GC	Gravity	5/29/07	4:42	-4.5790	100.8580	2751	1.77
42	RR0705-65TC	Trigger	5/29/07	6:49	-4.5790	100.8580	2751	2.68
42	RR0705-65PC	Piston	5/29/07	6:49	-4.5790	100.8580	2751	4.92
43	RR0705-66GC	Gravity	5/30/07	11:34	-3.6709	100.0425	3891	1.62
43	RR0705-67TC	Trigger	5/30/07	13:50	-3.6709	100.0425	3888	2.41
43	RR0705-67PC	Piston	5/30/07	13:50	-3.6709	100.0425	3888	4.87
43	RR0705-68MC	Multicore	5/30/07	18:50	-3.6709	100.0425	3890	0.00
43	RR0705-69MC	Multicore	5/30/07	23:45	-3.6709	100.0425	3890	0.00
33	RR0705-70TC	Trigger	5/31/07	6:39	-3.6581	99.6043	5804	1.81
33	RR0705-70PC	Piston	5/31/07	6:39	-3.6581	99.6043	5804	5.09
44	RR0705-71GC	Gravity	5/31/07	19:14	-2.9809	99.4283	4082	1.27
44	RR0705-72TC	Trigger	5/31/07	21:56	-2.9809	99.4283	4082	2.35
44	RR0705-72PC	Piston	5/31/07	21:56	-2.9809	99.4283	4082	4.99
44	RR0705-73MC	Multicore	6/1/07	3:14	-2.9809	99.4283	4080	0.20
45	RR0705-74MC	Multicore	6/1/07	16:20	-2.1325	98.6481	4080	0.00
45	RR0705-75MC	Multicore	6/1/07	19:50	-2.1325	98.6481	3221	0.12
45	RR0705-76TC	Trigger	6/2/07	0:40	-2.1325	98.6481	3221	1.14
45	RR0705-76PC	Piston	6/2/07	0:40	-2.1325	98.6481	3221	4.18
46	RR0705-77TC	Trigger	6/2/07	10:15	-1.4783	98.1547	3778	0.53
46	RR0705-77PC	Piston	6/2/07	10:15	-1.4783	98.1547	3778	2.66
24	RR0705-78TC	Trigger	6/2/07	17:30	-1.2879	97.6500	5455	1.52
24	RR0705-78PC	Piston	6/2/07	17:30	-1.2879	97.6500	5455	4.44
47	RR0705-79TC	Trigger	6/2/07	3:42	-0.8474	97.7936	3833	0.56
47	RR0705-79PC	Piston	6/2/07	3:42	-0.8474	97.7936	3833	4.20
47	RR0705-80MC	Multi	6/3/07	7:42	-0.8474	97.7936	3835	0.08
48	RR0705-81GC	Gravity	6/3/07	15:00	-0.6629	97.7424	3438	0.32
49	RR0705-82MC	Multi	6/3/07	22:48	0.1304	97.3608	3038	0.22
49	RR0705-83TC	Trigger	6/4/07	3:42	0.1304	97.3608	3034	2.09
49	RR0705-83PC	Piston	6/4/07	3:42	0.1304	97.3608	3034	4.87
19	RR0705-84TC	Trigger	6/4/07	12:00	0.0076	97.0078	5305	1.11
19	RR0705-84PC	Piston	6/4/07	12:00	0.0076	97.0078	5305	3.44
50	RR0705-85TC	Trigger	6/4/07	19:00	1.0288	96.7997	3337	1.78
50	RR0705-85PC	Piston	6/4/07	19:00	1.0288	96.7997	3337	4.87
50	RR0705-86MC	Multi	6/5/07	19:00	1.0288	96.7997	3337	0.13
17	RR0705-87TC	Trigger	6/5/07	9:48	0.9955	96.3720	5211	0.77
17	RR0705-87PC	Piston	6/5/07	9:48	0.9955	96.3720	5211	5.02
51	RR0705-88TC	Trigger	6/5/07	18:00	1.3115	96.2635	5197	0.91
51	RR0705-88PC	Piston	6/5/07	18:00	1.3115	96.2635	5197	4.71
52	RR0705-89TC	Trigger	6/5/07	2:30	1.5200	96.3793	3255	1.48
52	RR0705-89PC	Piston	6/6/07	2:30	1.5200	96.3793	3255	4.38
52	RR0705-90MC	Multi	6/6/07	7:25	1.5200	96.3793	3255	0.13
53	RR0705-91MC	Multi	6/6/07	14:45	1.8902	95.9726	3836	0.14
53	RR0705-92TC	Trigger	6/7/07	20:00	1.8902	95.9726	3836	1.14
53	RR0705-92PC	Piston	6/7/07	20:00	1.8902	95.9726	3836	4.77
54	RR0705-93TC	Trigger	6/7/07	2:35	1.7209	95.8124	5040	1.20
54	RR0705-93PC	Piston	6/7/07	2:35	1.7209	95.8124	5040	4.92
55	RR0705-94TC	Trigger	6/7/07	13:34	2.1242	95.0510	4918	0.00
55	RR0705-94PC	Piston	6/7/07	13:34	2.1242	95.0510	4918	3.81
56	RR0705-95TC	Trigger	6/8/07	4:37	2.8745	94.2061	3418	0.00
56	RR0705-95PC	Piston	6/8/07	4:37	2.8745	94.2061	3418	2.23
57	RR0705-96TC	Trigger	6/8/07	11:36	2.9336	94.1390	3410	1.33
57	RR0705-96PC	Piston	6/8/07	11:36	2.9336	94.1390	3410	4.40
57	RR0705-97MC	Multi	6/8/07	16:30	2.9336	94.1390	3412	0.68
58	RR0705-98TC	Trigger	6/8/07	23:56	2.6921	94.1000	3410	1.22
58	RR0705-98PC	Piston	6/8/07	23:56	2.6921	94.1000	3410	4.77
58	RR0705-99MC	Multi	6/9/07	5:42	2.6921	94.1000	4715	0.24
11	RR0705-100MC	Multi	6/9/07	13:50	3.2761	94.0198	1819	0.03
11	RR0705-101GC	Gravity	6/9/07	5:42	3.2761	94.0198	1823	0.53
59	RR0705-102MC	Multi	6/9/07	21:31	3.6051	93.6315	3073	0.22
59	RR0705-103TC	Trigger	6/8/07	2:00	3.6051	93.6315	3073	1.63
59	RR0705-103PC	Piston	6/8/07	2:00	3.6051	93.6315	3073	4.74
60	RR0705-104TC	Trigger	6/10/07	9:37	3.8716	93.4747	3476	1.92
60	RR0705-104PC	Piston	6/10/07	9:37	3.8716	93.4747	3476	4.58
61	RR0705-105TC	Trigger	6/10/07	17:55	4.0787	93.1810	4486	0.55
61	RR0705-105PC	Piston	6/10/07	17:55	4.0787	93.1810	4486	2.75
62	RR0705-106TC	Trigger	6/11/07	8:45	3.3297	91.9394	4142	2.45
62	RR0705-106PC	Piston	6/11/07	8:45	3.3297	91.9394	4142	3.51
63	RR0705-107TC	Trigger	6/11/07	22:10	4.3270	92.9177	4518	1.79
63	RR0705-107PC	Piston	6/11/07	22:10	4.3270	92.9177	4518	0.81
64	RR0705-108TC	Trigger	6/12/07	6:12	4.6598	93.1428	2959	1.28
64	RR0705-108PC	Piston	6/12/07	6:12	4.6598	93.1428	2959	3.70
64	RR0705-109MC	Multi	6/12/07	10:00	4.6598	93.1428	2959	0.06

Paleoquakes07
R/V Revelle Core Map

RR0705 Core

RR0705 Trackline

Earthquake Slip (year)

2004

2005

Historic Earthquake

Coastline

Elevation (m)

3600

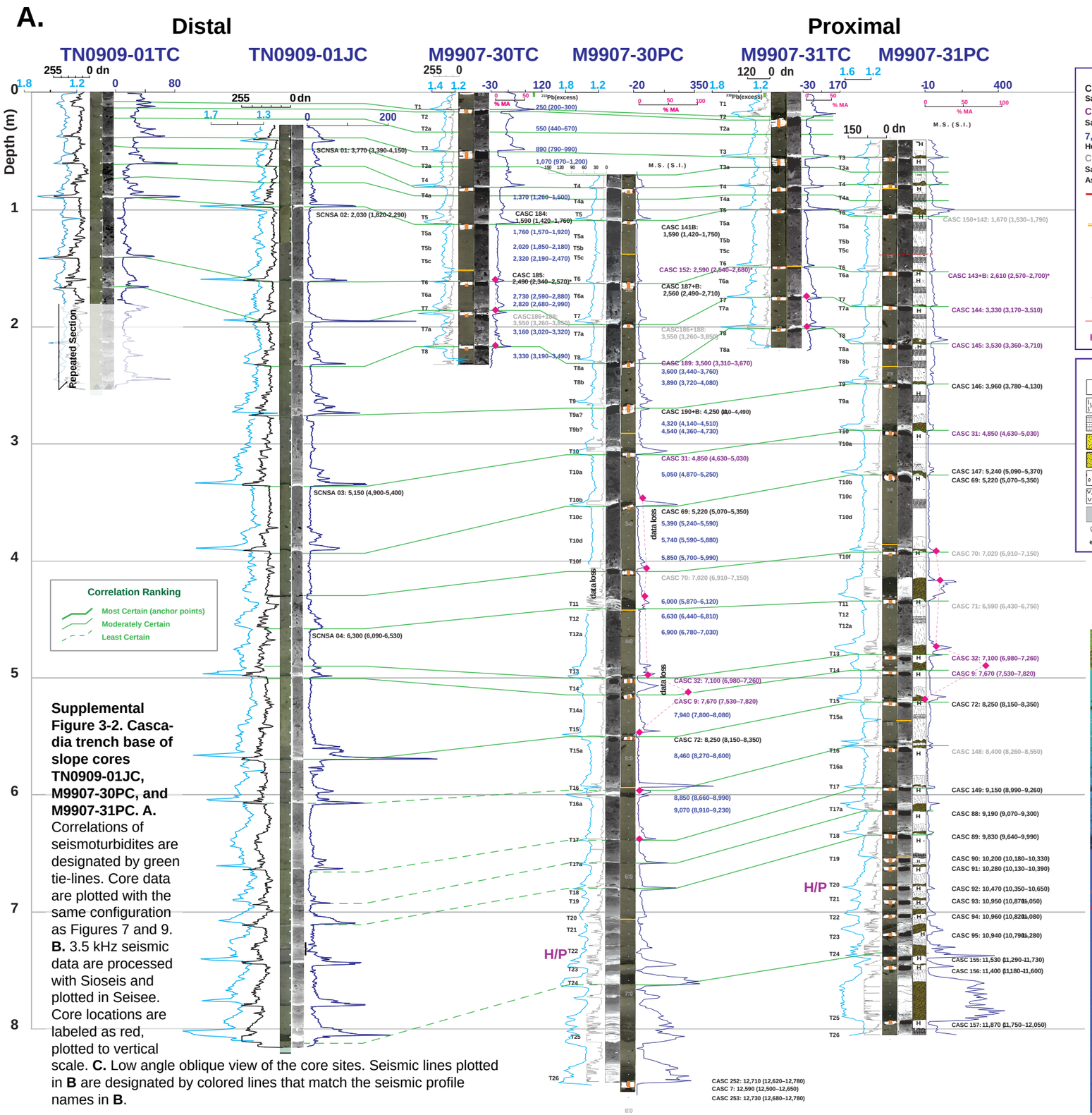
-7100

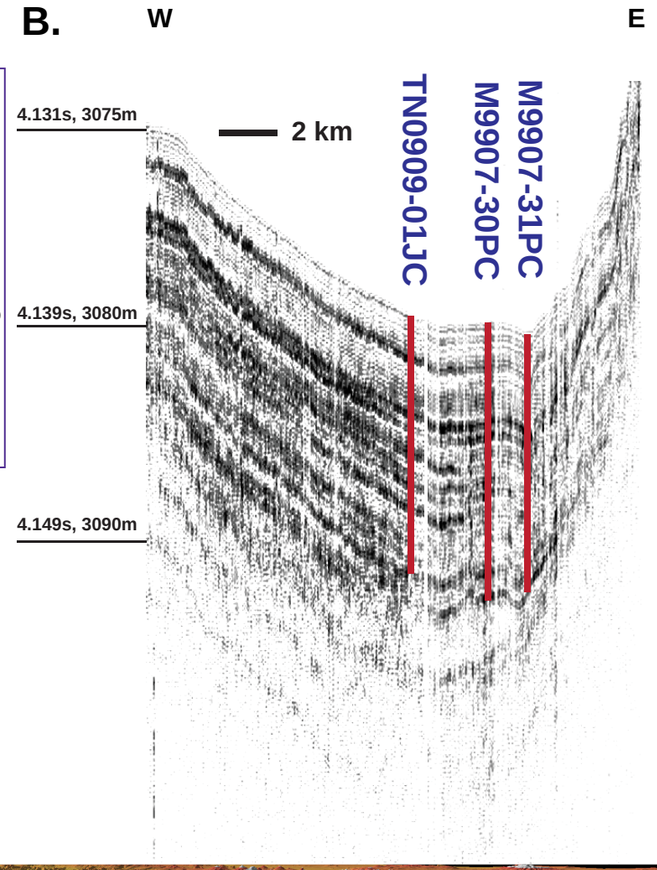
100 50 0 100

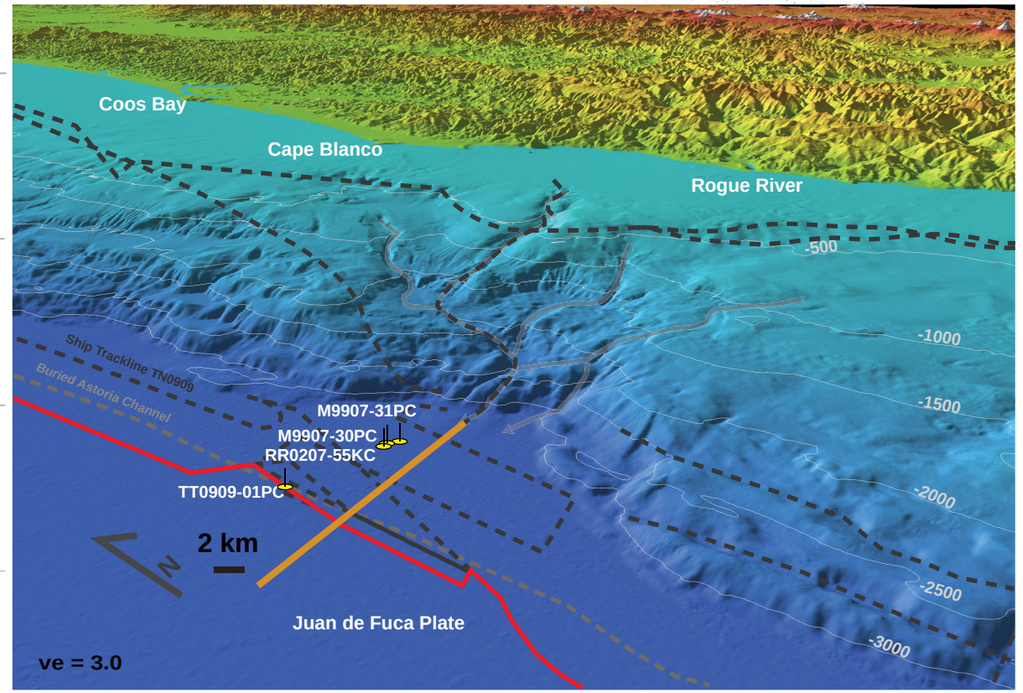
Kilometers

Prepared by Jason R. Patton
CEOAS, Oregon State University
2014.02.04
http://earthjay.com

Appendix S 3-2. Cascadia trench base of slope cores TN0909-01JC, M9907-30PC, and M9907-31PC



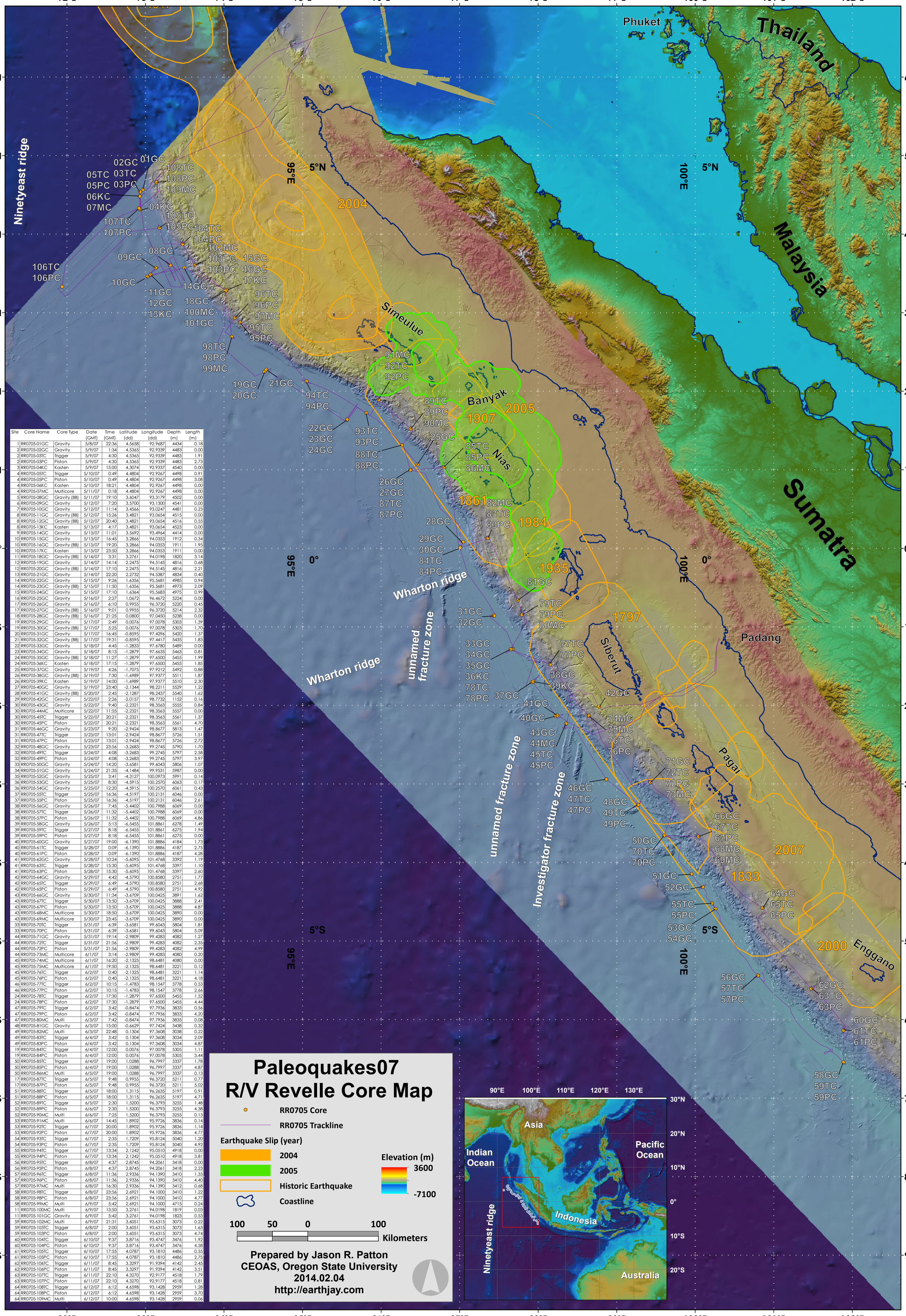




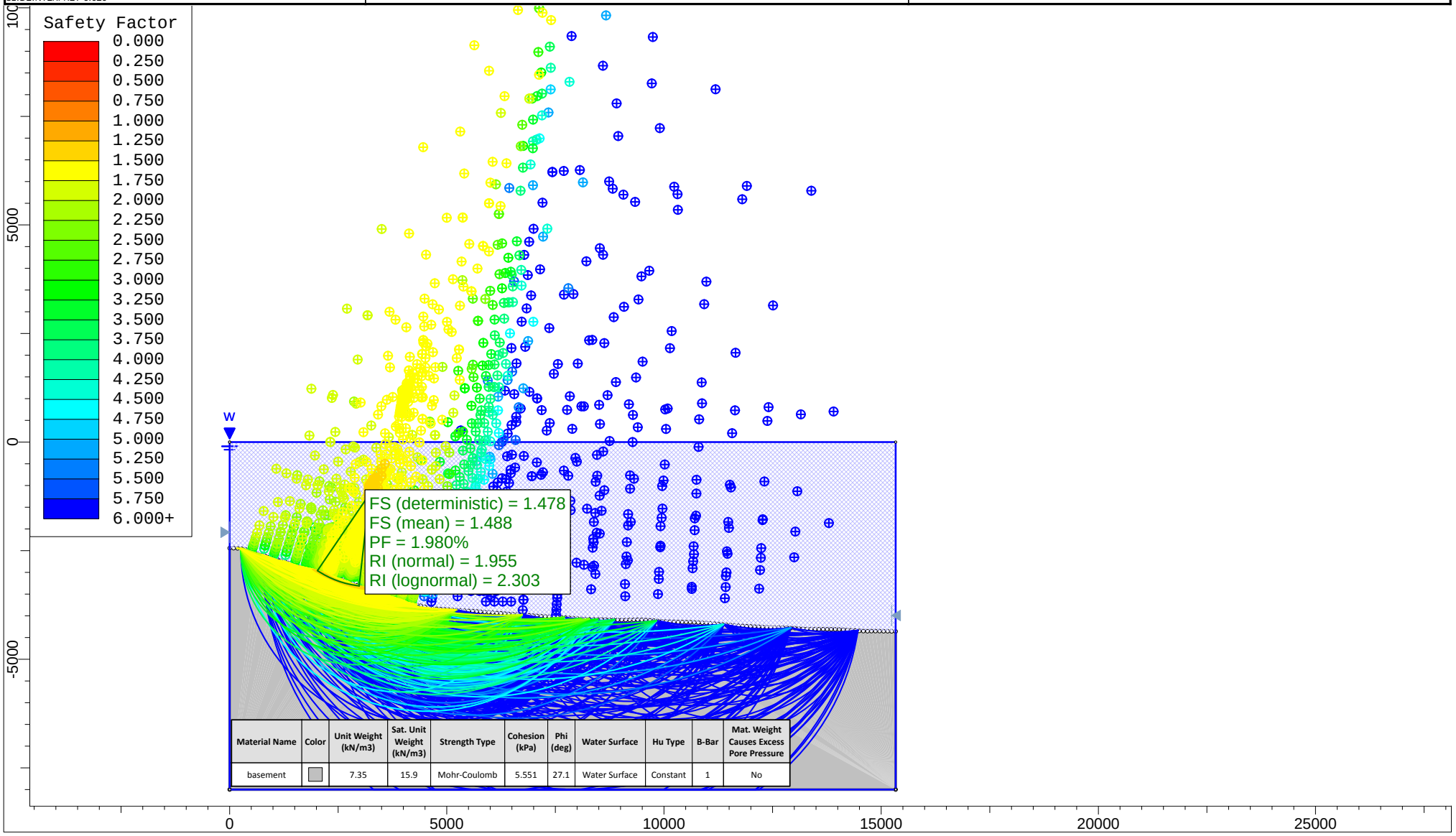
Supplemental Figure 3-2. Cascadia trench base of slope cores TN0909-01JC, M9907-30PC, and M9907-31PC. A. Correlations of seismoturbidites are designated by green tie-lines. Core data are plotted with the same configuration as Figures 7 and 9. **B.** 3.5 kHz seismic data are processed with Sioseis and plotted in Seisee. Core locations are labeled as red, plotted to vertical scale. **C.** Low angle oblique view of the core sites. Seismic lines plotted in **B** are designated by colored lines that match the seismic profile names in **B**.

Appendix S 3-3 Core Map and Core Table

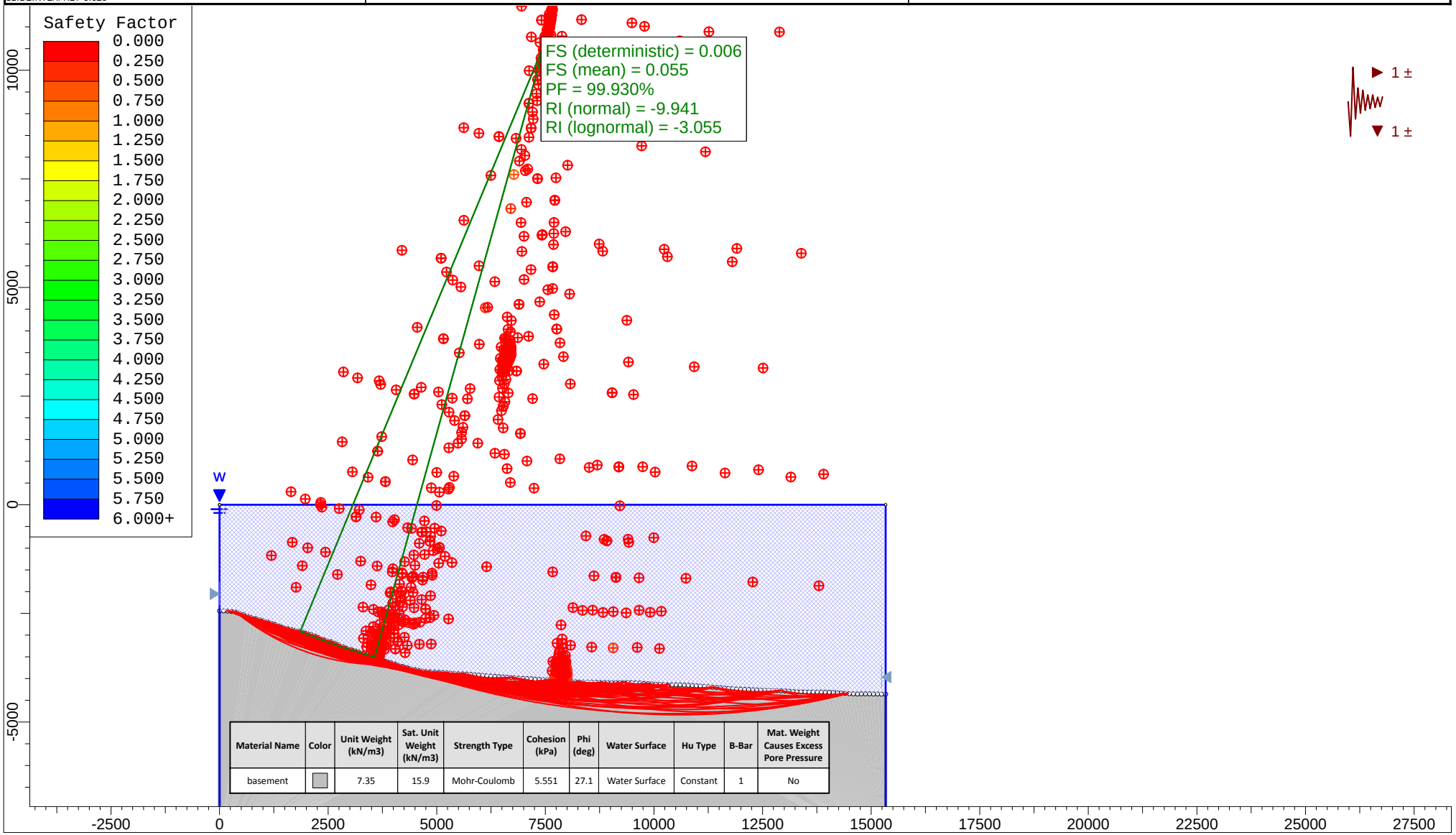
Site	Core Name	Core Type	Date (GMT)	Time (GMT)	Latitude (dd)	Longitude (dd)	Depth (m)	Length (m)
1	RR0705-01GC	Gravity	5/8/07	22:36	4.5658	92.9687	4434	0.18
2	RR0705-02GC	Gravity	5/9/07	1:34	4.5365	92.9339	4483	0.00
2	RR0705-03TC	Trigger	5/9/07	4:30	4.5365	92.9339	4483	1.91
2	RR0705-03PC	Piston	5/9/07	4:30	4.5365	92.9339	4483	2.73
3	RR0705-04KC	Kasten	5/9/07	15:00	4.3074	92.9337	4540	0.00
4	RR0705-05TC	Trigger	5/10/07	0:49	4.4804	92.9267	4498	0.91
4	RR0705-05PC	Piston	5/10/07	0:49	4.4804	92.9267	4498	3.08
4	RR0705-06KC	Kasten	5/10/07	18:21	4.4804	92.9267	4498	0.00
4	RR0705-07MC	Multicore	5/11/07	0:18	4.4804	92.9267	4498	0.00
5	RR0705-08GC	Gravity (BB)	5/11/07	19:10	3.6047	93.3179	4502	0.00
6	RR0705-09GC	Gravity	5/12/07	7:20	3.5700	93.1300	4541	0.00
7	RR0705-10GC	Gravity	5/12/07	11:14	3.4566	93.0247	4481	0.23
8	RR0705-11GC	Gravity (BB)	5/12/07	15:26	3.4821	93.0654	4515	0.00
8	RR0705-12GC	Gravity (BB)	5/12/07	20:40	3.4821	93.0654	4516	0.55
8	RR0705-13KC	Kasten	5/13/07	4:17	3.4821	93.0654	4523	0.00
9	RR0705-14GC	Gravity	5/13/07	11:01	3.5692	93.4964	4414	0.00
10	RR0705-15GC	Gravity	5/13/07	16:45	3.2866	94.0353	1912	0.34
10	RR0705-16GC	Gravity (BB)	5/13/07	19:20	3.2866	94.0353	1911	1.95
10	RR0705-17KC	Kasten	5/13/07	23:50	3.2866	94.0353	1911	0.00
11	RR0705-18GC	Gravity (BB)	5/14/07	3:31	3.2761	94.0198	1820	3.14
12	RR0705-19GC	Gravity	5/14/07	14:14	2.2475	94.5145	4816	0.68
12	RR0705-20GC	Gravity (BB)	5/14/07	17:10	2.2475	94.5145	4816	2.21
13	RR0705-21GC	Gravity	5/14/07	22:20	2.2732	94.5387	4834	0.40
14	RR0705-22GC	Gravity	5/15/07	9:26	1.6356	95.5681	4985	0.94
14	RR0705-23GC	Gravity (BB)	5/15/07	11:50	1.6356	95.5681	4973	2.09
15	RR0705-24GC	Gravity	5/15/07	17:10	1.6364	95.5683	4975	0.99
16	RR0705-25GC	Gravity	5/16/07	2:27	1.0672	96.4672	5224	0.00
17	RR0705-26GC	Gravity	5/16/07	6:10	0.9955	96.3720	5220	0.45
17	RR0705-27GC	Gravity (BB)	5/16/07	9:01	0.9955	96.3720	5214	2.32
18	RR0705-28GC	Gravity (BB)	5/16/07	21:25	0.0800	97.0450	5238	0.00
19	RR0705-29GC	Gravity	5/17/07	2:49	0.0076	97.0078	5303	1.39
19	RR0705-30GC	Gravity (BB)	5/17/07	5:25	0.0076	97.0078	5303	1.70
20	RR0705-31GC	Gravity	5/17/07	16:45	-0.8595	97.4296	5420	1.37
21	RR0705-32GC	Gravity (BB)	5/17/07	19:31	-0.8595	97.4417	5435	1.83
22	RR0705-33GC	Gravity	5/18/07	4:45	-1.2833	97.6780	5489	0.00
23	RR0705-34GC	Gravity	5/18/07	8:13	-1.2879	97.6635	5463	0.81
24	RR0705-35GC	Gravity (BB)	5/18/07	11:27	-1.2879	97.6500	5455	1.99
24	RR0705-36KC	Kasten	5/18/07	17:15	-1.2879	97.6500	5455	1.85
25	RR0705-37GC	Gravity	5/19/07	4:26	-1.7075	97.9212	5492	0.88
26	RR0705-38GC	Gravity (BB)	5/19/07	7:30	-1.6989	97.9377	5511	1.87
26	RR0705-39KC	Kasten	5/19/07	14:00	-1.6989	97.9377	5510	2.30
27	RR0705-40GC	Gravity	5/19/07	23:40	-2.1344	98.2211	5529	1.22
28	RR0705-41GC	Gravity (BB)	5/20/07	2:45	-2.1287	98.2437	5540	1.62
29	RR0705-42GC	Gravity	5/22/07	2:26	-2.0157	98.7732	1152	0.16
30	RR0705-43GC	Gravity	5/22/07	9:40	-2.2321	98.3563	5555	0.84
30	RR0705-44MC	Multicore	5/22/07	11:55	-2.2321	98.3563	5557	0.00
30	RR0705-45TC	Trigger	5/22/07	20:21	-2.2321	98.3563	5561	1.37
30	RR0705-45PC	Piston	5/22/07	20:21	-2.2321	98.3563	5561	4.70
31	RR0705-46GC	Gravity	5/23/07	9:20	-2.9424	98.8677	5813	1.47
31	RR0705-47TC	Trigger	5/23/07	13:01	-2.9424	98.8677	5726	1.51
31	RR0705-47PC	Piston	5/23/07	13:01	-2.9424	98.8677	5726	2.72
32	RR0705-48GC	Gravity	5/23/07	23:56	-3.2683	99.2745	5790	1.70
32	RR0705-49TC	Trigger	5/24/07	4:08	-3.2683	99.2745	5797	2.58
32	RR0705-49PC	Piston	5/24/07	4:08	-3.2683	99.2745	5797	3.97
33	RR0705-50GC	Gravity	5/24/07	14:20	-3.6581	99.6043	5806	1.07
34	RR0705-51GC	Gravity	5/24/07	21:35	-4.1484	99.9531	5987	0.00
35	RR0705-52GC	Gravity	5/25/07	3:41	-4.3127	100.0973	5991	0.14
36	RR0705-53GC	Gravity	5/25/07	8:30	-4.5915	100.2570	6063	0.17
36	RR0705-54GC	Gravity	5/25/07	12:20	-4.5915	100.2570	6061	0.43
37	RR0705-55TC	Trigger	5/25/07	16:36	-4.5197	100.2131	6046	0.00
37	RR0705-55PC	Piston	5/25/07	16:36	-4.5197	100.2131	6046	2.61
38	RR0705-56GC	Gravity	5/26/07	7:45	-5.4402	100.7988	6069	0.00
38	RR0705-57TC	Trigger	5/26/07	11:32	-5.4402	100.7988	6069	0.00
38	RR0705-57PC	Piston	5/26/07	11:32	-5.4402	100.7988	6069	4.86
39	RR0705-58GC	Gravity	5/26/07	5:13	-6.5455	101.8861	6278	1.49
39	RR0705-59TC	Trigger	5/27/07	8:18	-6.5455	101.8861	6275	1.94
39	RR0705-59PC	Piston	5/27/07	8:18	-6.5455	101.8861	6275	0.00
40	RR0705-60GC	Gravity	5/27/07	19:00	-6.1390	101.8886	4184	1.73
40	RR0705-61TC	Trigger	5/28/07	0:09	-6.1390	101.8886	4187	2.75
40	RR0705-61PC	Piston	5/28/07	0:09	-6.1390	101.8886	4187	4.28
41	RR0705-62GC	Gravity	5/28/07	10:24	-5.6095	101.4768	3392	1.19
41	RR0705-63TC	Trigger	5/28/07	15:30	-5.6095	101.4768	3397	1.10
41	RR0705-63PC	Piston	5/28/07	15:30	-5.6095	101.4768	3397	2.60
42	RR0705-64GC	Gravity	5/29/07	4:42	-4.5790	100.8580	2751	1.77
42	RR0705-65TC	Trigger	5/29/07	6:49	-4.5790	100.8580	2751	2.68
42	RR0705-65PC	Piston	5/29/07	6:49	-4.5790	100.8580	2751	4.92
43	RR0705-66GC	Gravity	5/30/07	11:34	-3.6709	100.0425	3891	1.62
43	RR0705-67TC	Trigger	5/30/07	13:50	-3.6709	100.0425	3888	2.41
43	RR0705-67PC	Piston	5/30/07	13:50	-3.6709	100.0425	3888	4.87
43	RR0705-68MC	Multicore	5/30/07	18:50	-3.6709	100.0425	3890	0.00
43	RR0705-69MC	Multicore	5/30/07	23:45	-3.6709	100.0425	3890	0.00
33	RR0705-70TC	Trigger	5/31/07	6:39	-3.6581	99.6043	5804	1.81
33	RR0705-70PC	Piston	5/31/07	6:39	-3.6581	99.6043	5804	5.09
44	RR0705-71GC	Gravity	5/31/07	19:14	-2.9809	99.4283	4082	1.27
44	RR0705-72TC	Trigger	5/31/07	21:56	-2.9809	99.4283	4082	2.35
44	RR0705-72PC	Piston	5/31/07	21:56	-2.9809	99.4283	4082	4.99
44	RR0705-73MC	Multicore	6/1/07	3:14	-2.9809	99.4283	4080	0.20
45	RR0705-74MC	Multicore	6/1/07	16:20	-2.1325	98.6481	4080	0.00
45	RR0705-75MC	Multicore	6/1/07	19:50	-2.1325	98.6481	3221	0.12
45	RR0705-76TC	Trigger	6/2/07	0:40	-2.1325	98.6481	3221	1.14
45	RR0705-76PC	Piston	6/2/07	0:40	-2.1325	98.6481	3221	4.18
46	RR0705-77TC	Trigger	6/2/07	10:15	-1.4783	98.1547	3778	0.53
46	RR0705-77PC	Piston	6/2/07	10:15	-1.4783	98.1547	3778	2.66
24	RR0705-78TC	Trigger	6/2/07	17:30	-1.2879	97.6500	5455	1.52
24	RR0705-78PC	Piston	6/2/07	17:30	-1.2879	97.6500	5455	4.44
47	RR0705-79TC	Trigger	6/2/07	3:42	-0.8474	97.7936	3833	0.56
47	RR0705-79PC	Piston	6/2/07	3:42	-0.8474	97.7936	3833	4.20
47	RR0705-80MC	Multi	6/3/07	7:42	-0.8474	97.7936	3835	0.08
48	RR0705-81GC	Gravity	6/3/07	15:00	-0.6629	97.7424	3438	0.32
49	RR0705-82MC	Multi	6/3/07	22:48	0.1304	97.3608	3038	0.22
49	RR0705-83TC	Trigger	6/4/07	3:42	0.1304	97.3608	3034	2.09
49	RR0705-83PC	Piston	6/4/07	3:42	0.1304	97.3608	3034	4.87
19	RR0705-84TC	Trigger	6/4/07	12:00	0.0076	97.0078	5305	1.11
19	RR0705-84PC	Piston	6/4/07	12:00	0.0076	97.0078	5305	3.44
50	RR0705-85TC	Trigger	6/4/07	19:00	1.0288	96.7997	3337	1.78
50	RR0705-85PC	Piston	6/4/07	19:00	1.0288	96.7997	3337	4.87
50	RR0705-86MC	Multi	6/5/07	19:00	1.0288	96.7997	3337	0.13
17	RR0705-87TC	Trigger	6/5/07	9:48	0.9955	96.3720	5211	0.77
17	RR0705-87PC	Piston	6/5/07	9:48	0.9955	96.3720	5211	5.02
51	RR0705-88TC	Trigger	6/5/07	18:00	1.3115	96.2635	5197	0.91
51	RR0705-88PC	Piston	6/5/07	18:00	1.3115	96.2635	5197	4.71
52	RR0705-89TC	Trigger	6/5/07	2:30	1.5200	96.3793	3255	1.48
52	RR0705-89PC	Piston	6/6/07	2:30	1.5200	96.3793	3255	4.38
52	RR0705-90MC	Multi	6/6/07	7:25	1.5200	96.3793	3255	0.13
53	RR0705-91MC	Multi	6/6/07	14:45	1.8902	95.9726	3836	0.14
53	RR0705-92TC	Trigger	6/7/07	20:00	1.8902	95.9726	3836	1.14
53	RR0705-92PC	Piston	6/7/07	20:00	1.8902	95.9726	3836	4.77
54	RR0705-93TC	Trigger	6/7/07	2:35	1.7209	95.8124	5040	1.20
54	RR0705-93PC	Piston	6/7/07	2:35	1.7209	95.8124	5040	4.92
55	RR0705-94TC	Trigger	6/7/07	13:34	2.1242	95.0510	4918	0.00
55	RR0705-94PC	Piston	6/7/07	13:34	2.1242	95.0510	4918	3.81
56	RR0705-95TC	Trigger	6/8/07	4:37	2.8745	94.2061	3418	0.00
56	RR0705-95PC	Piston	6/8/07	4:37	2.8745	94.2061	3418	2.23
57	RR0705-96TC	Trigger	6/8/07	11:36	2.9336	94.1390	3410	1.33
57	RR0705-96PC	Piston	6/8/07	11:36	2.9336	94.1390	3410	4.40
57	RR0705-97MC	Multi	6/8/07	16:30	2.9336	94.1390	3412	0.68
58	RR0705-98TC	Trigger	6/8/07	23:56	2.6921	94.1000	3410	1.22
58	RR0705-98PC	Piston	6/8/07	23:56	2.6921	94.1000	3410	4.77
58	RR0705-99MC	Multi	6/9/07	5:42	2.6921	94.1000	4715	0.24
11	RR0705-100MC	Multi	6/9/07	13:50	3.2761	94.0198	1819	0.03
11	RR0705-101GC	Gravity	6/9/07	5:42	3.2761	94.0198	1823	0.53
59	RR0705-102MC	Multi	6/9/07	21:31	3.6051	93.6315	3073	0.22
59	RR0705-103TC	Trigger	6/8/07	2:00	3.6051	93.6315	3073	1.63
59	RR0705-103PC	Piston	6/8/07	2:00	3.6051	93.6315	3073	4.74
60	RR0705-104TC	Trigger	6/10/07	9:37	3.8716	93.4747	3476	1.92
60	RR0705-104PC	Piston	6/10/07	9:37	3.8716	93.4747	3476	4.58
61	RR0705-105TC	Trigger	6/10/07	17:55	4.0787	93.1810	4486	0.55
61	RR0705-105PC	Piston	6/10/07	17:55	4.0787	93.1810	4486	2.75
62	RR0705-106TC	Trigger	6/11/07	8:45	3.3297	91.9394	4142	2.45
62	RR0705-106PC	Piston	6/11/07	8:45	3.3297	91.9394	4142	3.51
63	RR0705-107TC	Trigger	6/11/07	22:10	4.3270	92.9177	4518	1.79
63	RR0705-107PC	Piston	6/11/07	22:10	4.3270	92.9177	4518	0.81
64	RR0705-108TC	Trigger	6/12/07	6:12	4.6598	93.1428	2959	1.28
64	RR0705-108PC	Piston	6/12/07	6:12	4.6598	93.1428	2959	3.70
64	RR0705-109MC	Multi	6/12/07	10:00	4.6598	93.1428	2959	0.06



SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 03PC Site 100		
	Drawn By	Jason R. Patton	Scale 1:125000	Company Oregon State University
	Date	3/25/2013		File Name RR0705_03_100_0g.sli

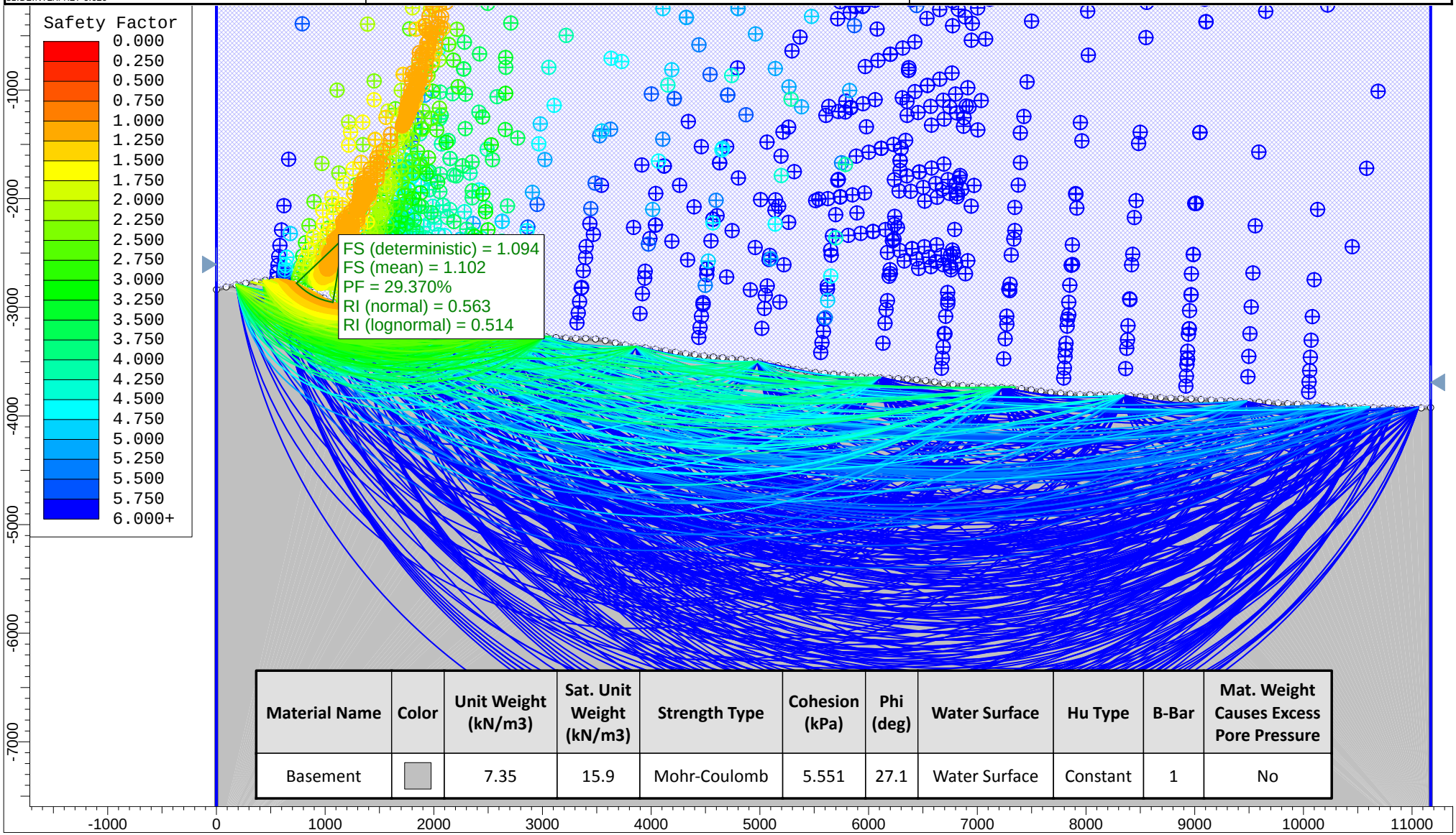


SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 03PC Site 100		
	Drawn By: Jason R. Patton	Scale: 1:125000	Company: Oregon State University	
	Date: 3/25/2013		File Name: RR0705_03_100_1g.sli	



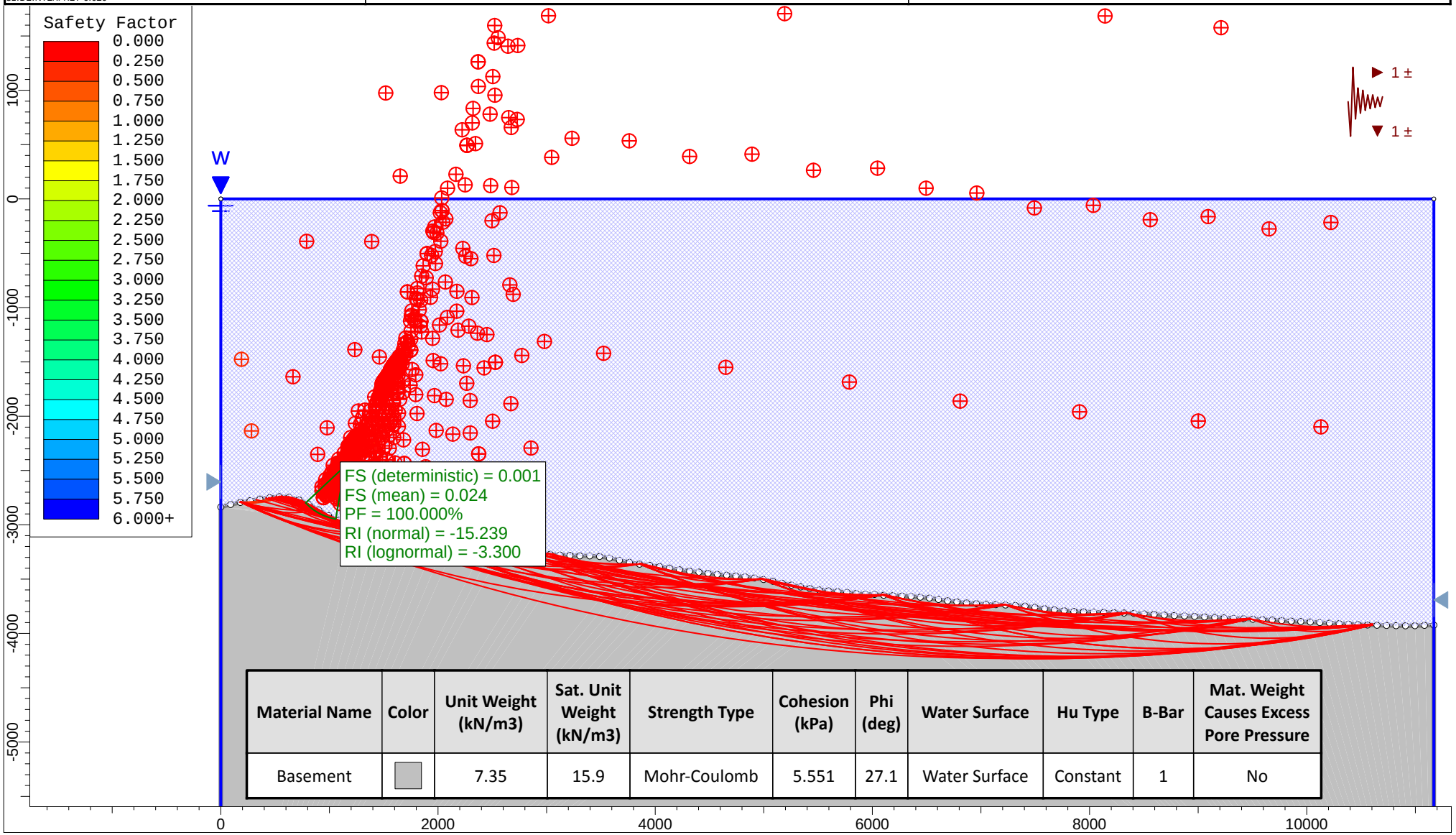
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 03PC Site 33		
	Drawn By	Jason R. Patton	Scale 1:50000	Company Oregon State University
	Date	3/14/2013, 11:40:16 PM		File Name RR0705_03_33_0g.slim



Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
Basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

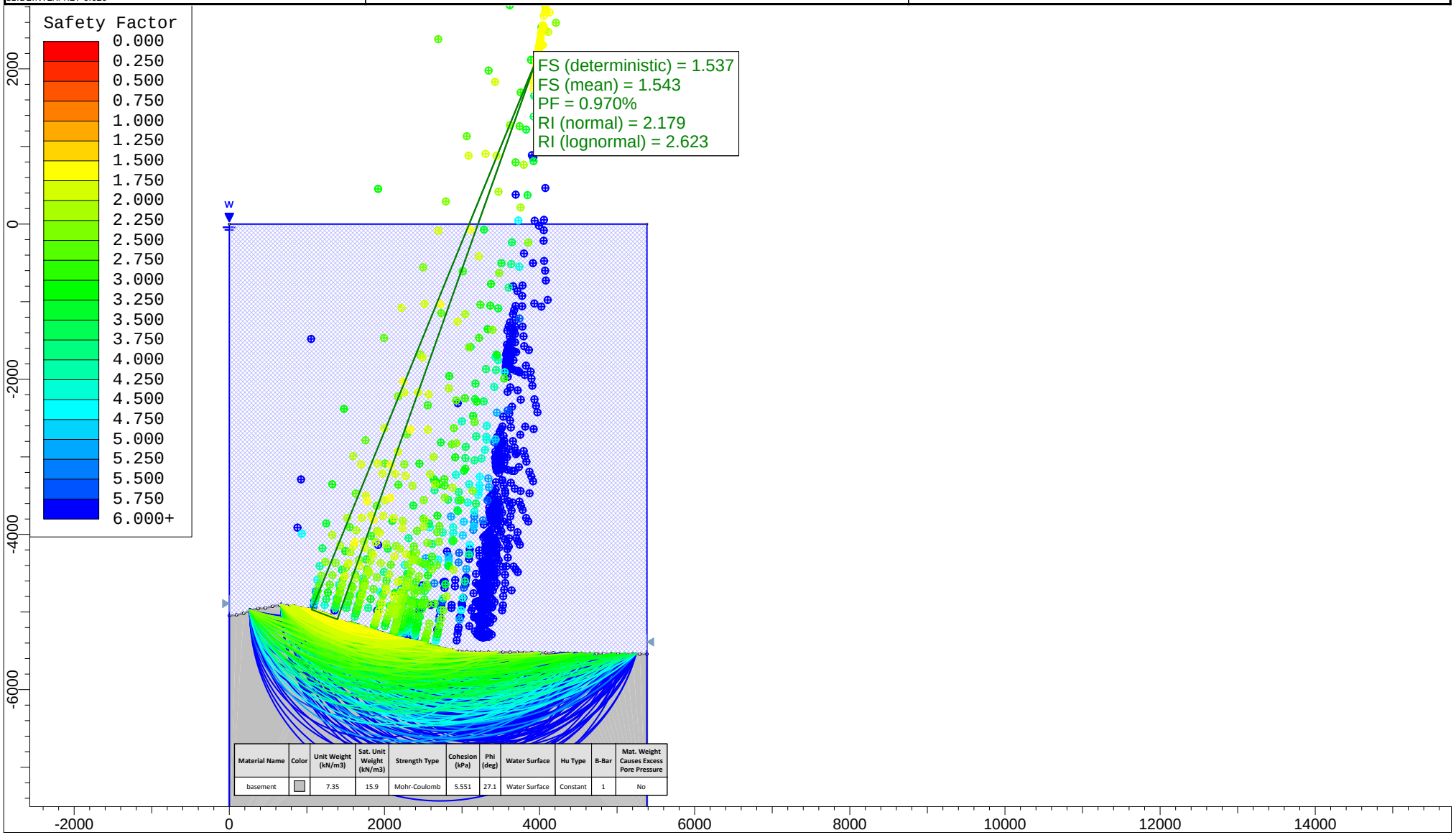
SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 03PC Site 33		
	Drawn By	Jason R. Patton	Scale 1:50000	Company Oregon State University
	Date	3/14/2013, 11:40:16 PM		File Name RR0705_03_33_1g.sli



Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
Basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

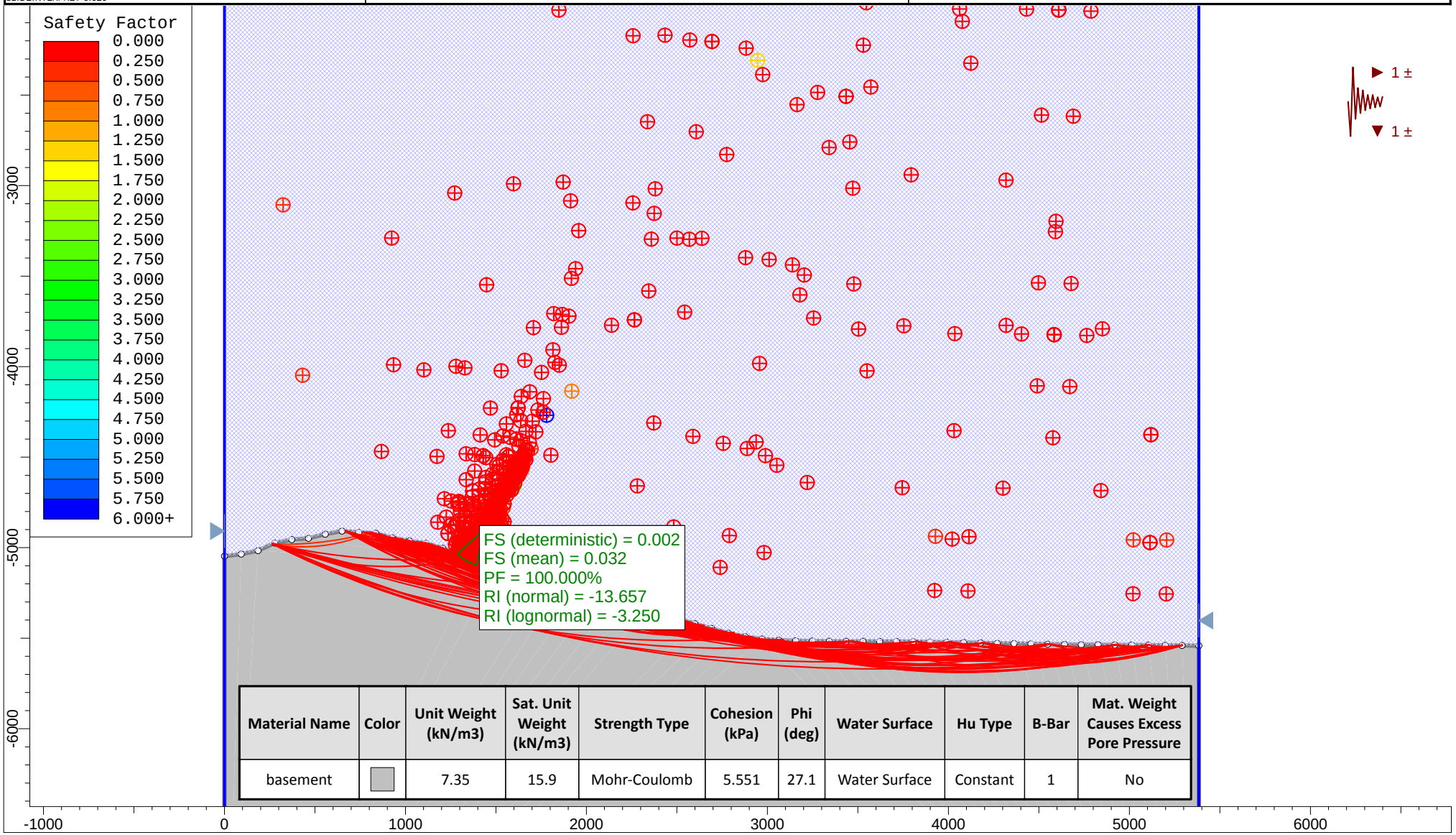
rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 45PC Site 85		
	Drawn By	Jason R. Patton	Scale 1:70000	Company Oregon State University
	Date	3/25/2013		File Name RR0705_45_85_0g.sli

SLIDEINTERPRET 6.020



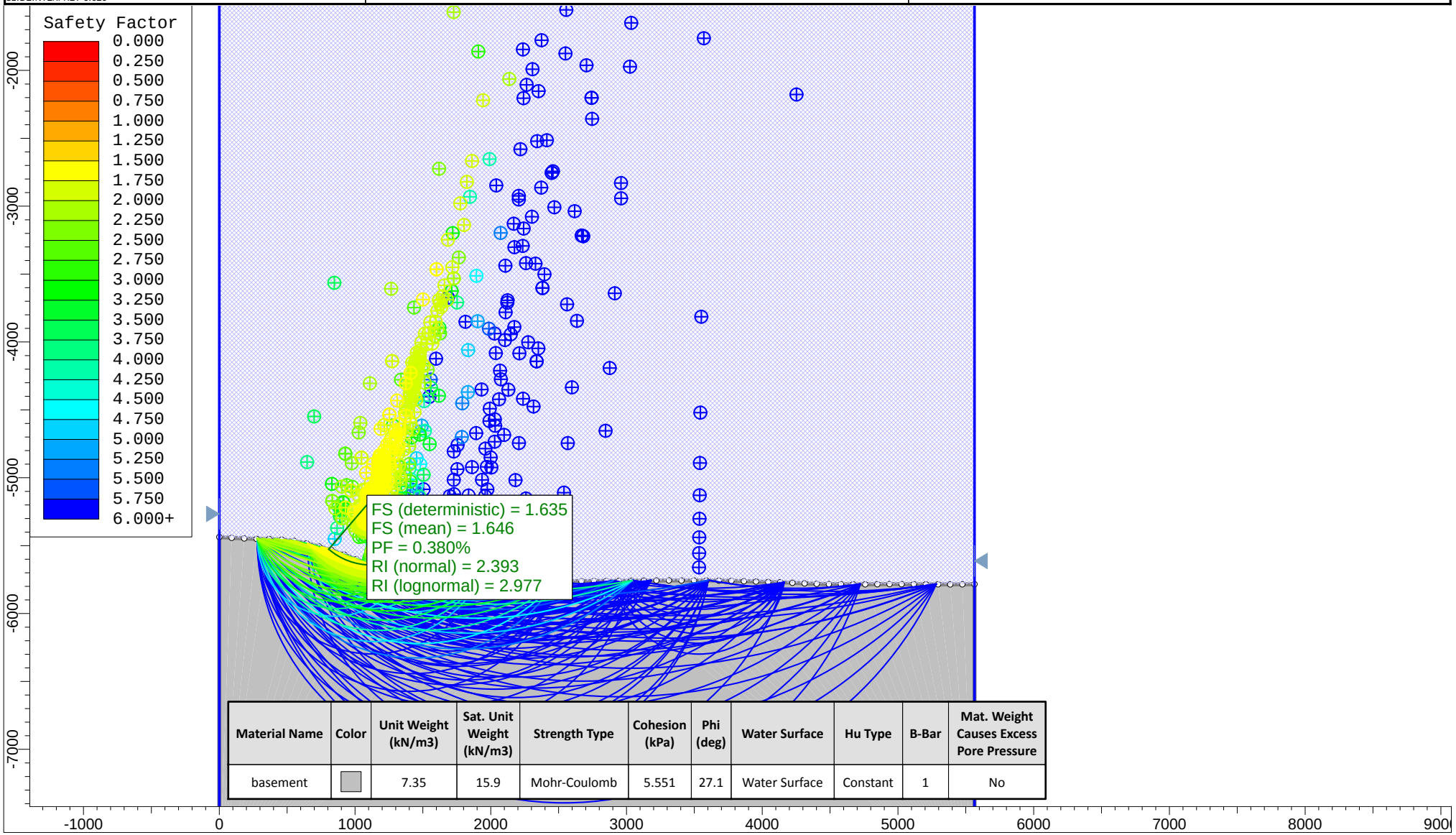
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 45PC Site 85		
	Drawn By	Jason R. Patton	Scale 1:30000	Company Oregon State University
	Date	3/25/2013		File Name RR0705_45_85_1g.sli



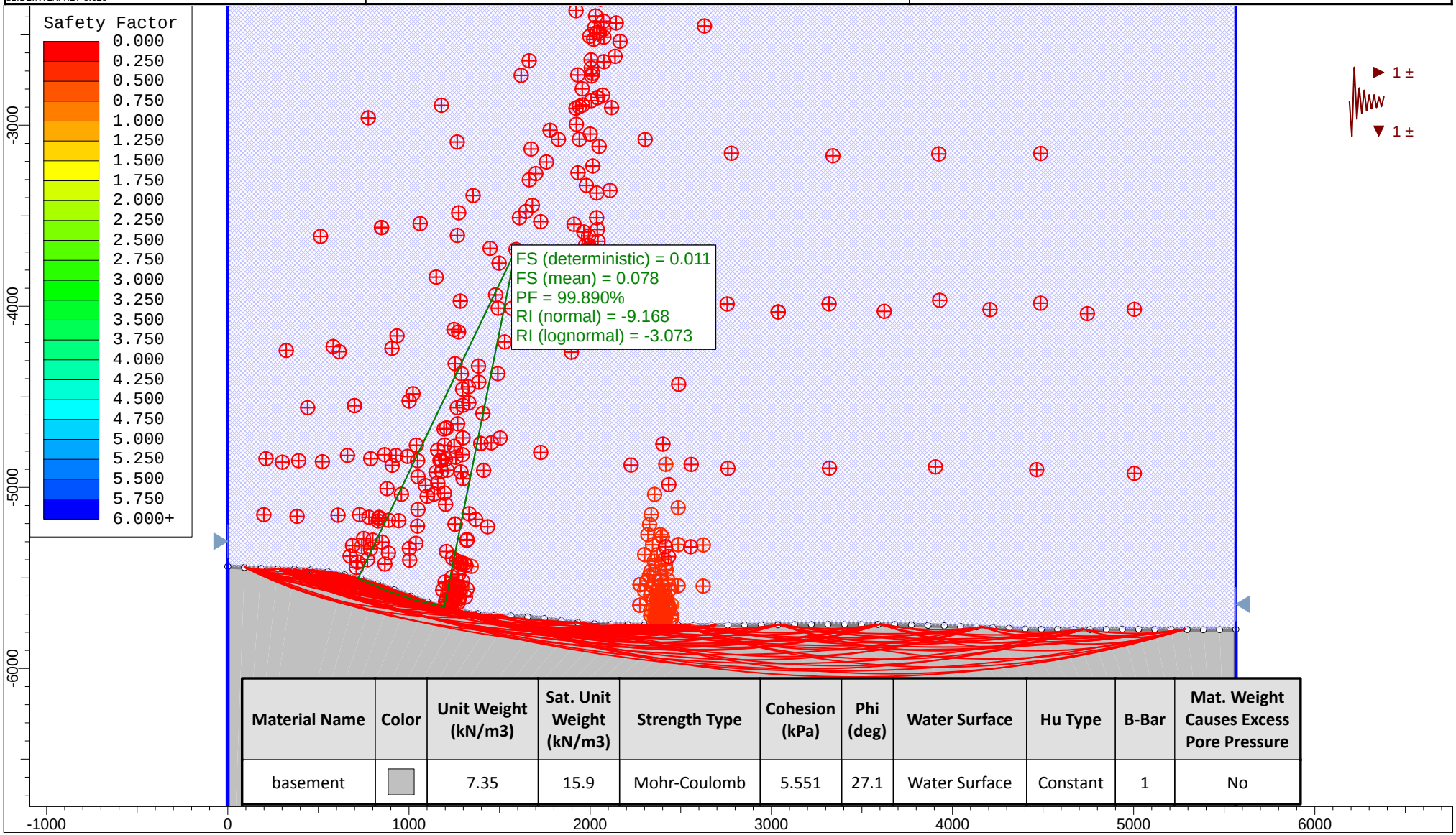
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 49PC Site 67		
	Drawn By	Jason R. Patton	Scale 1:40000	Company Oregon State
	Date	3/25/2013		File Name RR0705_49_67_0g.sli



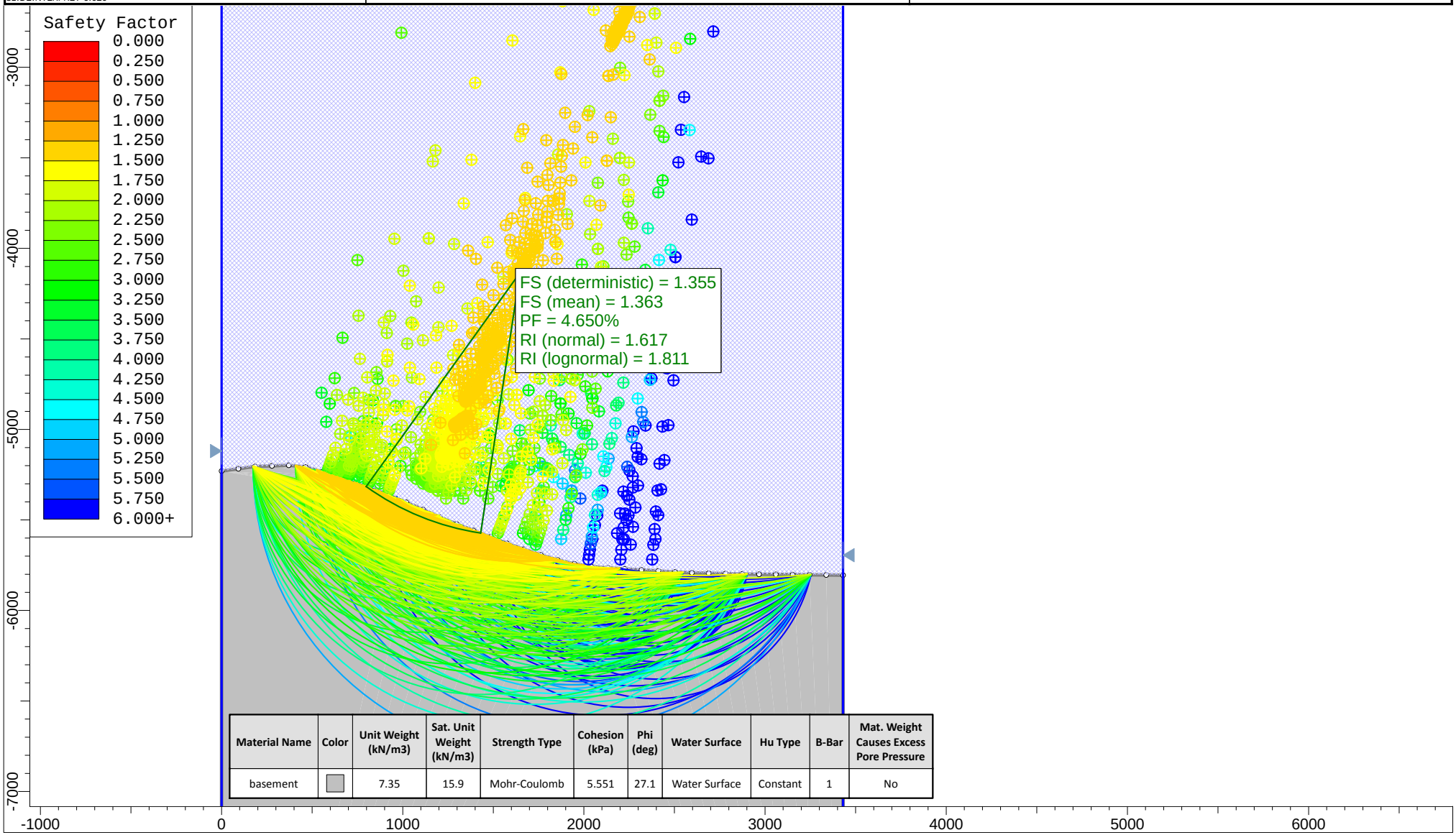
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 49PC Site 67		
	Drawn By	Jason R. Patton	Scale 1:30000	Company Oregon State
	Date	3/25/2013		File Name RR0705_49_67_1g.sli



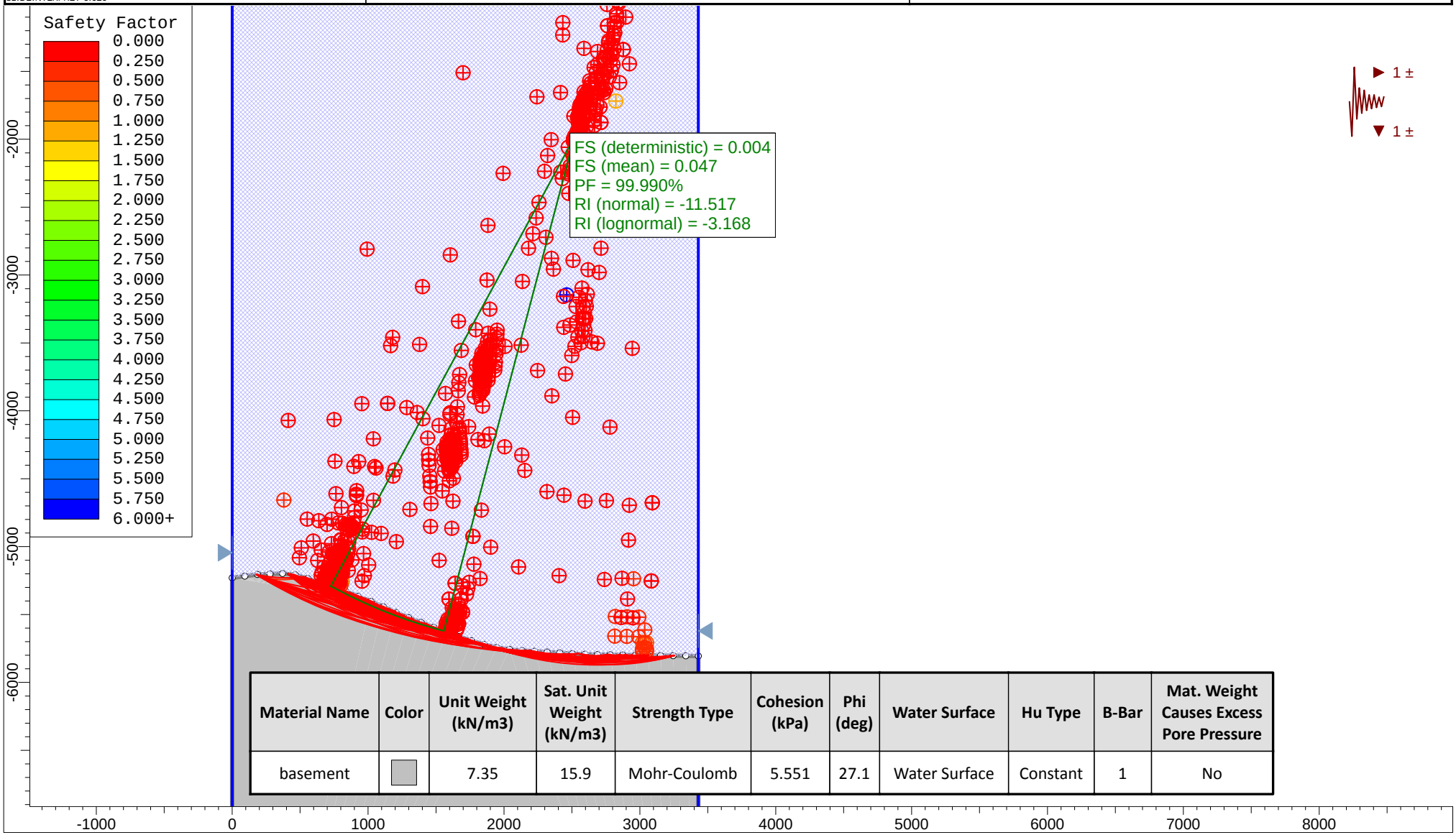
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 55PC Site 82		
	Drawn By	Jason R. Patton	Scale 1:30000	Company Oregon State University
	Date	4/01/2013		File Name RR0705_55_82_0g.slim



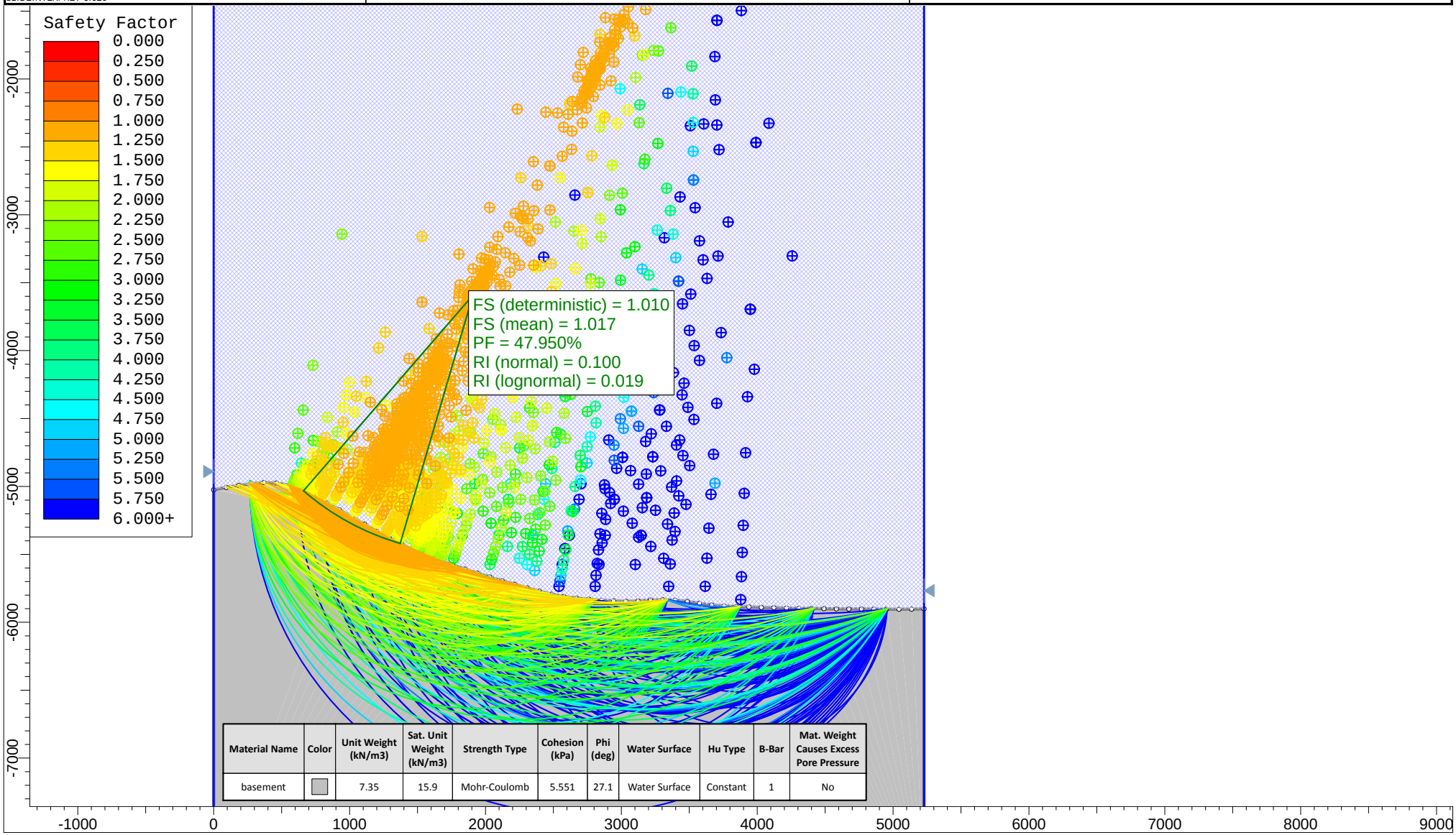
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 55PC Site 82		
	Drawn By	Jason R. Patton	Scale 1:40000	Company Oregon State University
	Date	4/01/2013		File Name RR0705_55_82_1g.slim



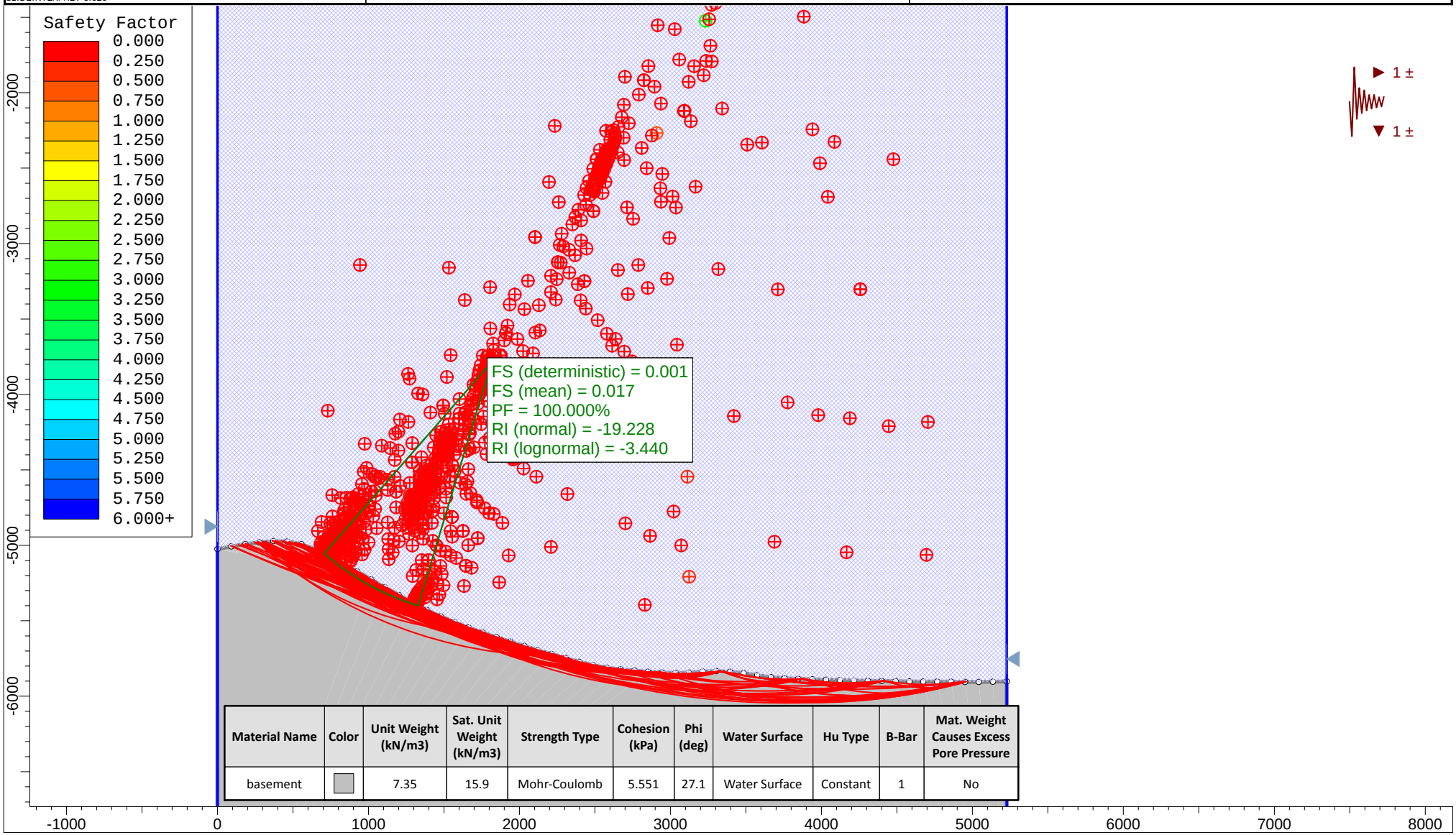
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 57PC Site 81		
	Drawn By	Jason R. Patton	Scale 1:40000	Company Oregon State University
	Date	3/25/2013		File Name RR0705_57_81_0g.sli



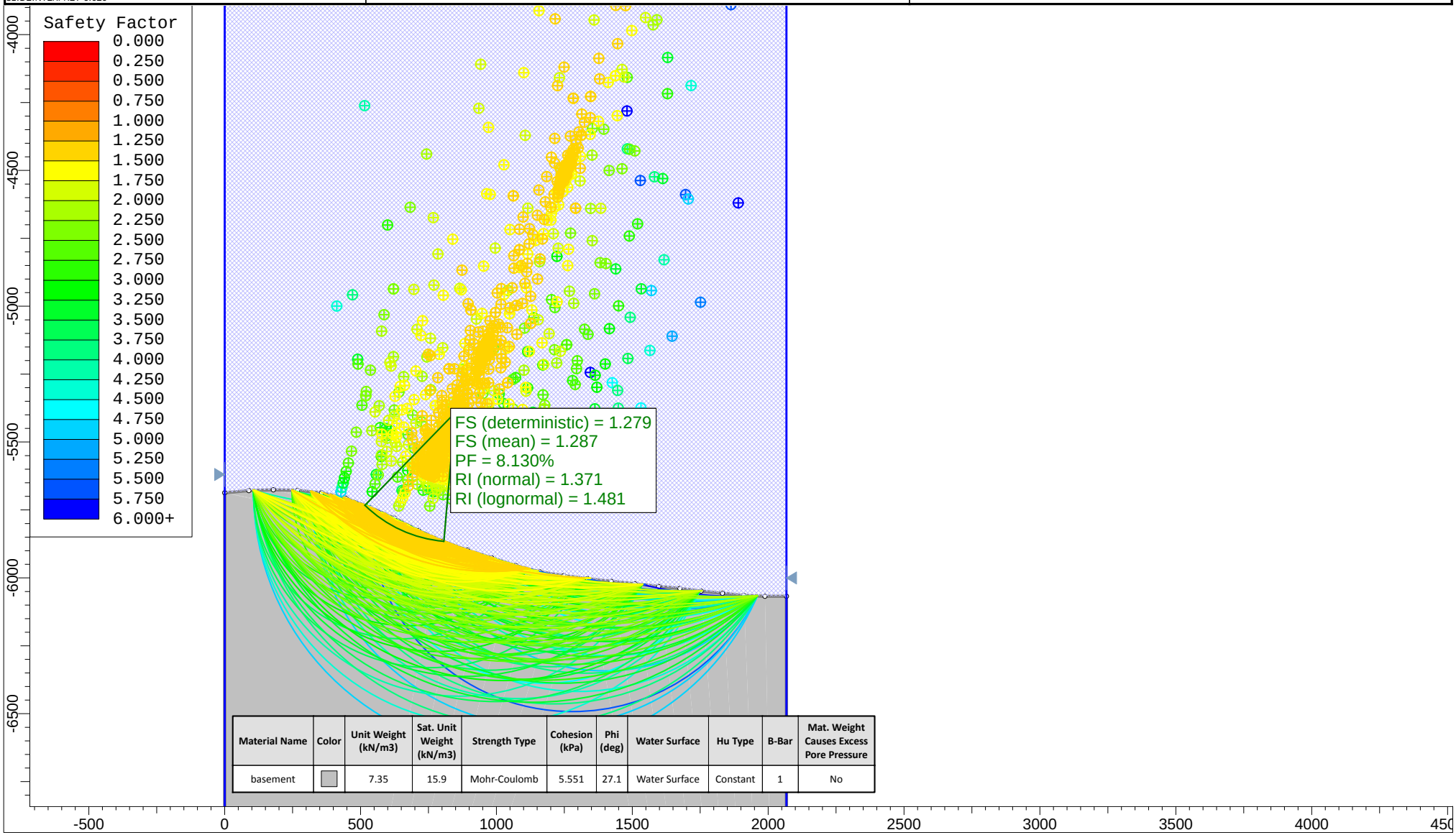
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 57PC Site 81		
	Drawn By	Jason R. Patton	Scale 1:36000	Company Oregon State University
	Date	3/25/2013		File Name RR0705_57_81_1g.sli



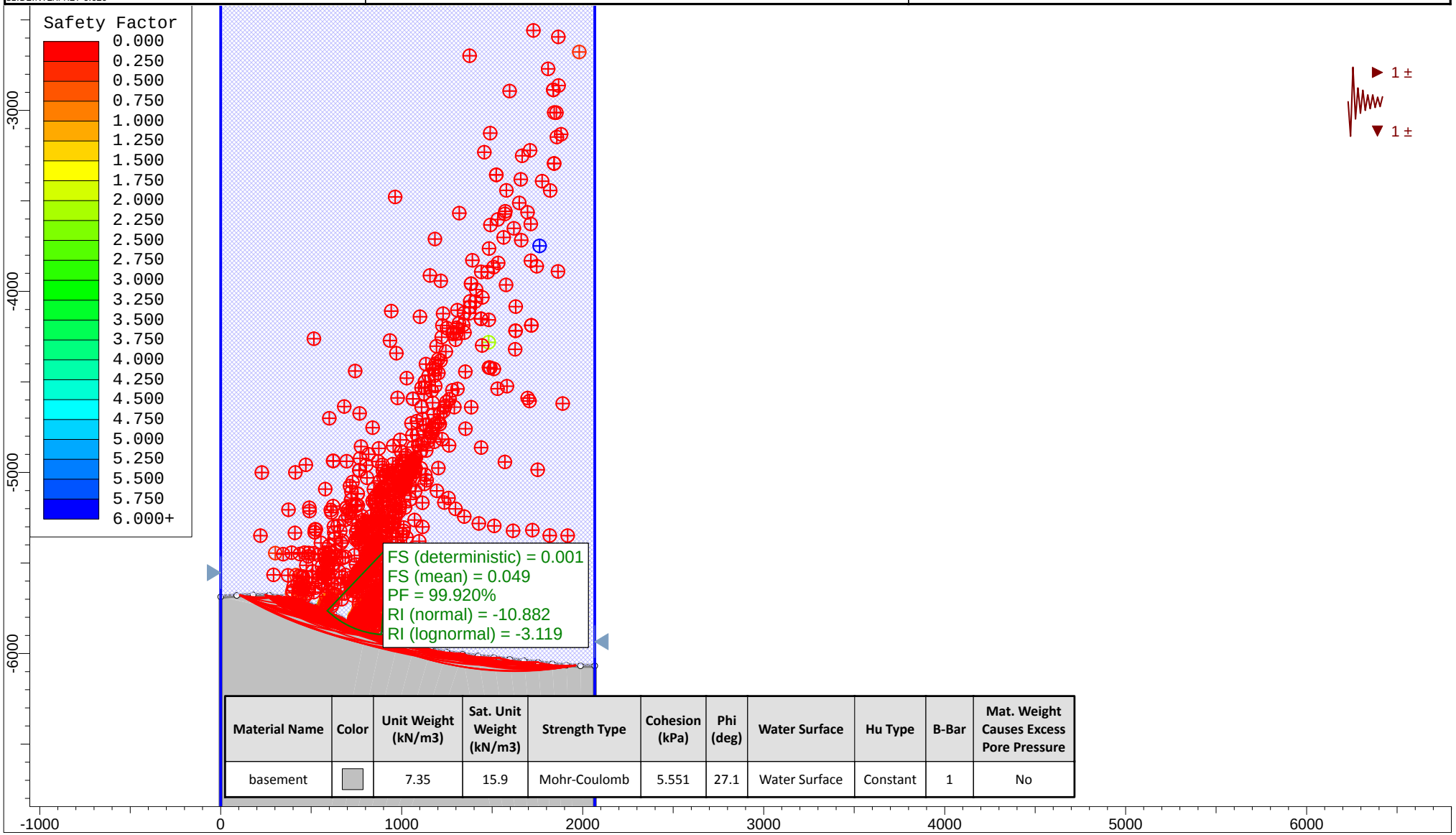
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 59PC Site 76		
	Drawn By	Jason R. Patton	Scale 1:20000	Company Oregon State University
	Date	3/25/2013, 3:32:59 PM		File Name RR0705_59_76_0g.sli



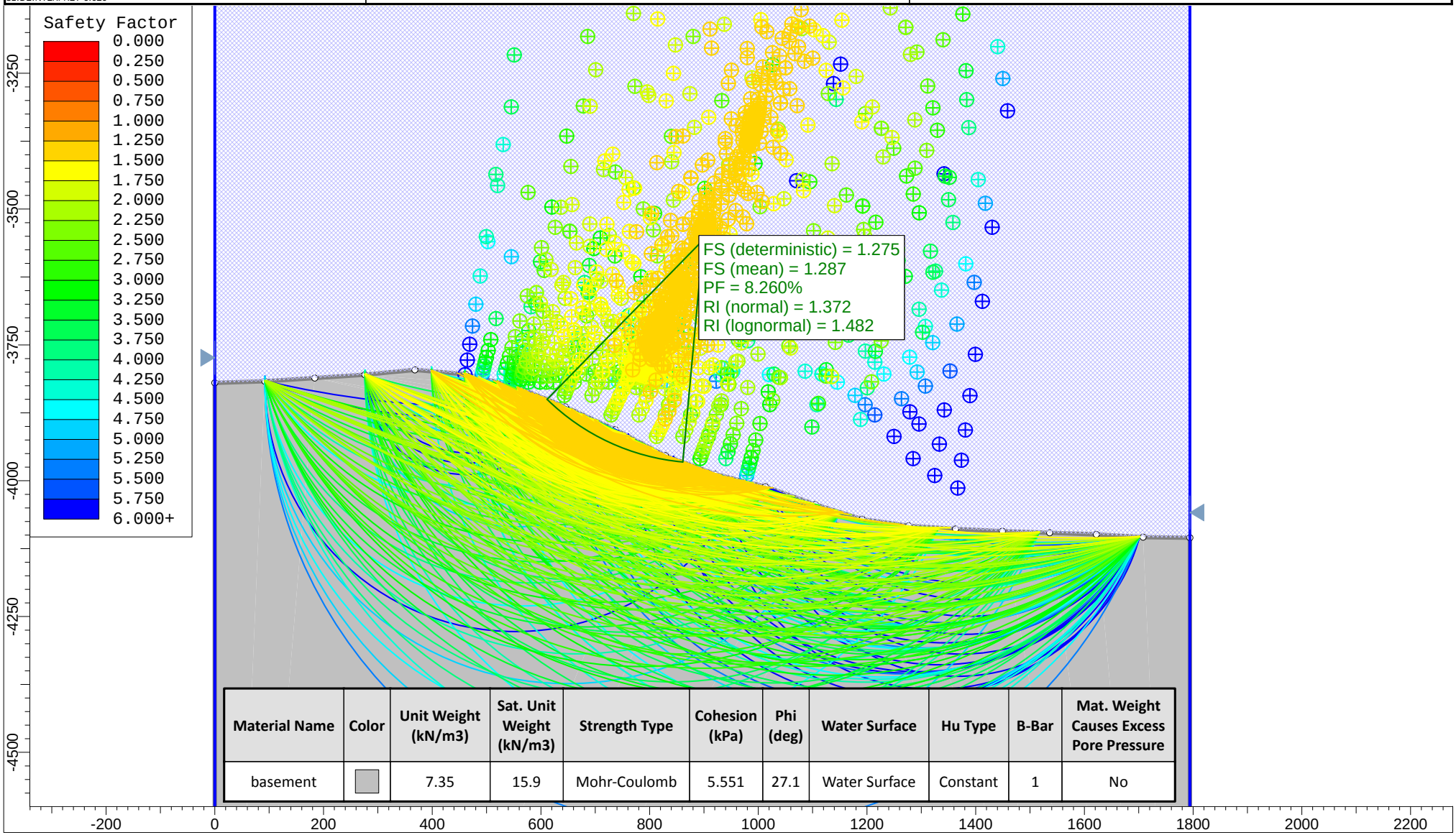
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 59PC Site 76		
	Drawn By	Jason R. Patton	Scale 1:30000	Company Oregon State University
	Date	3/25/2013, 3:32:59 PM		File Name RR0705_59_76_1g.sli



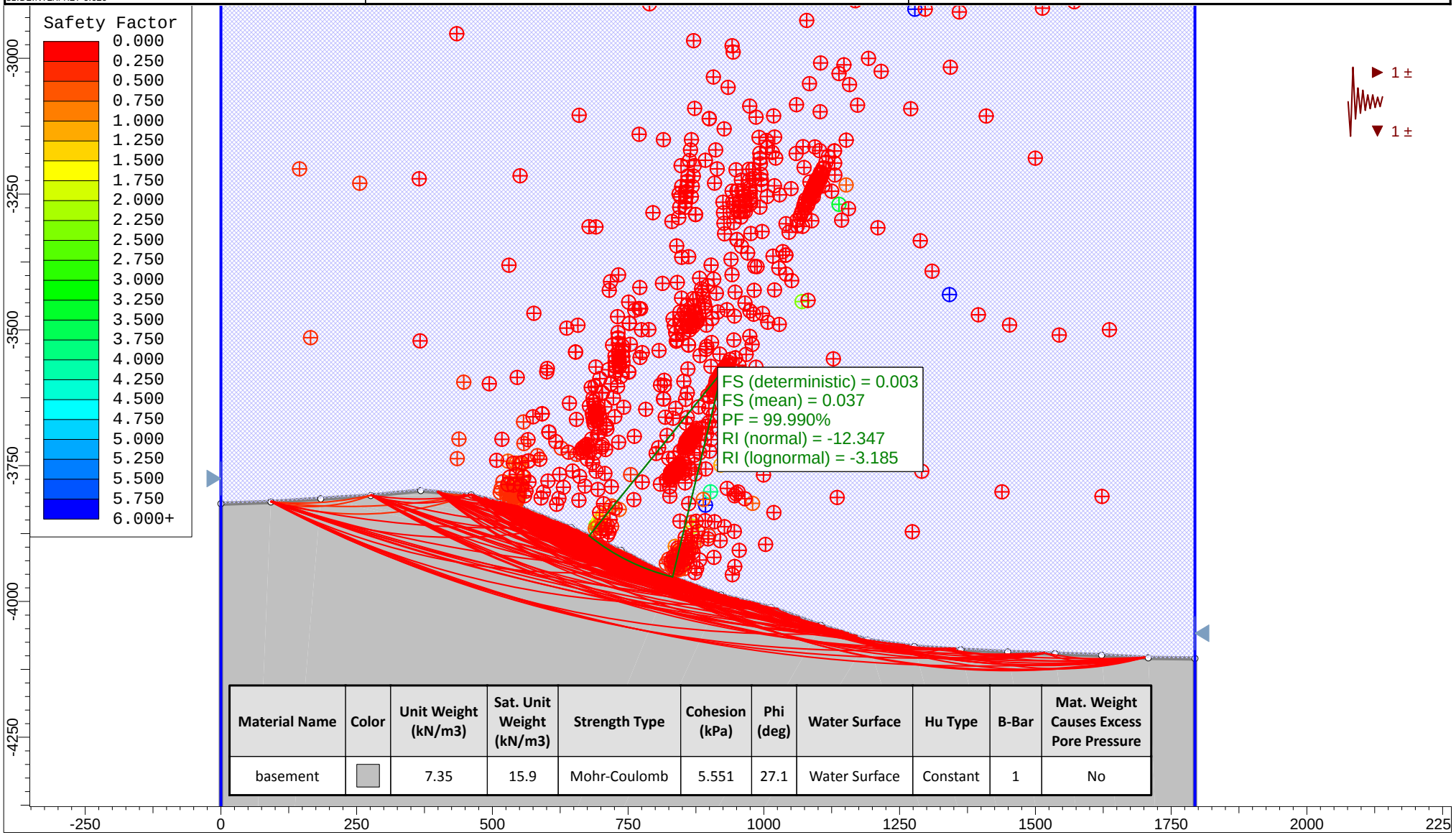
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 61PC Site 78		
	Drawn By	Jason R. Patton	Scale 1:10000	Company Oregon State University
	Date	3/25/2013		File Name RR0705_61_78_0g.sli



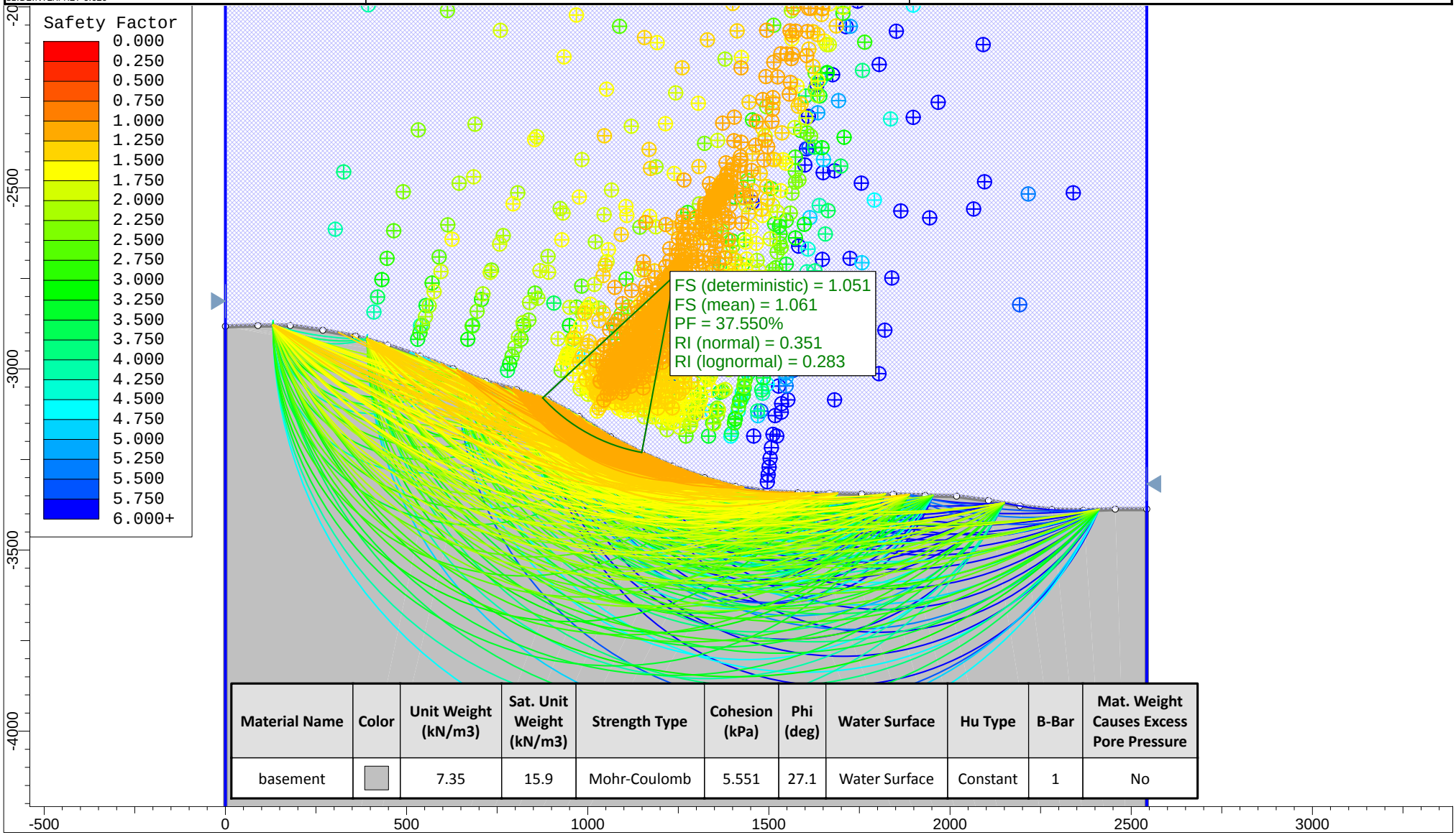
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 61PC Site 78		
	Drawn By	Jason R. Patton	Scale 1:10000	Company Oregon State University
	Date	3/25/2013		File Name RR0705_61_78_1g.sli



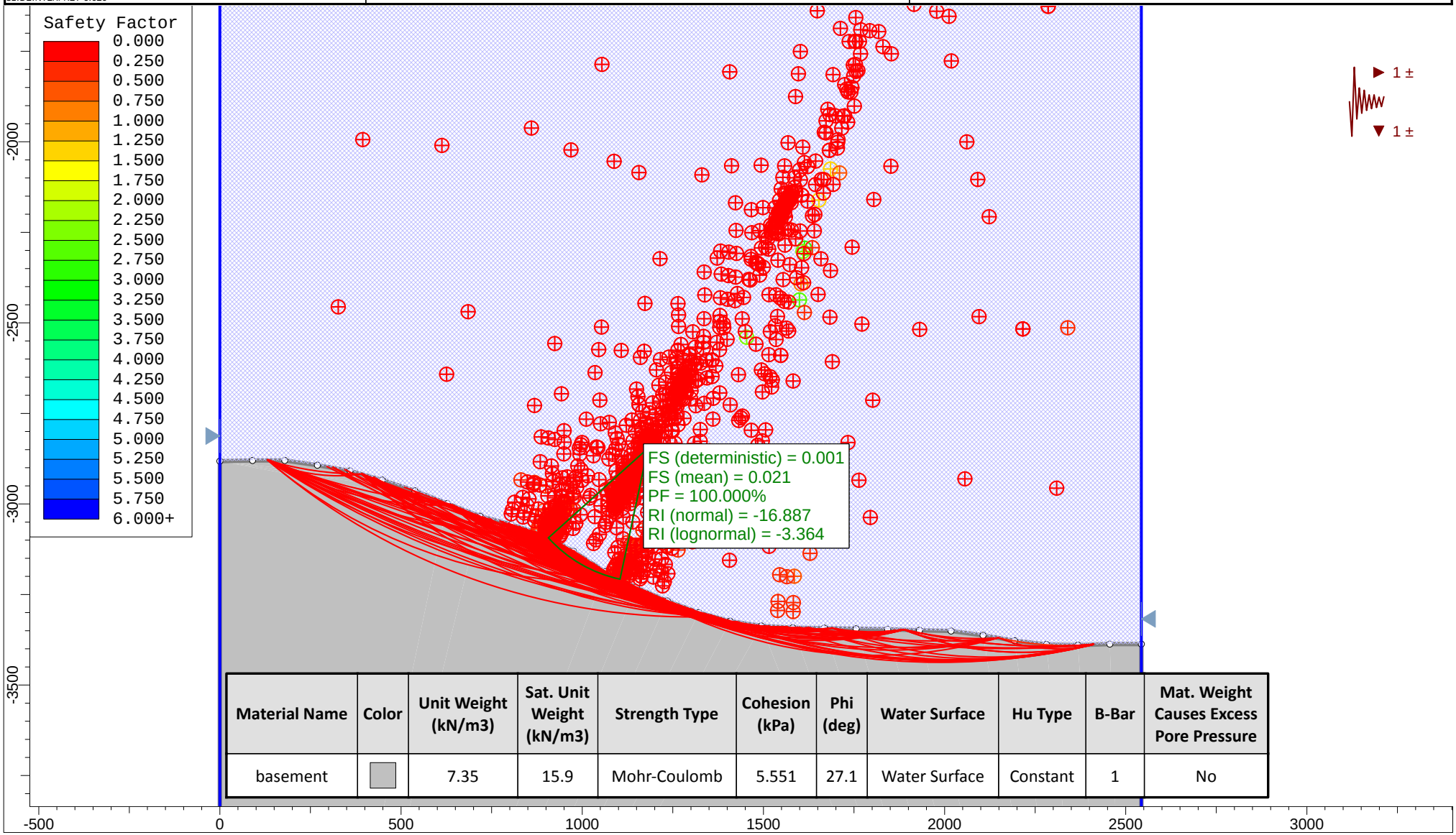
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 63PC Site 75		
	Drawn By: Jason R. Patton	Scale: 1:15000	Company: Oregon State University	
	Date: 3/25/2013		File Name: RR0705_63_75_0g.sli	



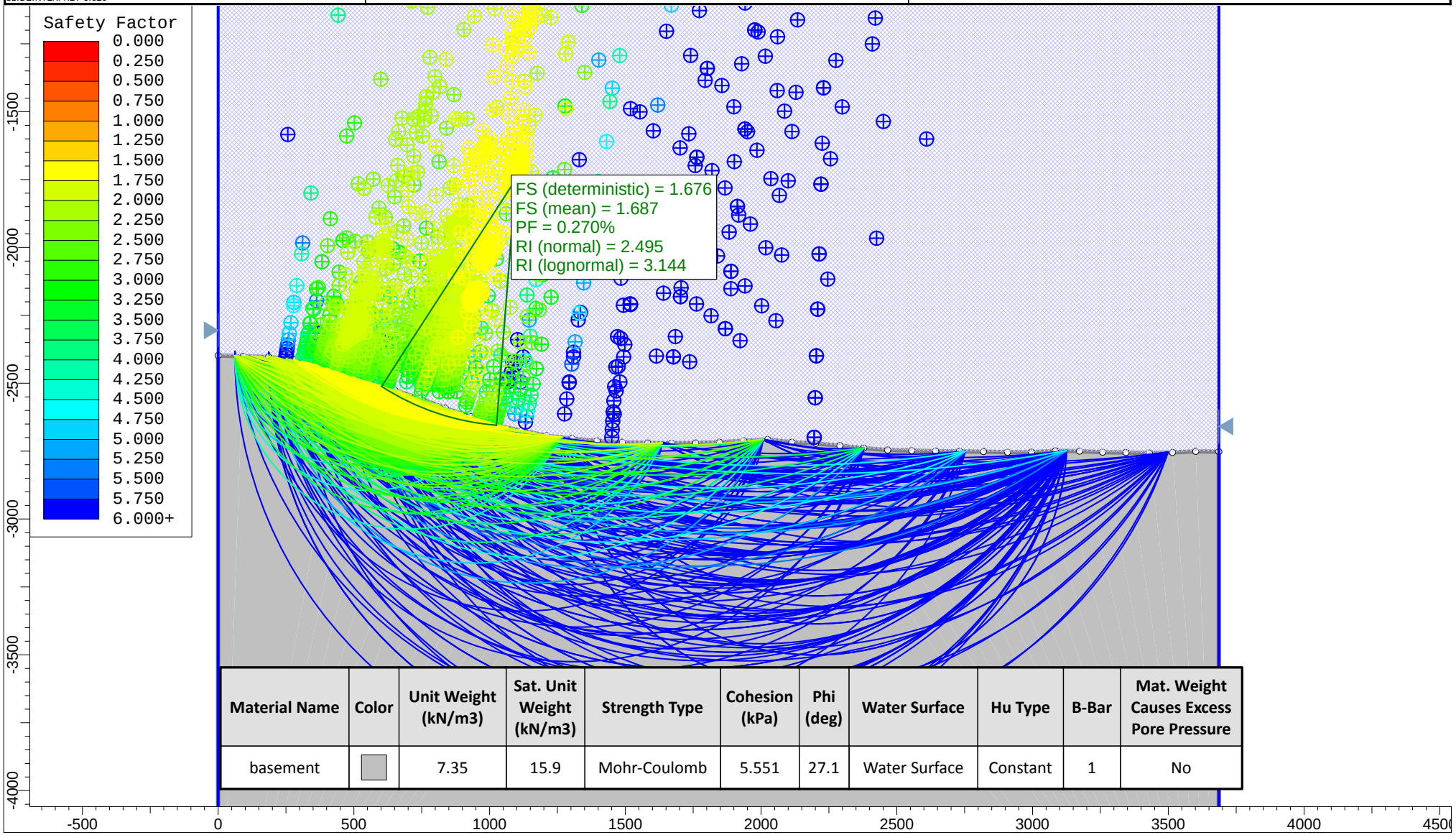
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 63PC Site 75		
	Drawn By	Jason R. Patton	Scale 1:15000	Company Oregon State University
	Date	3/25/2013		File Name RR0705_63_75_1g.sli



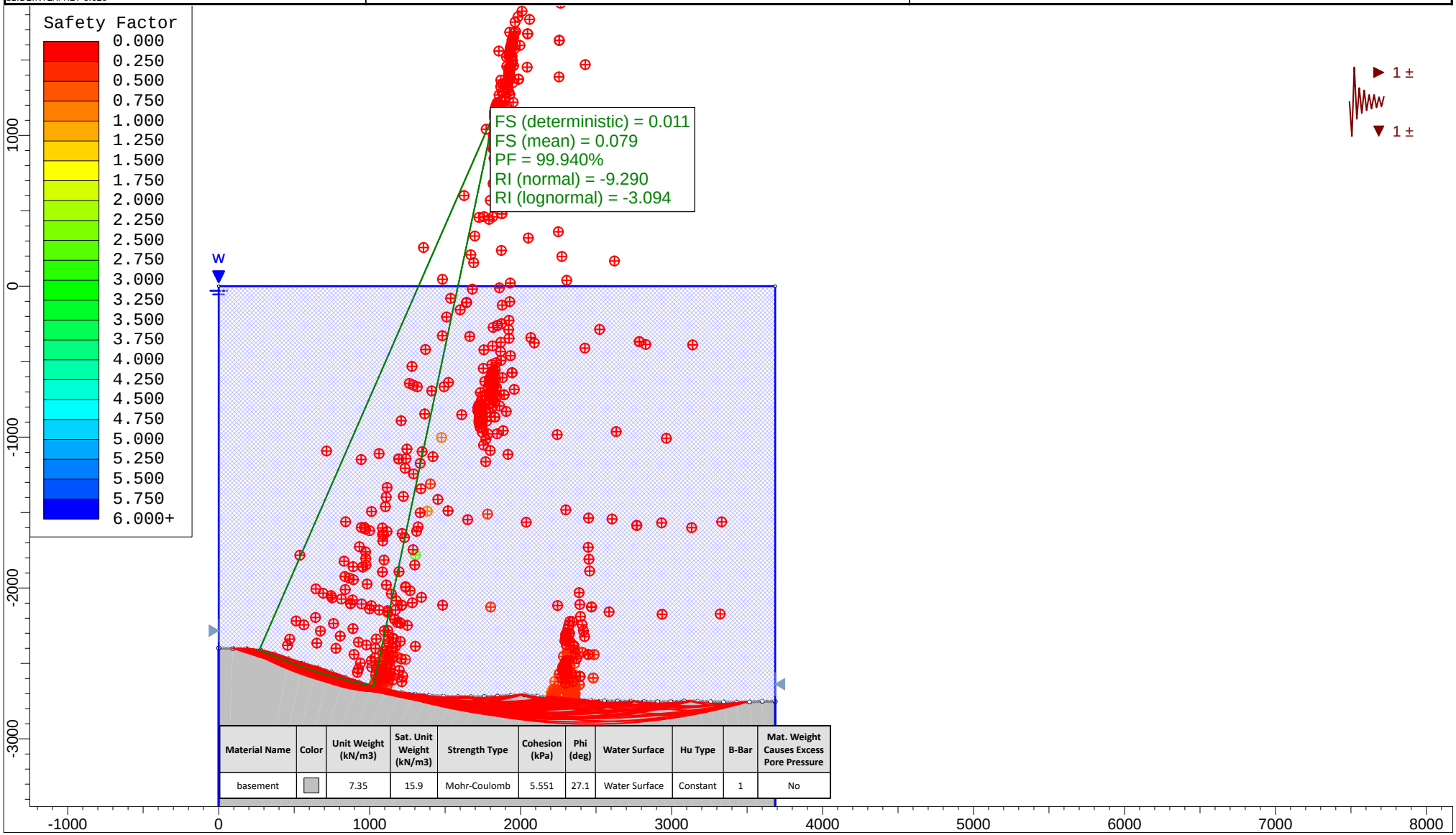
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 65PC Site 70		
	Drawn By	Jason R. Patton	Scale 1:20000	Company Oregon State University
	Date	3/25/2013		File Name RR0705_65_70_0g.sli



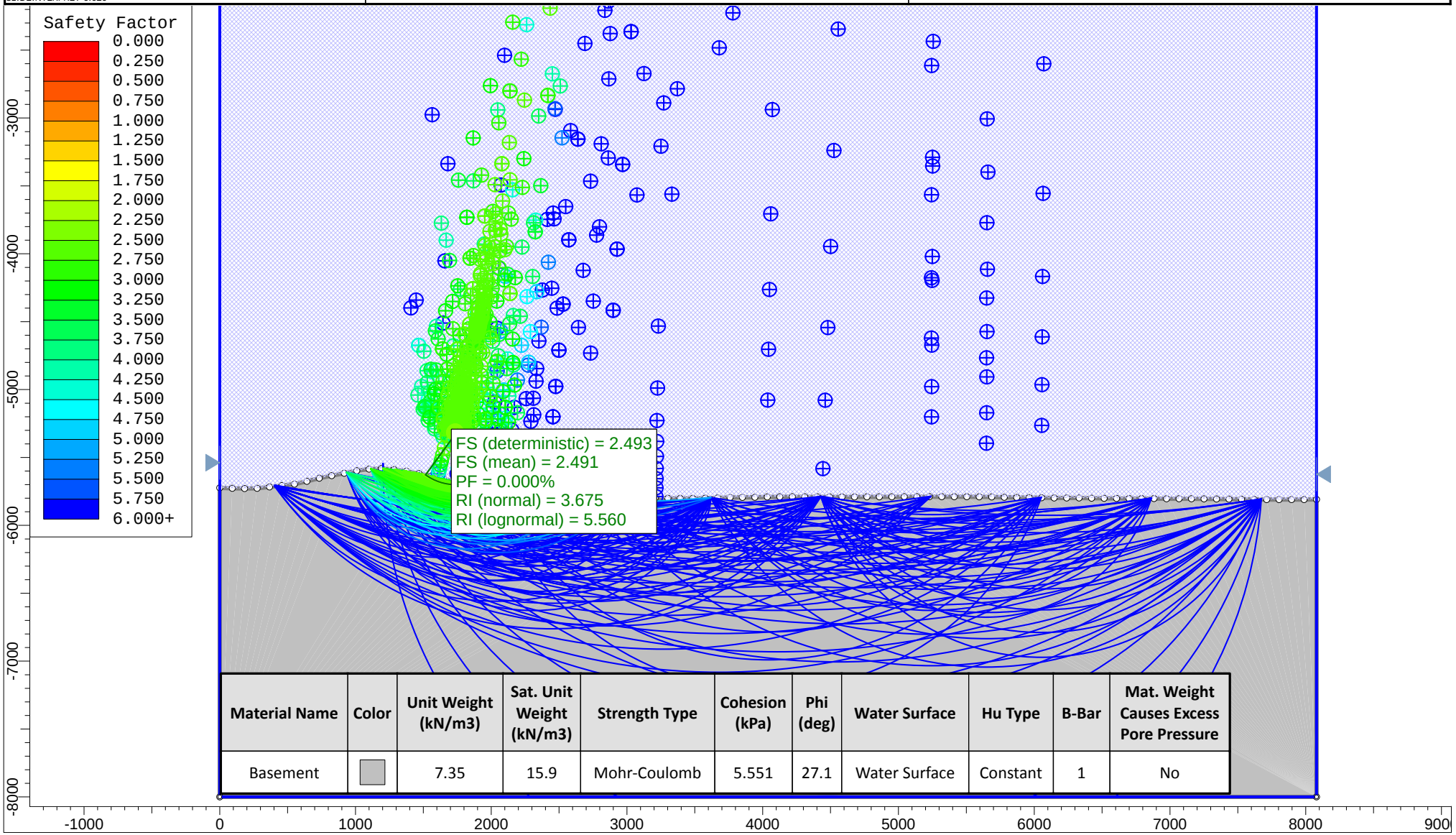
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 65PC Site 70		
	Drawn By	Jason R. Patton	Scale 1:36000	Company Oregon State University
	Date	3/25/2013		File Name RR0705_65_70_1g.slim



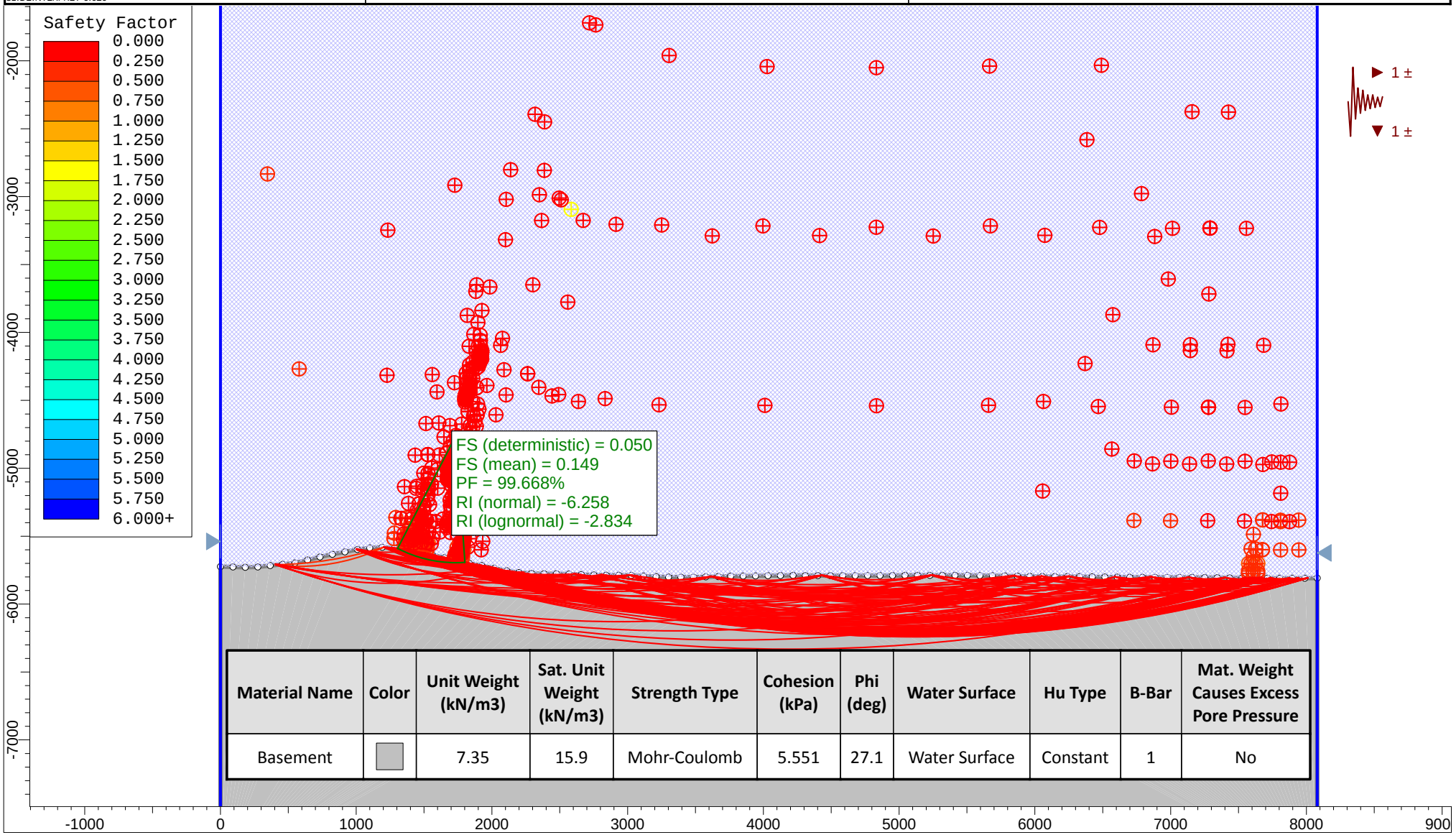
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 70PC Site 68		
	Drawn By	Jason R. Patton	Scale 1:40000	Company Oregon State University
SLIDEINTERPRET 6.020	Date	3/14/2013, 11:10:35 PM		File Name RR0705_70_68_1g.sli



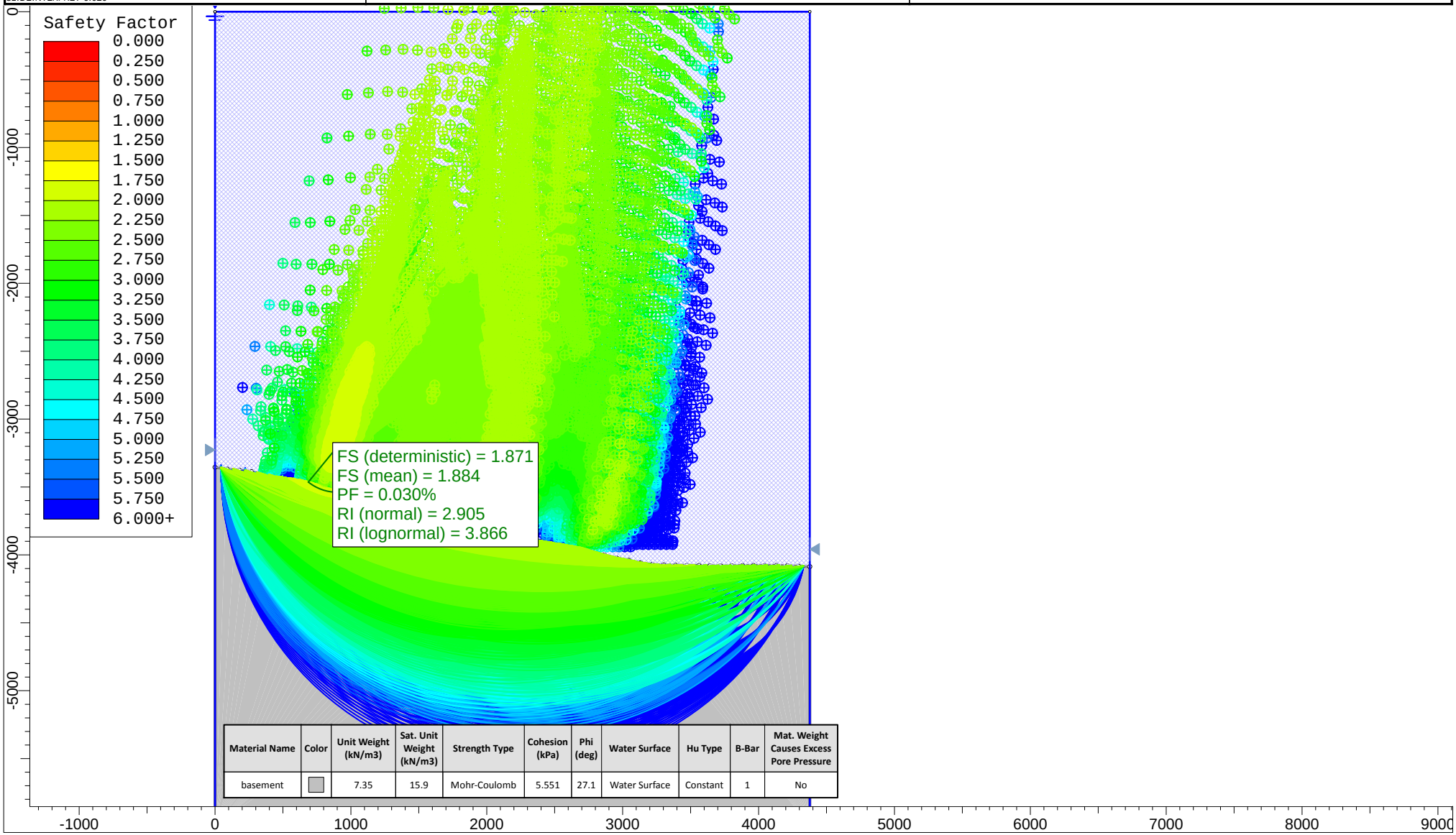
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
Basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 70PC Site 68		
	Drawn By	Jason R. Patton	Scale 1:40000	Company Oregon State University
	Date	3/14/2013, 11:10:35 PM		File Name RR0705_70_68_0g.sli



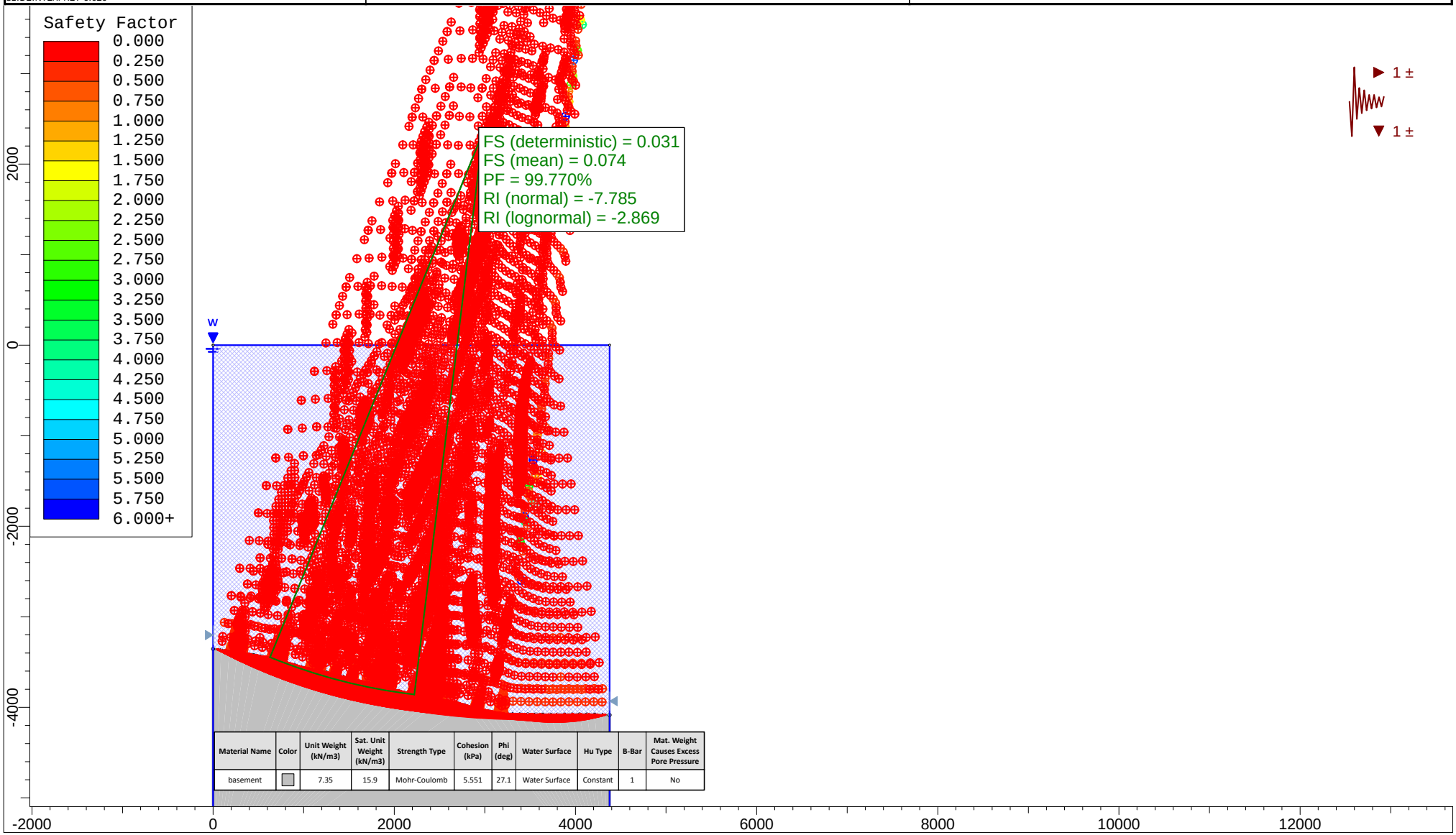
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
Basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	*Project*	Sumatra Submarine Slide		
	Analysis Description	Core RR0705 72PC Site 64		
	Drawn By Jason R. Patton	*Scale* 1:40000	*Company*	Oregon State University
	Date 3/14/2013		*File Name*	RR0705_72_64_0g.sli



Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

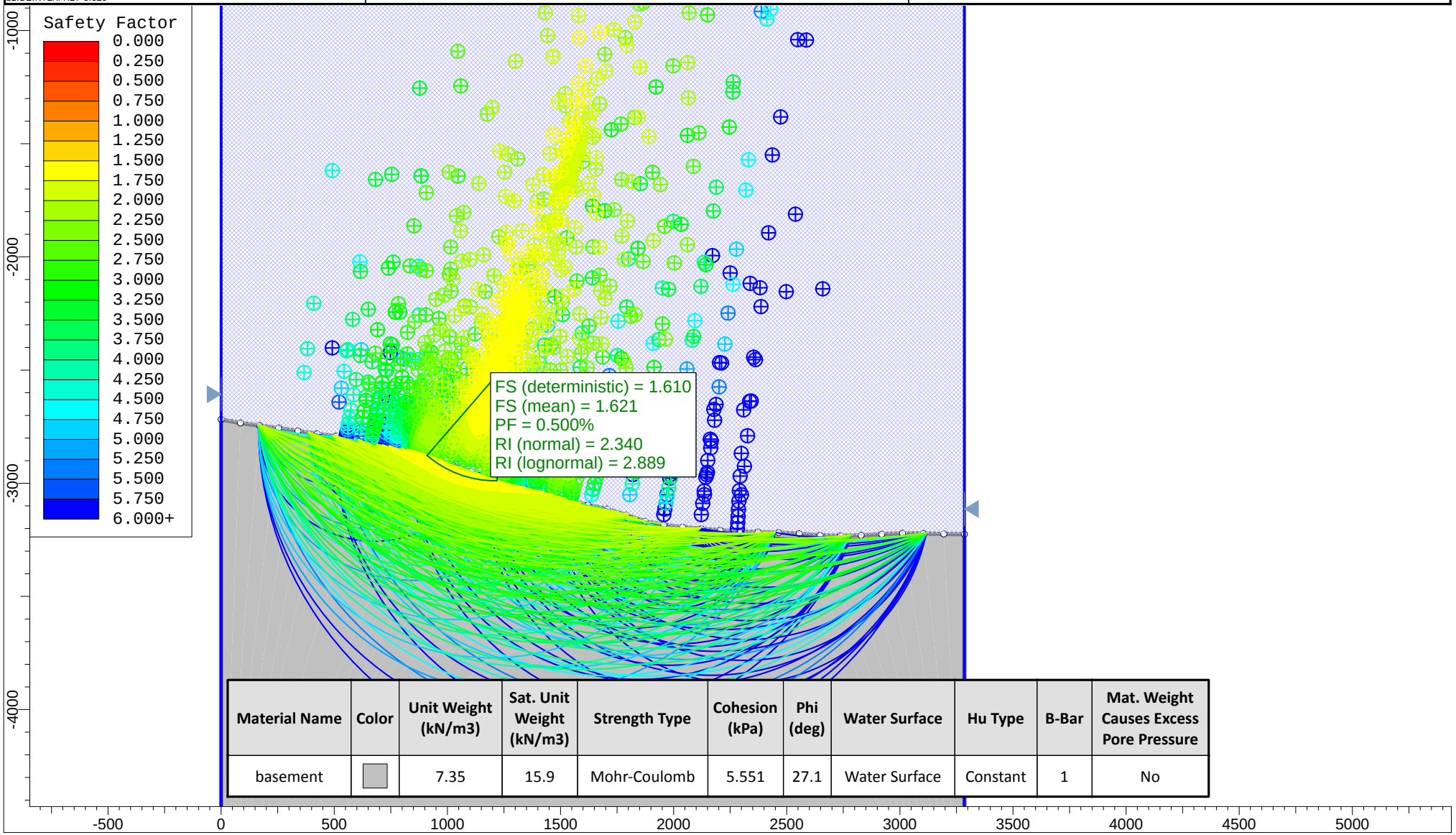
SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	Core RR0705 72PC Site 64		
	Drawn By	Jason R. Patton	Scale 1:60000	Company Oregon State University
	Date	3/14/2013		File Name RR0705_72_64_1g.sli



Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

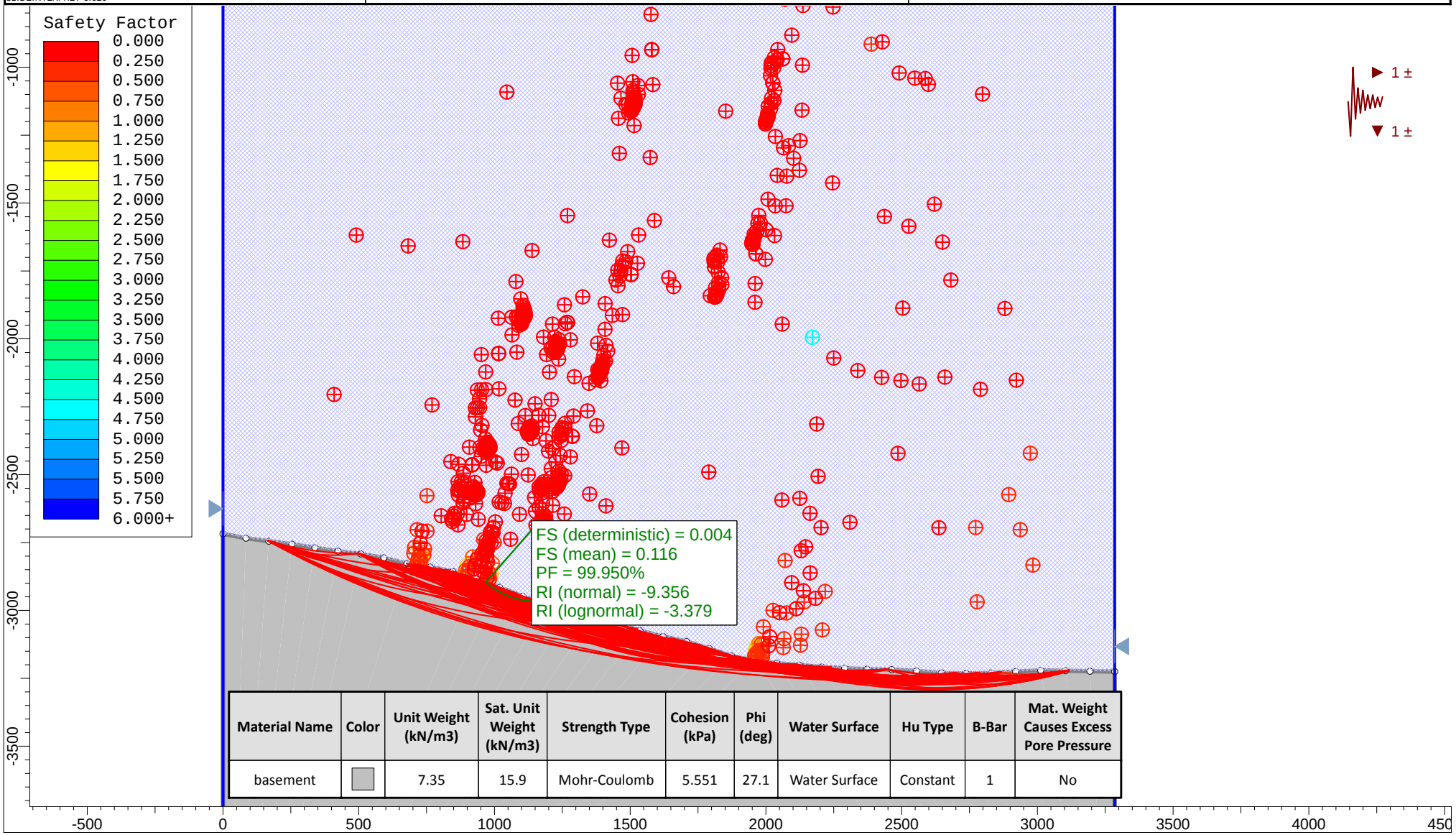
rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 76PC Site 63		
	Drawn By	Jason R. Patton	Scale 1:24000	Company Oregon State University
	Date	3/25/2013		File Name RR0705_76_63_0g.sli

SLIDEINTERPRET 6.020



Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

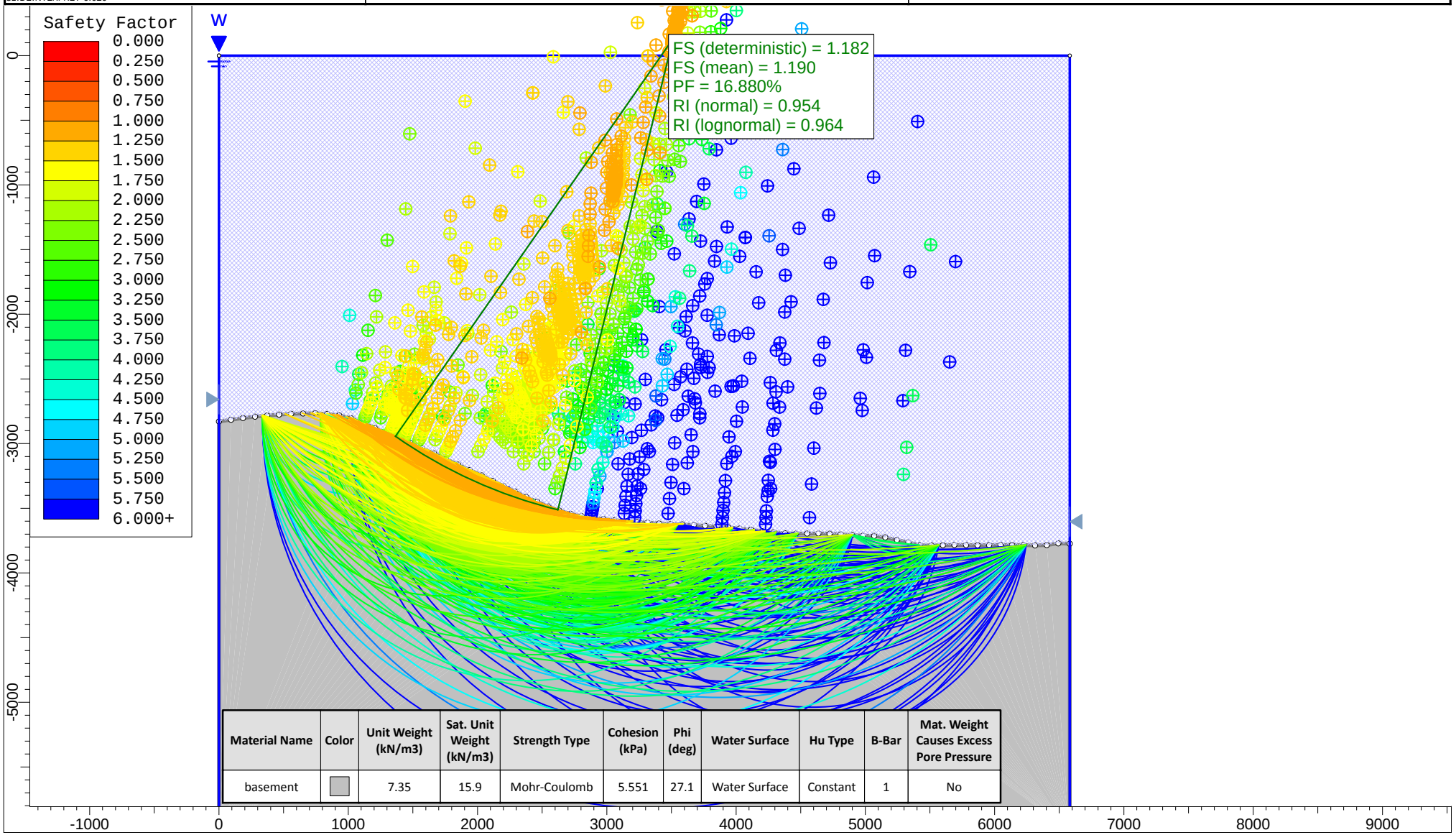
SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 76PC Site 63		
	Drawn By	Jason R. Patton	Scale 1:20000	Company Oregon State University
	Date	3/25/2013		File Name RR0705_76_63_0g.sli



Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 76PC Site 63		
	Drawn By	Jason R. Patton	Scale 1:42000	Company Oregon State University
	Date	3/25/2013		File Name RR0705_77_58_0g.sli

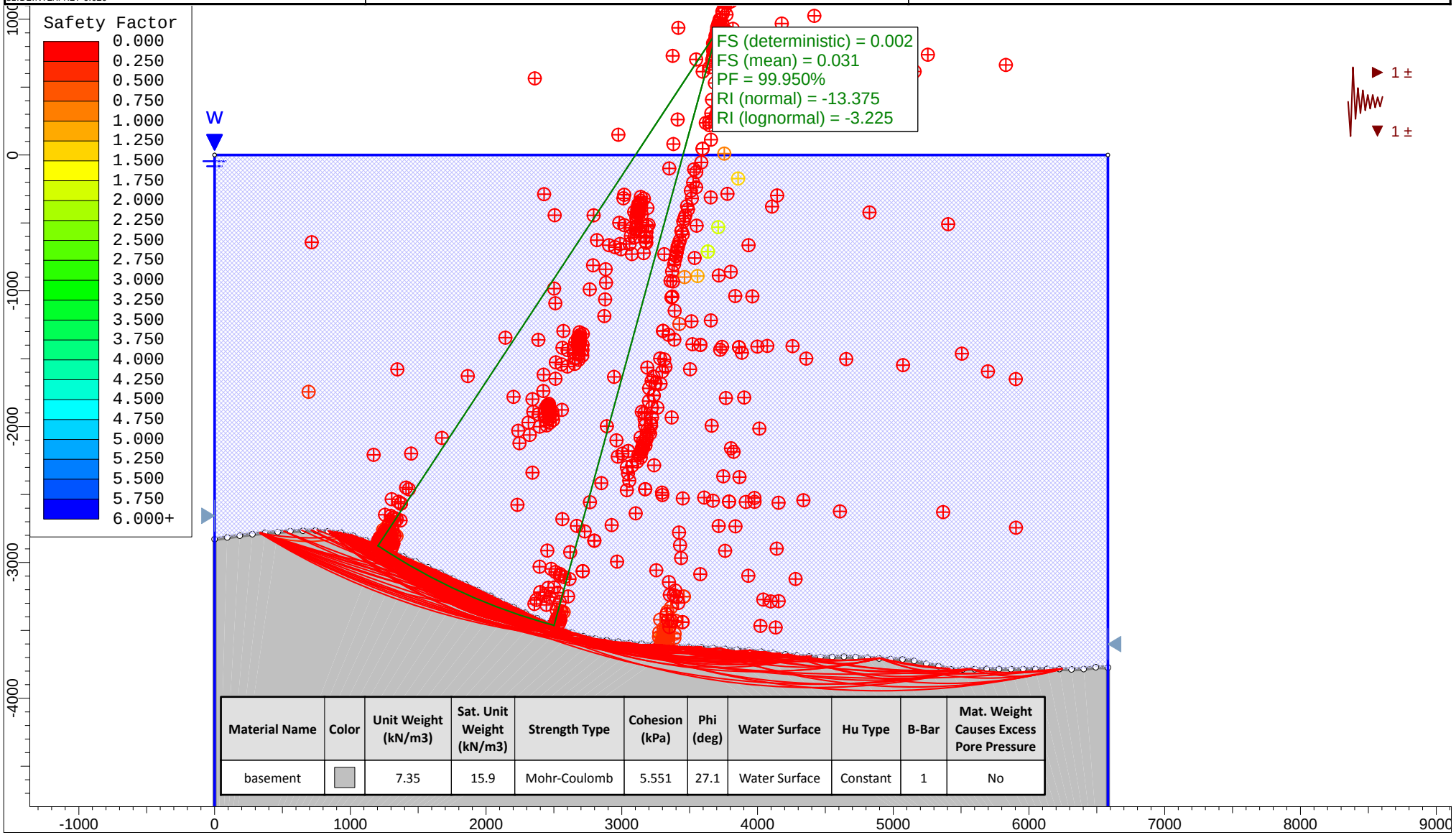
SLIDEINTERPRET 6.020



Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

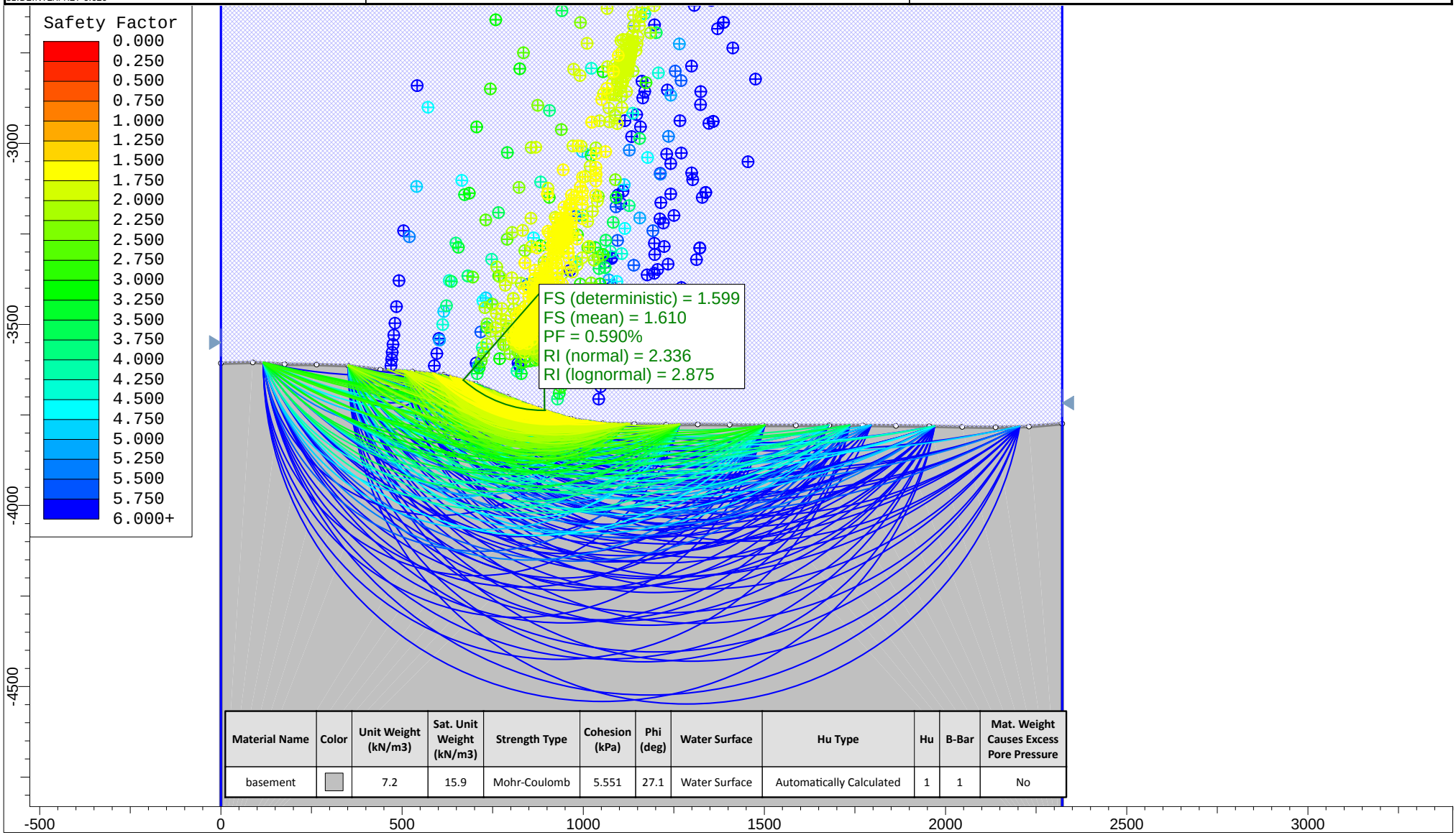
rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 76PC Site 63		
	Drawn By	Jason R. Patton	Scale 1:40000	Company Oregon State University
	Date	3/25/2013		File Name RR0705_77_58_0g.sli

SLIDEINTERPRET 6.020



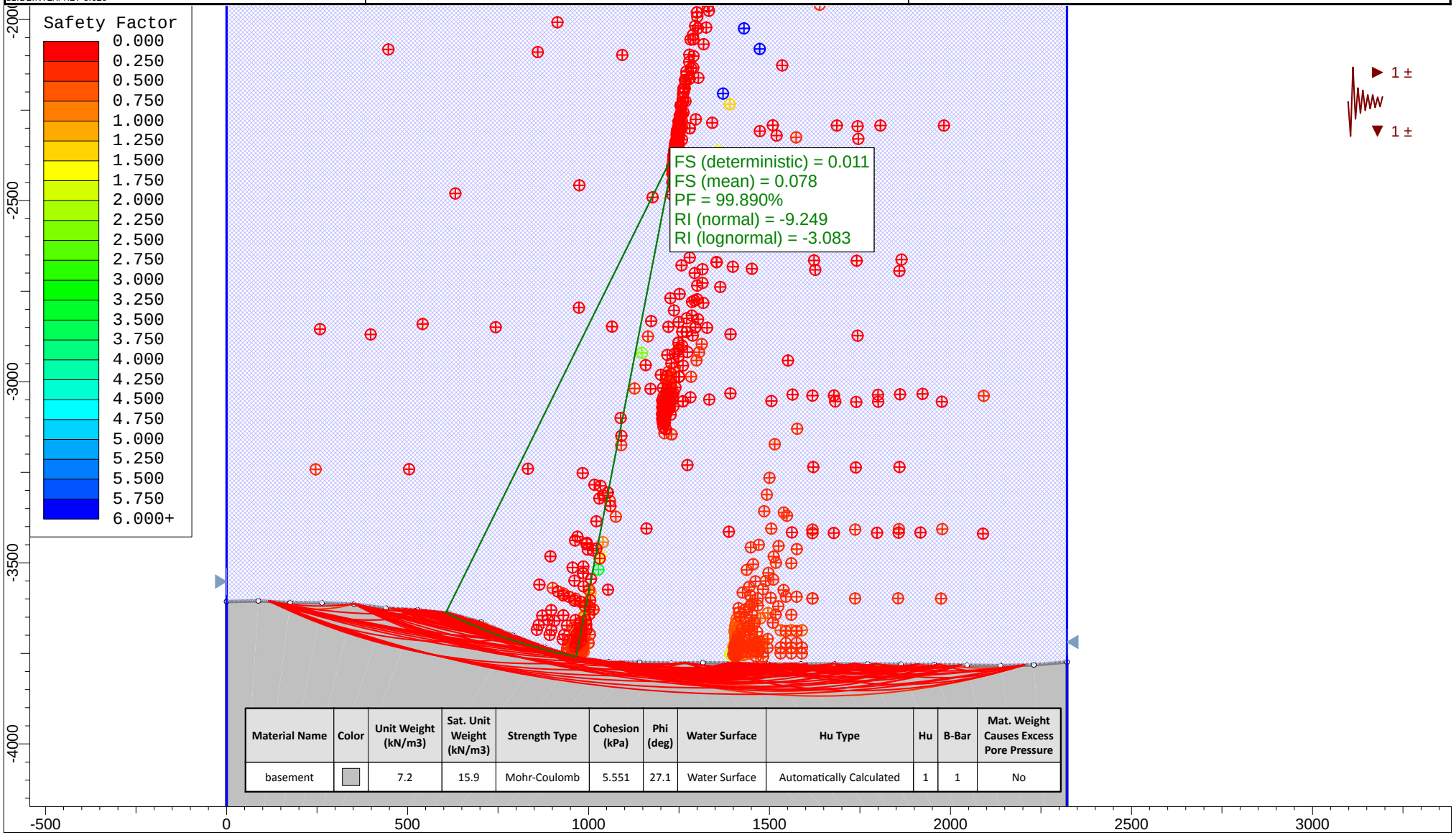
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 77PC Site 61		
	Drawn By	Jason R. Patton	Scale 1:15000	Company Oregon State University
	Date	3/25/2013		File Name RR0705_77_61_0g.sli



Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.2	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Automatically Calculated	1	1	No

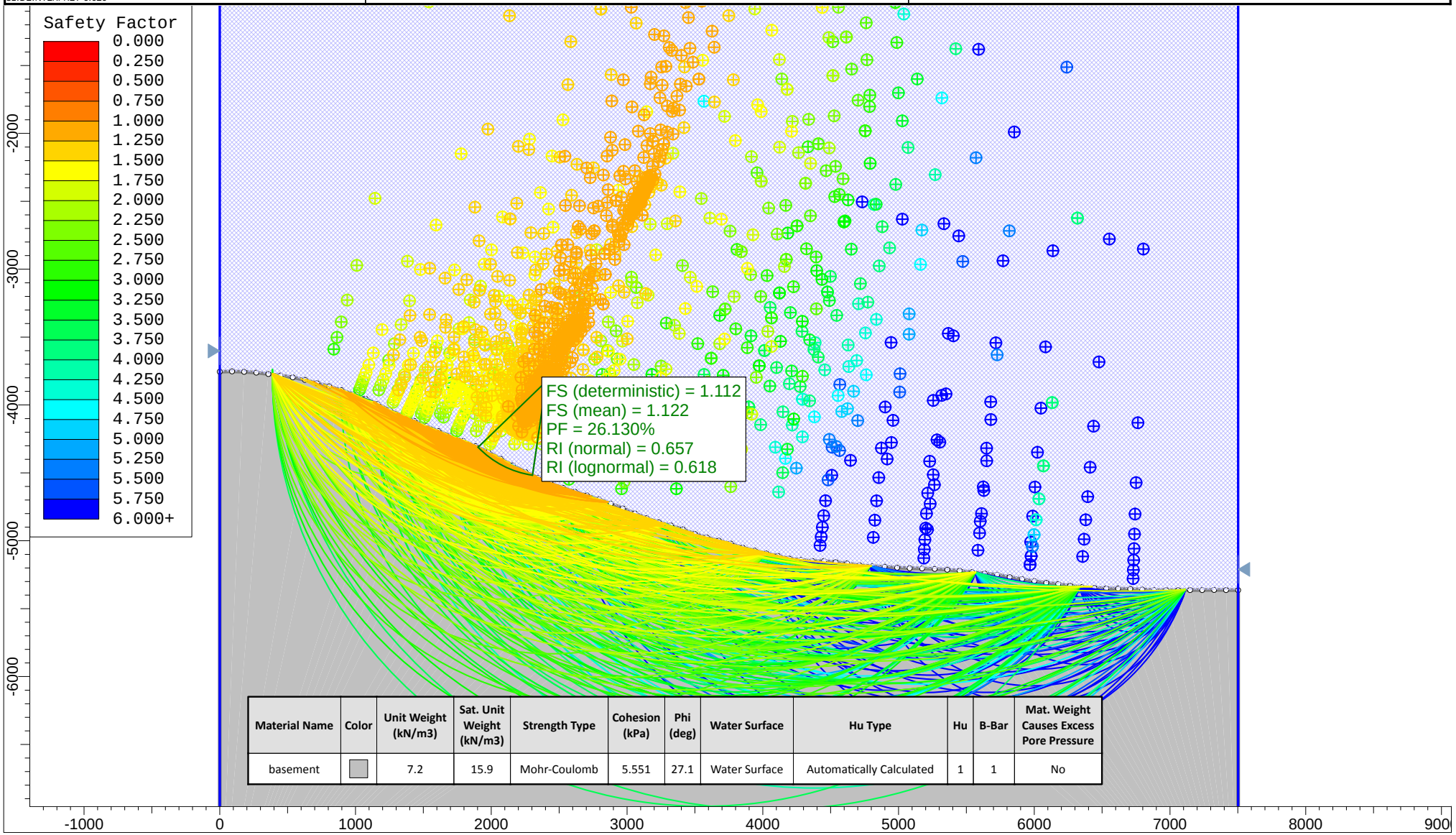
SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 77PC Site 61		
	Drawn By	Jason R. Patton	Scale 1:15000	Company Oregon State University
	Date	3/25/2013		File Name RR0705_77_61_1g.sli



Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.2	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Automatically Calculated	1	1	No

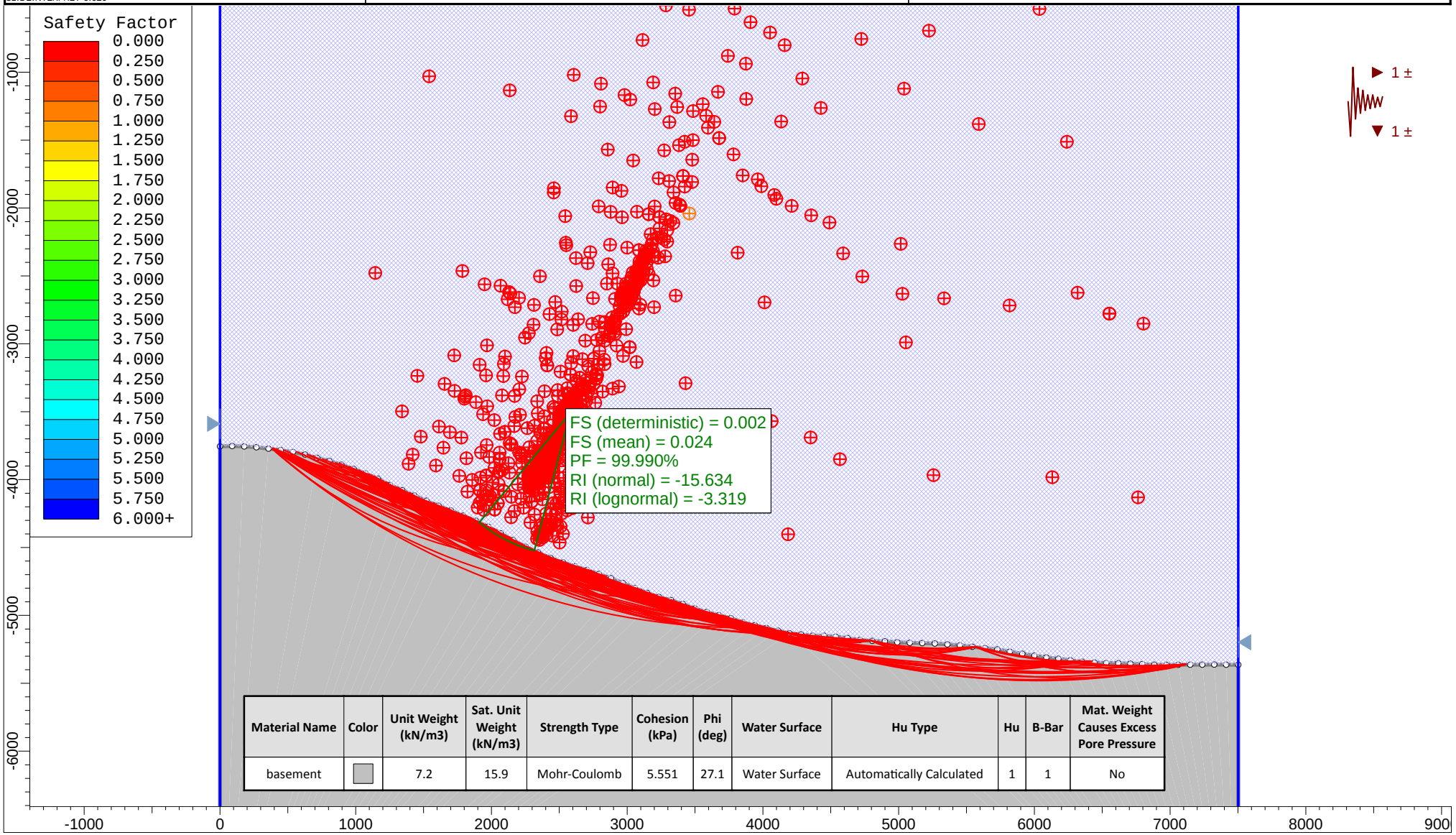
rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 78PC Site 57		
	Drawn By	Jason R. Patton	Scale 1:40000	Company Oregon State University
	Date	3/26/2013		File Name RR0705_78_57_0g.sli

SLIDEINTERPRET 6.020



Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.2	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Automatically Calculated	1	1	No

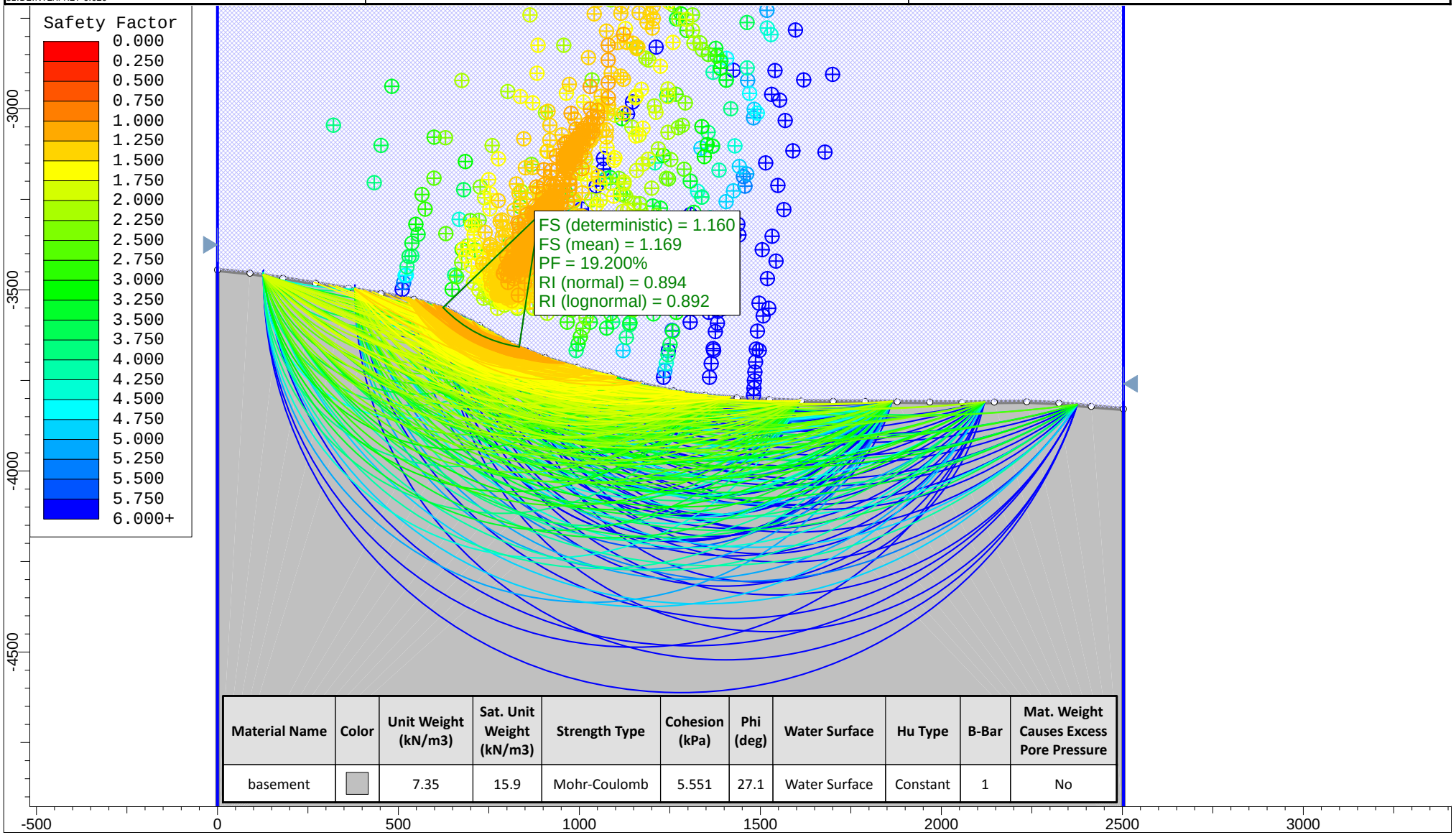
SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 78PC Site 57		
	Drawn By	Jason R. Patton	Scale 1:40000	Company Oregon State University
	Date	3/26/2013		File Name RR0705_78_57_1g.sli



Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.2	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Automatically Calculated	1	1	No

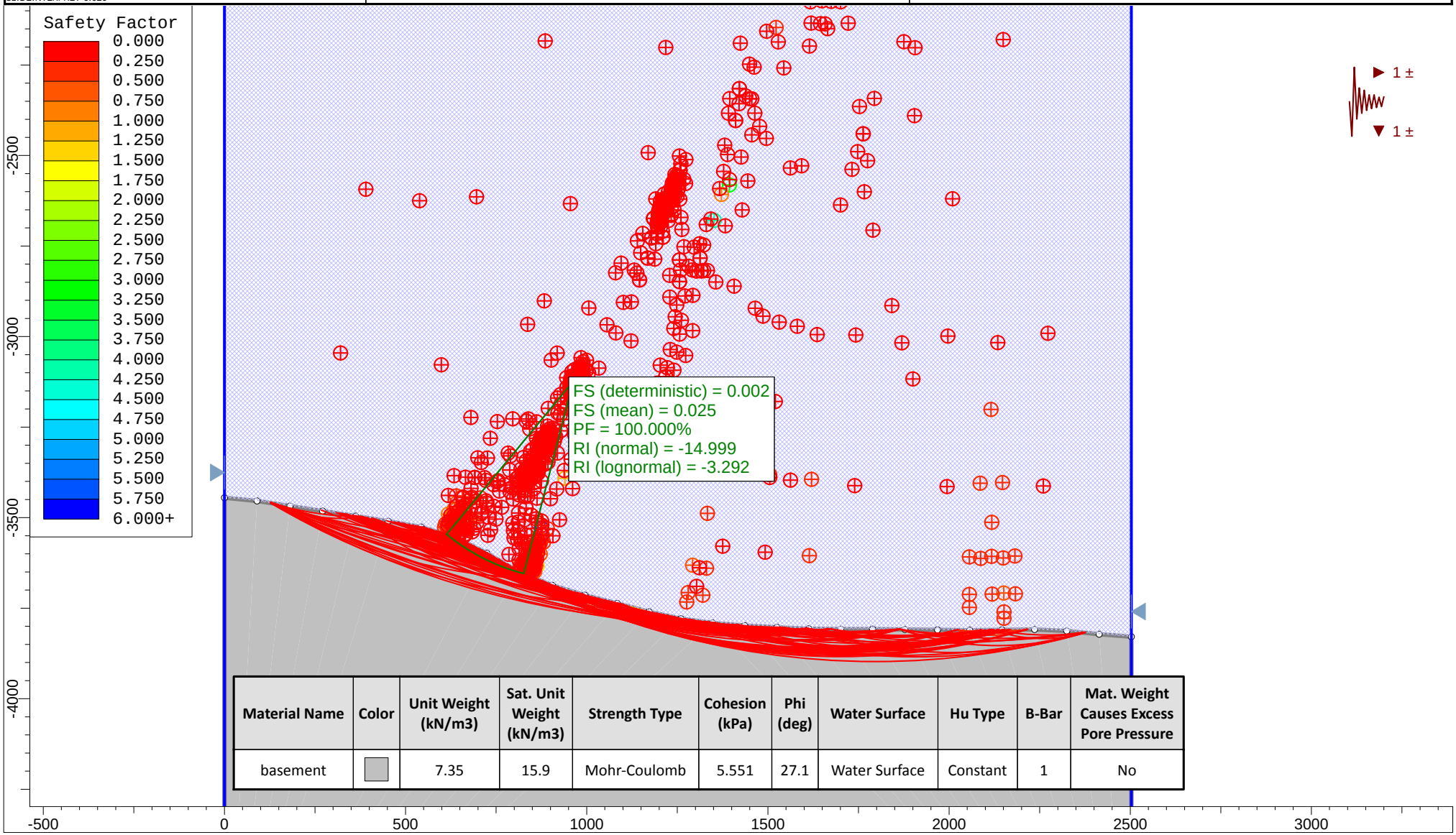
rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 79PC Site 54		
	Drawn By	Jason R. Patton	Scale 1:15000	Company Oregon State University
	Date	3/24/2013		File Name RR0705_79_54_0g.sli

SLIDEINTERPRET 6.020



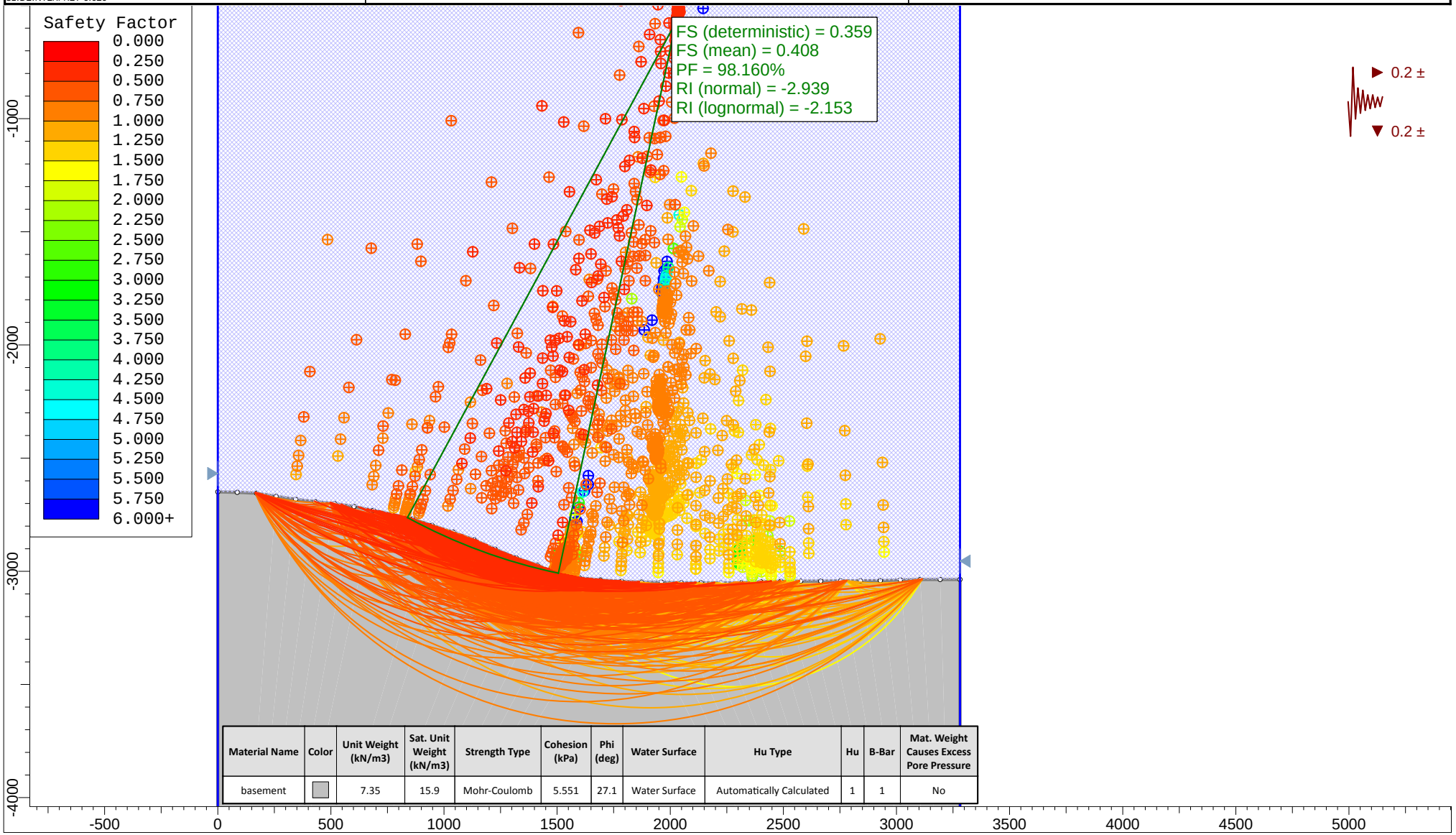
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 79PC Site 54		
	Drawn By	Jason R. Patton	Scale 1:15000	Company Oregon State University
	Date	3/24/2013		File Name RR0705_79_54_1g.sli



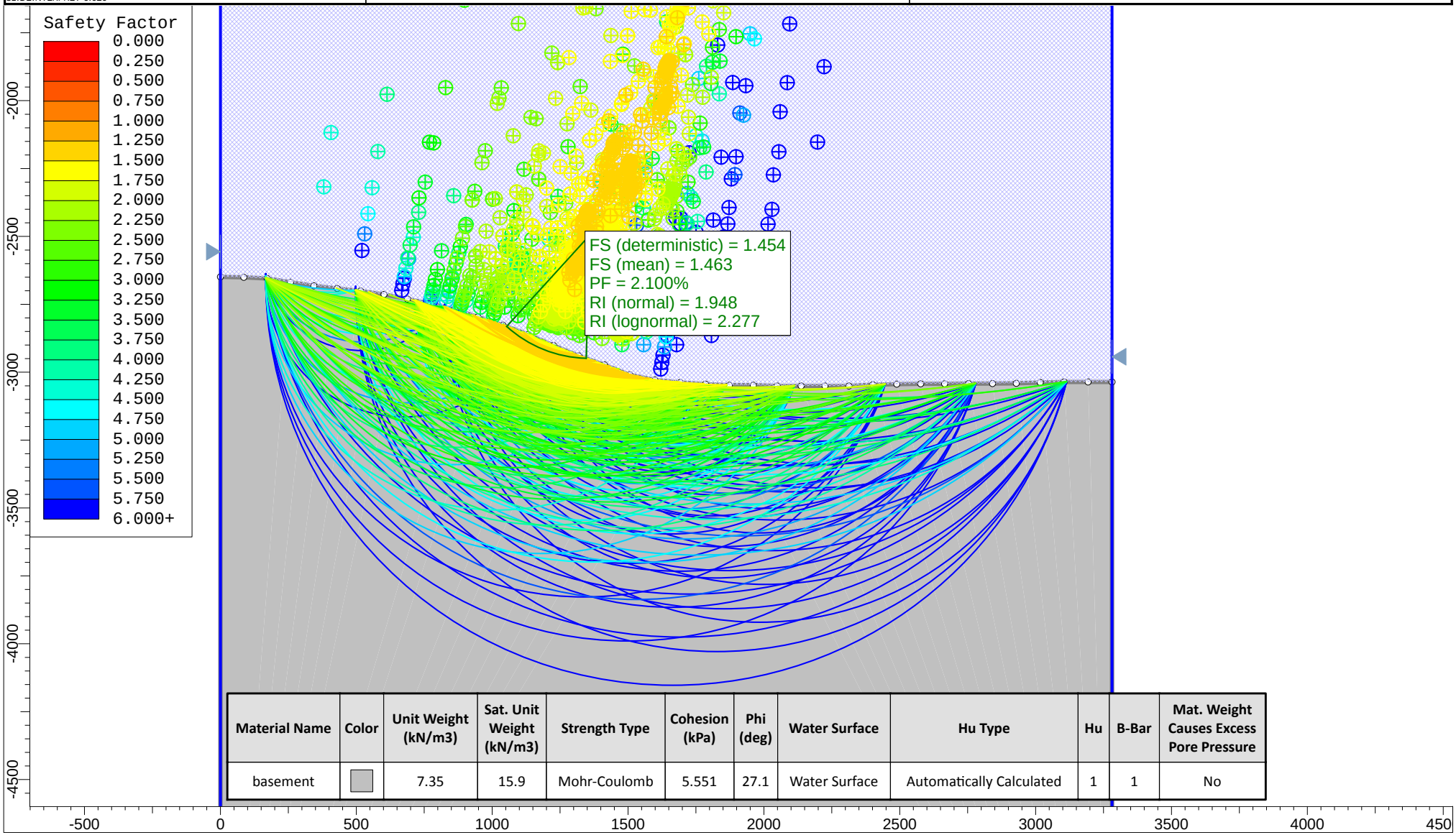
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 83PC Site 47		
	Drawn By	Jason R. Patton	Scale 1:24000	Company Oregon State University
	Date	3/26/2013		File Name RR0705_83_47_02g.sli



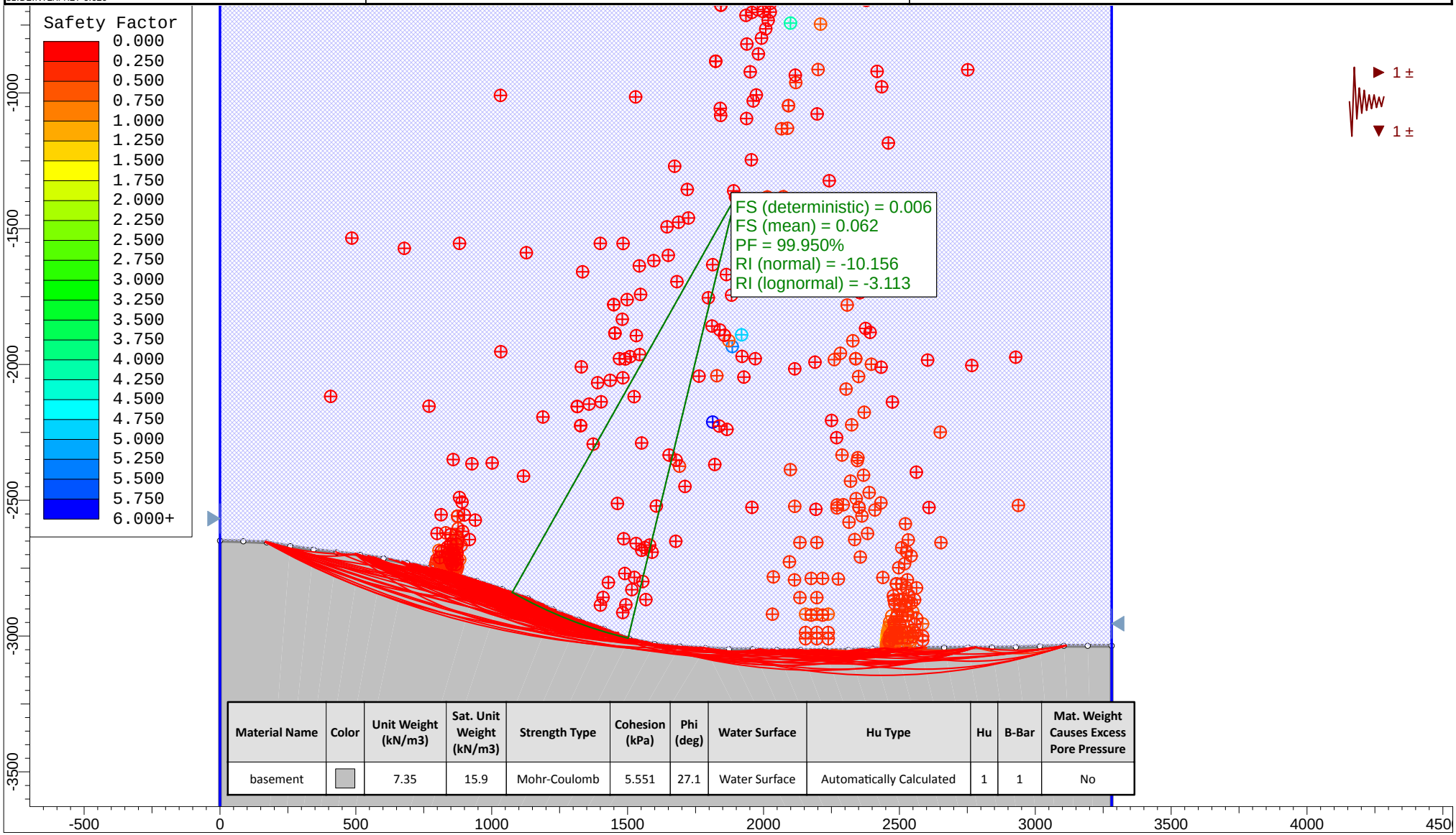
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Automatically Calculated	1	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 83PC Site 47		
	Drawn By: Jason R. Patton	Scale: 1:20000	Company: Oregon State University	
	Date: 3/26/2013		File Name: RR0705_83_47_0g.sli	



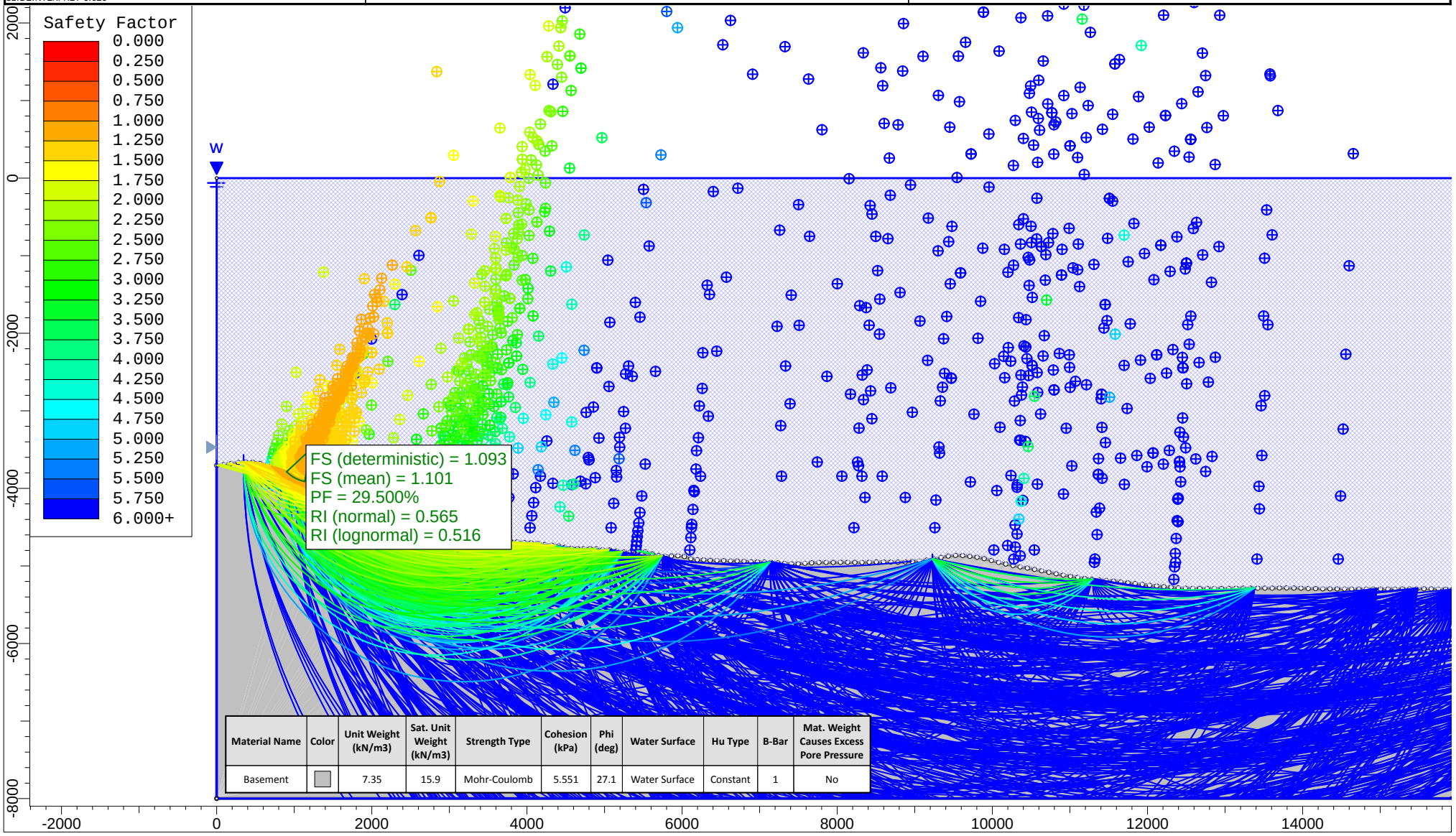
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Automatically Calculated	1	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 83PC Site 47		
	Drawn By	Jason R. Patton	Scale 1:20000	Company Oregon State University
	Date	3/26/2013		File Name RR0705_83_47_1g.sli



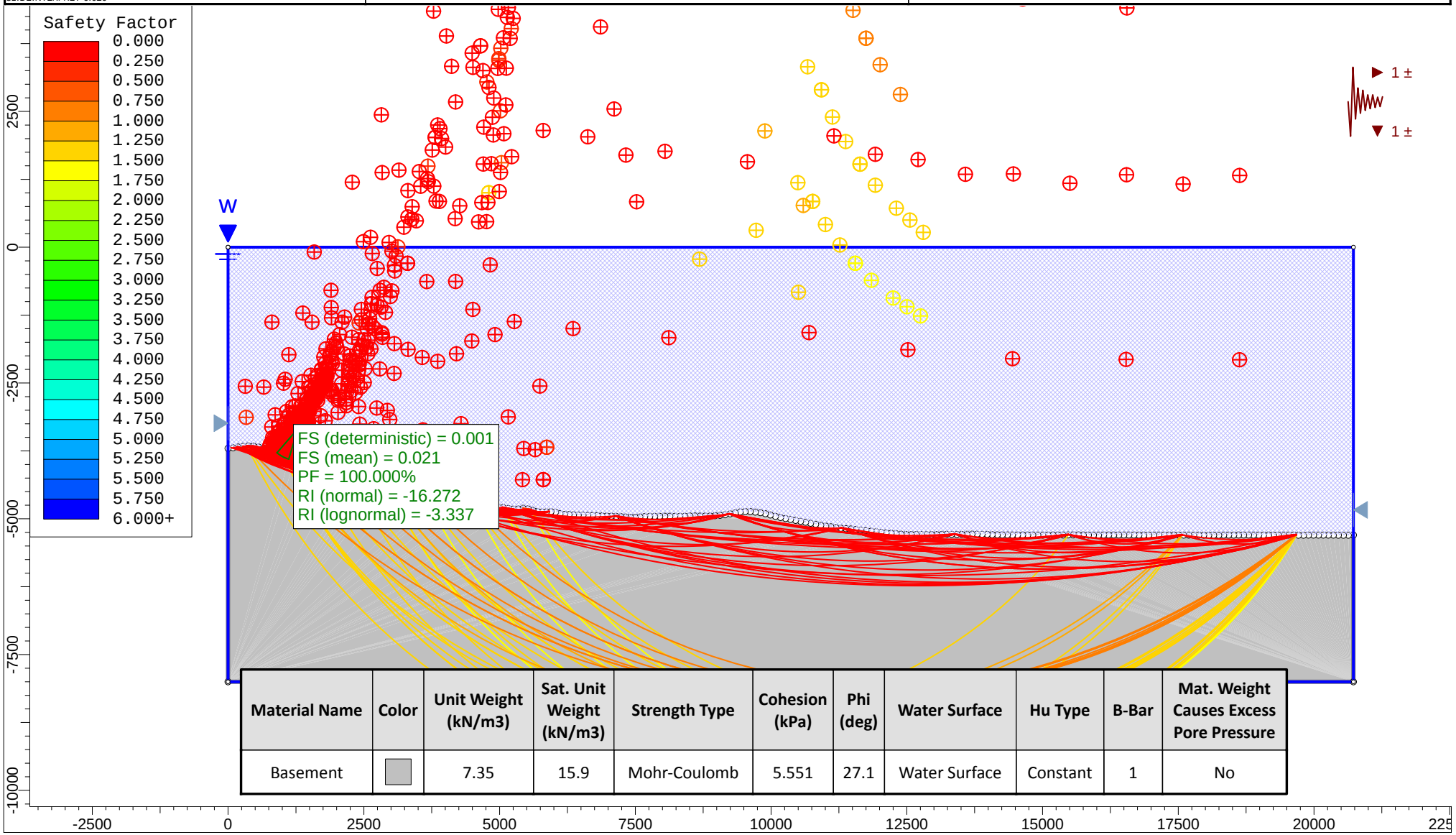
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Automatically Calculated	1	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 84PC Site 49		
	Drawn By	Jason R. Patton	Scale 1:70000	Company Oregon State University
	Date	3/24/2013		File Name RR0705_84_49_0g.sli



Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
Basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

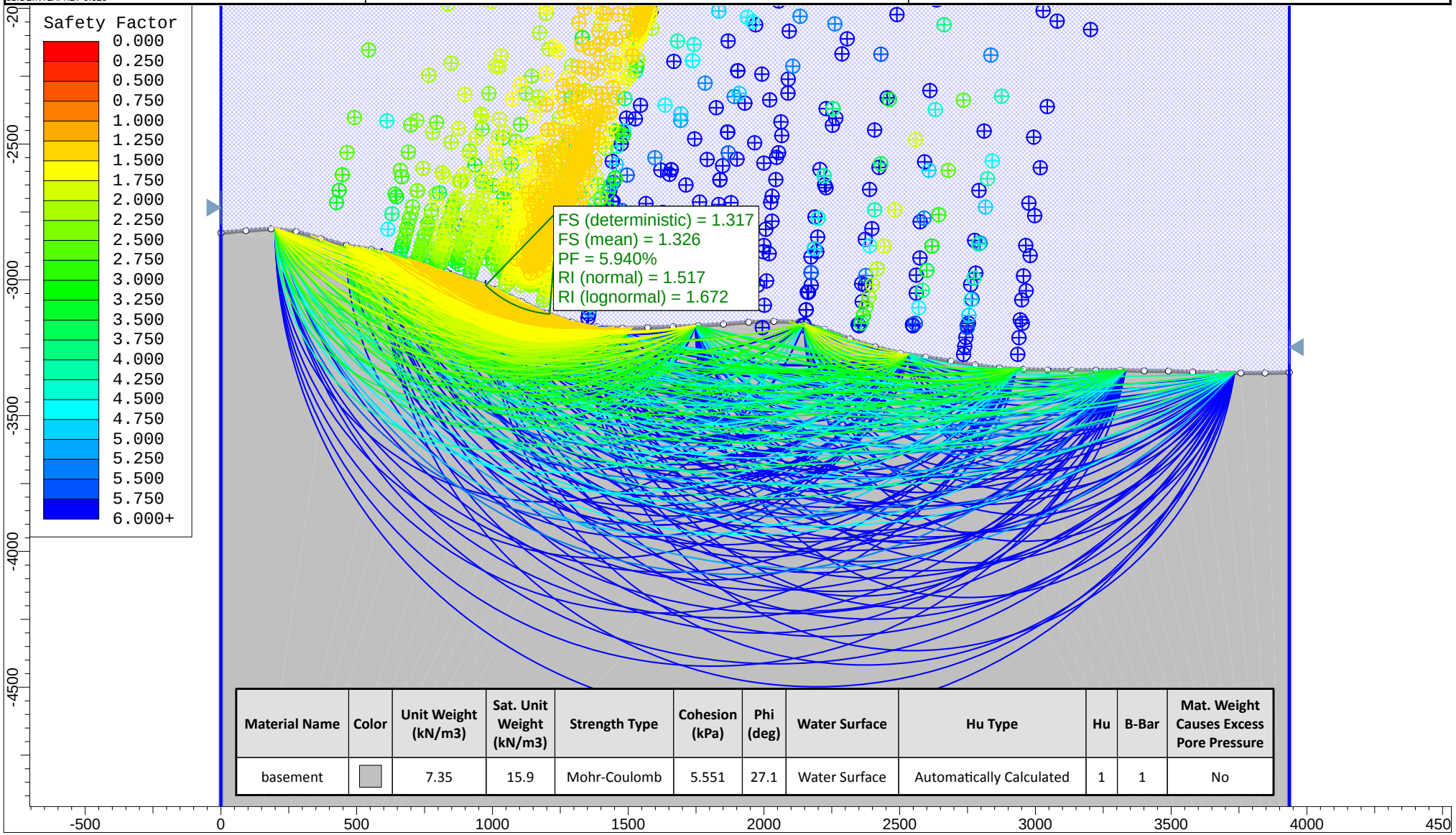
SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 84PC Site 49		
	Drawn By	Jason R. Patton	Scale 1:100000	Company Oregon State University
	Date	3/24/2013		File Name RR0705_84_49_1g.sli



Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
Basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

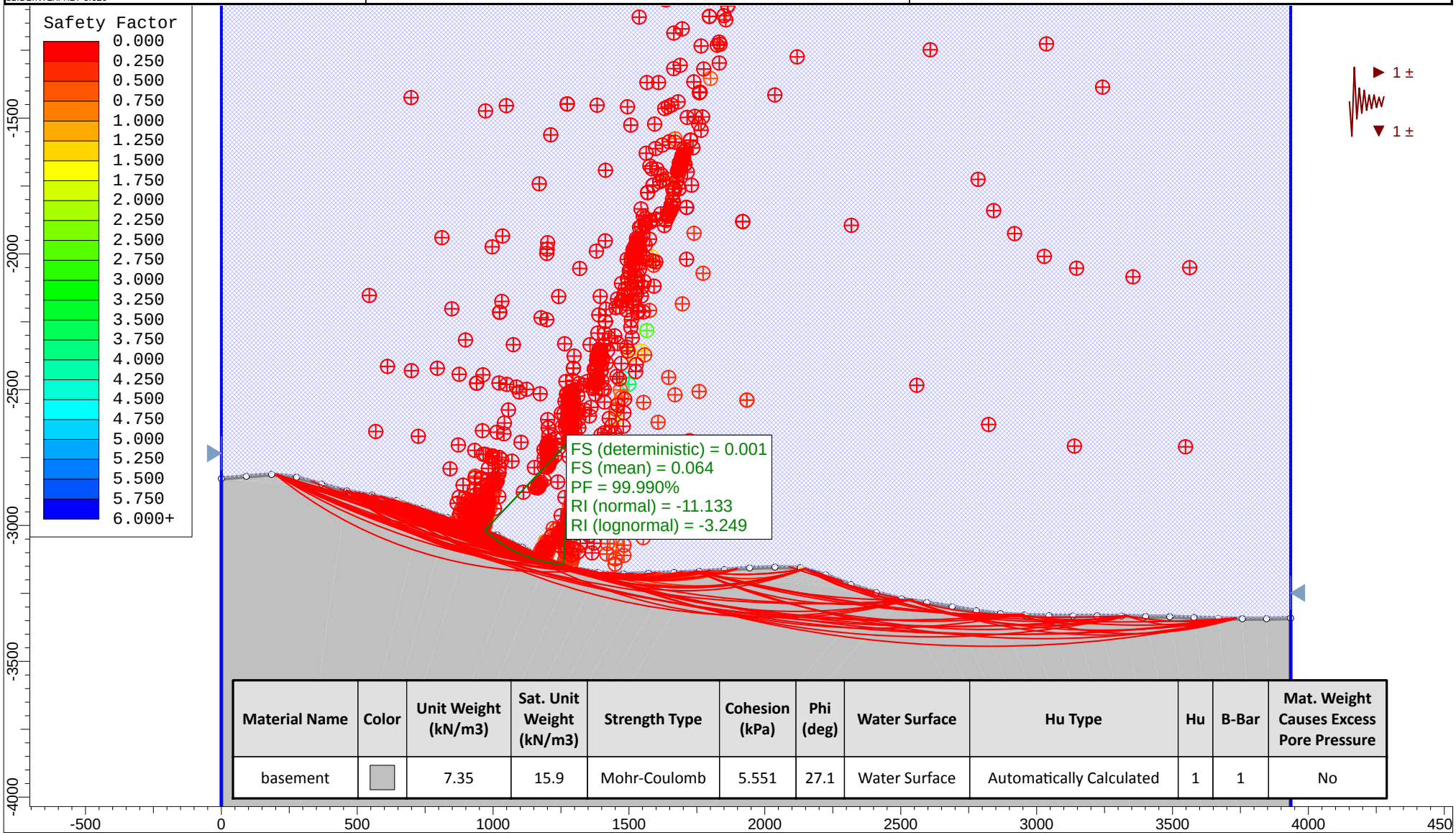
rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 85PC Site 43		
	Drawn By	Jason R. Patton	Scale 1:20000	Company Oregon State University
	Date	3/26/2013		File Name RR0705_85_43_0g.sli

SLIDEINTERPRET 6.020



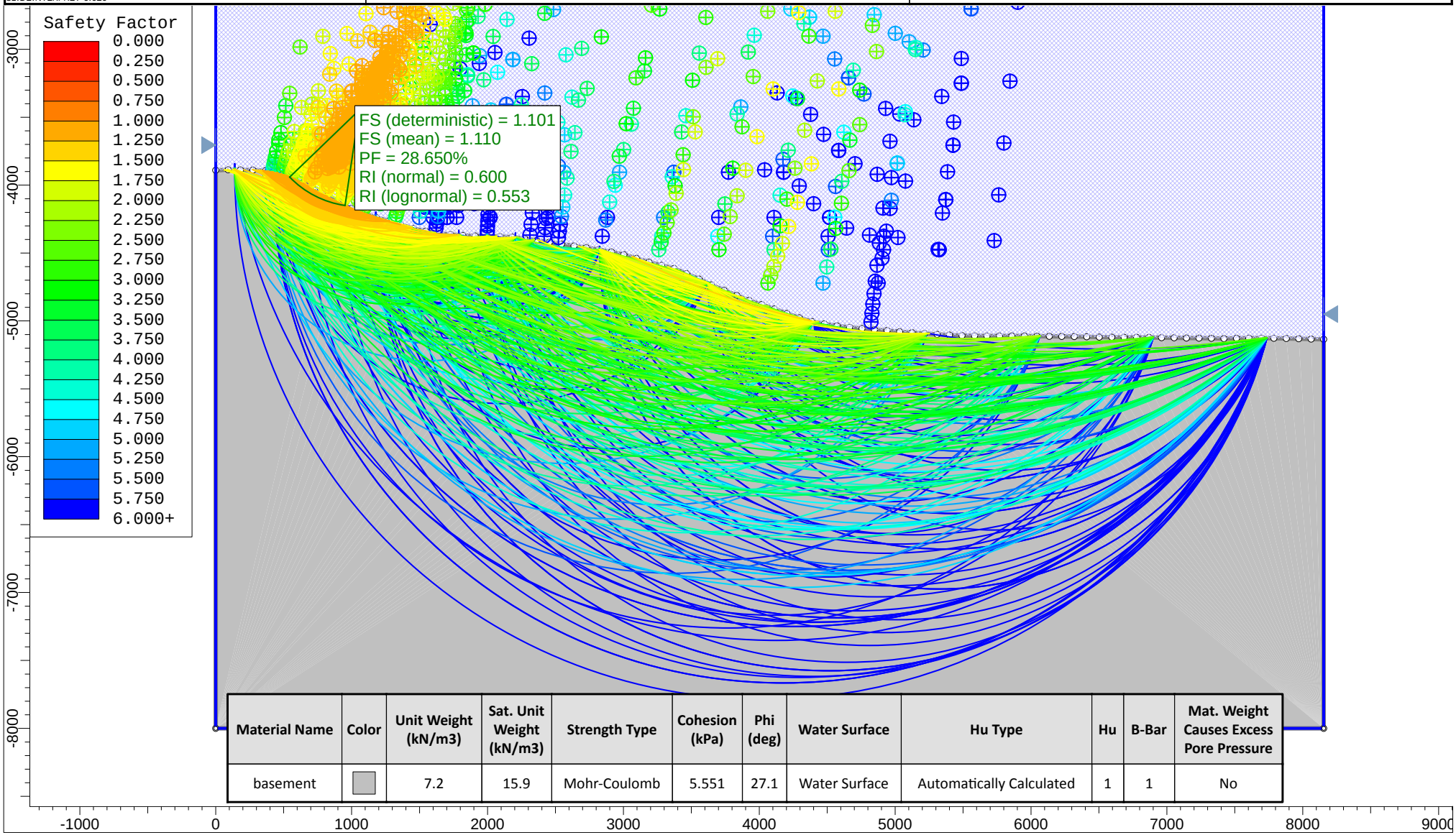
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Automatically Calculated	1	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 85PC Site 43		
	Drawn By	Jason R. Patton	Scale 1:20000	Company Oregon State University
	Date	3/26/2013		File Name RR0705_85_43_1g.sli



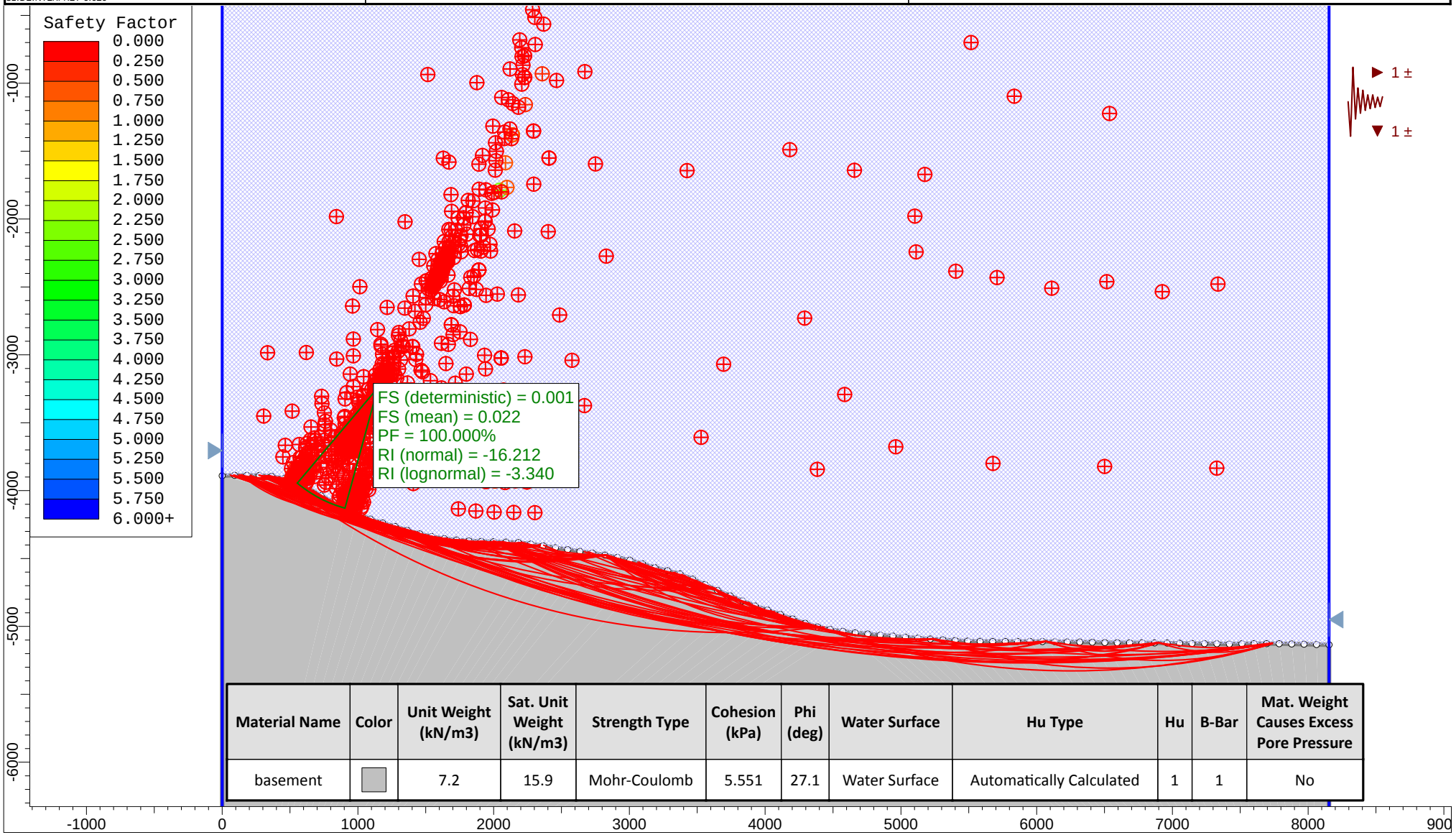
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Automatically Calculated	1	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 875PC Site 87		
	Drawn By	Jason R. Patton	Scale 1:40000	Company Oregon State University
	Date	3/26/2013		File Name RR0705_87_87_0g.slim



Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.2	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Automatically Calculated	1	1	No

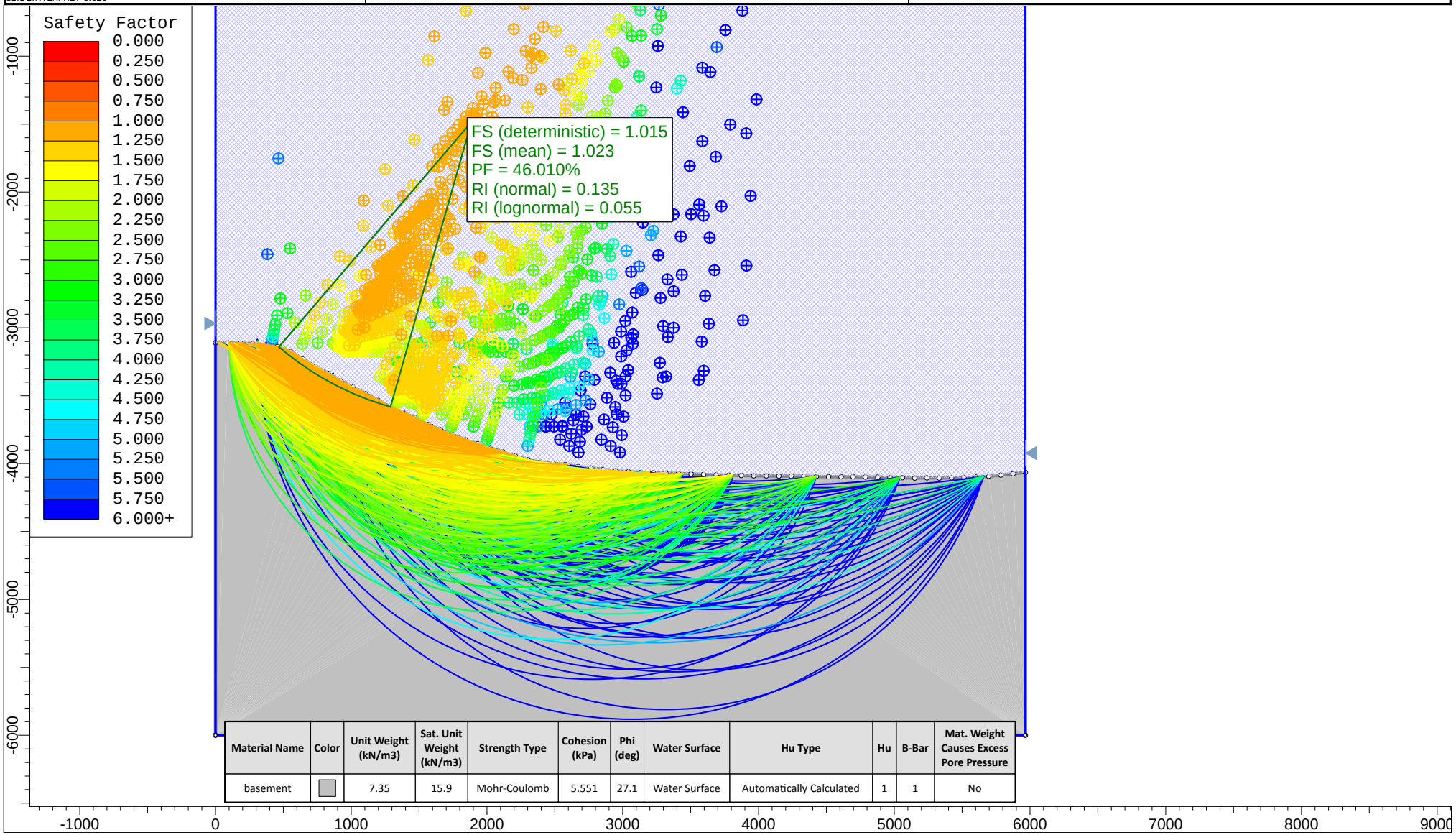
SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 875PC Site 87		
	Drawn By	Jason R. Patton	Scale 1:40000	Company Oregon State University
	Date	3/26/2013		File Name RR0705_87_87_1g.sli



Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.2	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Automatically Calculated	1	1	No

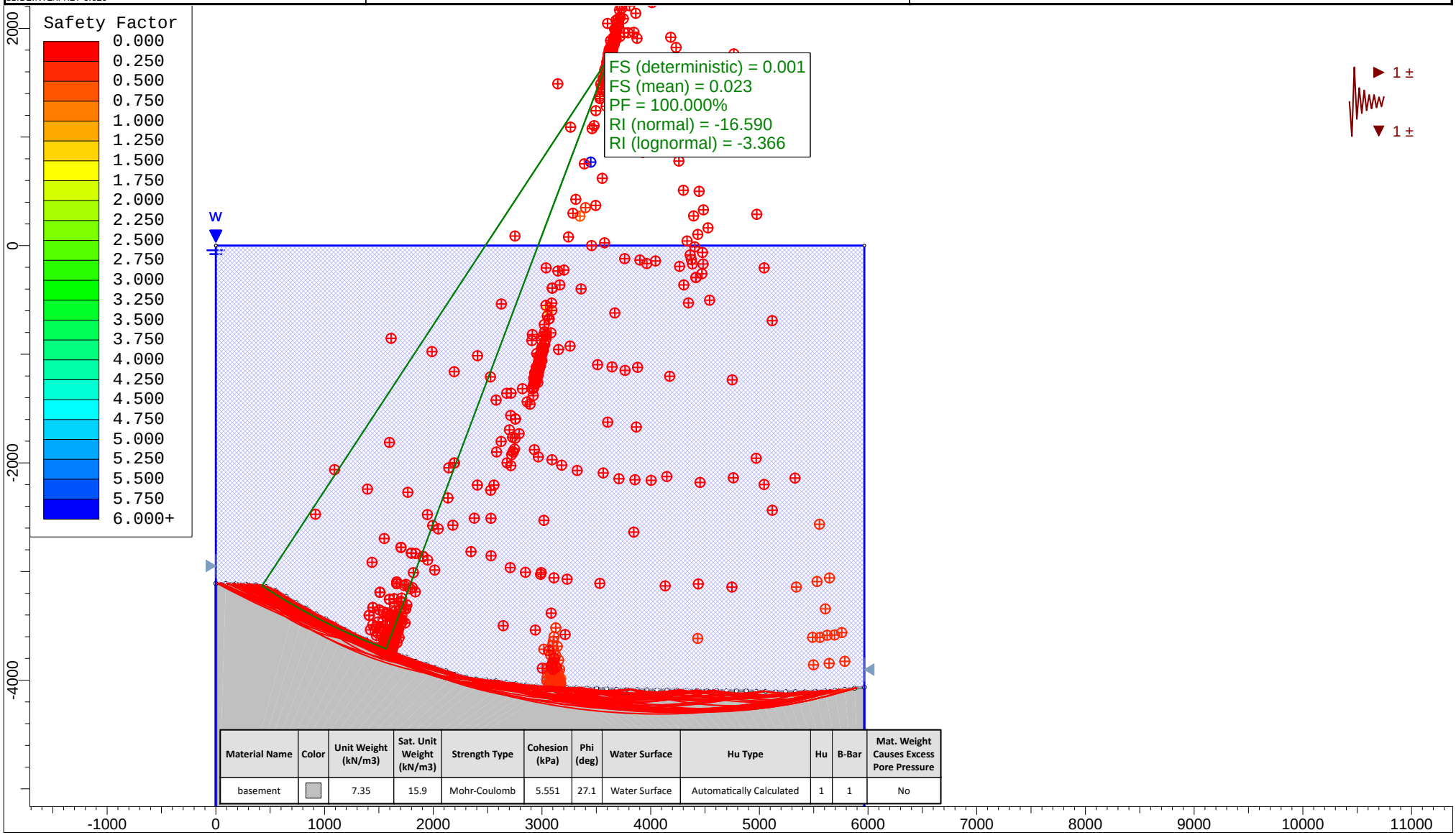
rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 88PC Site 88		
	Drawn By	Jason R. Patton	Scale 1:40000	Company Oregon State University
	Date	3/26/2013		File Name RR0705_88_88_0g.sli

SLIDEINTERPRET 6.020



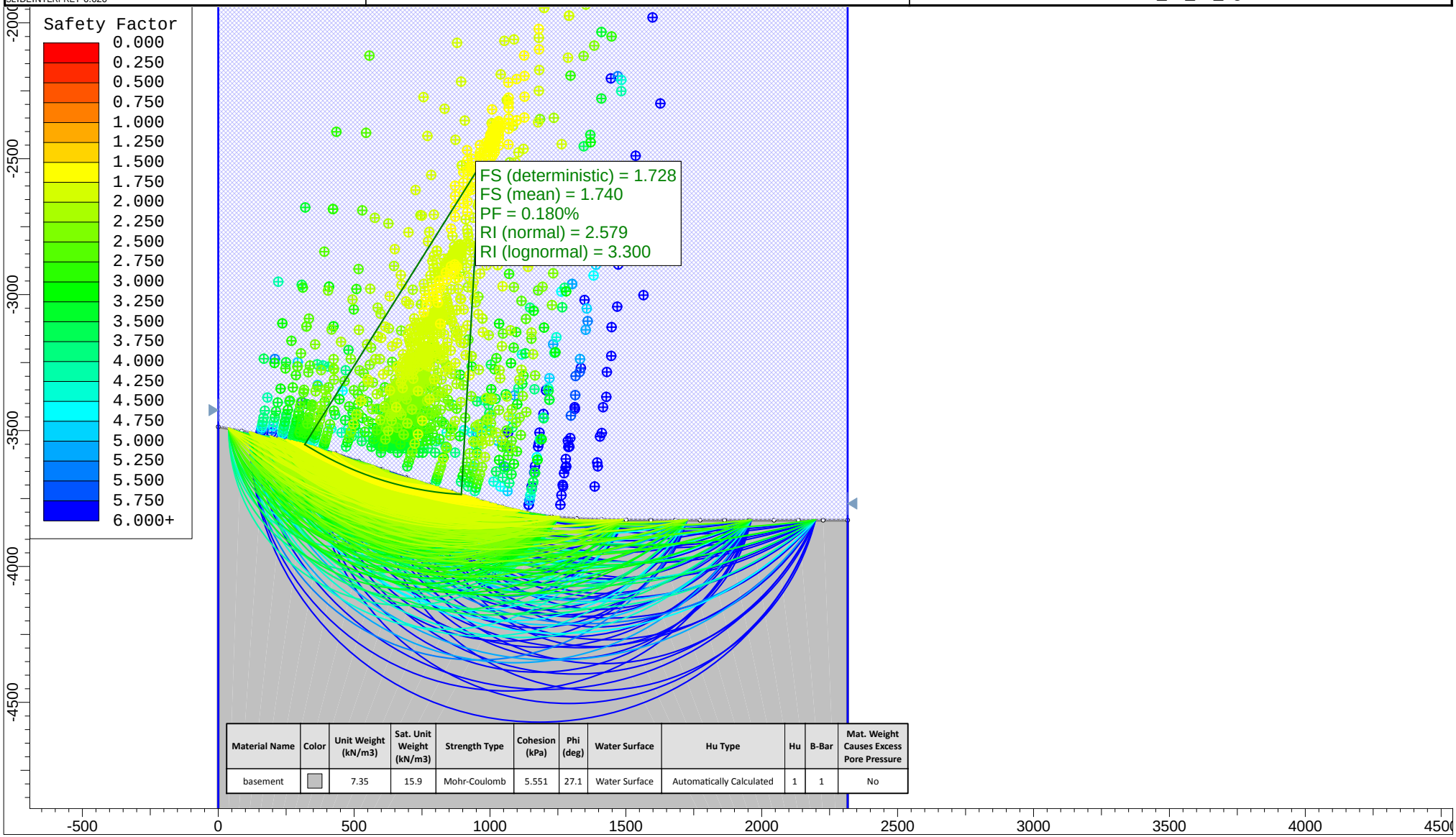
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Automatically Calculated	1	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 88PC Site 88		
	Drawn By	Jason R. Patton	Scale 1:50000	Company Oregon State University
	Date	3/26/2013		File Name RR0705_88_88_1g.sli



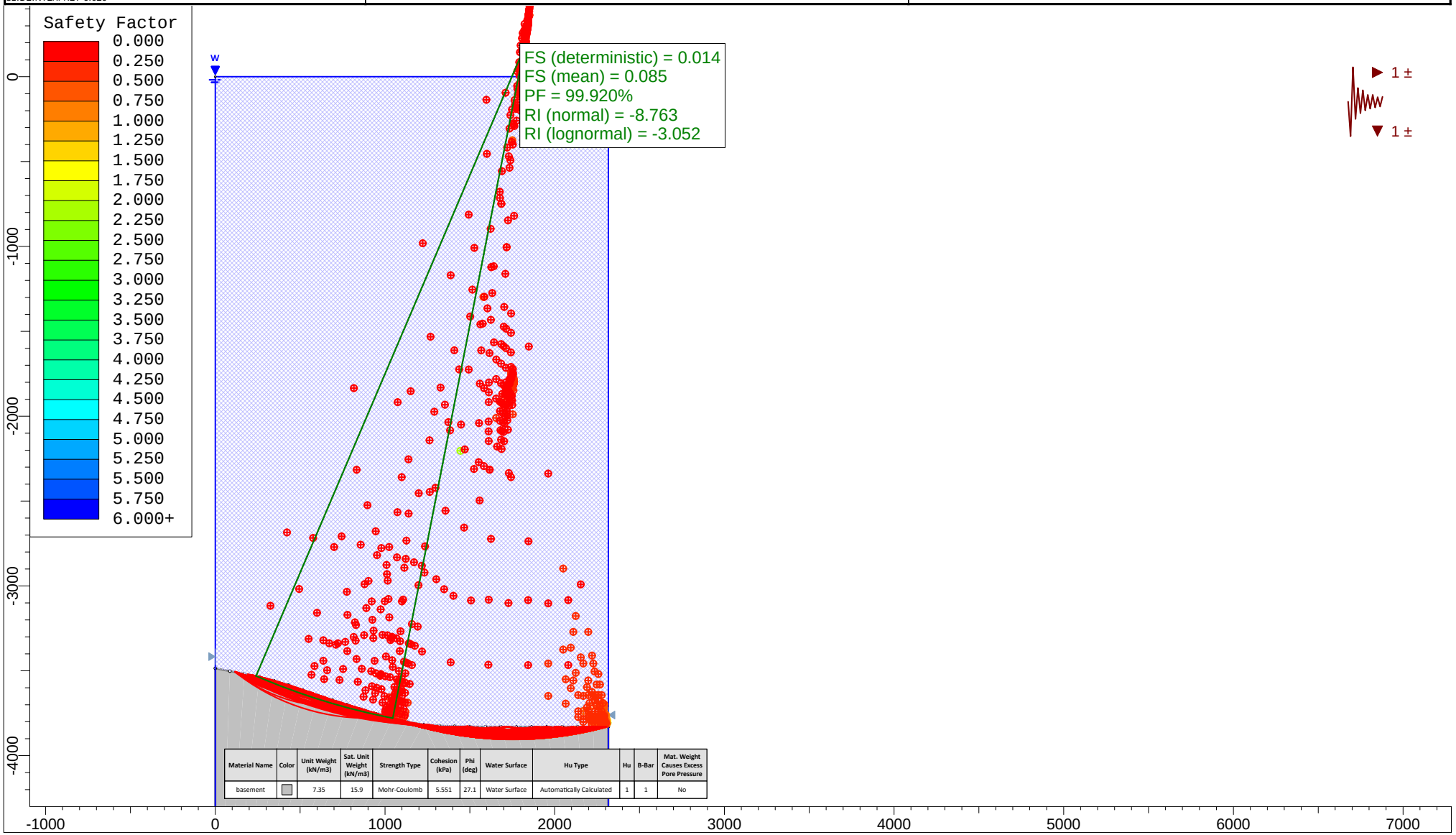
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Automatically Calculated	1	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 92PC Site 37		
	Drawn By: Jason R. Patton	Scale: 1:20000	Company: Oregon State University	
	Date: 3/26/2013		File Name: RR0705_92_37_0g.sli	



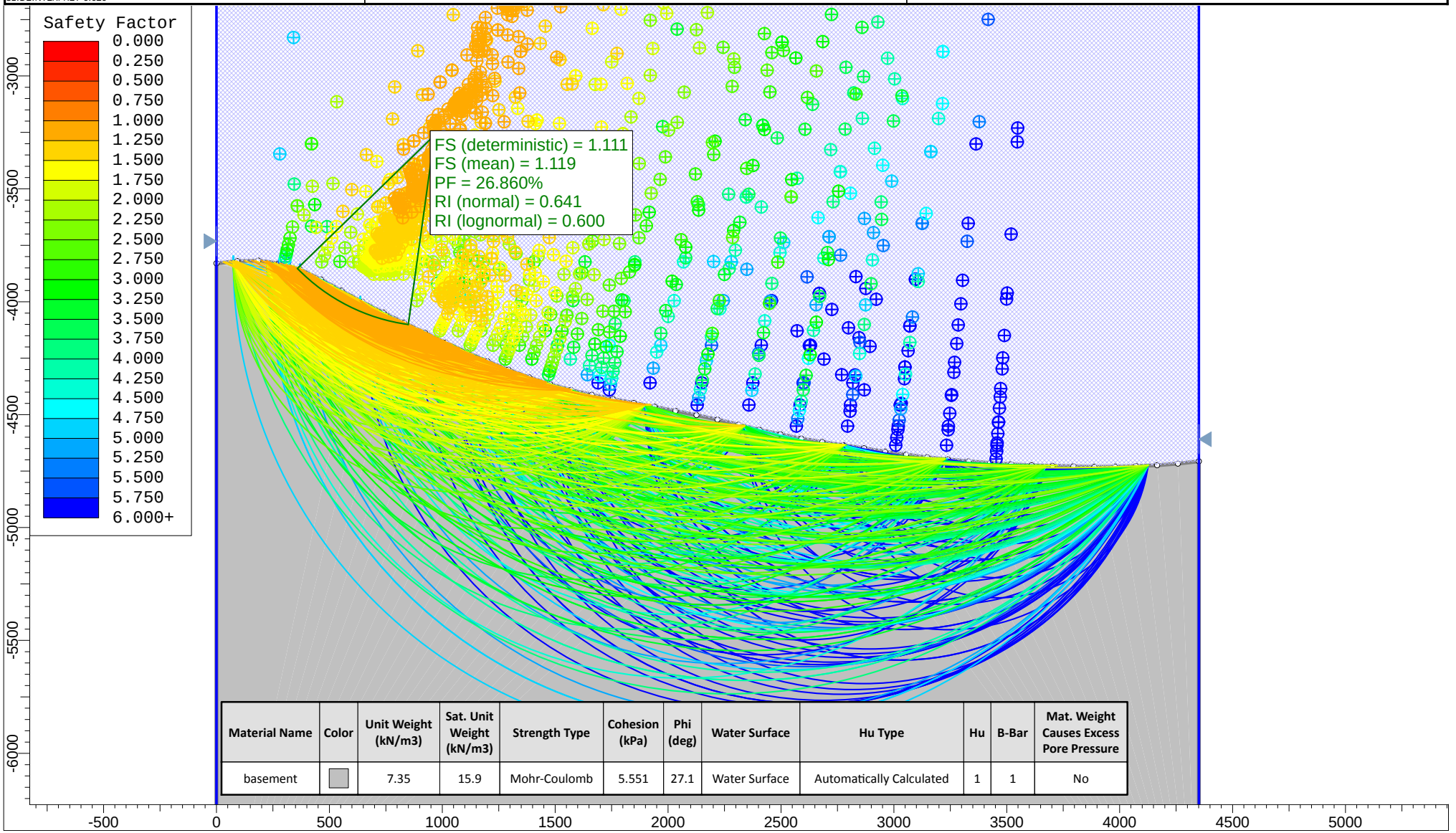
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Automatically Calculated	1	1	No

rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 92PC Site 37		
	Drawn By	Jason R. Patton	Scale 1:32000	Company Oregon State University
SLIDEINTERPRET 6.020	Date	3/26/2013		File Name RR0705_92_37_1g.slim



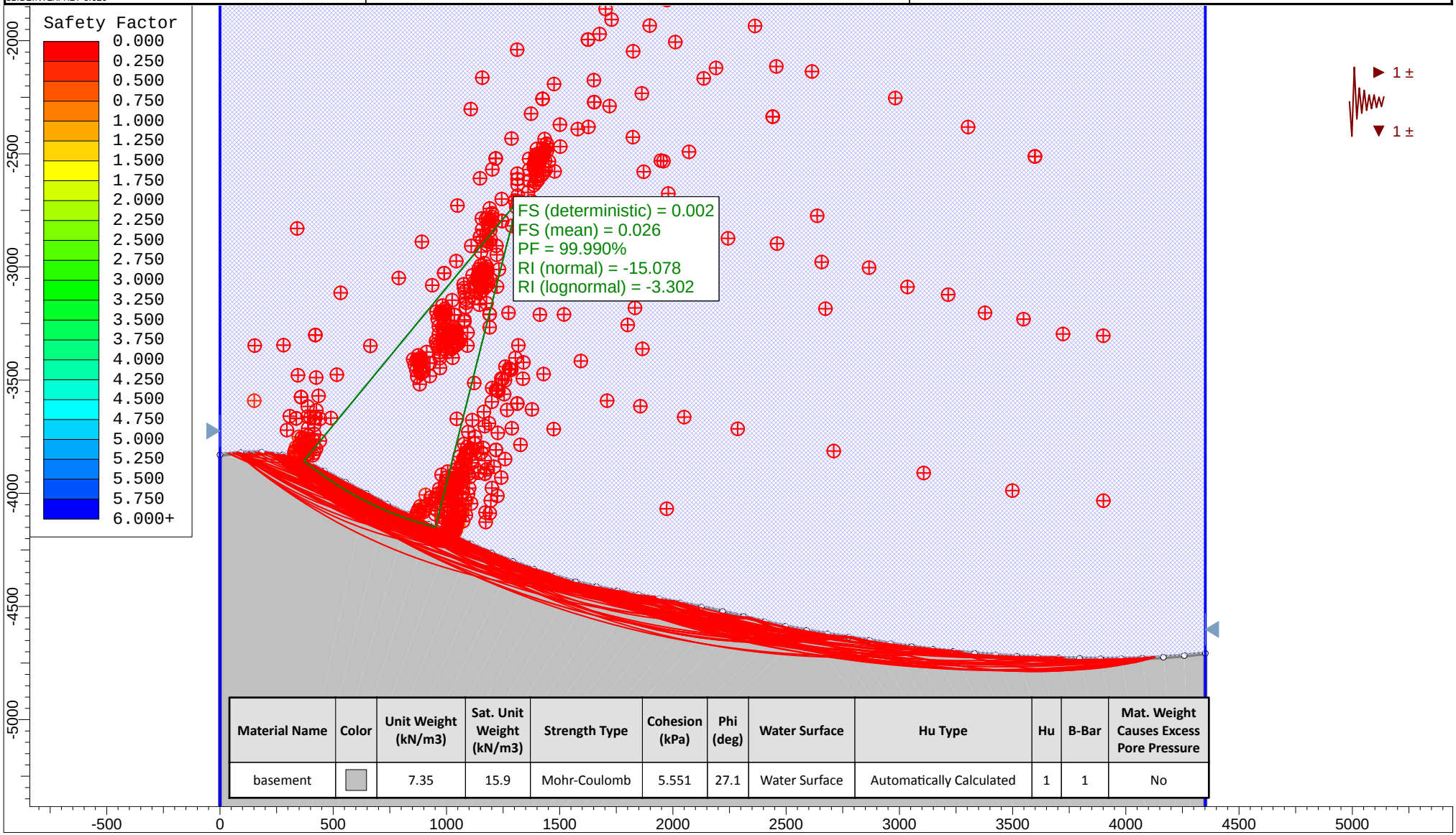
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Automatically Calculated	1	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 93PC Site 90		
	Drawn By	Jason R. Patton	Scale 1:24000	Company Oregon State University
	Date	3/26/2013		File Name RR0705_93_90_0g.sli



Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Automatically Calculated	1	1	No

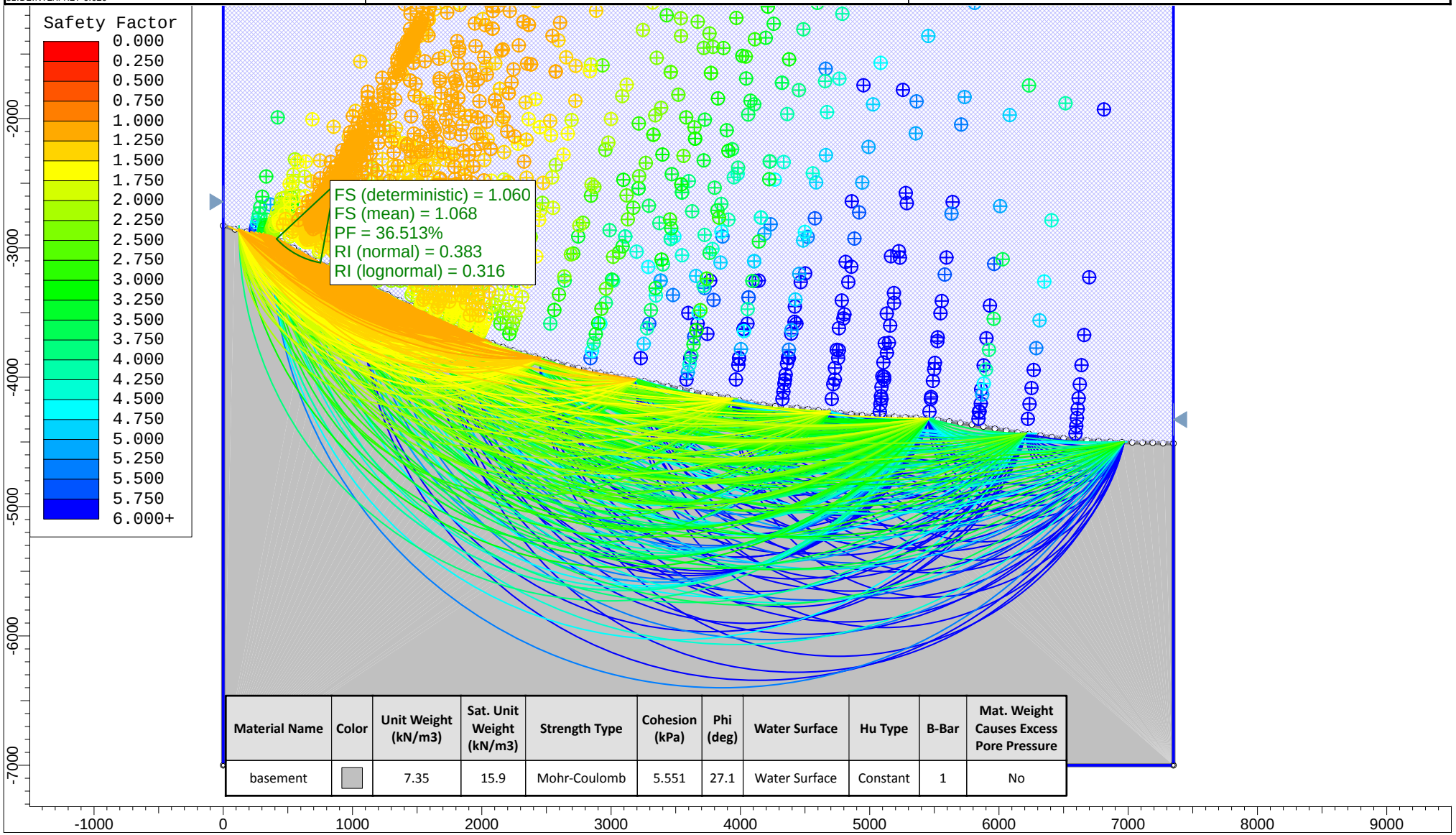
SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 93PC Site 90		
	Drawn By	Jason R. Patton	Scale 1:24000	Company Oregon State University
	Date	3/26/2013		File Name RR0705_93_90_1g.sli



Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Automatically Calculated	1	1	No

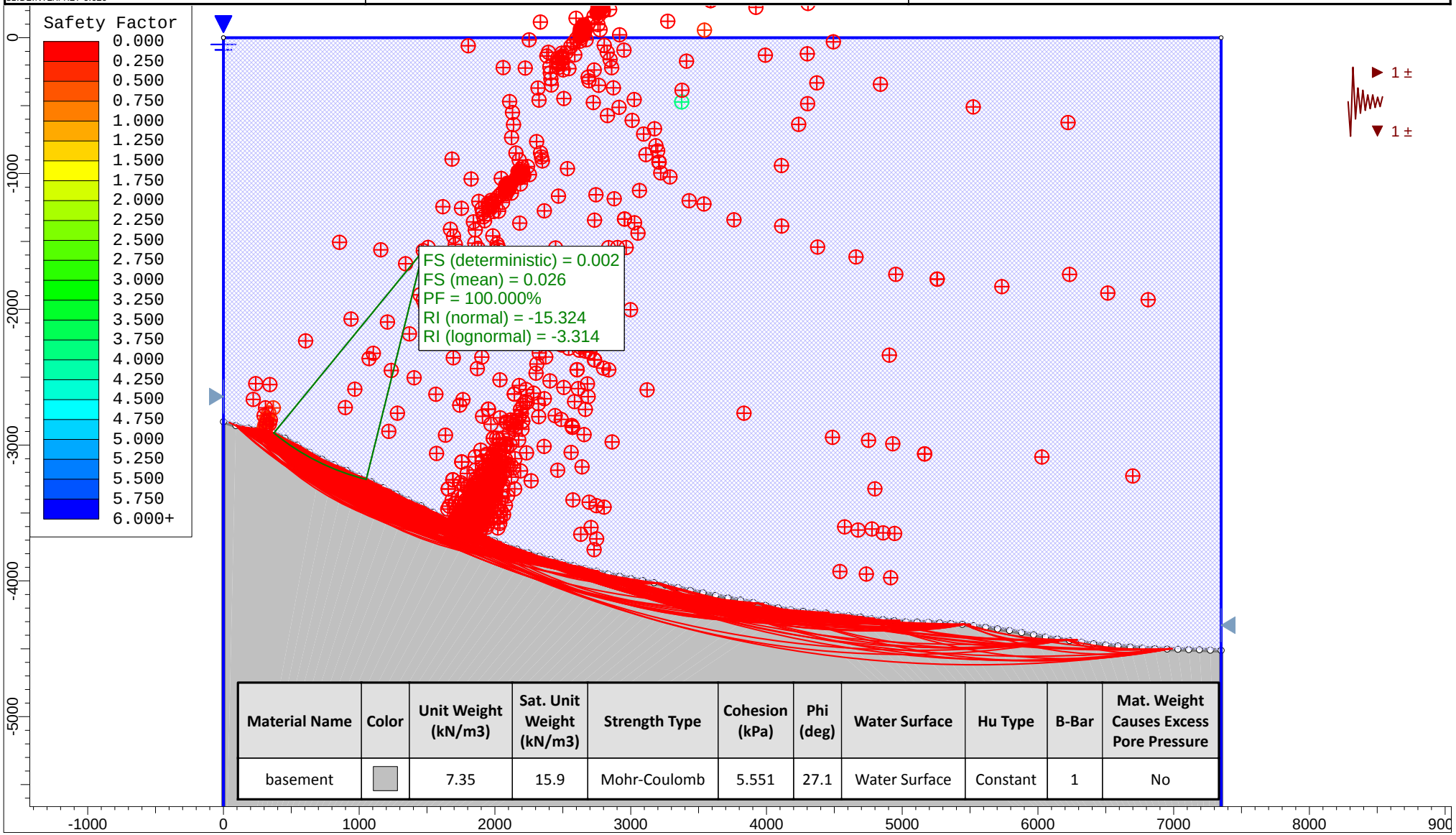
rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 94PC Site 93		
	Drawn By: Jason R. Patton	Scale: 1:42000	Company: Oregon State University	
	Date: 3/26/2013		File Name: RR0705_94_93_0g.sli	

SLIDEINTERPRET 6.020



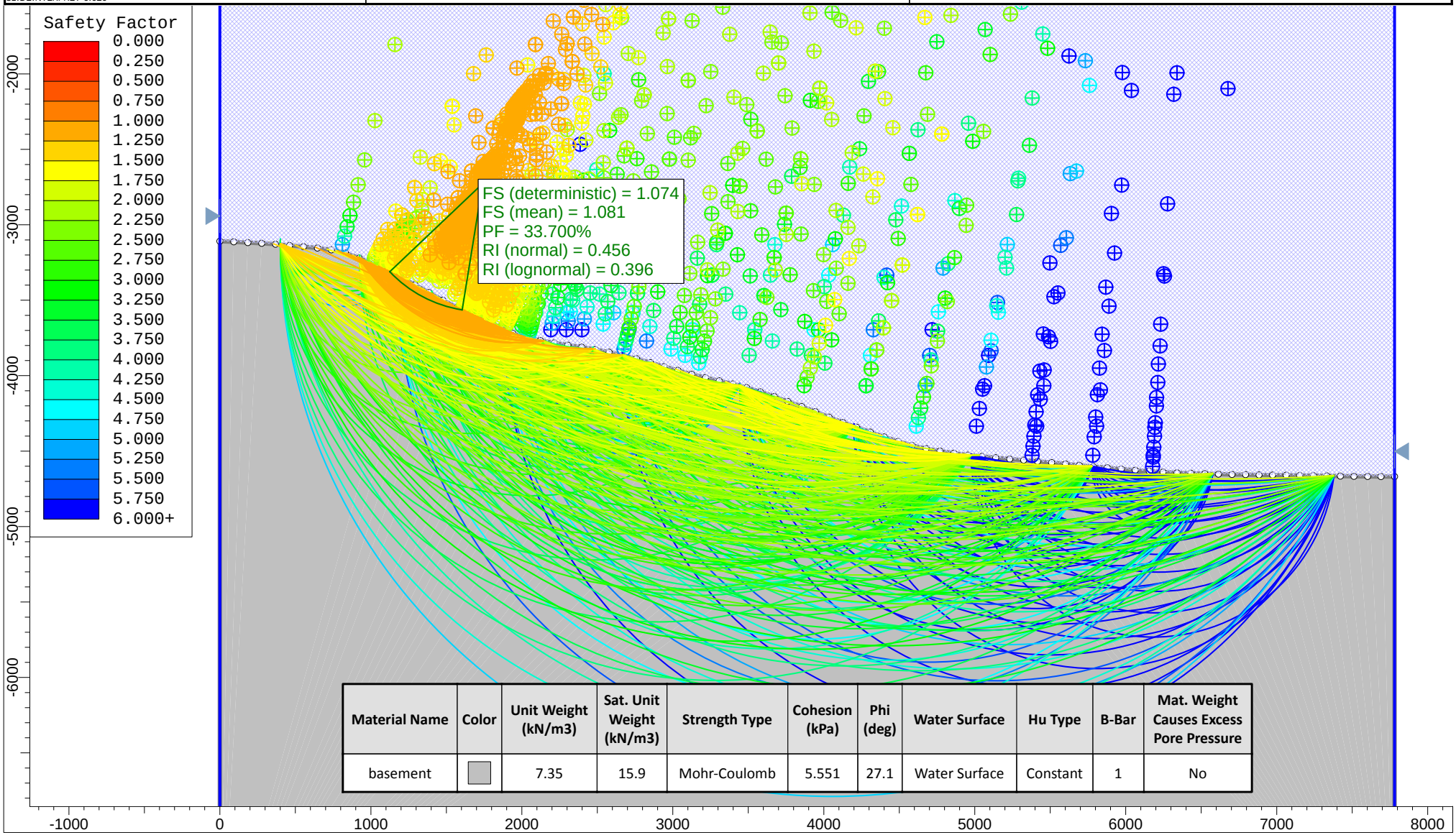
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 94PC Site 93		
	Drawn By	Jason R. Patton	Scale 1:40000	Company Oregon State University
	Date	3/26/2013		File Name RR0705_94_93_1g.sli



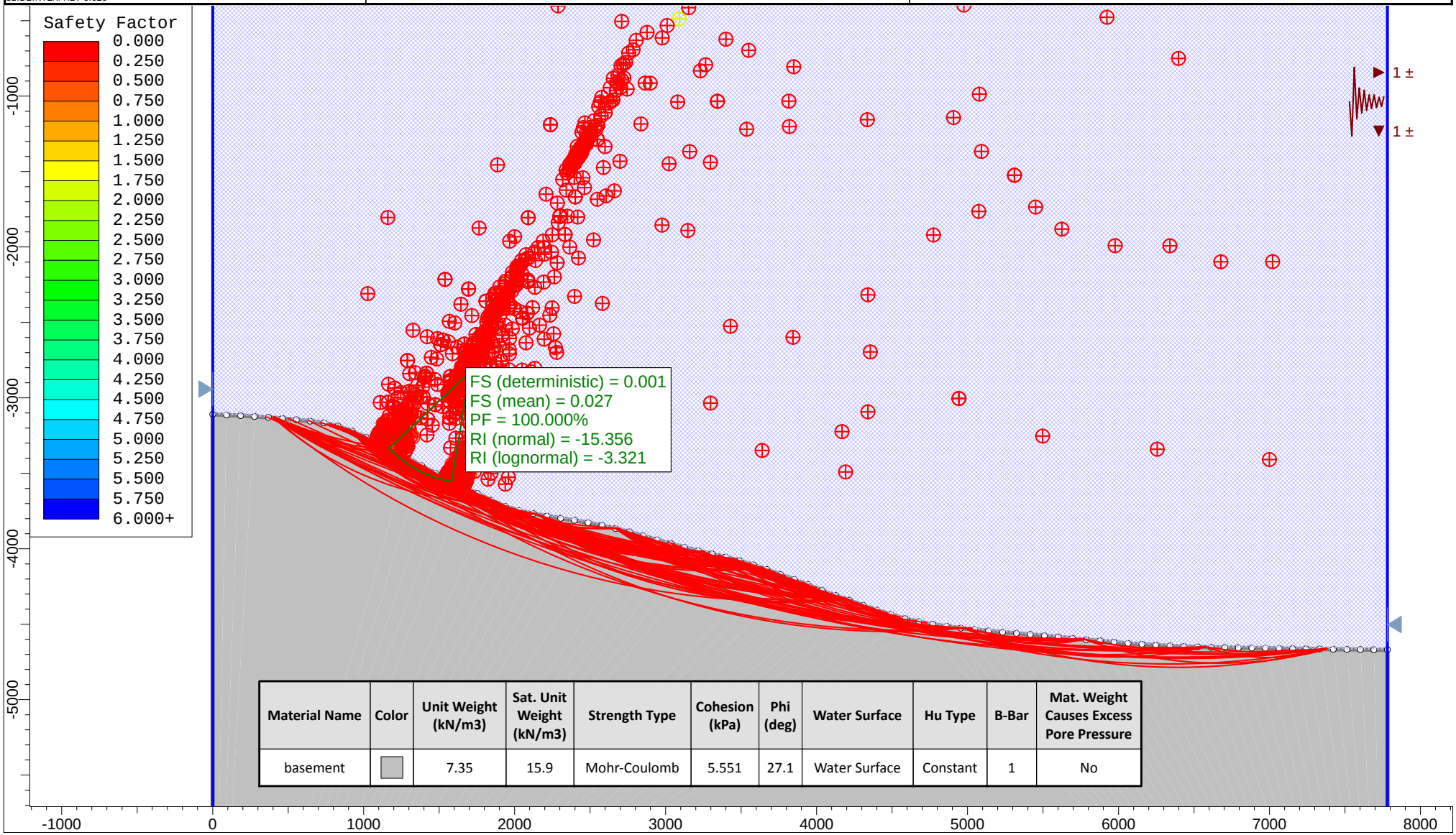
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 94PC Site 95		
	Drawn By	Jason R. Patton	Scale 1:36000	Company Oregon State University
	Date	3/26/2013		File Name RR0705_94_95_0g.slim



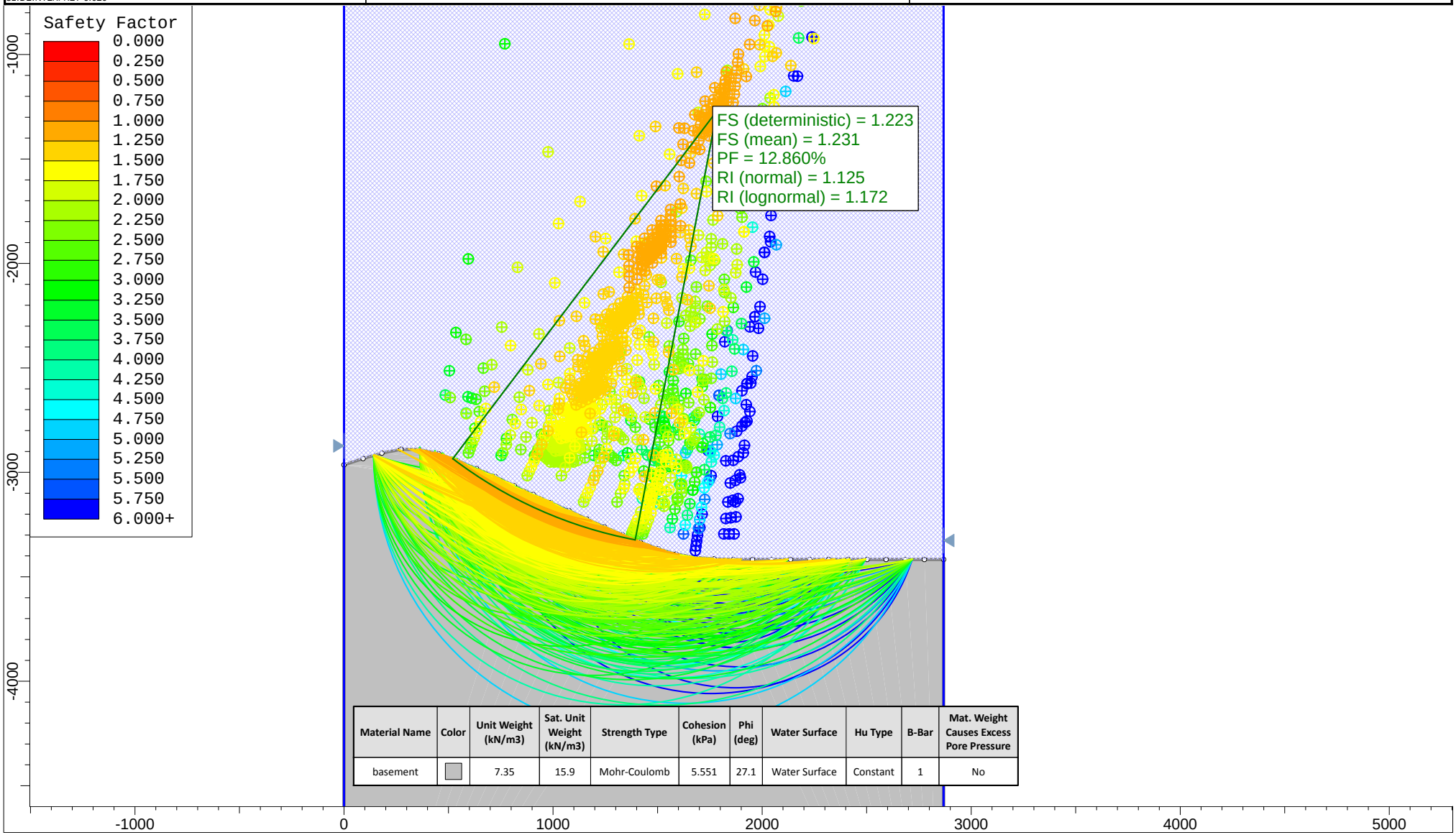
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 94PC Site 95		
	Drawn By	Jason R. Patton	Scale 1:36000	Company Oregon State University
	Date	3/26/2013		File Name RR0705_94_95.slim



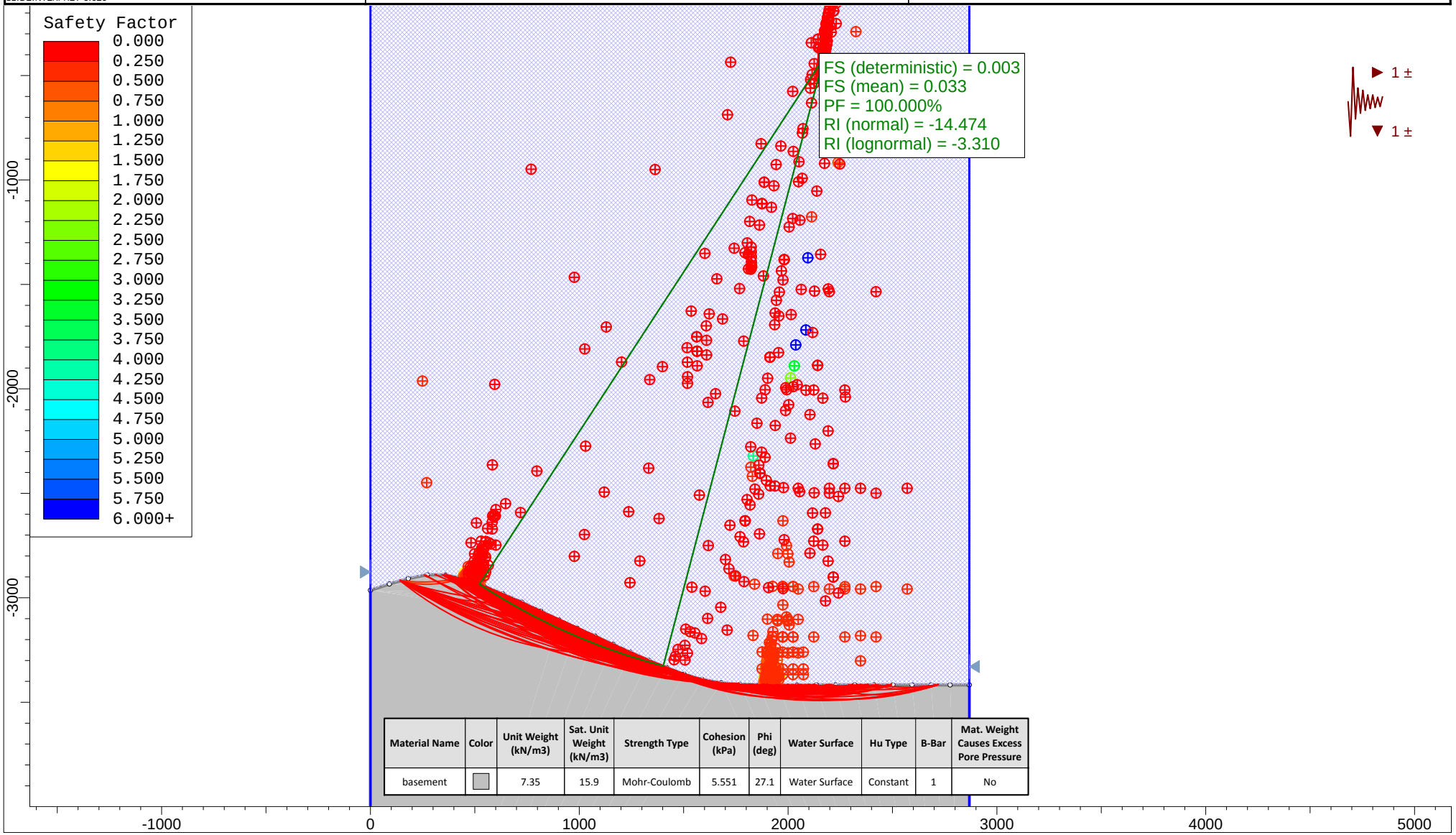
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 95PC Site 26		
	Drawn By	Jason R. Patton	Scale 1:26000	Company Oregon State University
	Date	3/31/2013		File Name RR0705_95_26_0g.slim



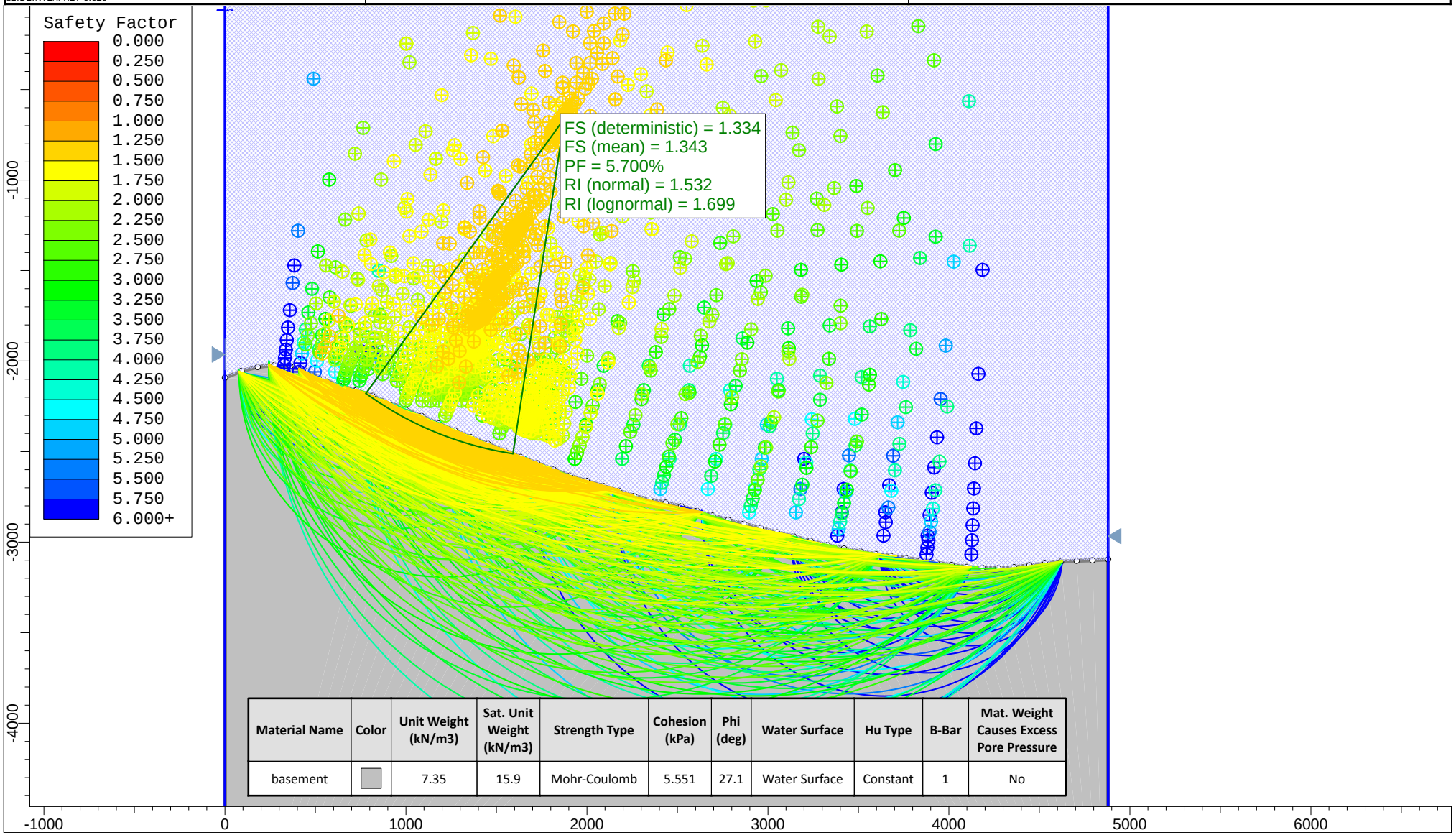
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 95PC Site 26		
	Drawn By	Jason R. Patton	Scale 1:26000	Company Oregon State University
	Date	3/31/2013		File Name RR0705_95_26.slim



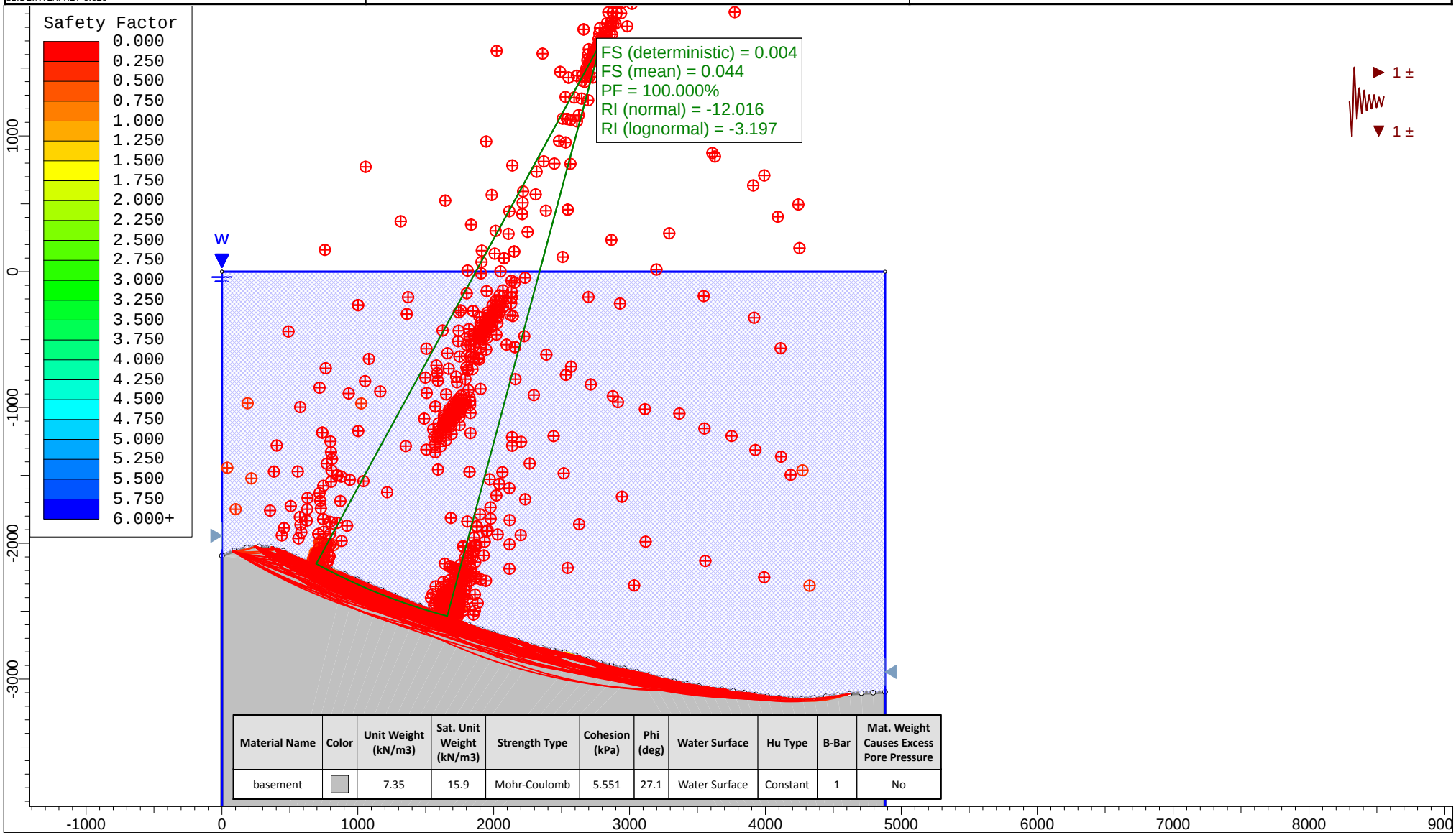
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 95PC Site 27		
	Drawn By	Jason R. Patton	Scale 1:30000	Company Oregon State University
	Date	3/31/2013		File Name RR0705_95_27_0g.slim



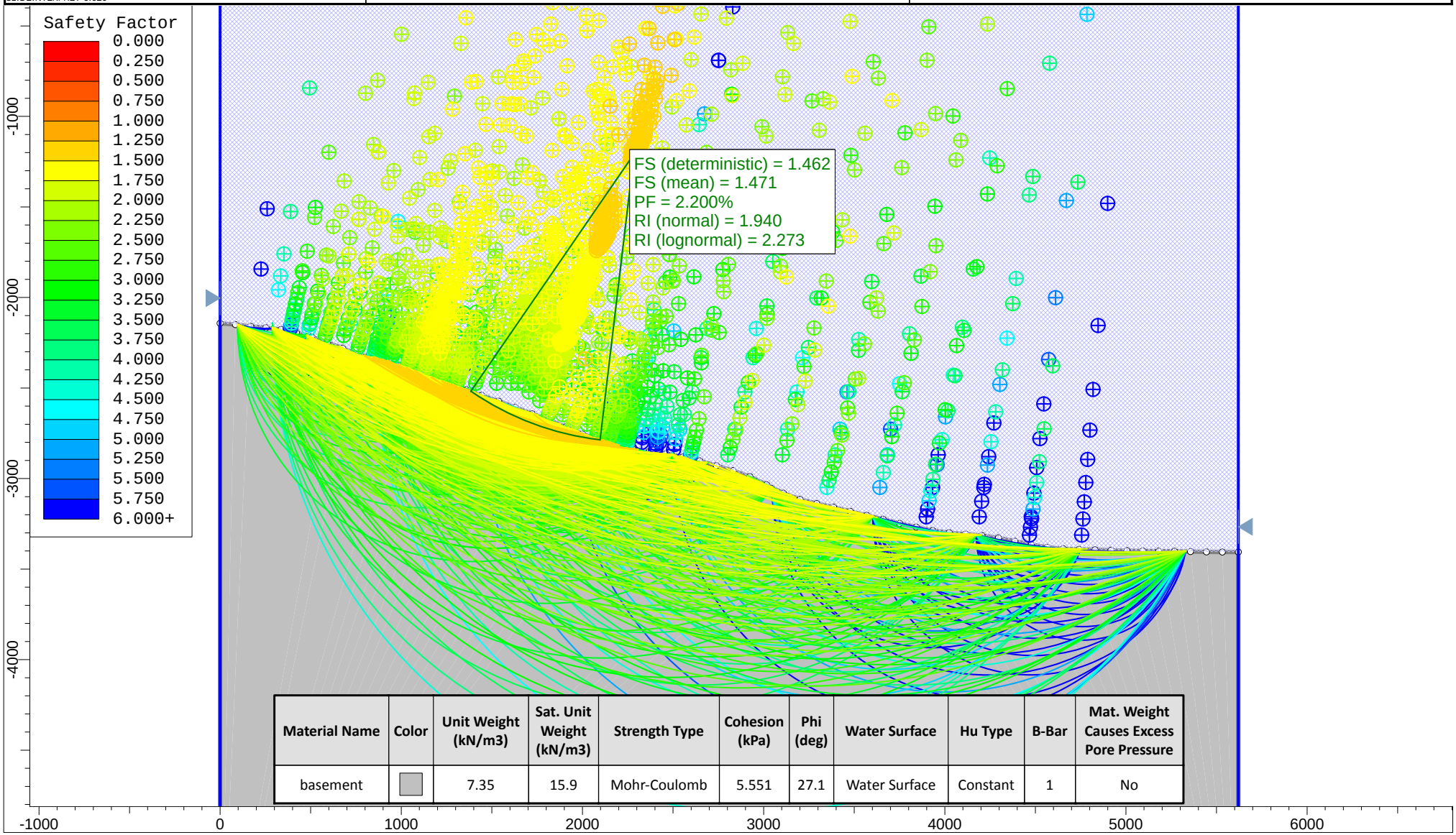
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 95PC Site 27		
	Drawn By	Jason R. Patton	Scale 1:40000	Company Oregon State University
	Date	3/31/2013		File Name RR0705_95_27_1g.slim



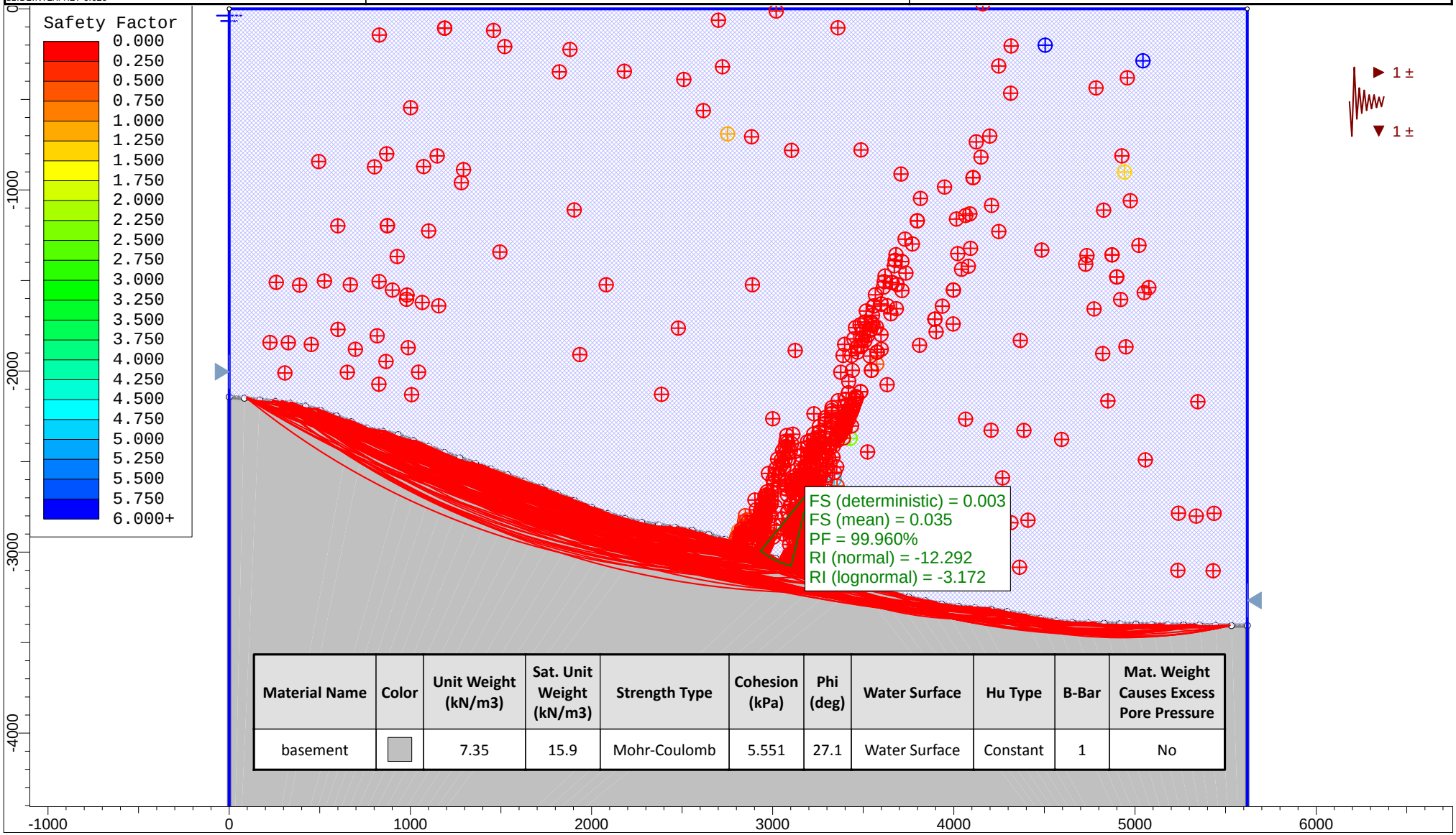
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 95PC Site 28		
	Drawn By	Jason R. Patton	Scale 1:30000	Company Oregon State University
	Date	3/31/2013		File Name RR0705_95_28_0g.slim



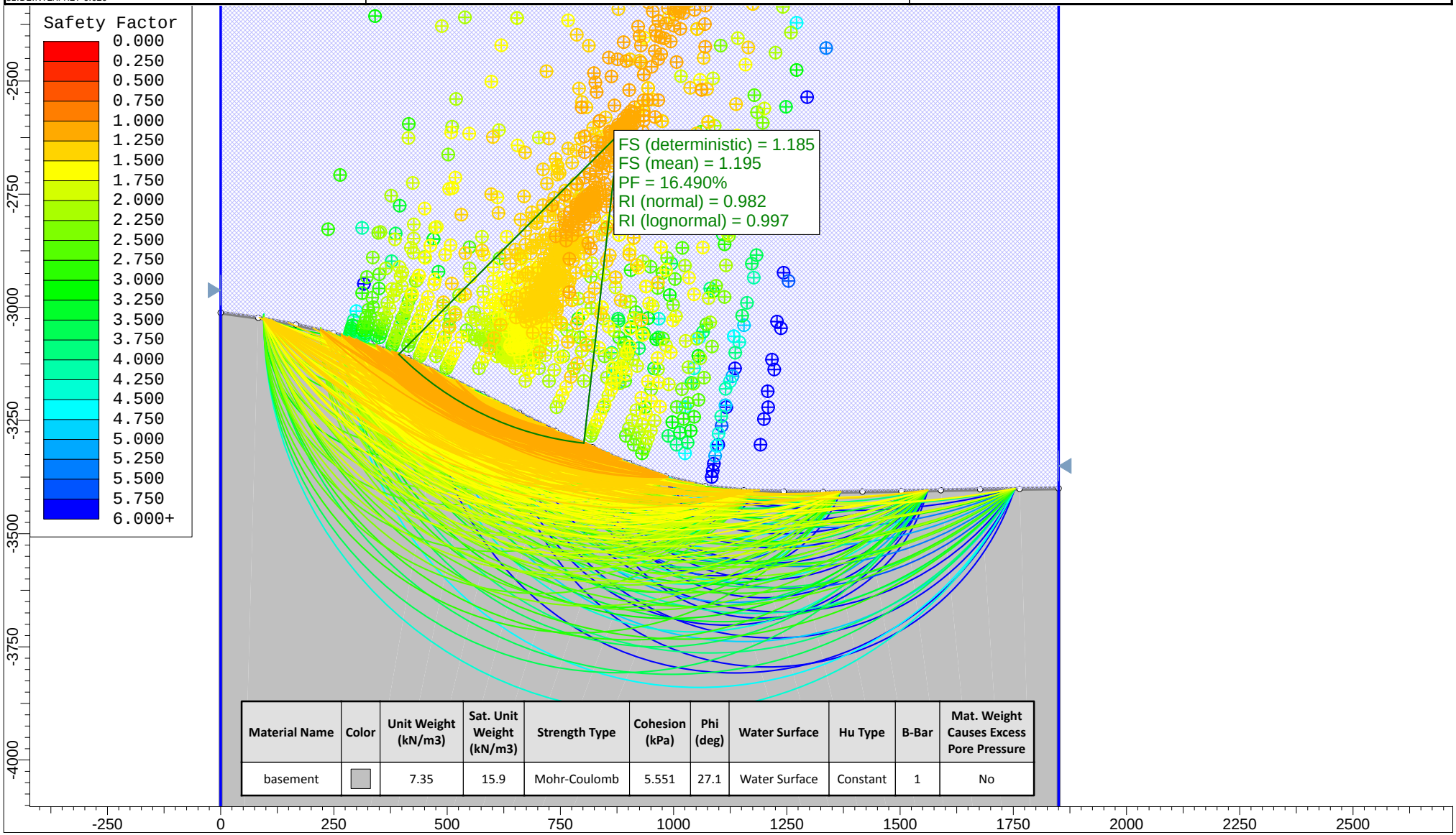
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 95PC Site 28		
	Drawn By	Jason R. Patton	Scale 1:30000	Company Oregon State University
	Date	3/31/2013		File Name RR0705_95_28_1g.slim



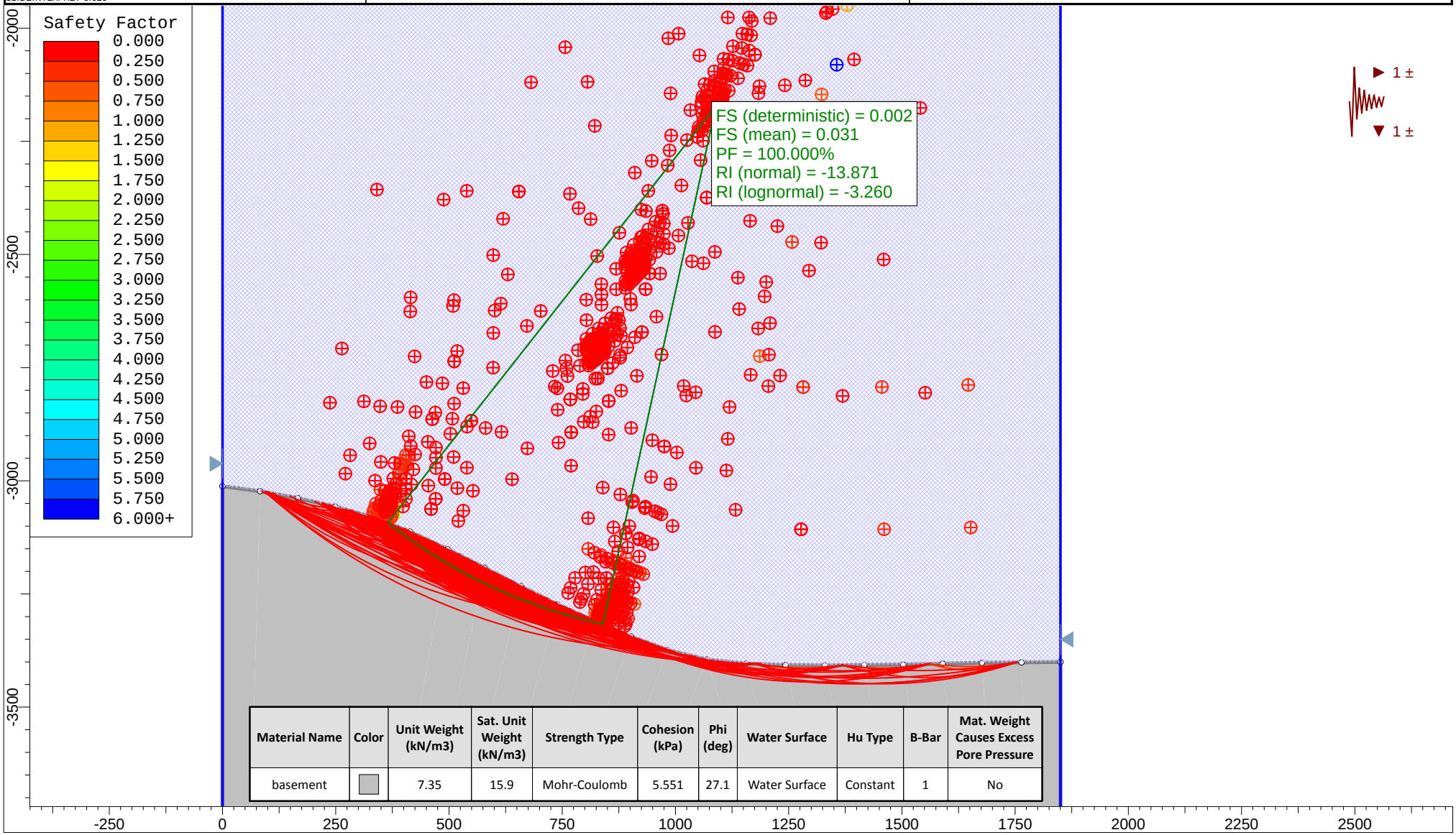
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 96PC Site 18		
	Drawn By	Jason R. Patton	Scale 1:12000	Company Oregon State University
	Date	3/31/2013		File Name RR0705_96_18_0g.slim



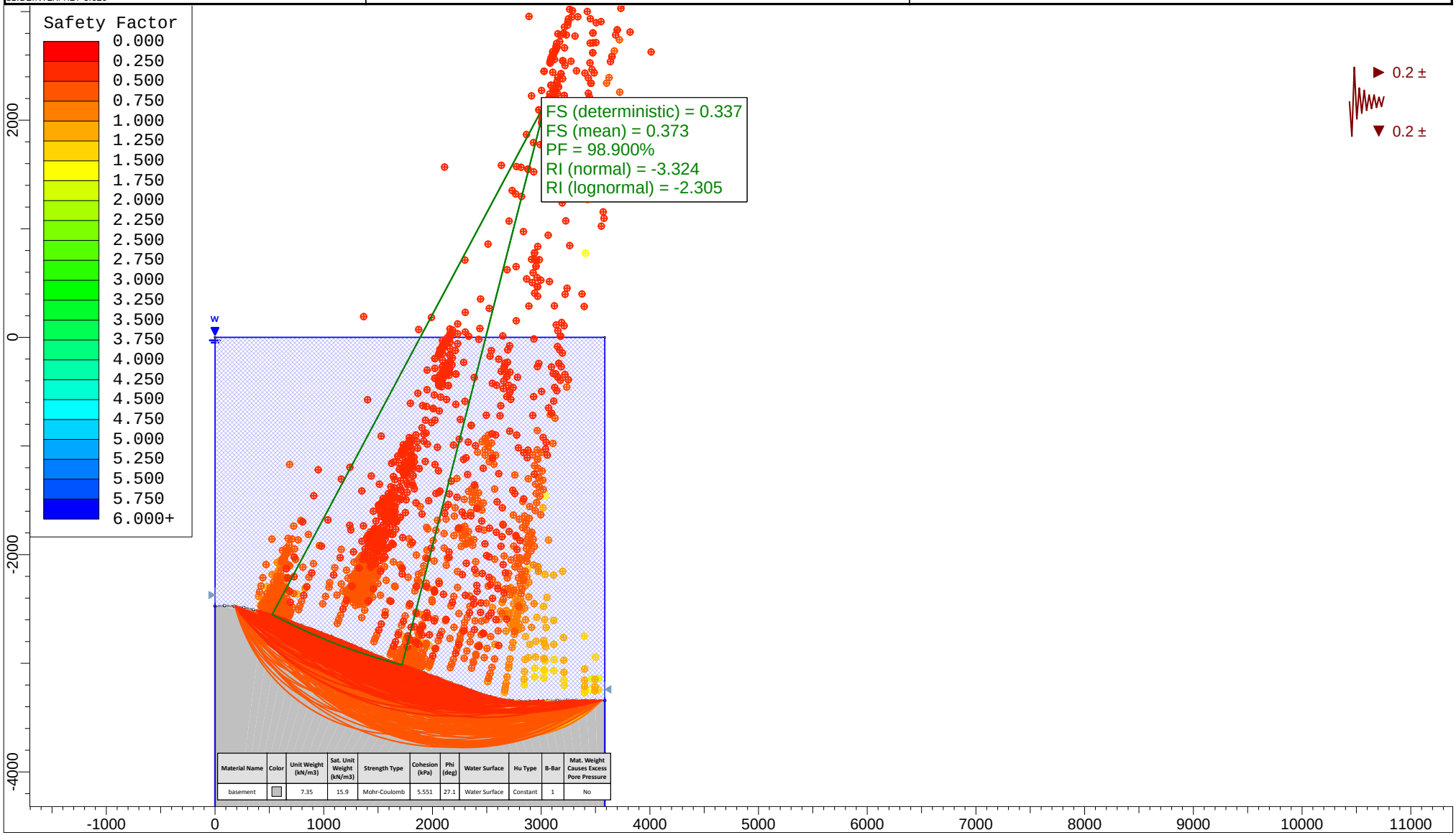
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 96PC Site 18		
	Drawn By	Jason R. Patton	Scale 1:12000	Company Oregon State University
	Date	3/31/2013		File Name RR0705_96_18_1g.slim

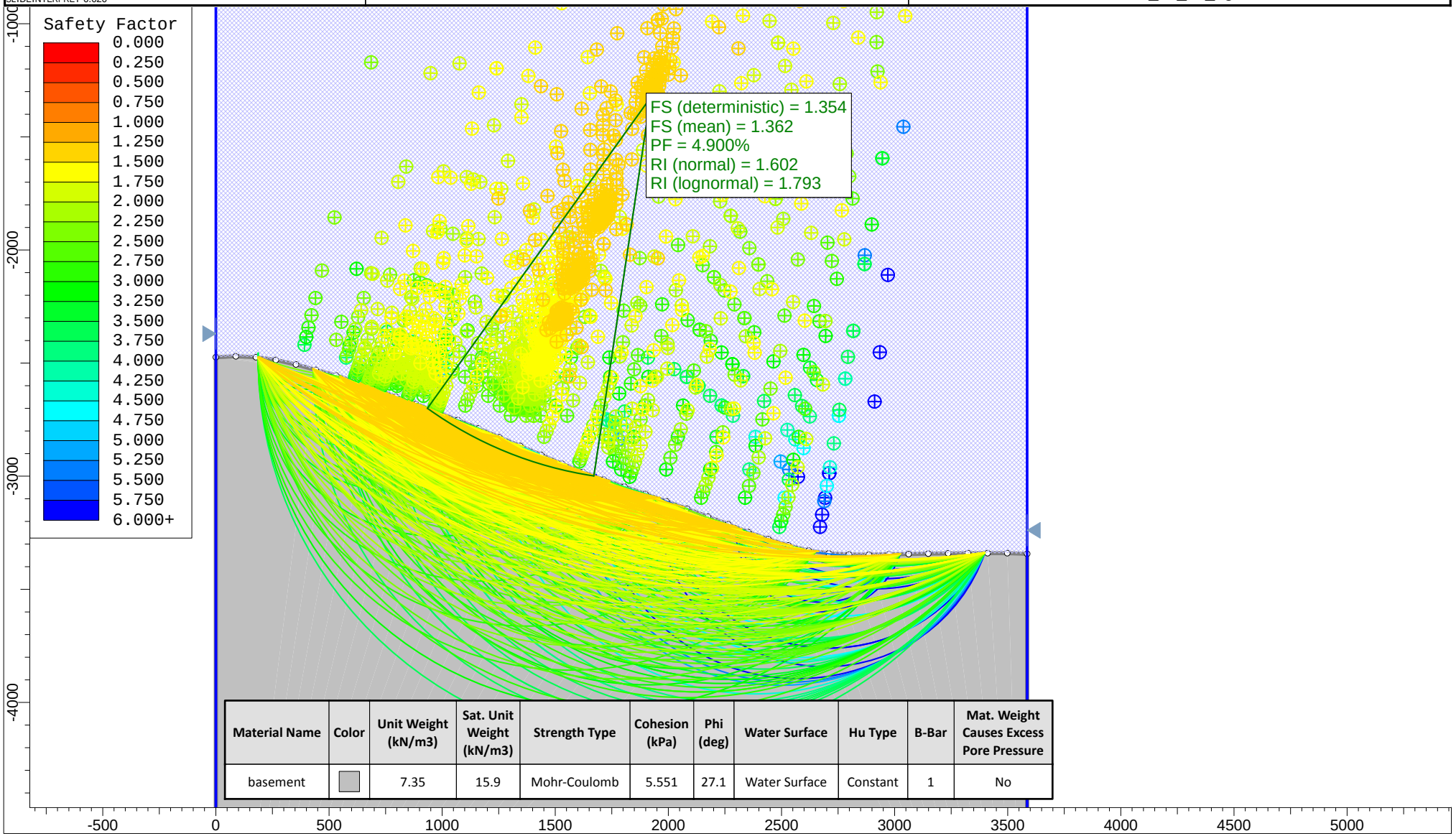


Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 96PC Site 21		
	Drawn By	Jason R. Patton	Scale 1:50000	Company Oregon State University
	Date	3/31/2013		File Name RR0705_96_21_02g.sli

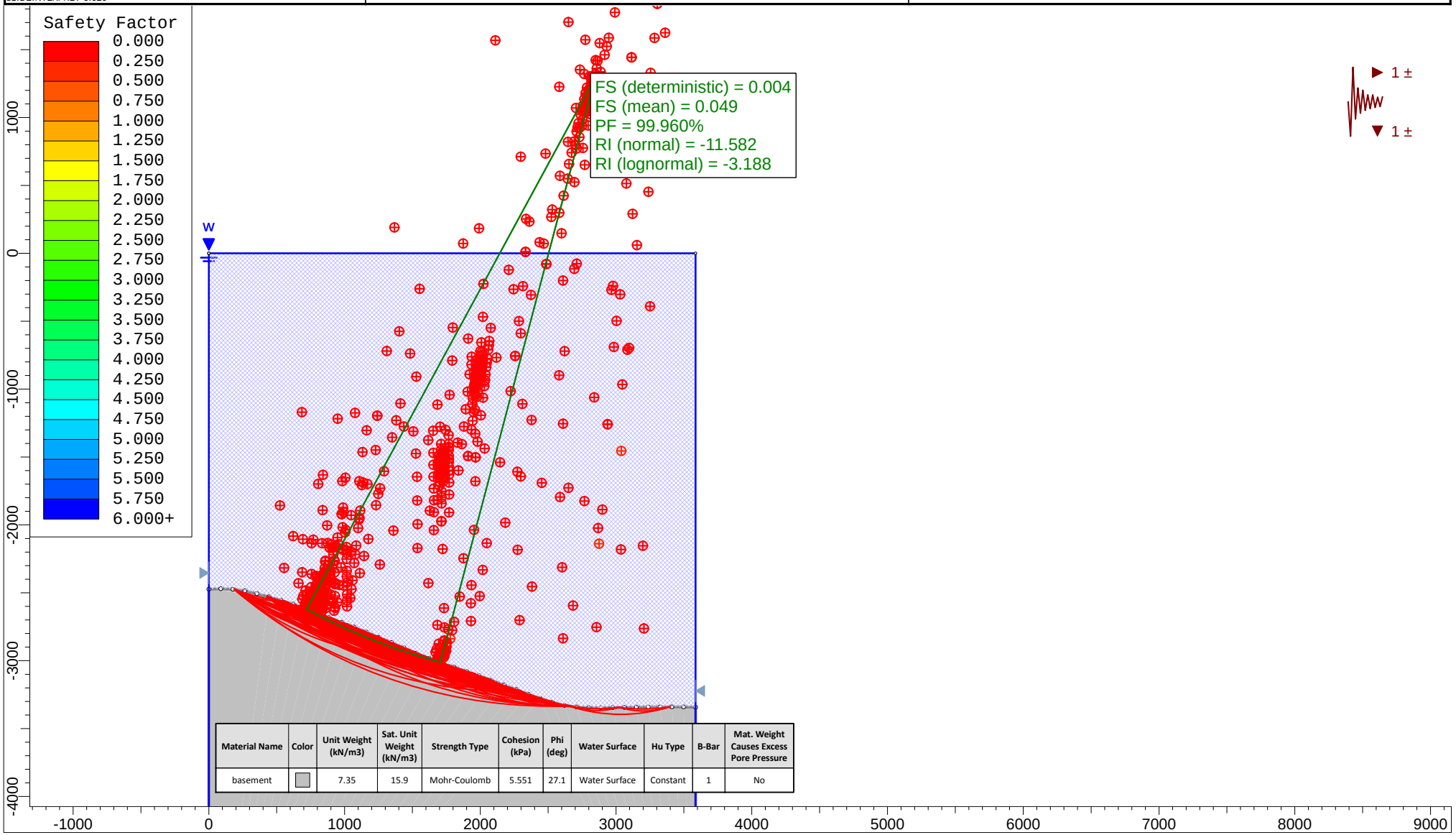


SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 96PC Site 21		
	Drawn By	Jason R. Patton	Scale 1:24000	Company Oregon State University
	Date	3/31/2013		File Name RR0705_96_21_0g.slim



Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

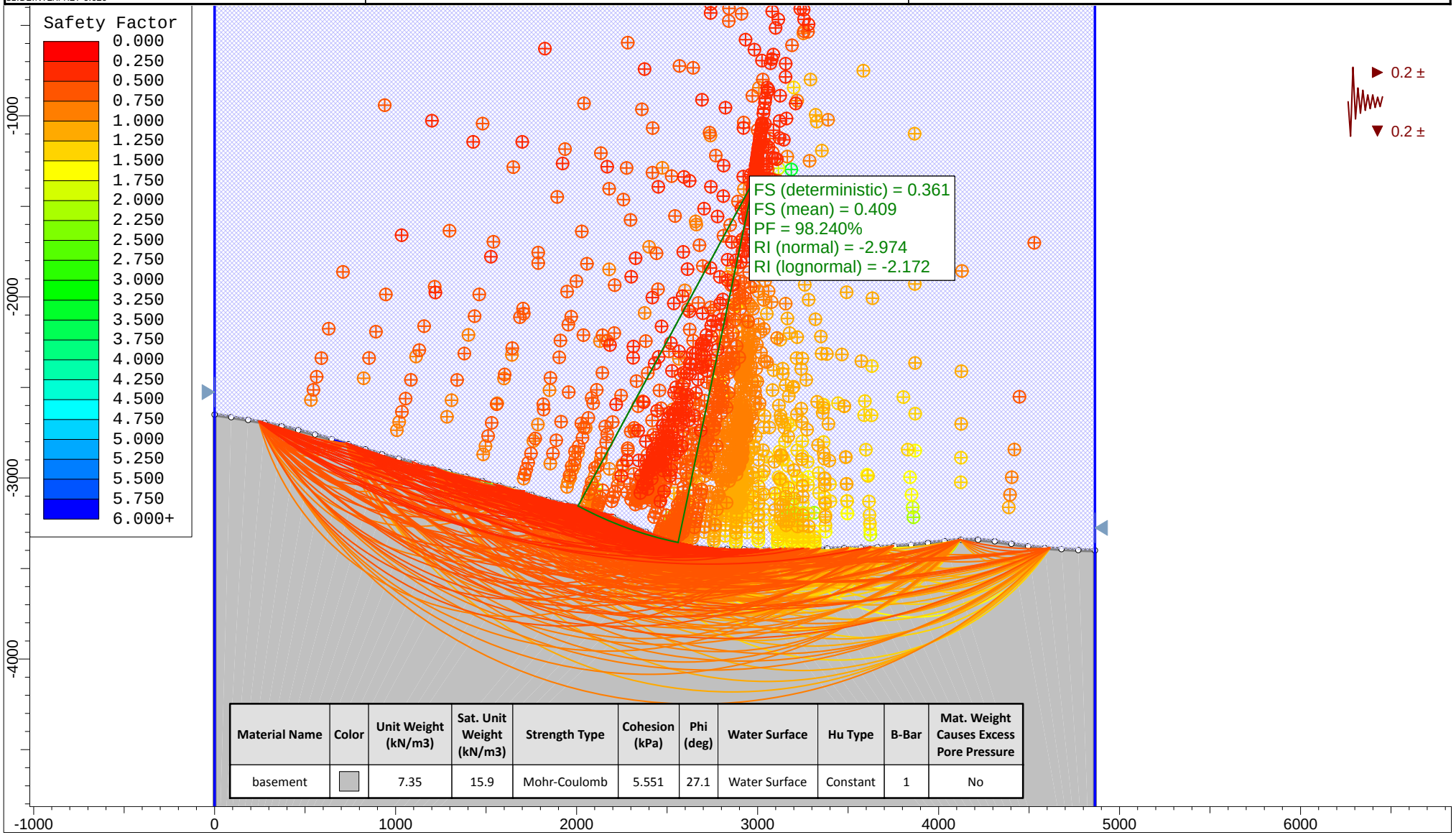
SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 96PC Site 21		
	Drawn By	Jason R. Patton	Scale 1:40000	Company Oregon State University
	Date	3/31/2013		File Name RR0705_96_21_1g.slim



Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

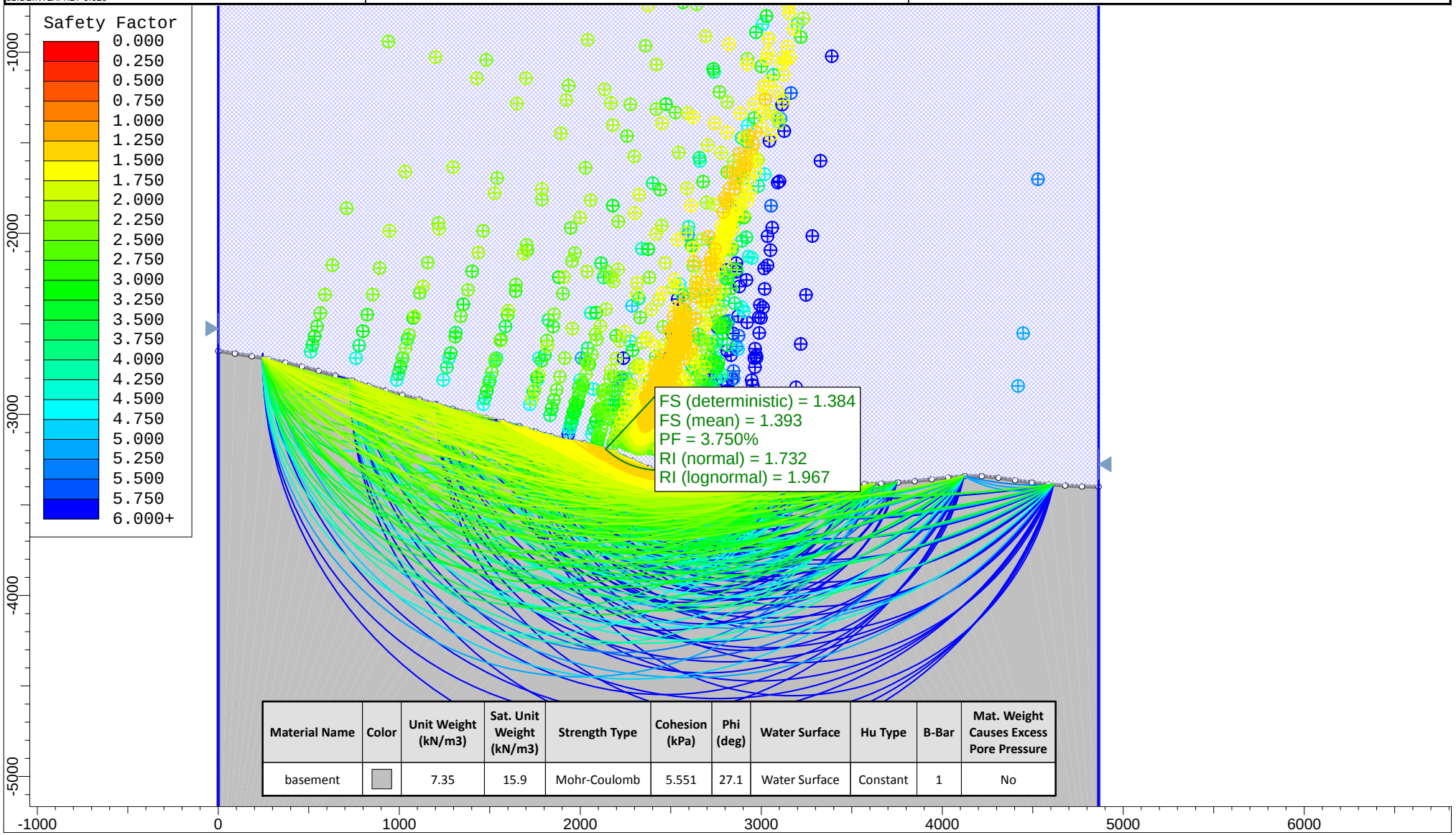
rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 95PC Site 27		
	Drawn By	Jason R. Patton	Scale 1:30000	Company Oregon State University
	Date	3/31/2013		File Name RR0705_96_22_02g.sli

SLIDEINTERPRET 6.020



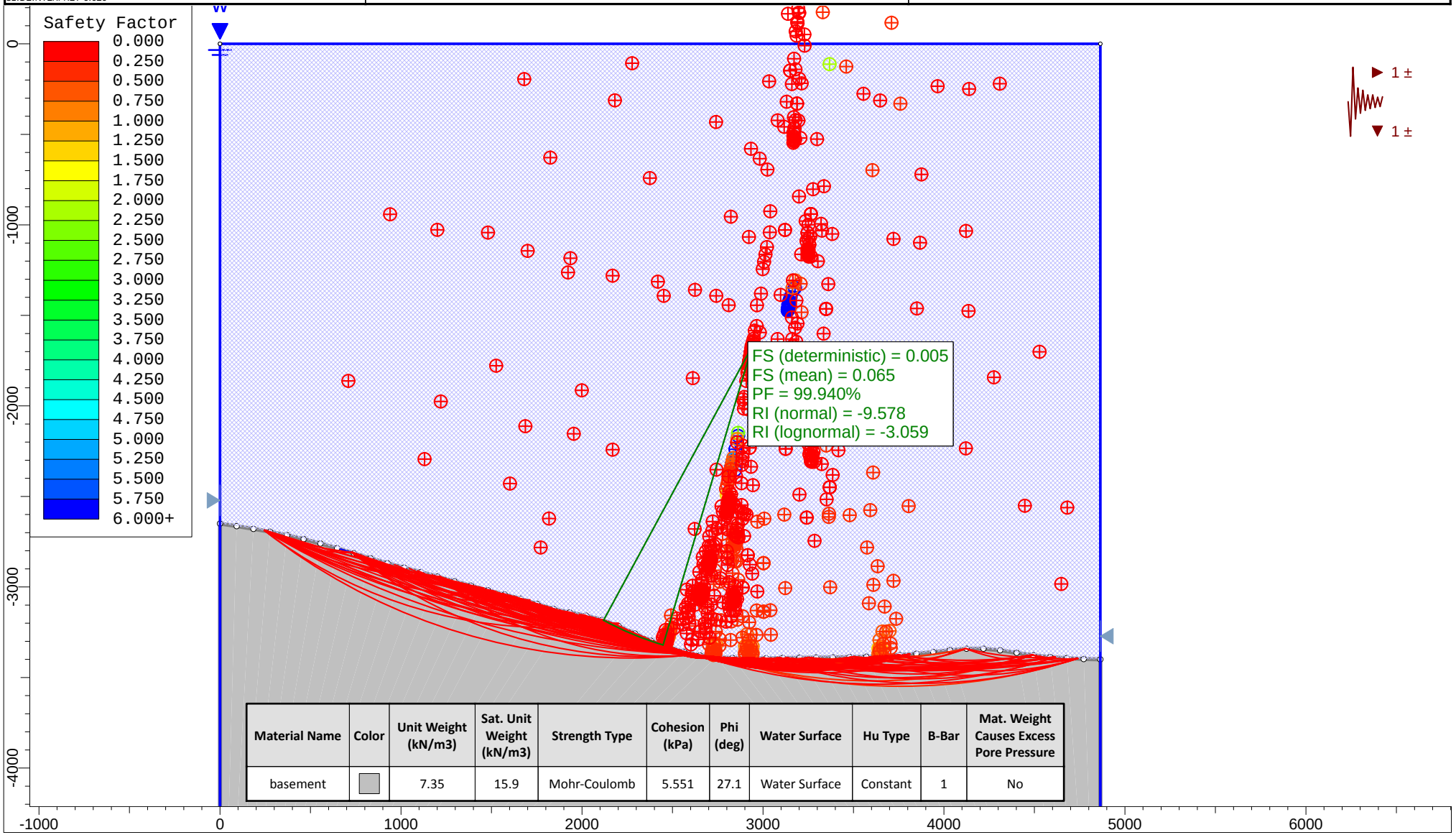
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 95PC Site 27		
	Drawn By	Jason R. Patton	Scale 1:30000	Company Oregon State University
	Date	3/31/2013		File Name RR0705_96_22_0g.slim



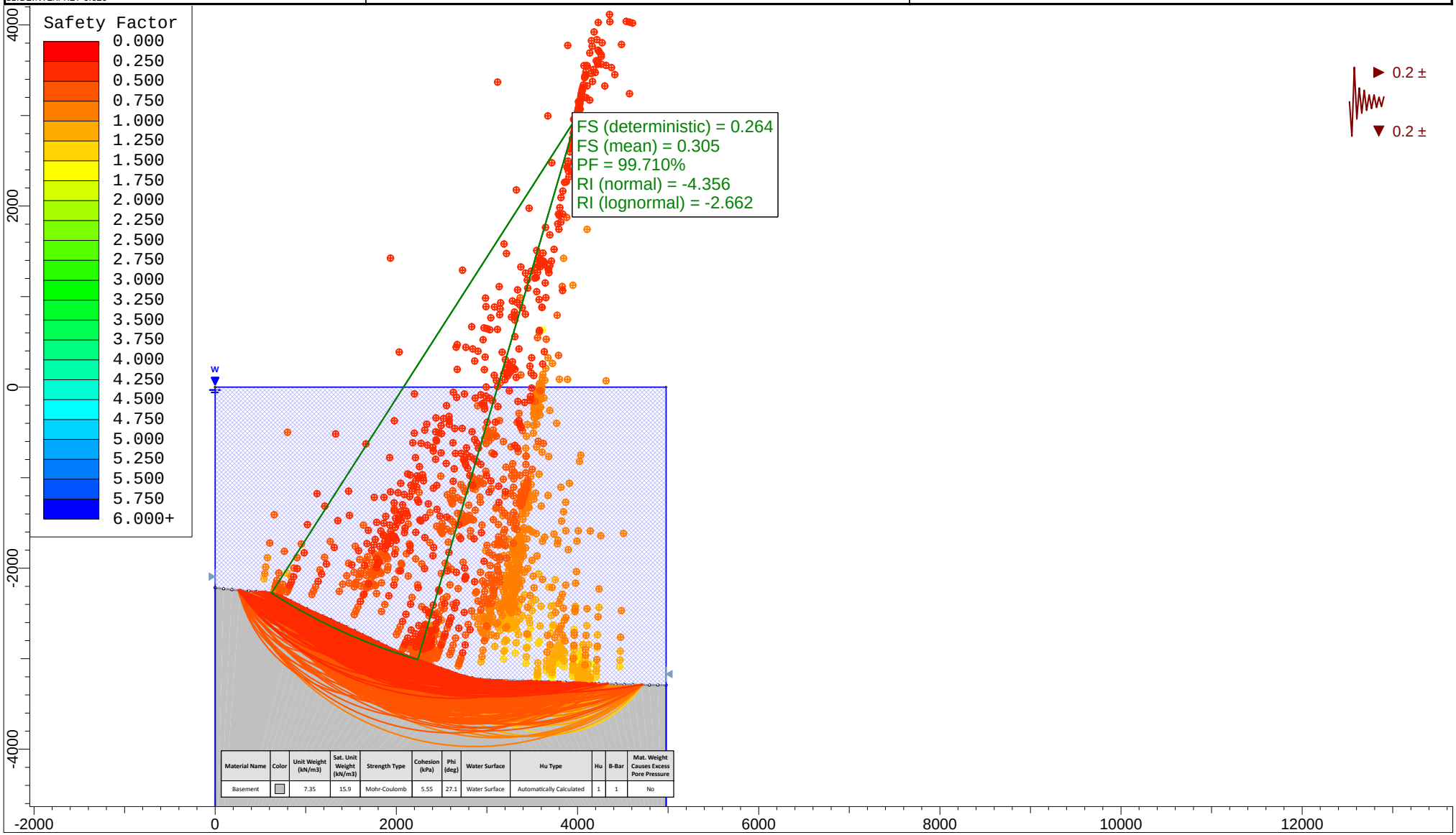
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 95PC Site 27		
	Drawn By	Jason R. Patton	Scale 1:30000	Company Oregon State University
	Date	3/31/2013		File Name RR0705_96_22_1g.slim

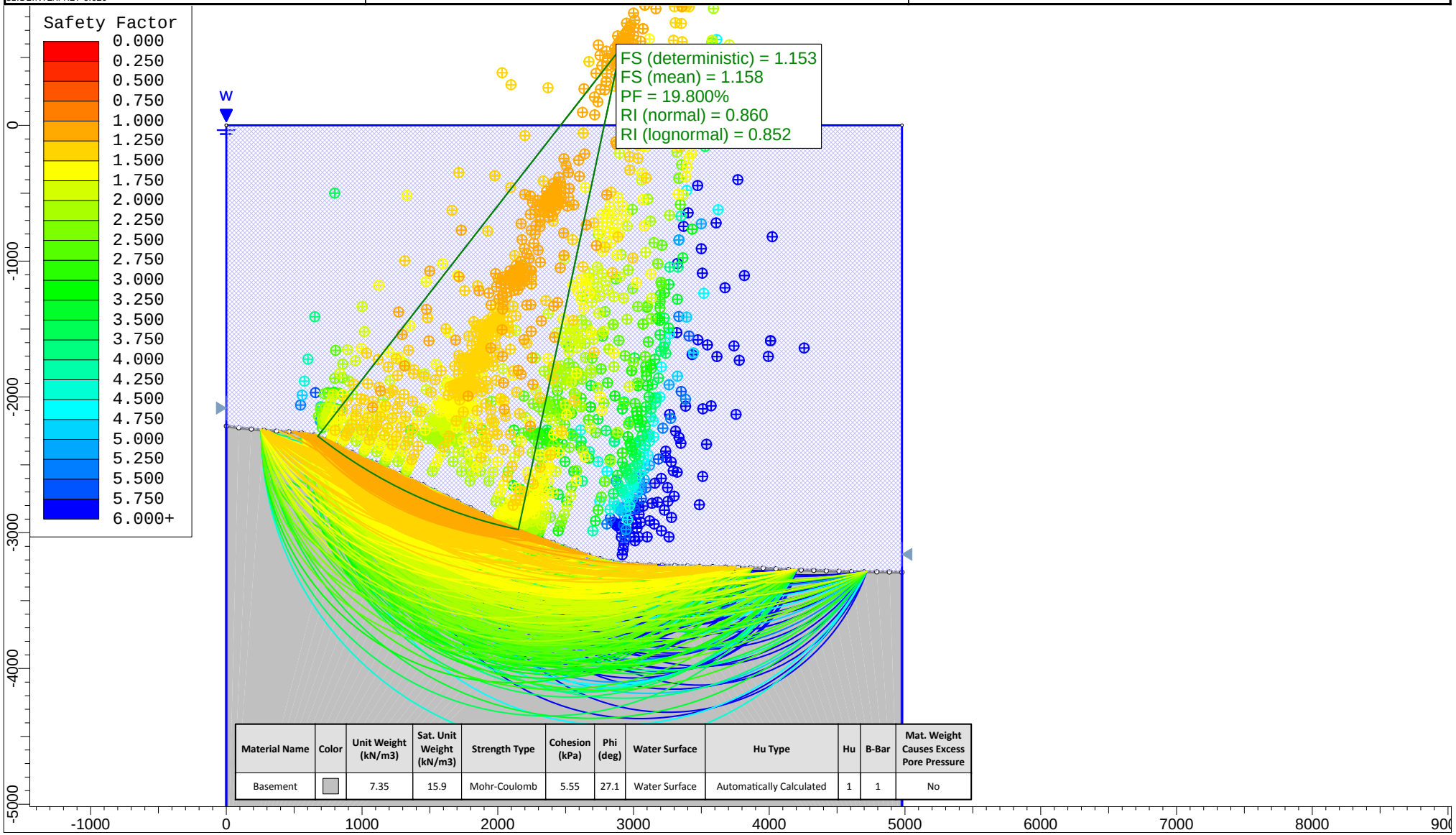


Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 96PC Site 24		
	Drawn By	Jason R. Patton	Scale 1:60000	Company Oregon State University
	Date	3/25/2013		File Name RR0705_96_24_02g.sli

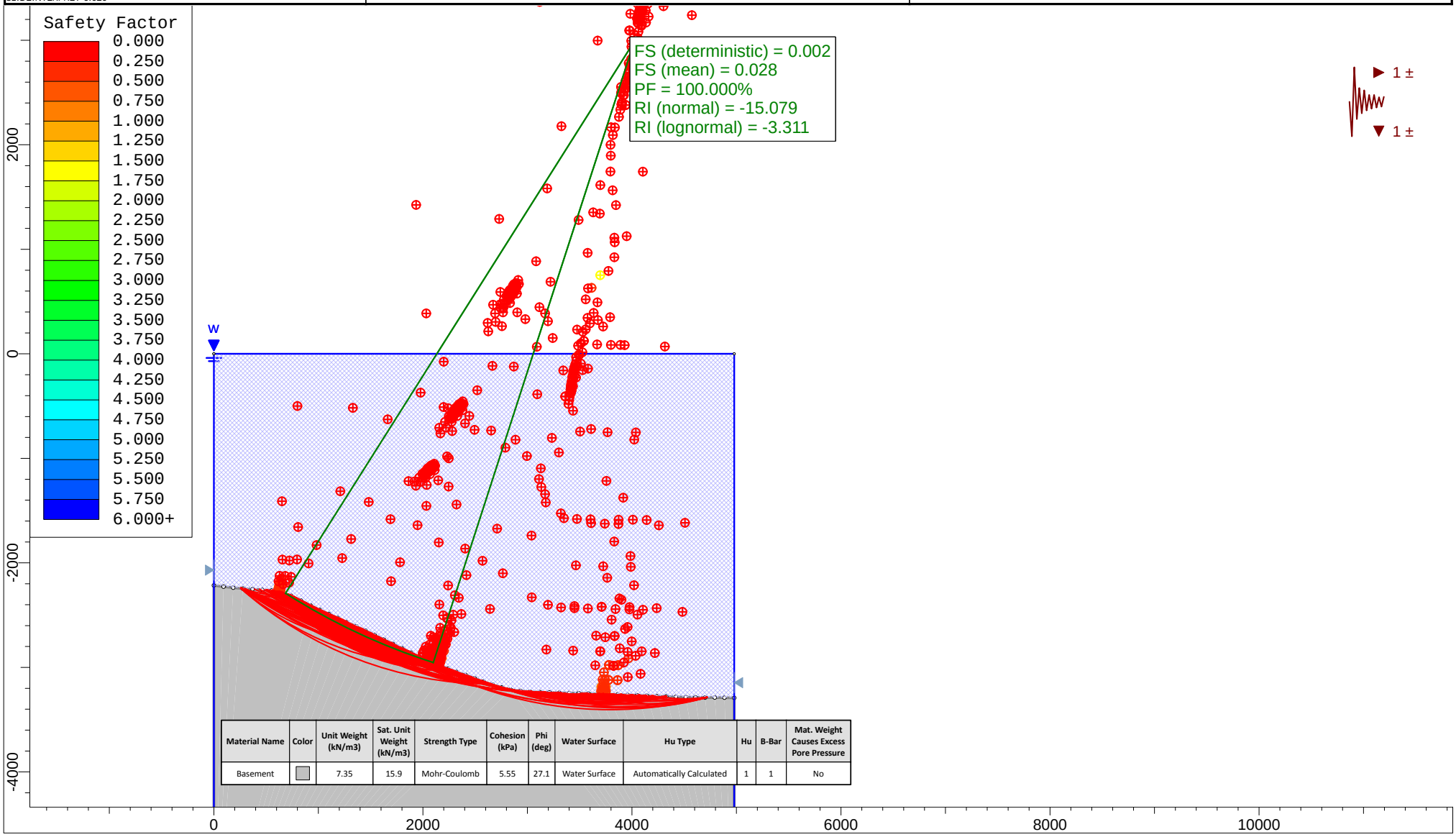


SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 96PC Site 24		
	Drawn By	Jason R. Patton	Scale 1:40000	Company Oregon State University
	Date	3/25/2013		File Name RR0705_96_24_0g.slim



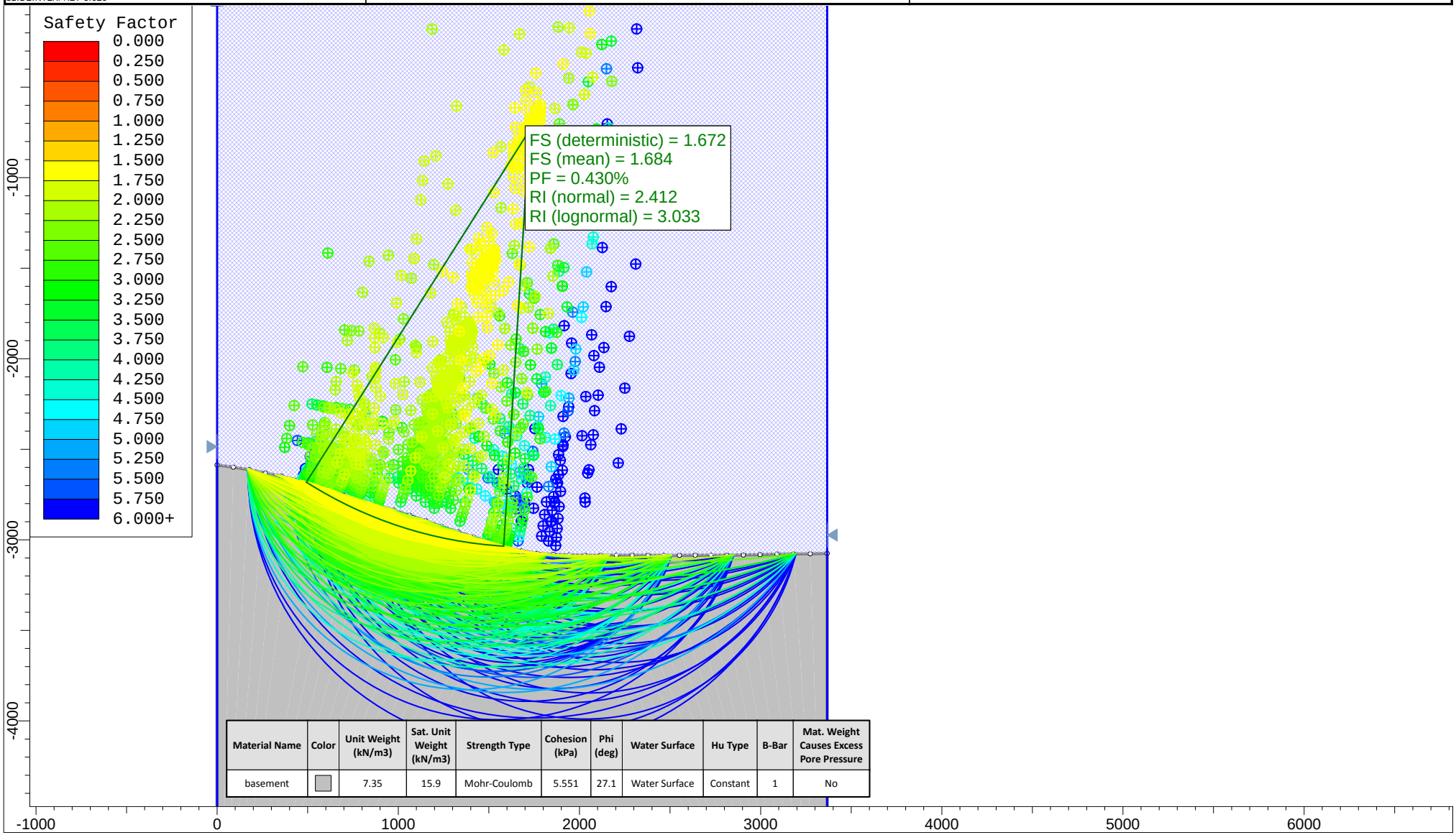
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu	B-Bar	Mat. Weight Causes Excess Pore Pressure
Basement		7.35	15.9	Mohr-Coulomb	5.55	27.1	Water Surface	Automatically Calculated	1	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 96PC Site 24		
	Drawn By	Jason R. Patton	Scale 1:52000	Company Oregon State University
	Date	3/25/2013		File Name RR0705_96_24_1g.slim



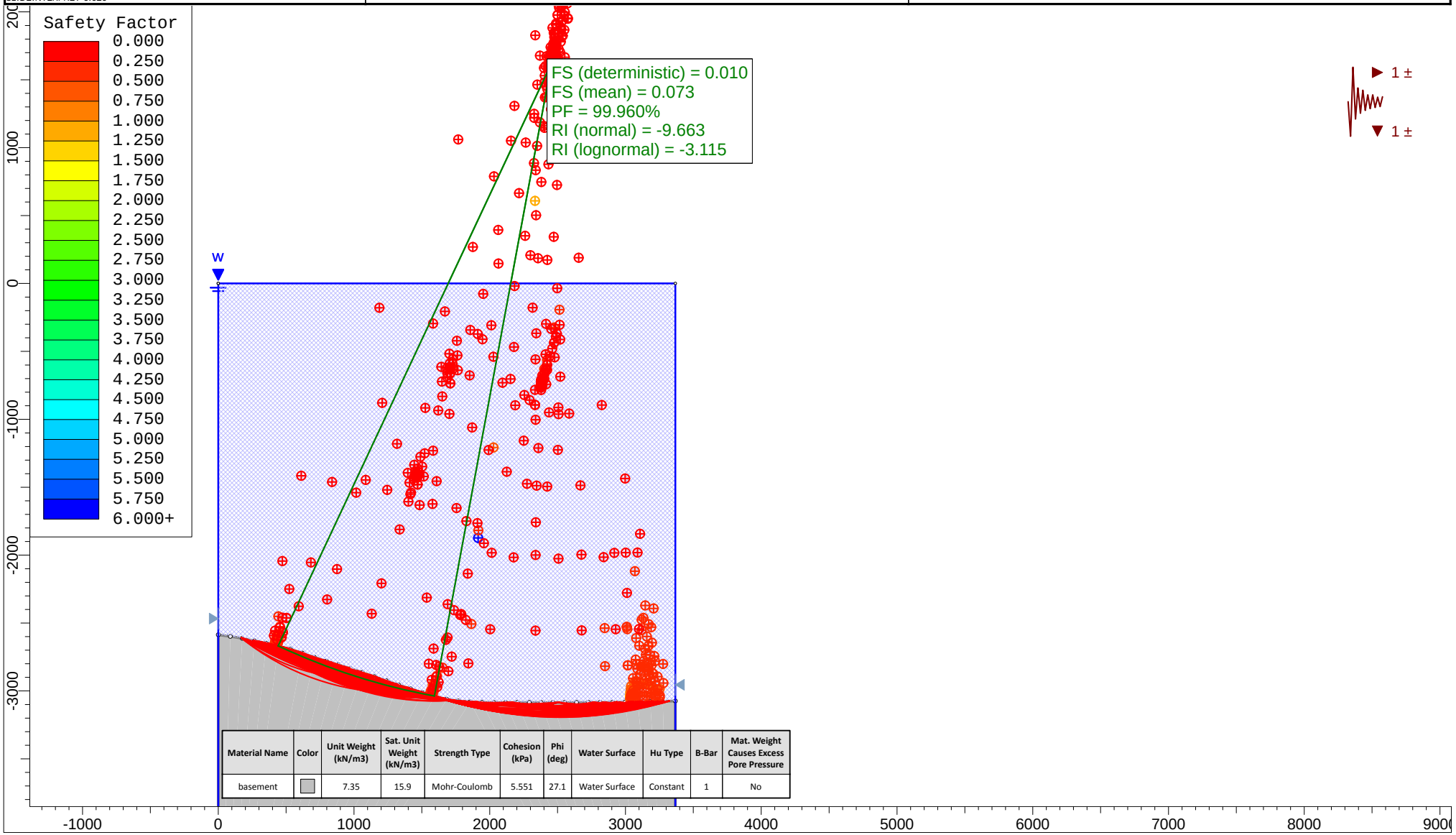
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu	B-Bar	Mat. Weight Causes Excess Pore Pressure
Basement		7.35	15.9	Mohr-Coulomb	5.55	27.1	Water Surface	Automatically Calculated	1	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 103PC Site 10		
	Drawn By: Jason R. Patton	Scale: 1:30000	Company: Oregon State University	
	Date: 3/31/2013		File Name: RR0705_103_10_0g.slim	



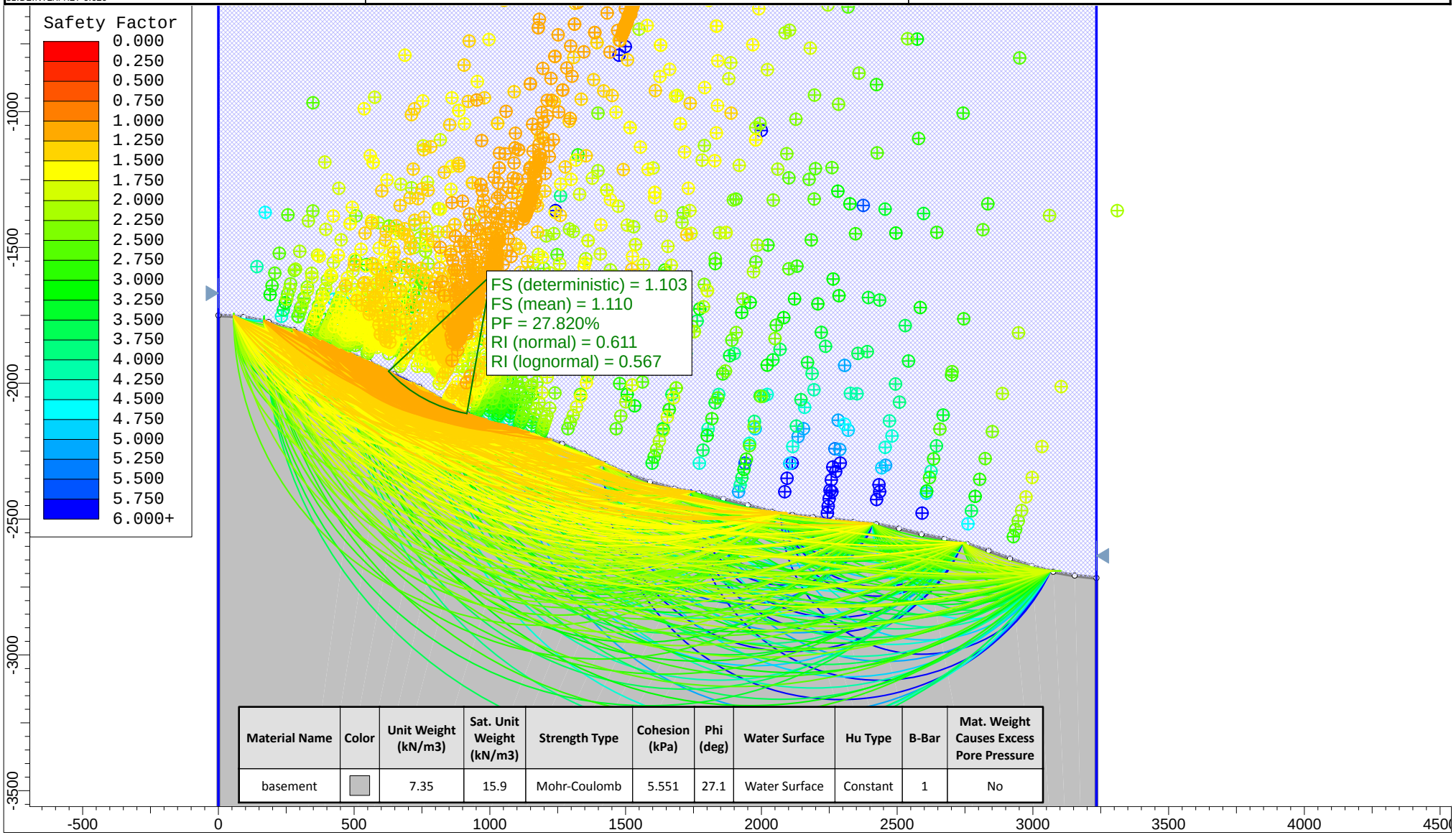
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 103PC Site 10		
	Drawn By	Jason R. Patton	Scale 1:40000	Company Oregon State University
	Date	3/31/2013		File Name RR0705_103_10_1g.slim



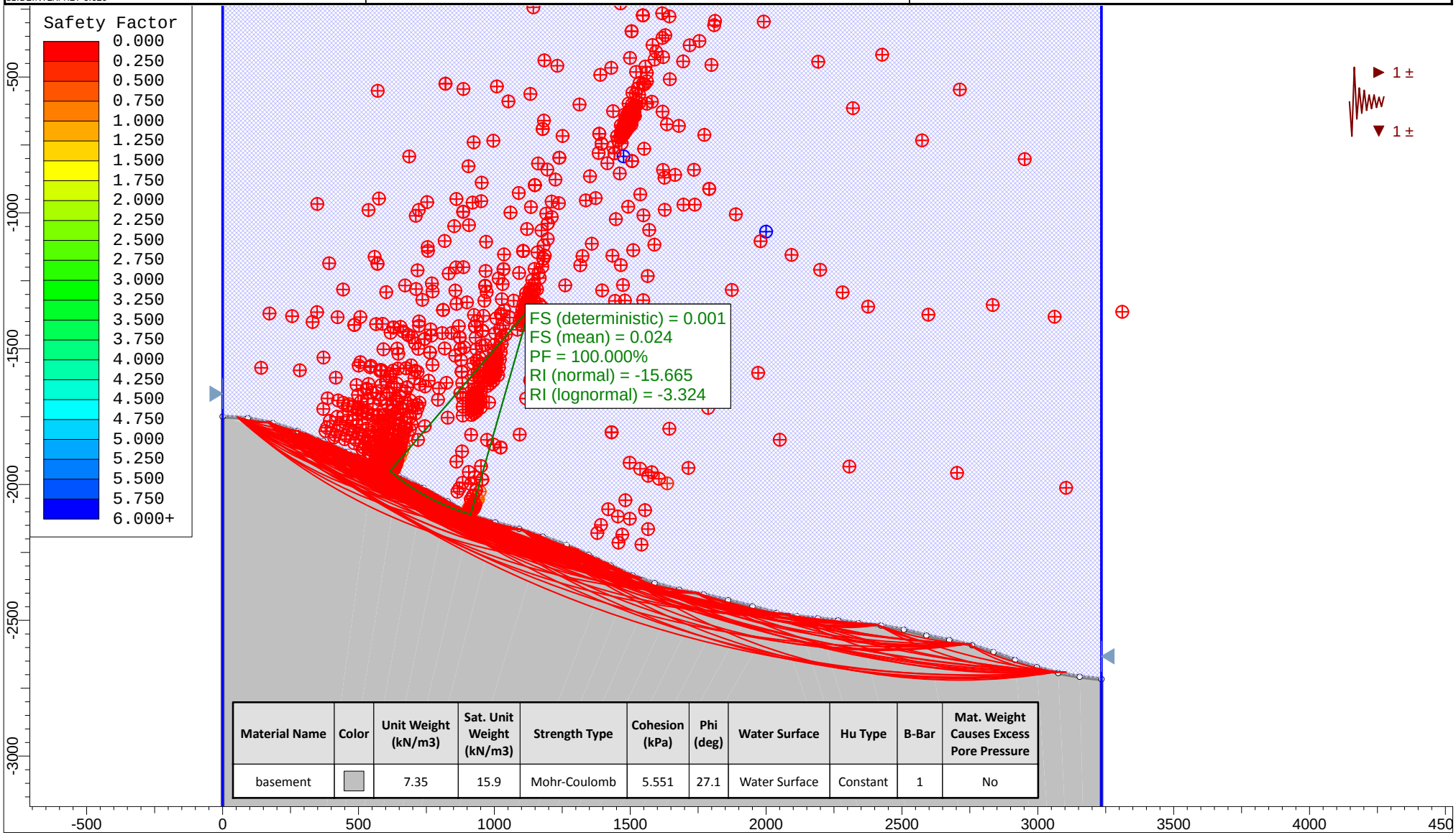
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 103PC Site 11		
	Drawn By	Jason R. Patton	Scale 1:20000	Company Oregon State University
	Date	3/31/2013		File Name RR0705_103_11_0g.slim



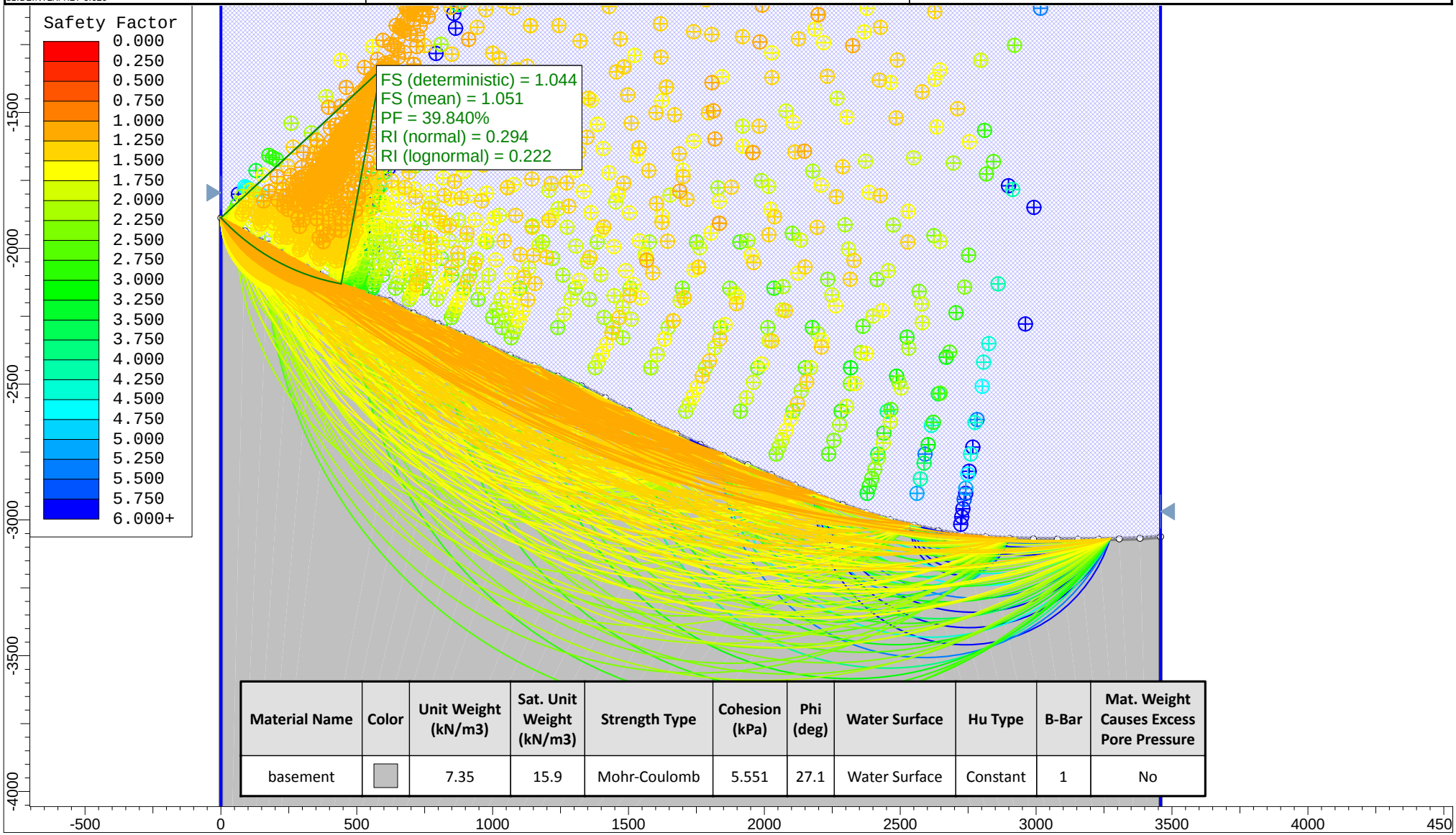
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 103PC Site 11		
	Drawn By	Jason R. Patton	Scale 1:20000	Company Oregon State University
	Date	3/31/2013		File Name RR0705_103_11_1g.slim



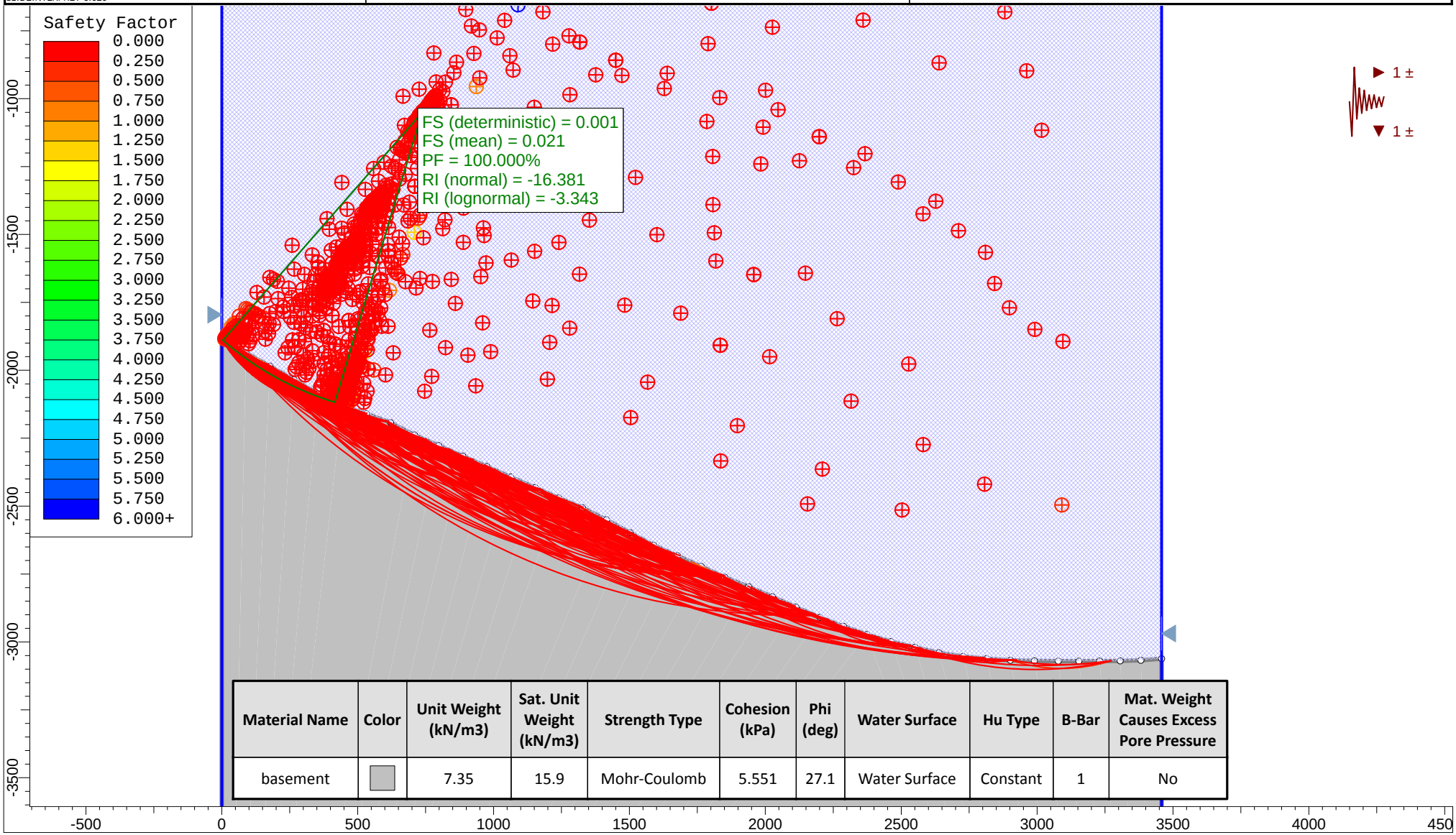
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 103PC Site 12		
	Drawn By: Jason R. Patton	Scale: 1:20000	Company: Oregon State University	
	Date: 3/31/2013		File Name: RR0705_103_12_0g.slim	



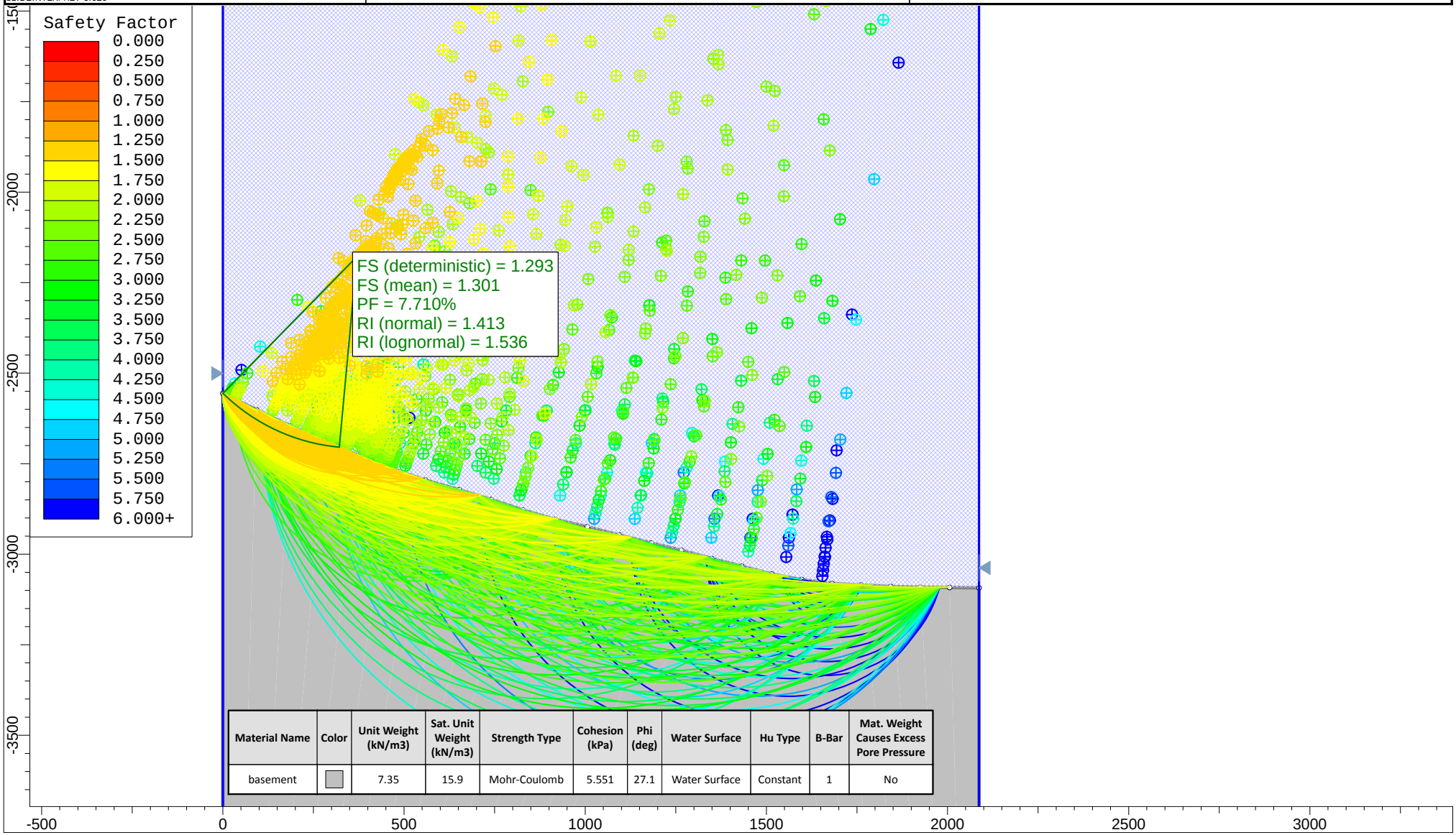
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 103PC Site 12		
	Drawn By: Jason R. Patton	Scale: 1:20000	Company: Oregon State University	
	Date: 3/31/2013		File Name: RR0705_103_12_1g.slim	



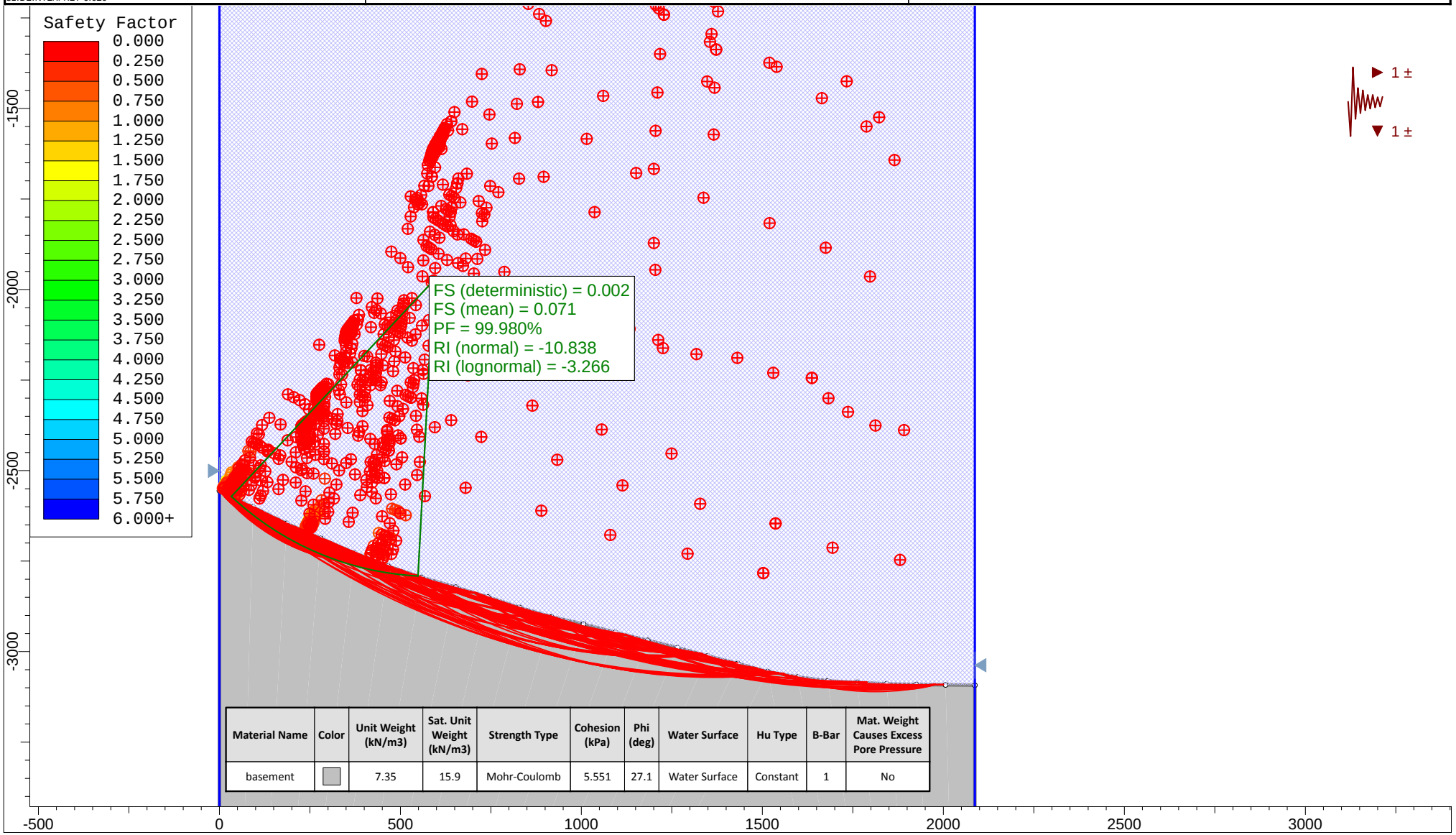
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 103PC Site 13		
	Drawn By	Jason R. Patton	Scale 1:15000	Company Oregon State University
	Date	4/01/2013		File Name RR0705_103_13_0g.slim



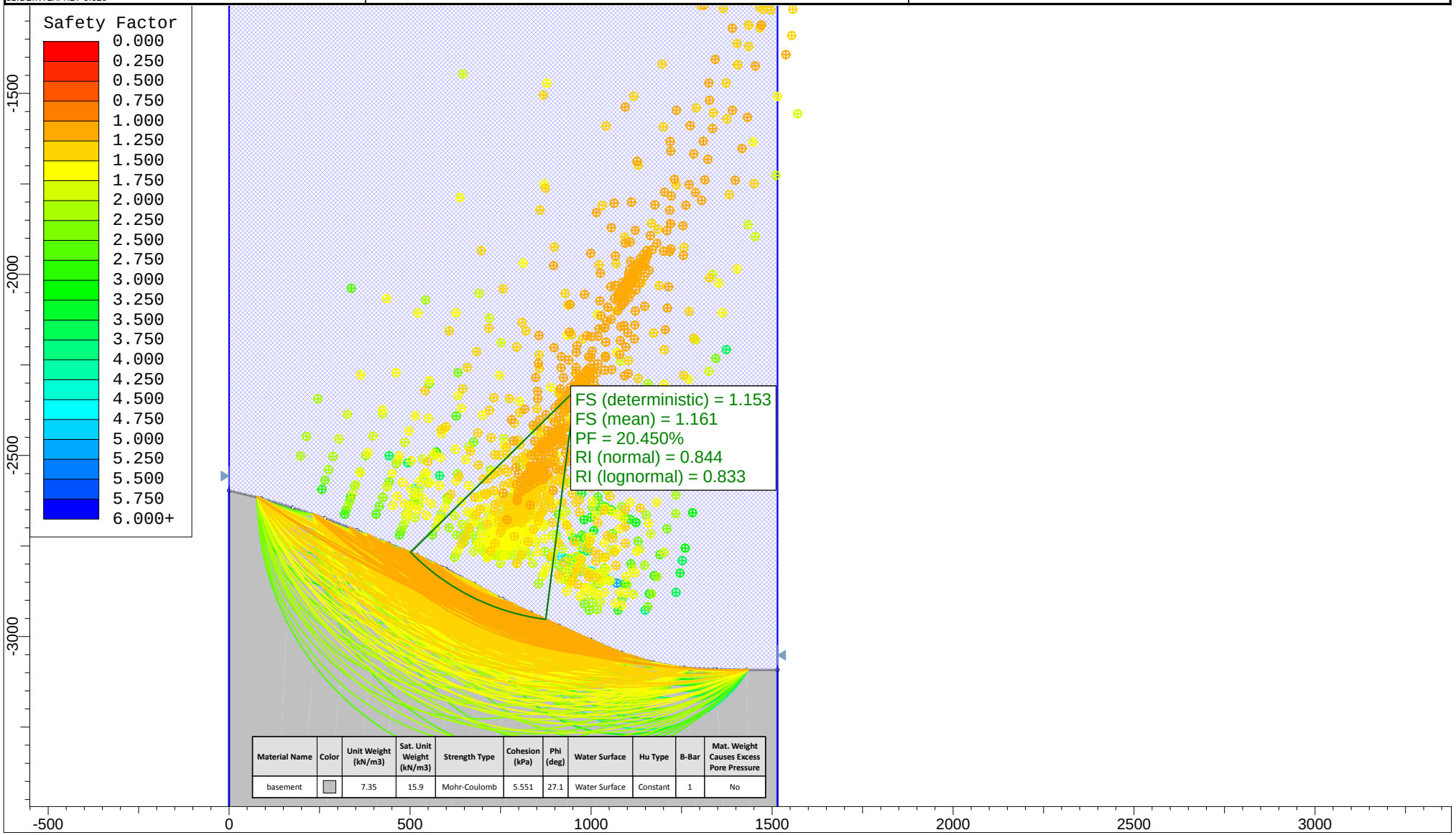
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 103PC Site 13		
	Drawn By	Jason R. Patton	Scale 1:15000	Company Oregon State University
	Date	4/01/2013		File Name RR0705_103_13_1g.slim



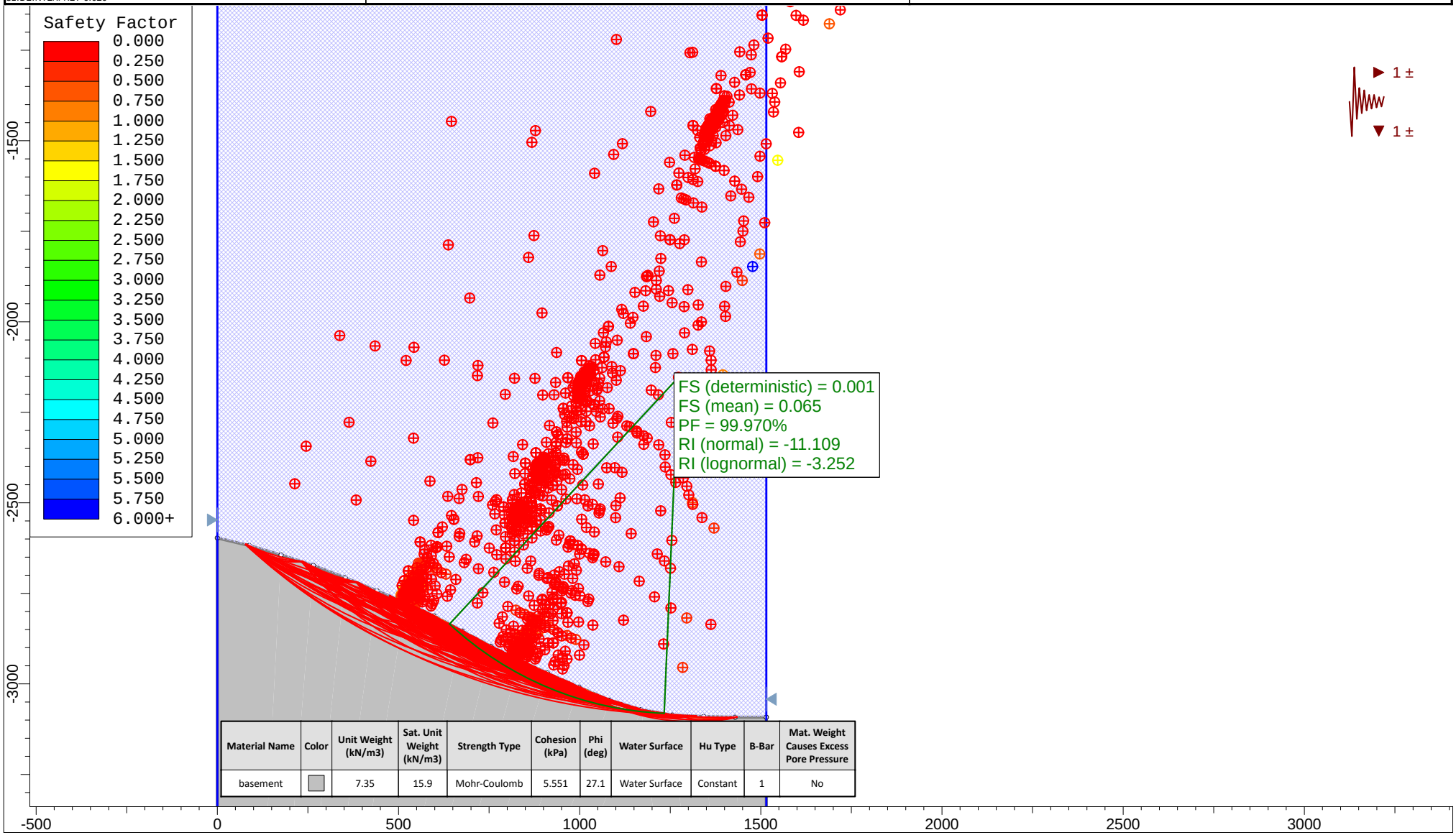
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 103PC Site 14		
	Drawn By: Jason R. Patton	Scale: 1:15000	Company: Oregon State University	
	Date: 4/01/2013		File Name: RR0705_103_14_0g.slim	



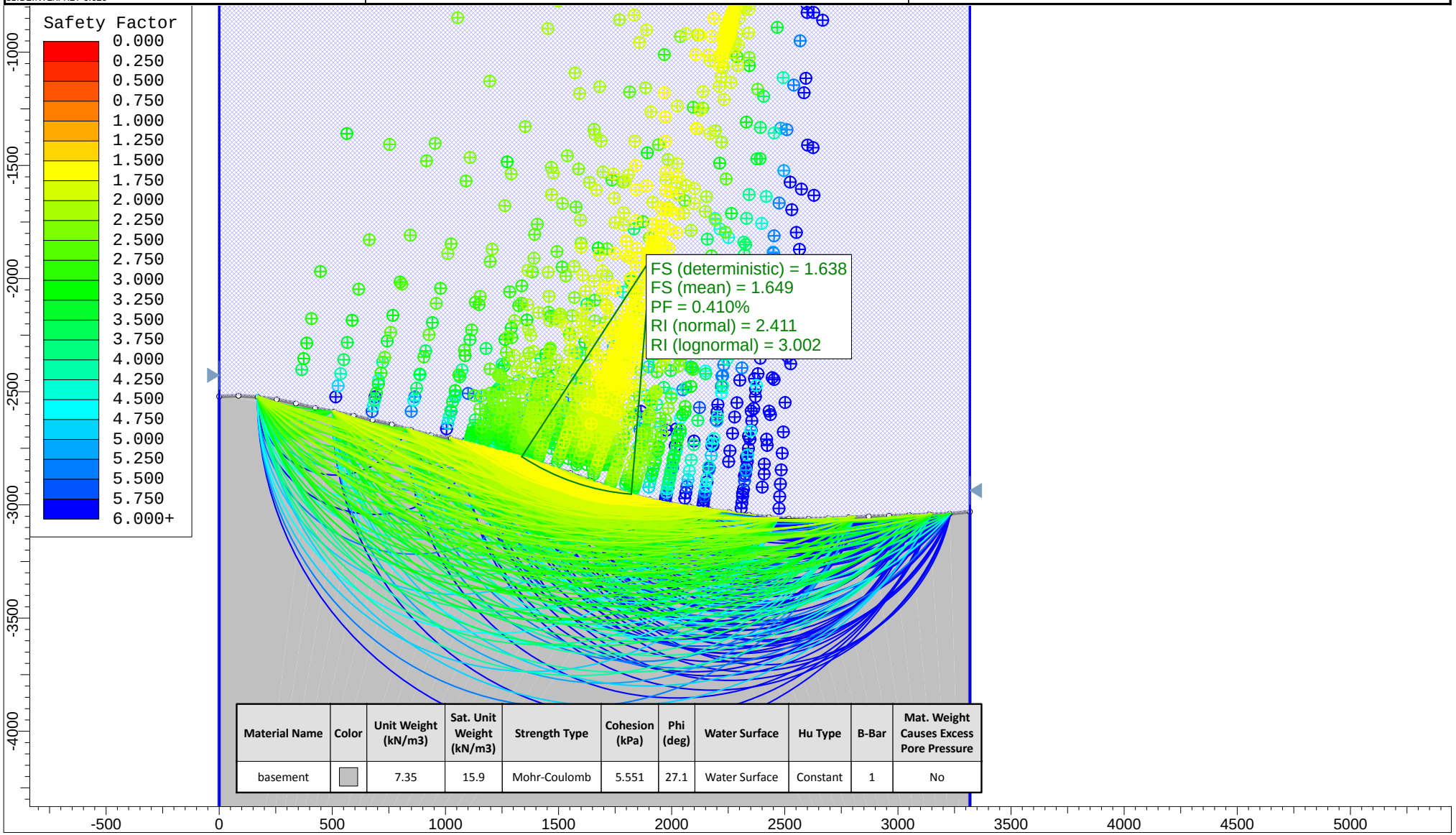
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 103PC Site 14		
	Drawn By	Jason R. Patton	Scale 1:15000	Company Oregon State University
	Date	4/01/2013		File Name RR0705_103_14_1g.slim



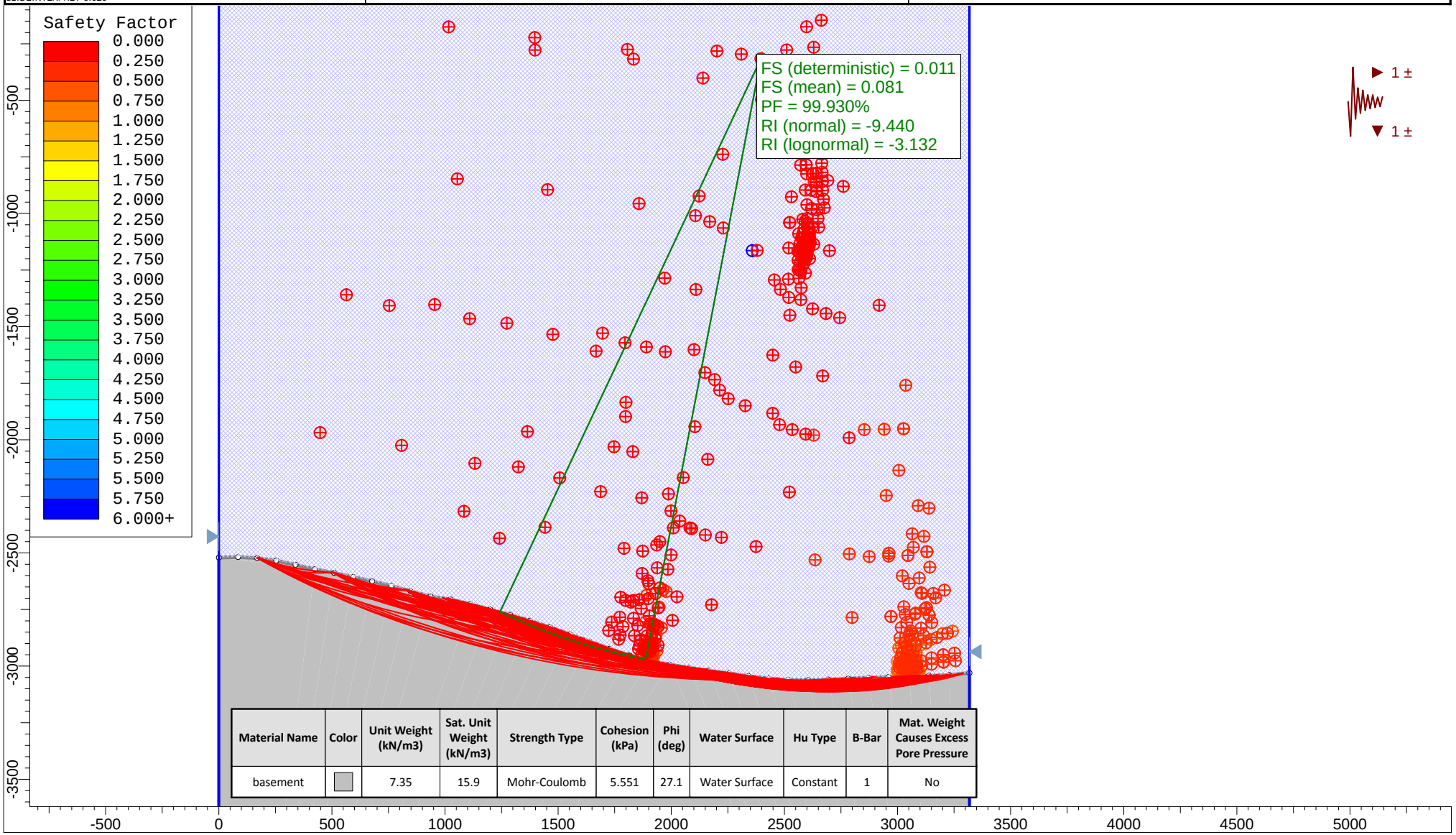
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 103PC Site 15		
	Drawn By	Jason R. Patton	Scale 1:24000	Company Oregon State University
	Date	4/01/2013		File Name RR0705_103_15_0g.sli



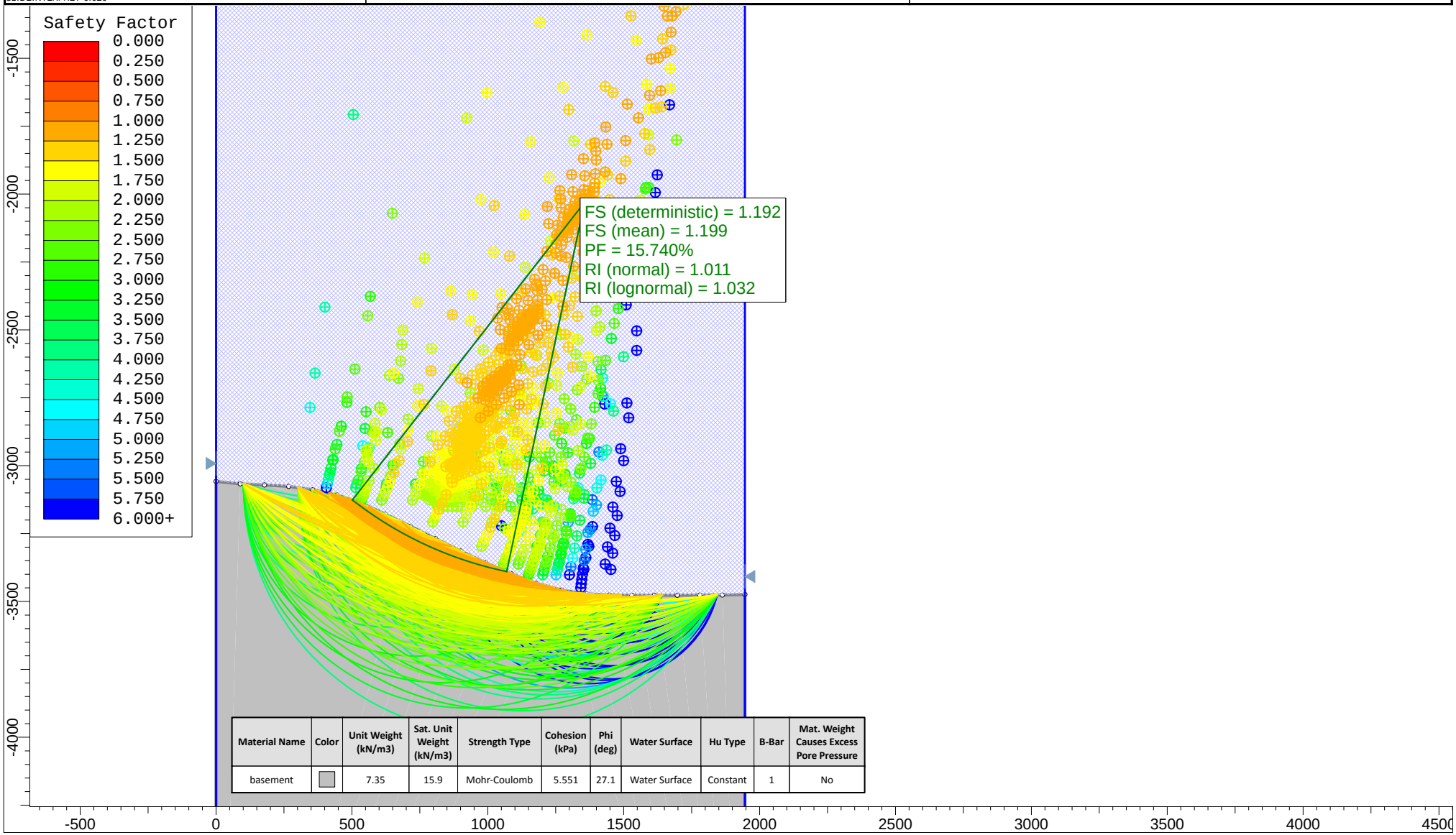
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 103PC Site 15		
	Drawn By	Jason R. Patton	Scale 1:24000	Company Oregon State University
	Date	4/01/2013		File Name RR0705_103_15_1g.sli



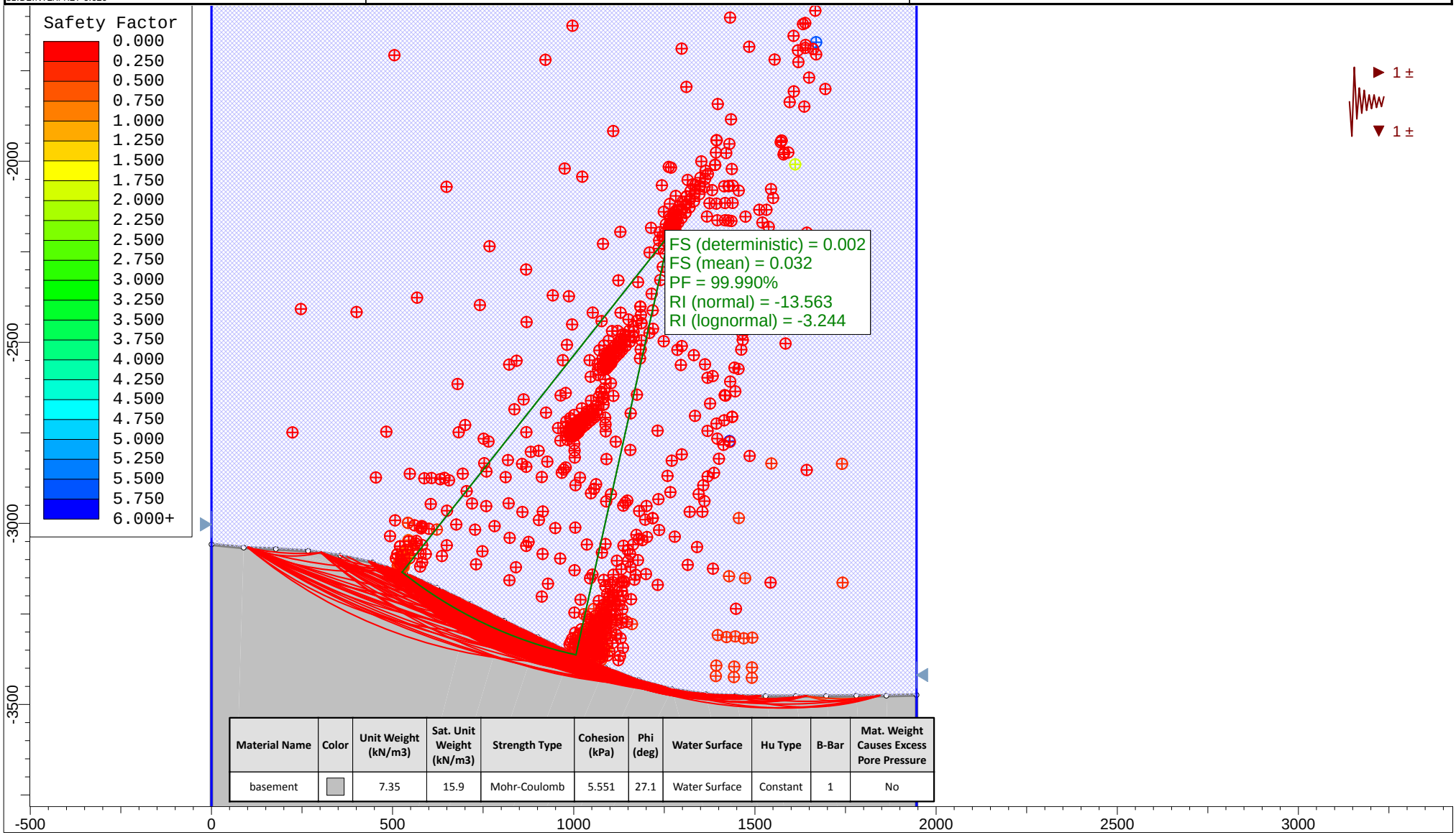
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 104PC Site 06		
	Drawn By: Jason R. Patton	Scale: 1:20000	Company: Oregon State University	
	Date: 3/31/2013		File Name: RR0705_104_06_0g.slim	



Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

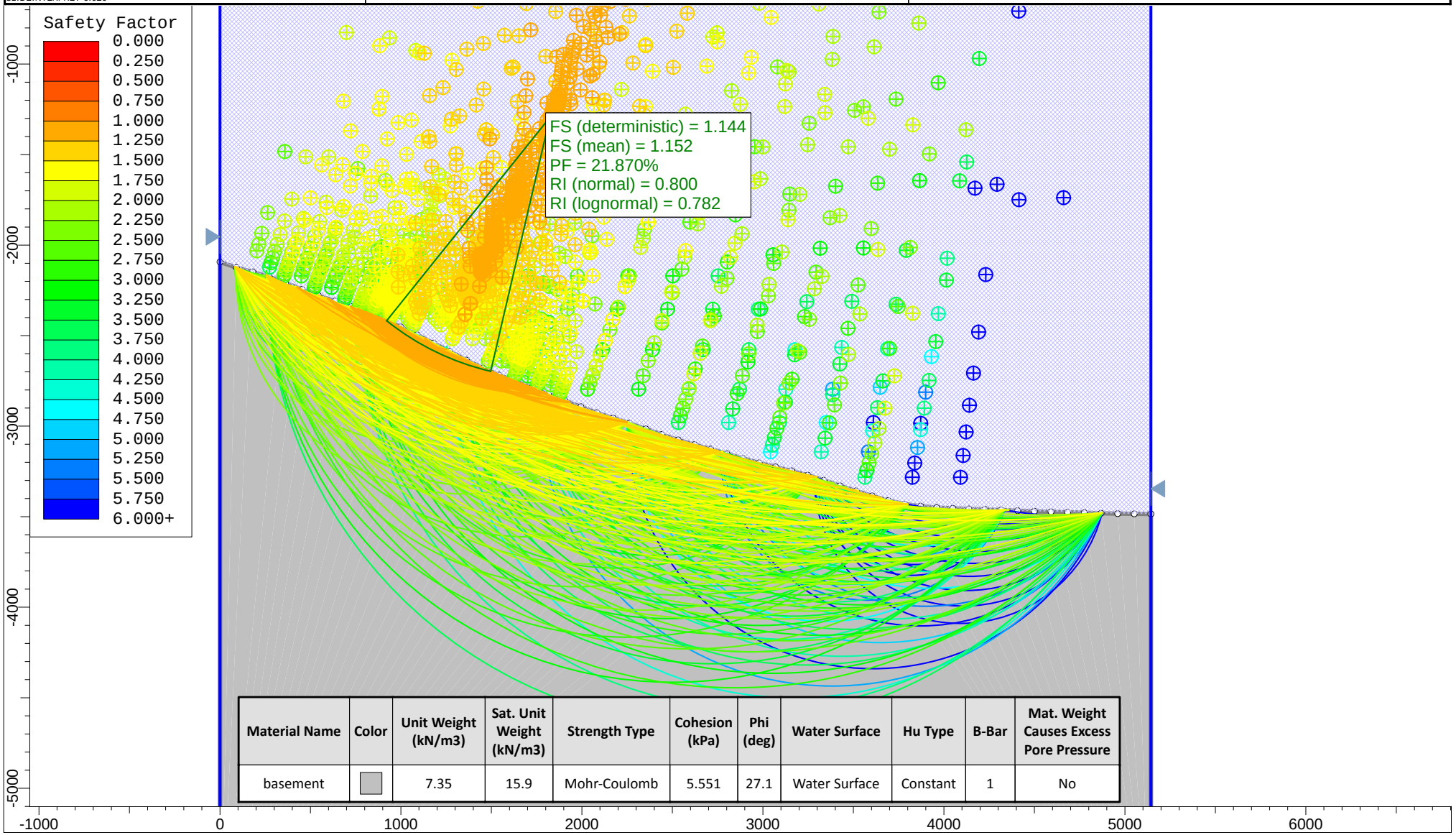
SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 104PC Site 06		
	Drawn By	Jason R. Patton	Scale 1:15000	Company Oregon State University
	Date	3/31/2013		File Name RR0705_104_06_1g.slim



Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

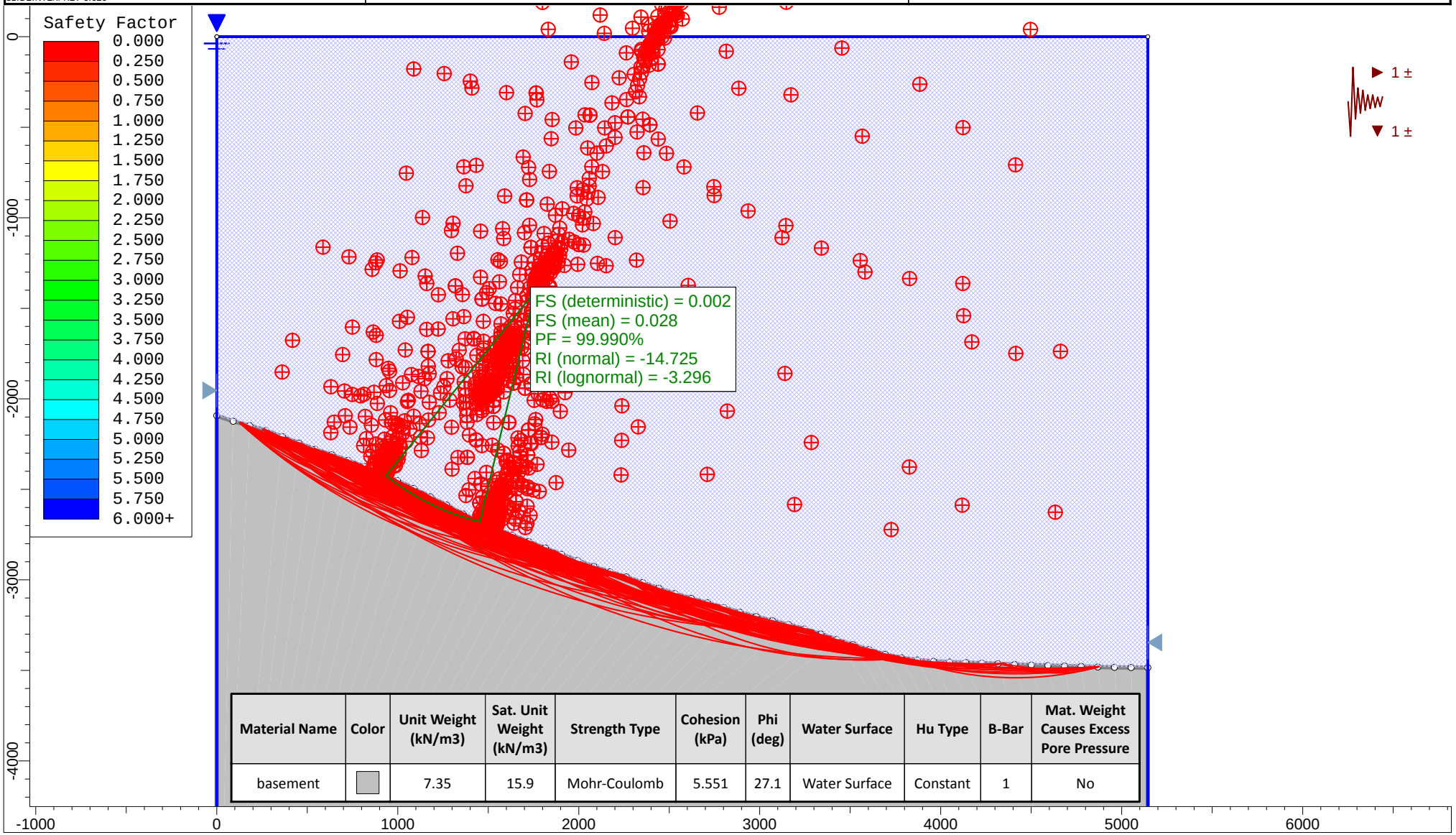
rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 104PC Site 07		
	Drawn By	Jason R. Patton	Scale 1:30000	Company Oregon State University
	Date	3/31/2013		File Name RR0705_104_07_0g.slim

SLIDEINTERPRET 6.020



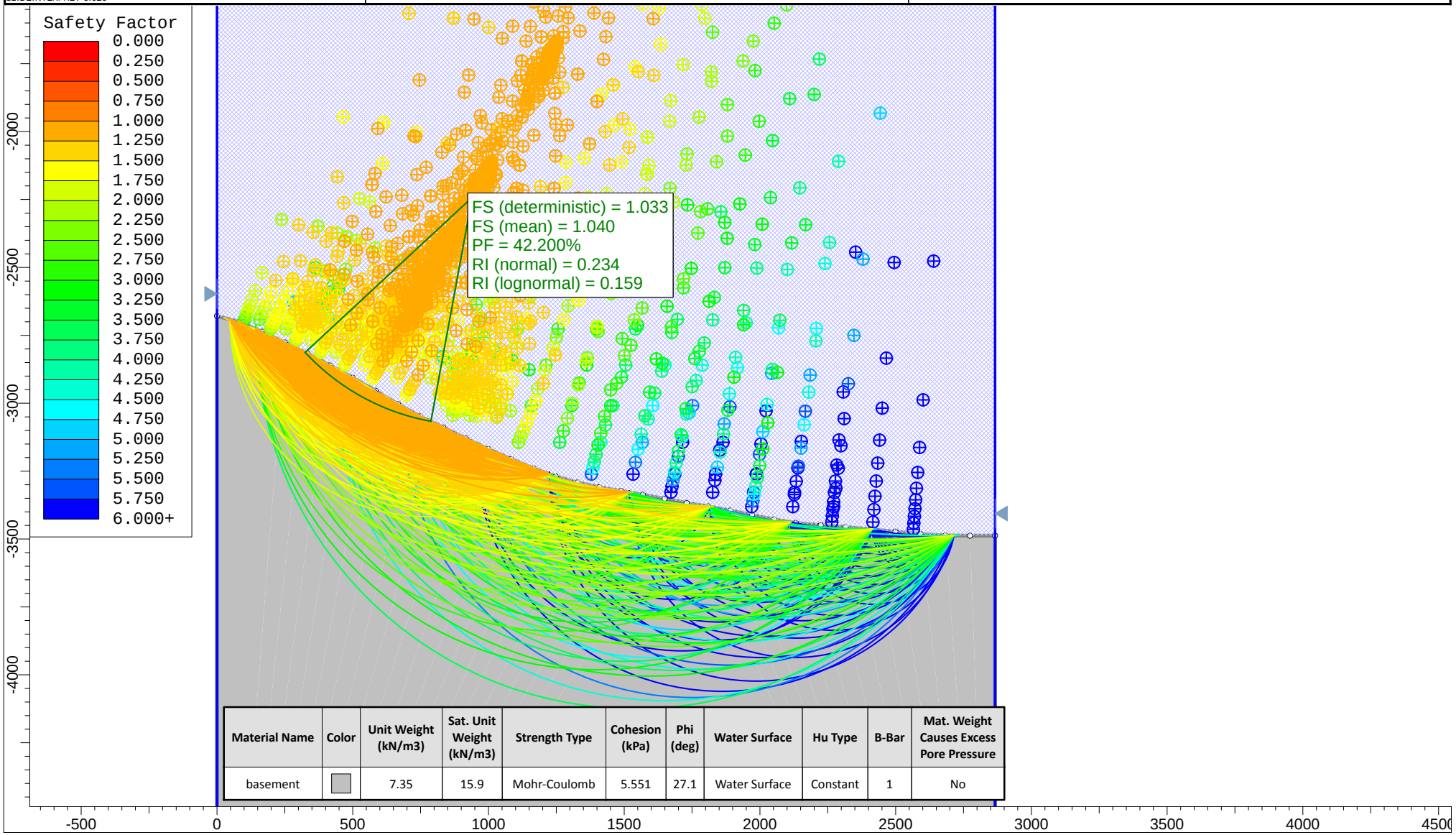
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 104PC Site 07		
	Drawn By	Jason R. Patton	Scale 1:30000	Company Oregon State University
	Date	3/31/2013		File Name RR0705_104_07_1g.slim



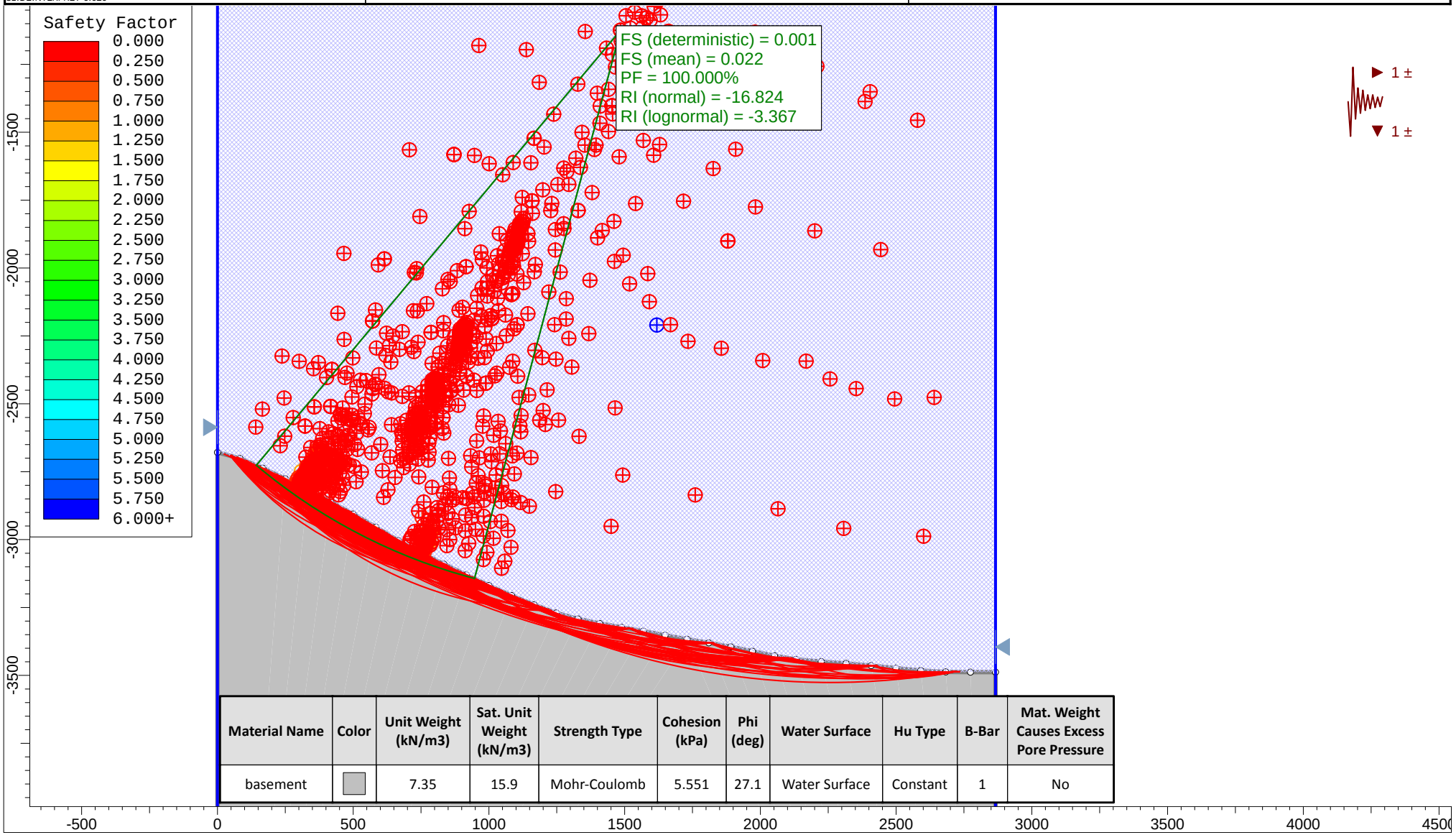
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 104PC Site 09		
	Drawn By	Jason R. Patton	Scale 1:20000	Company Oregon State University
	Date	3/31/2013		File Name RR0705_104_09_0g.slim



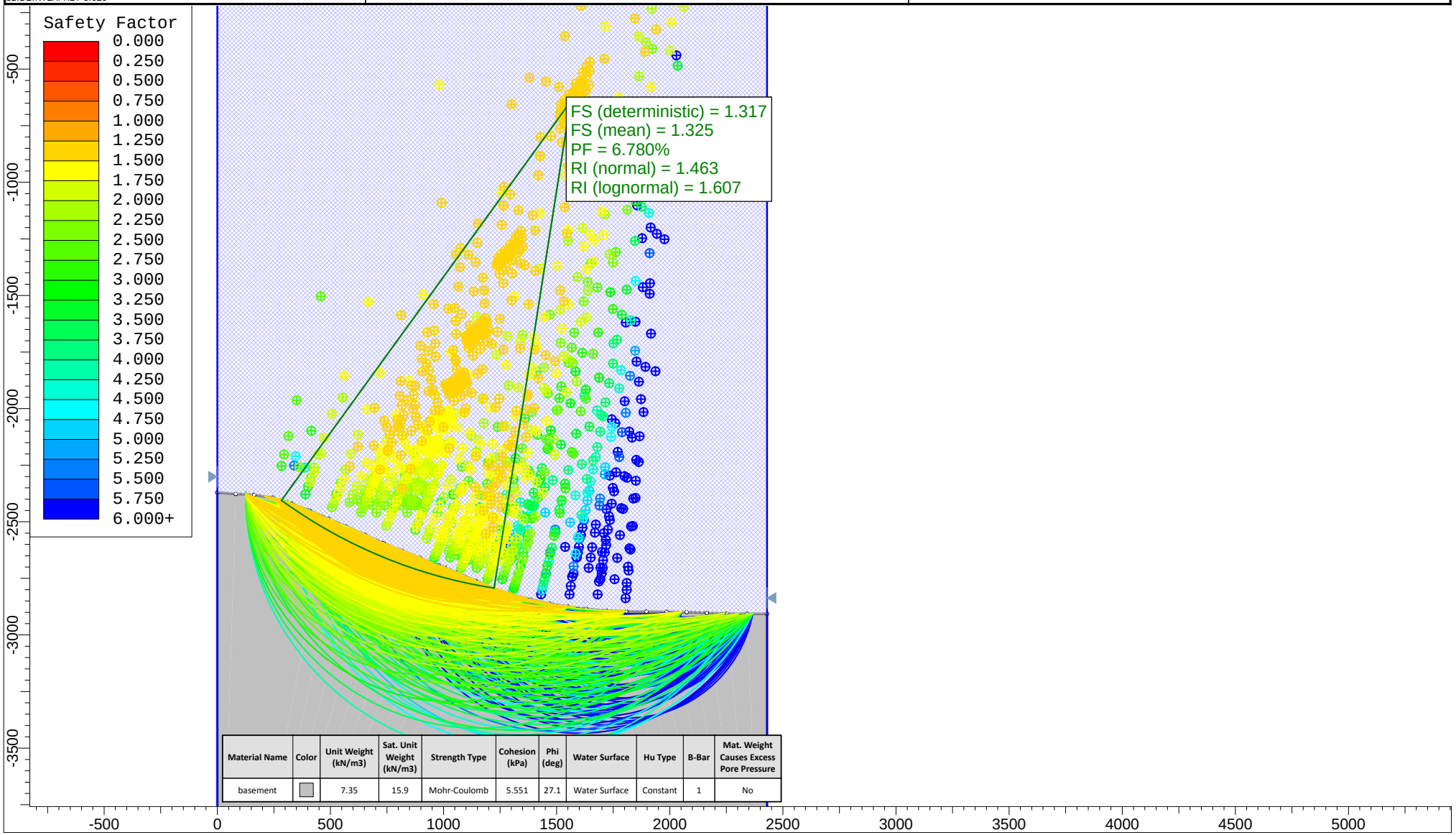
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 104PC Site 09		
	Drawn By: Jason R. Patton	Scale: 1:20000	Company: Oregon State University	
	Date: 3/31/2013		File Name: RR0705_104_09_1g.slim	



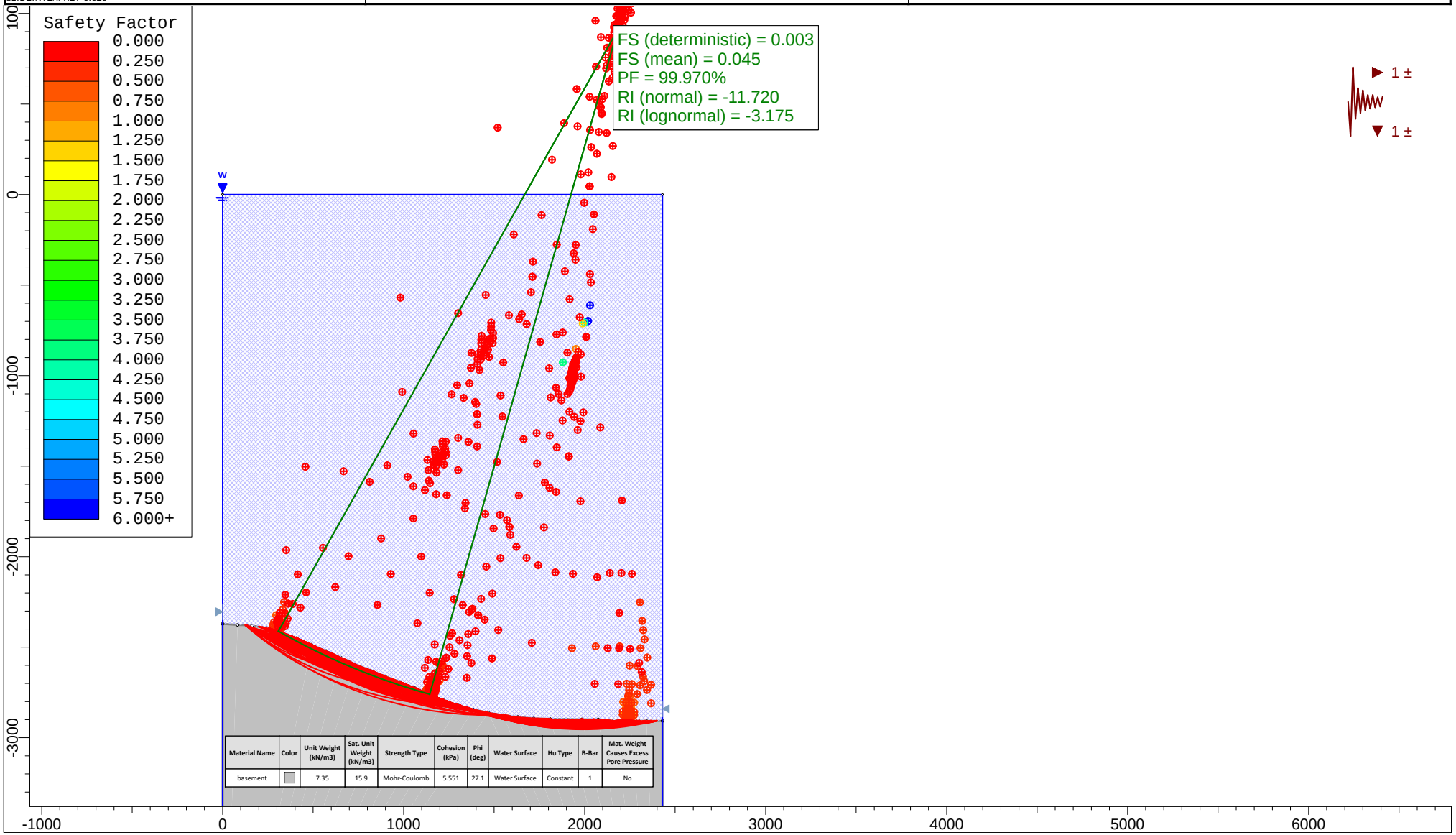
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 00		
	Drawn By: Jason R. Patton	Scale: 1:24000	Company: Oregon State University	
	Date: 4/01/2013		File Name: RR0705_108_0_0g.sli	



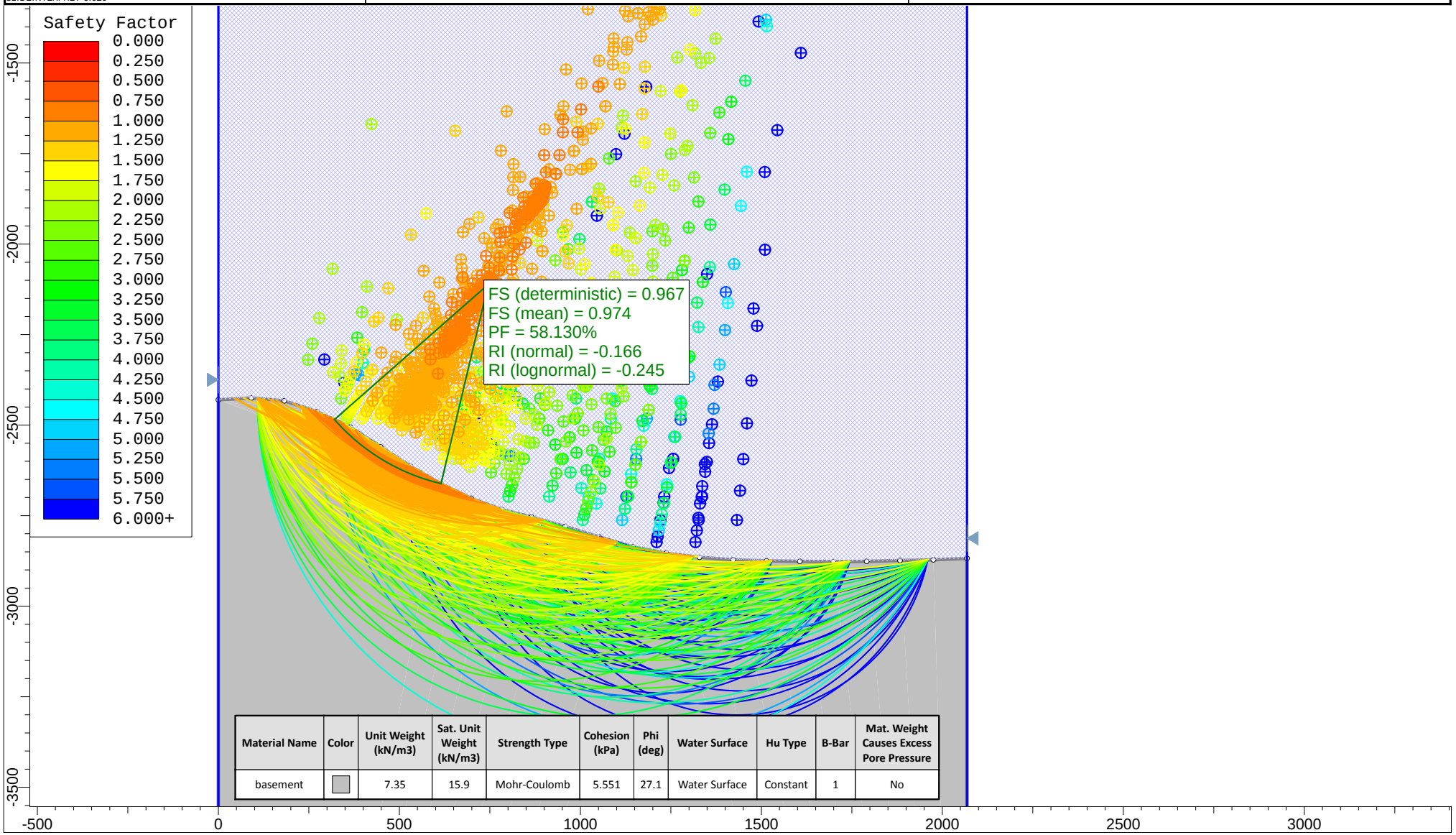
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 00		
	Drawn By	Jason R. Patton	Scale 1:30000	Company Oregon State University
	Date	4/01/2013		File Name RR0705_108_0_1g.sli



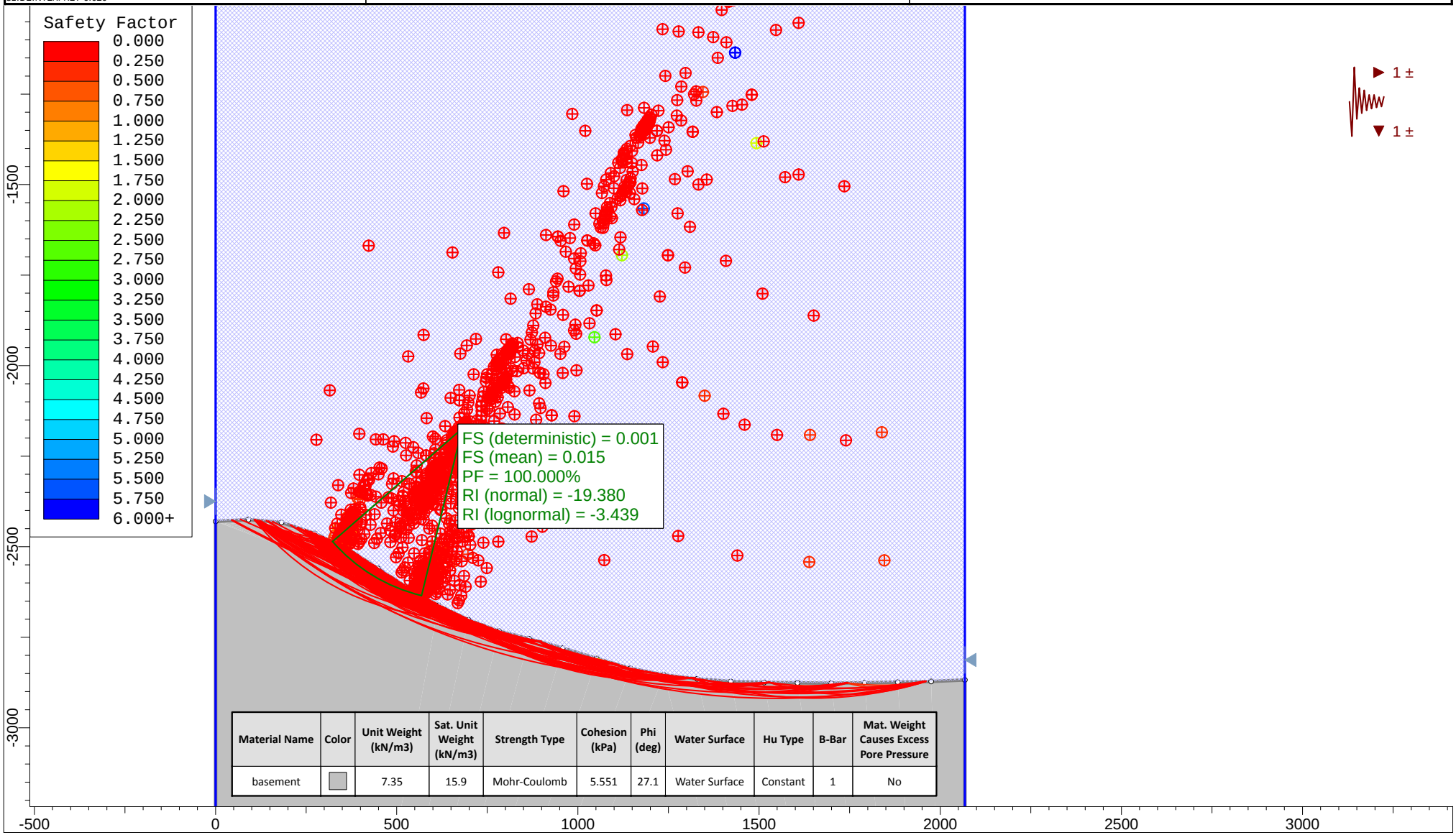
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 01		
	Drawn By	Jason R. Patton	Scale 1:15000	Company Oregon State University
	Date	4/01/2013		File Name RR0705_108_01_0g.sli



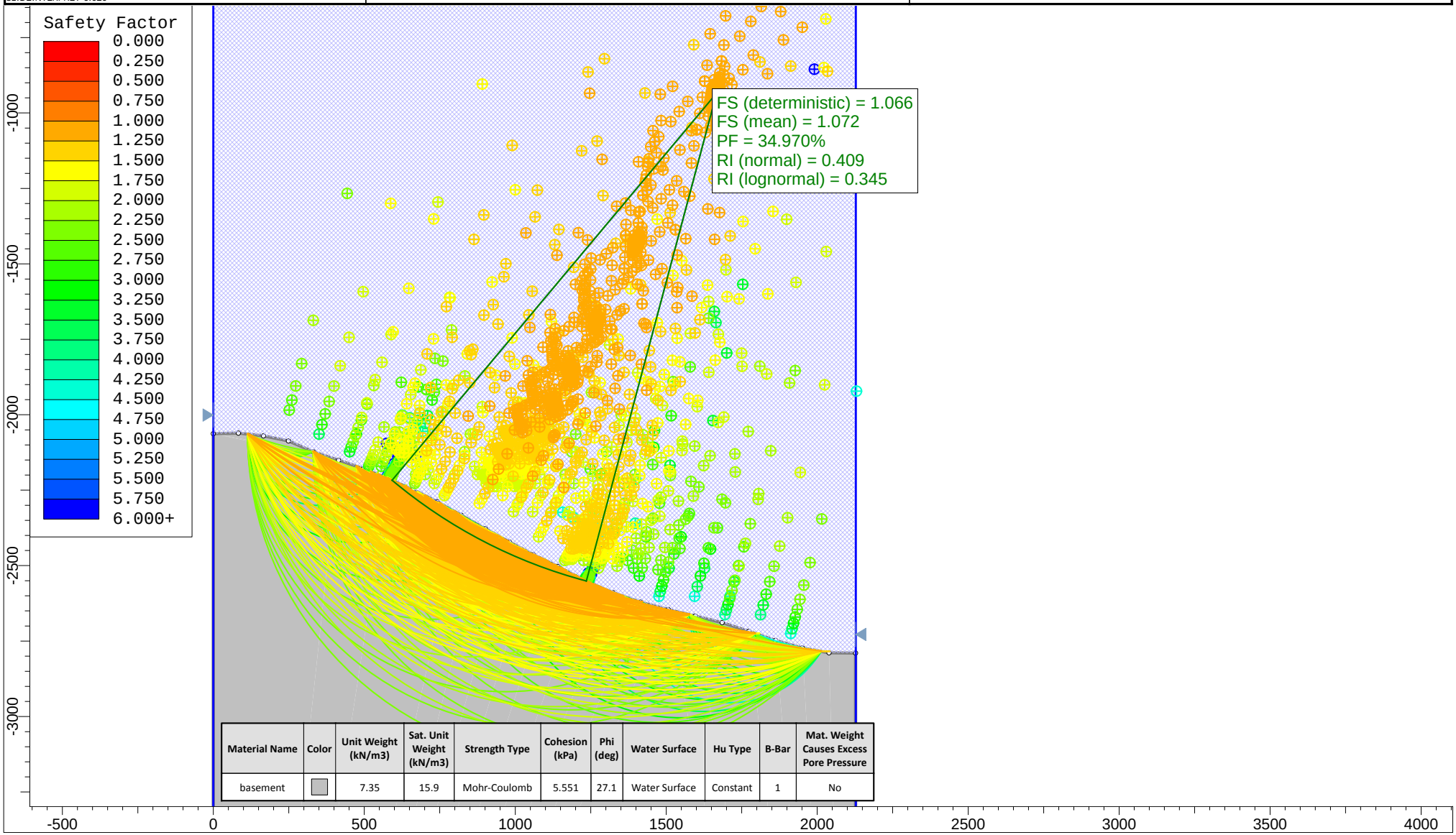
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 01		
	Drawn By	Jason R. Patton	Scale 1:15000	Company Oregon State University
	Date	4/01/2013		File Name RR0705_108_01_1g.sli



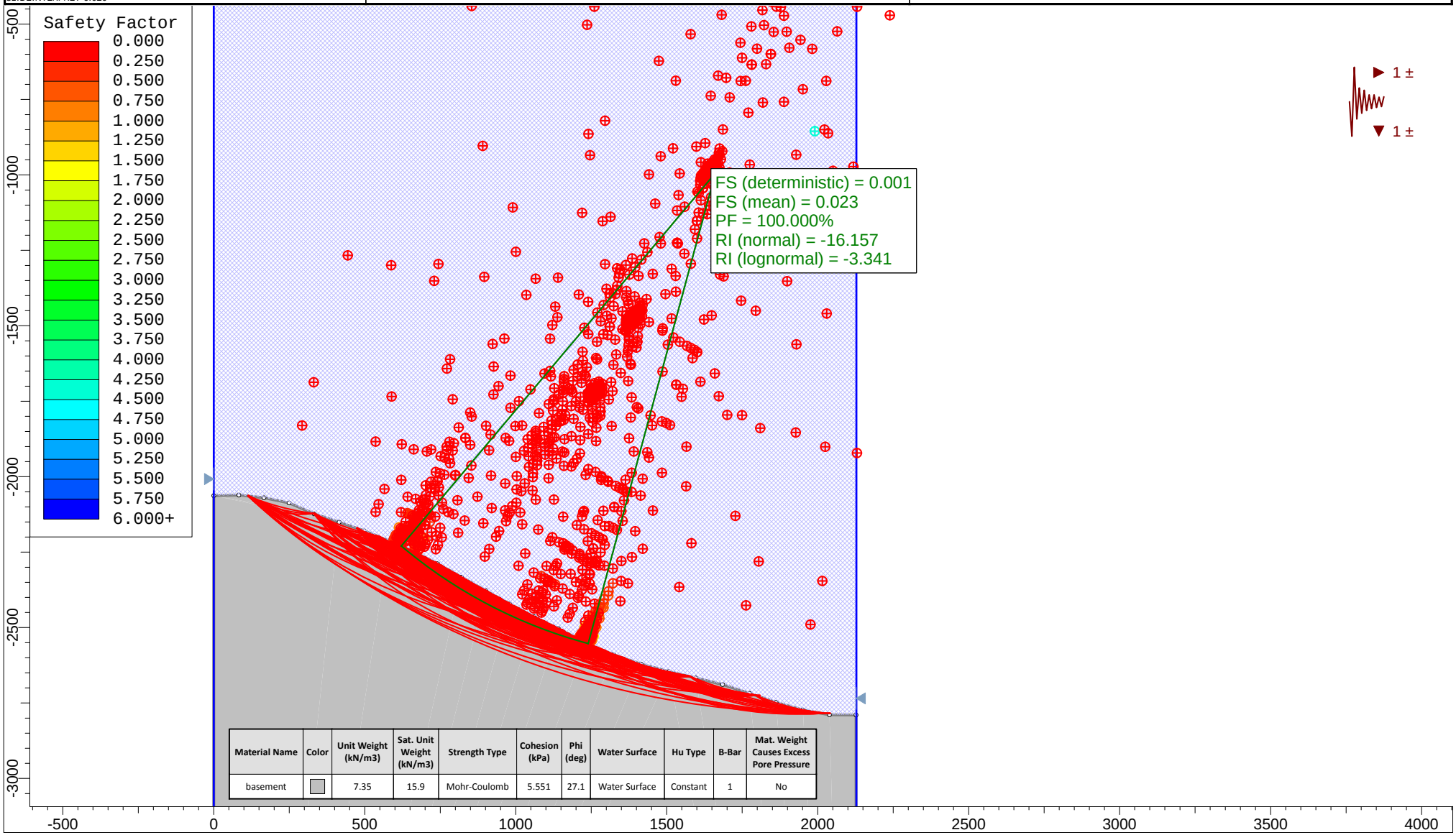
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 02		
	Drawn By	Jason R. Patton	Scale 1:18000	Company Oregon State University
	Date	3/31/2013		File Name RR0705_108_02_0g.sli



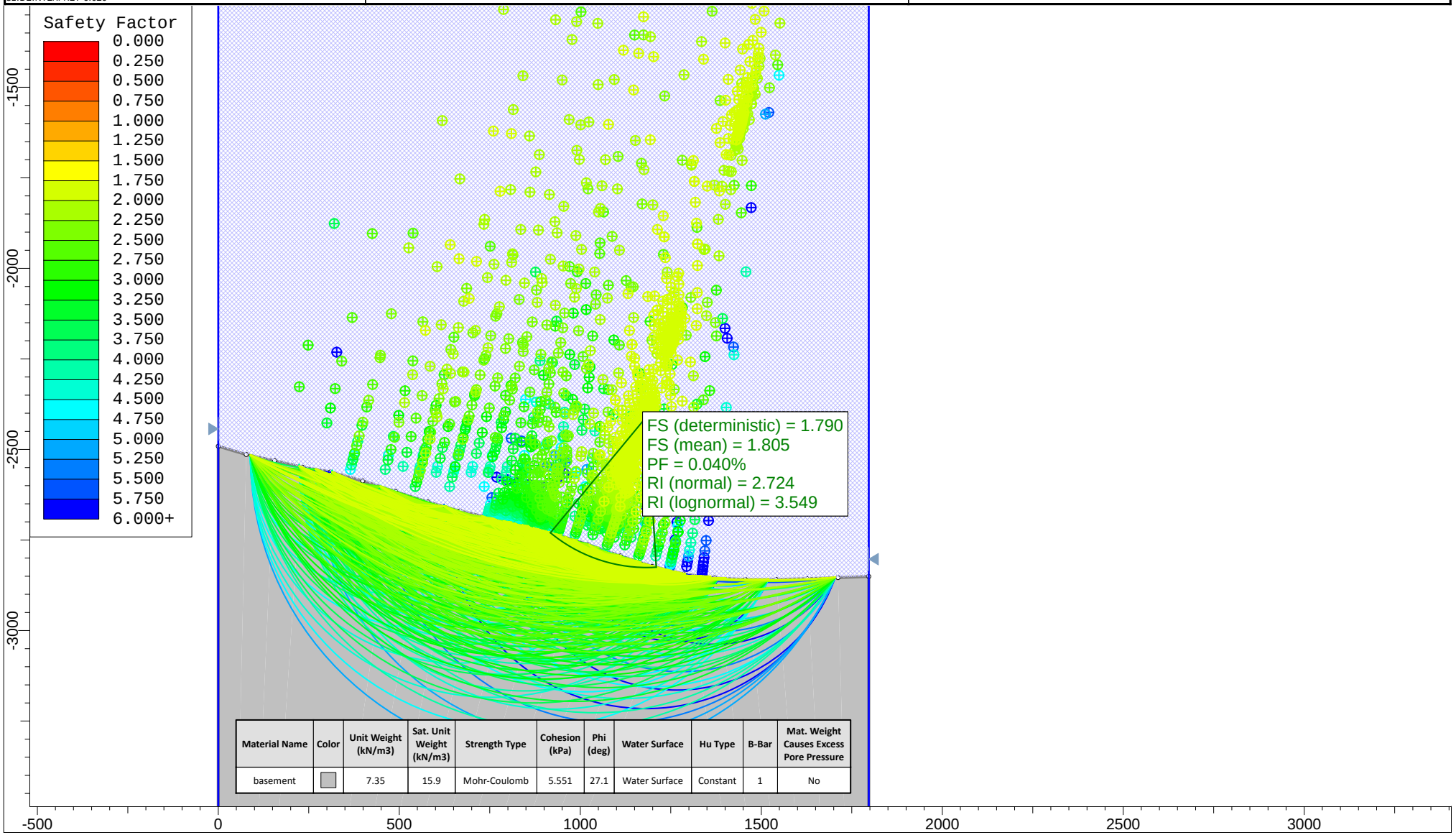
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 02		
	Drawn By	Jason R. Patton	Scale 1:18000	Company Oregon State University
	Date	3/31/2013		File Name RR0705_108_02_1g.sli



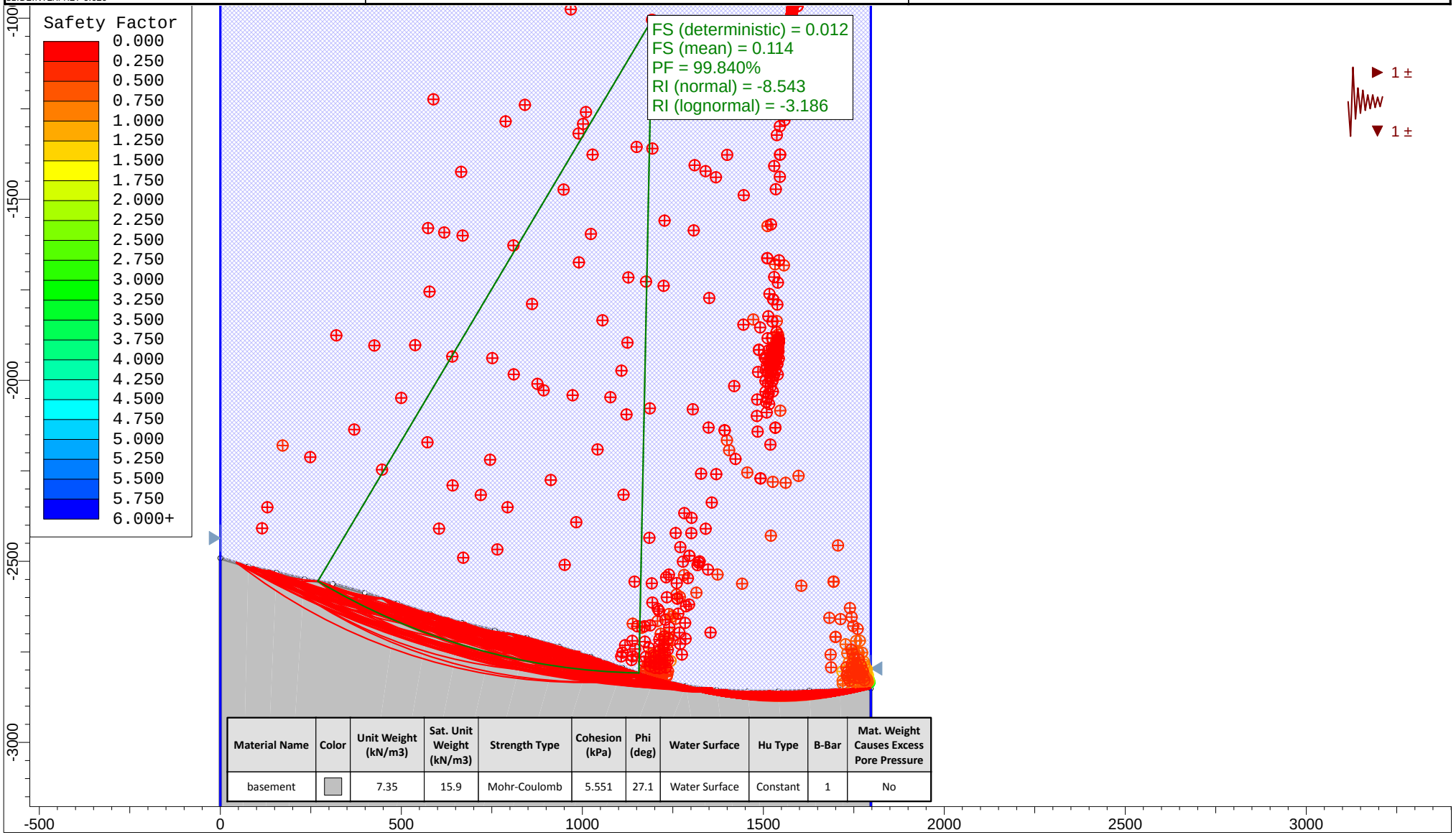
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 03		
	Drawn By: Jason R. Patton	Scale: 1:15000	Company: Oregon State University	
	Date: 3/31/2013		File Name: RR0705_108_03_0g.sli	



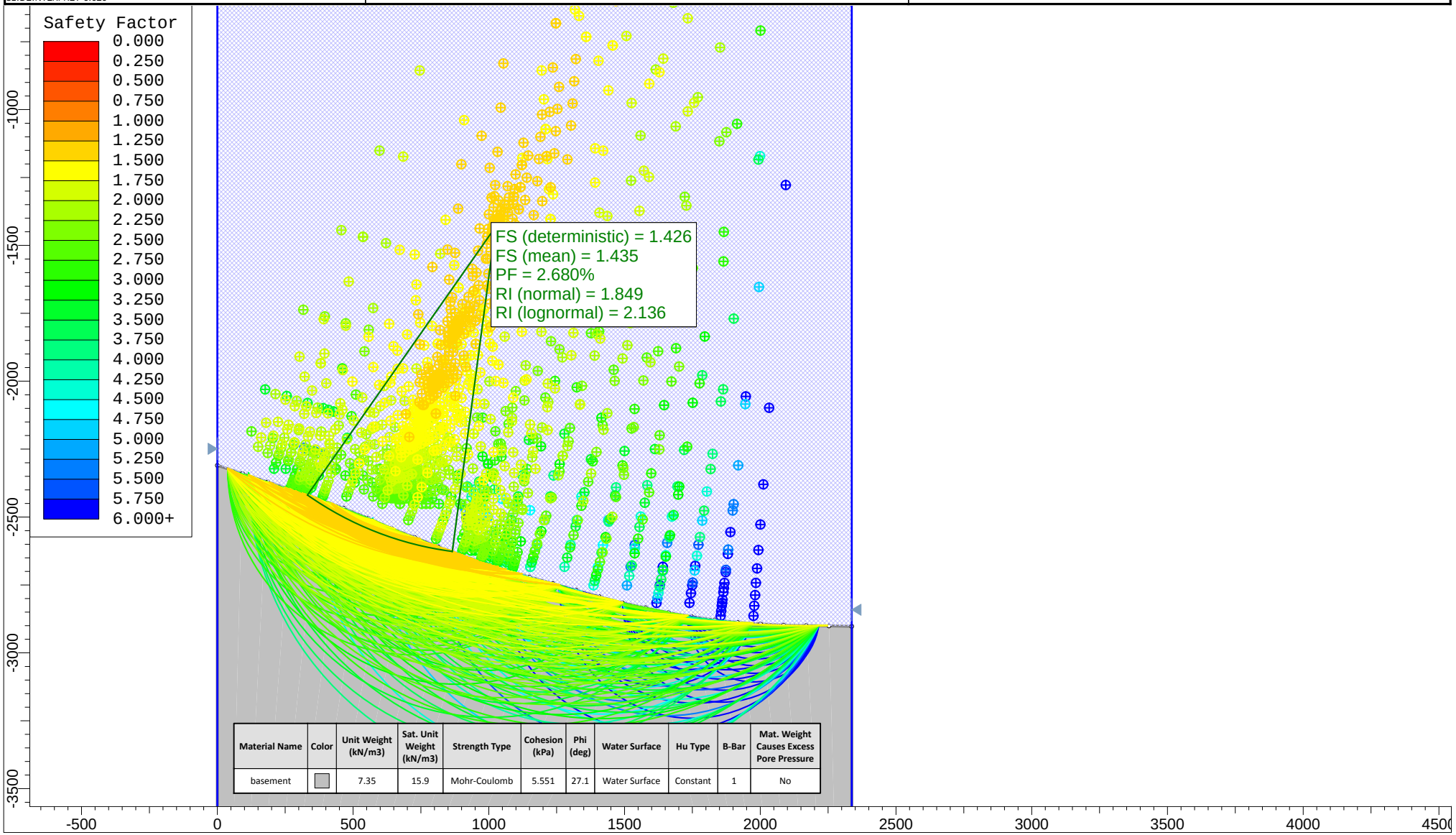
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 03		
	Drawn By	Jason R. Patton	Scale 1:15000	Company Oregon State University
	Date	3/31/2013		File Name RR0705_108_03_1g.sli



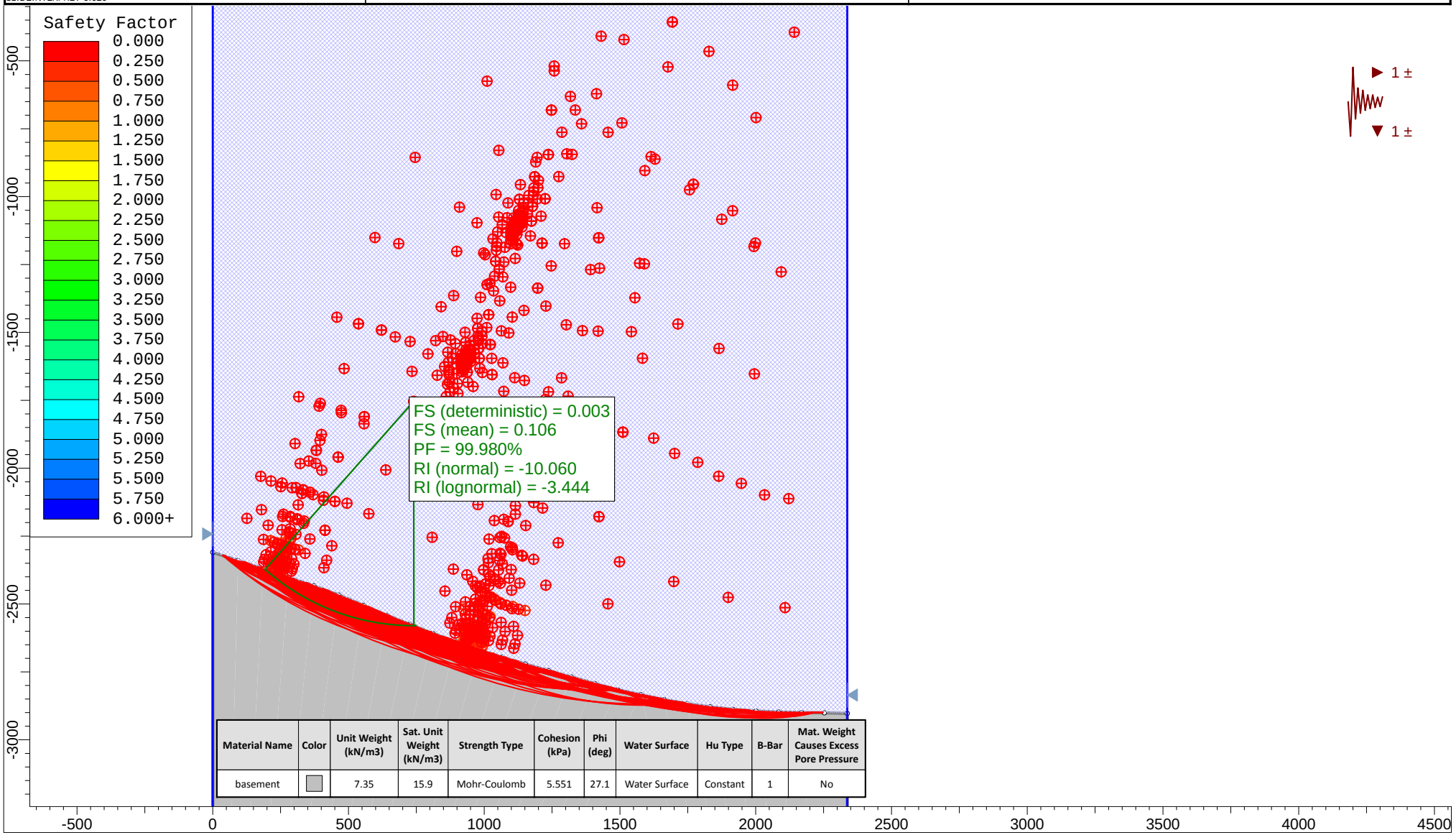
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 04		
	Drawn By	Jason R. Patton	Scale 1:20000	Company Oregon State University
	Date	4/01/2013		File Name RR0705_108_04_0g.sli



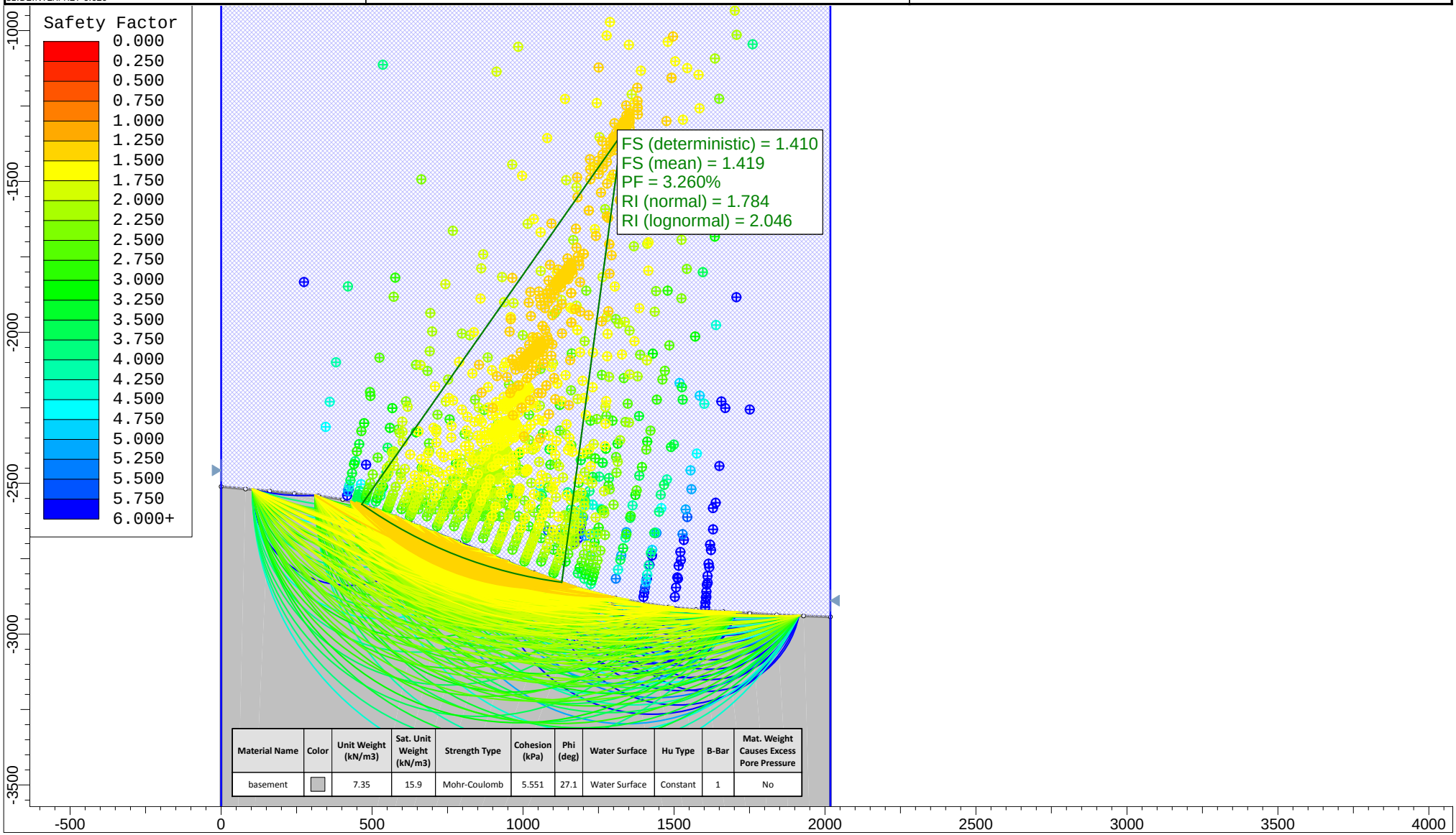
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 04		
	Drawn By	Jason R. Patton	Scale 1:20000	Company Oregon State University
	Date	4/01/2013		File Name RR0705_108_04_1g.sli



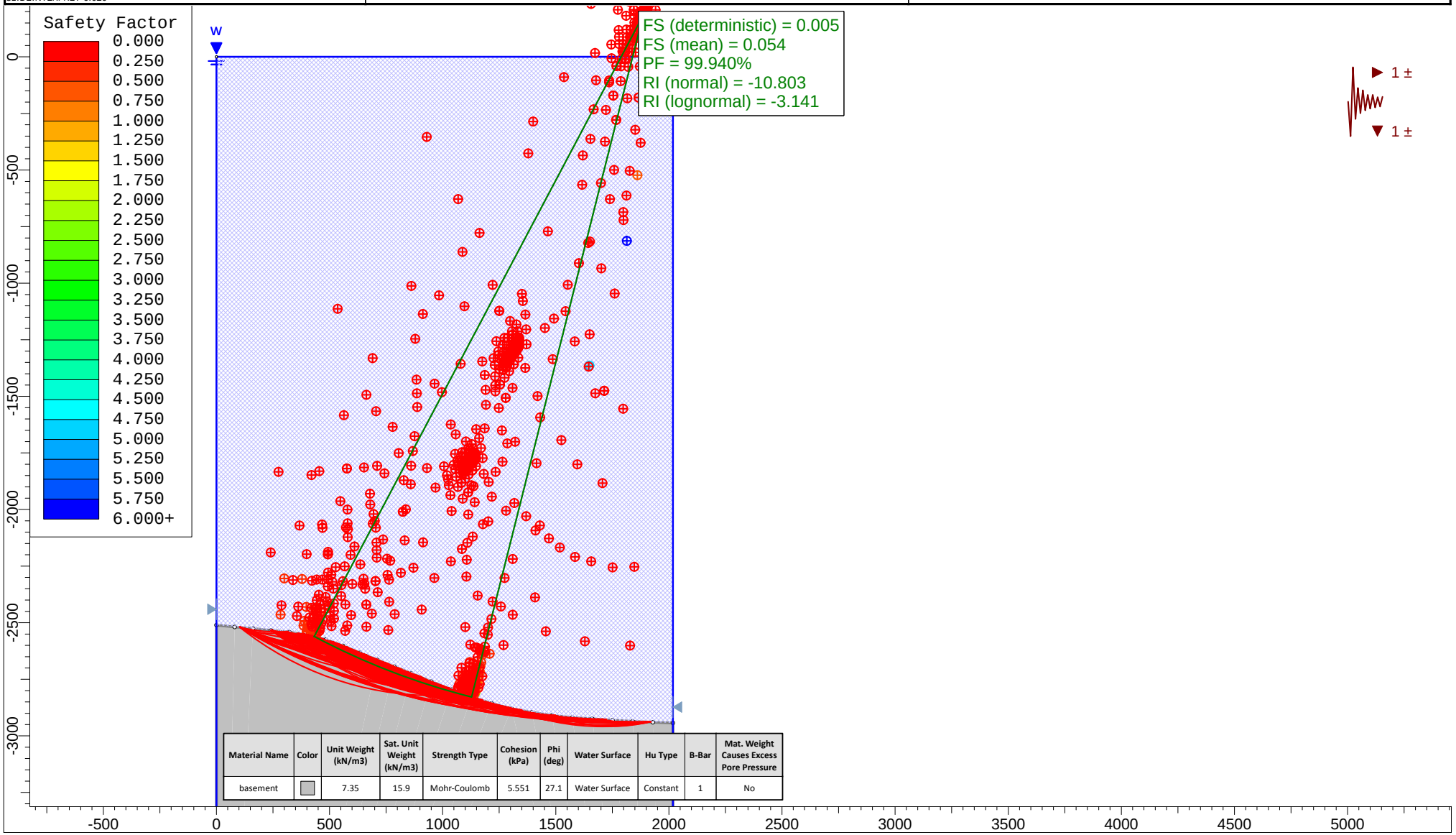
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 05		
	Drawn By	Jason R. Patton	Scale 1:18000	Company Oregon State University
	Date	4/01/2013		File Name RR0705_108_05_0g.sli



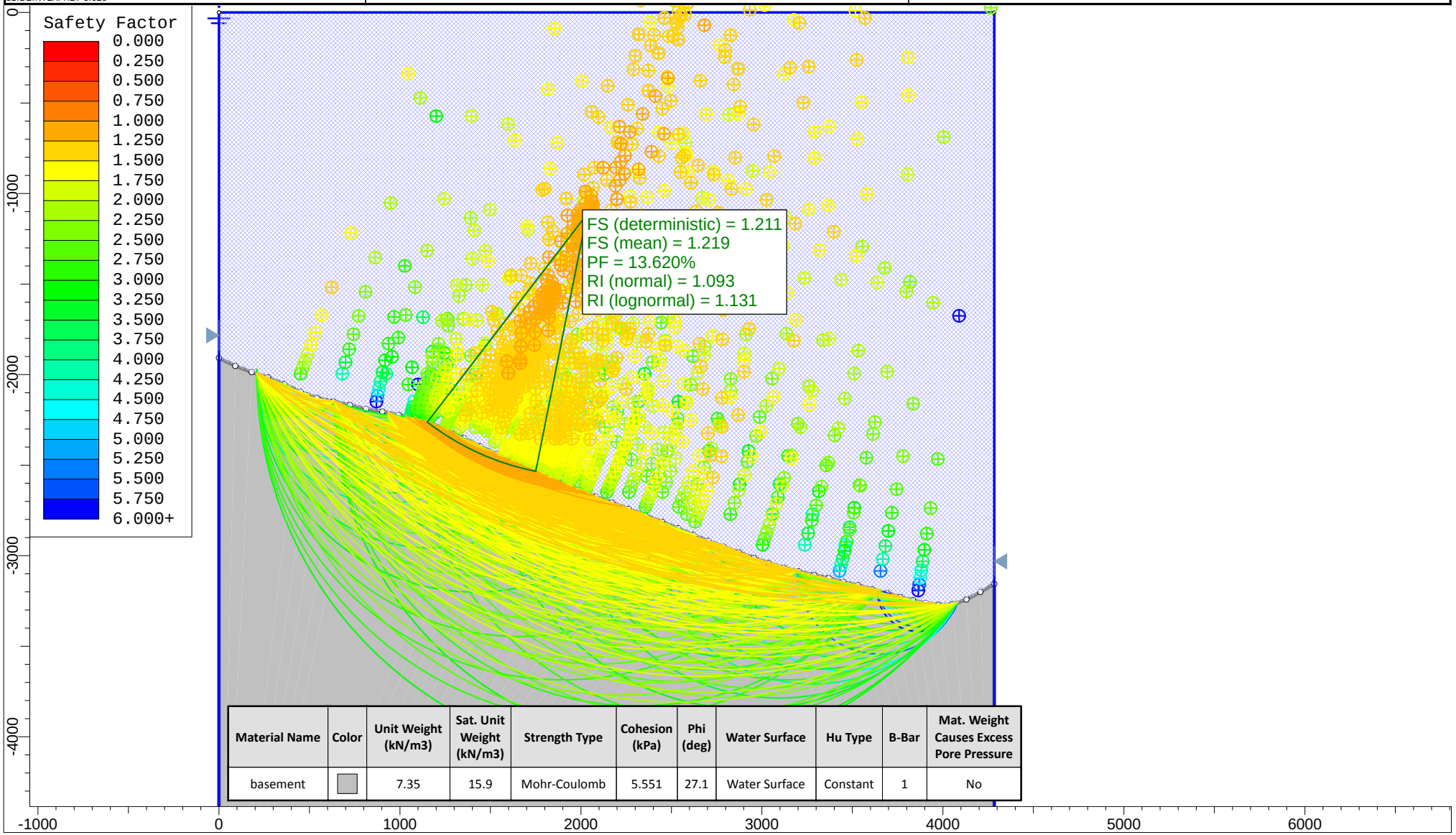
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 05		
	Drawn By	Jason R. Patton	Scale 1:24000	Company Oregon State University
	Date	4/01/2013		File Name RR0705_108_05_1g.sli



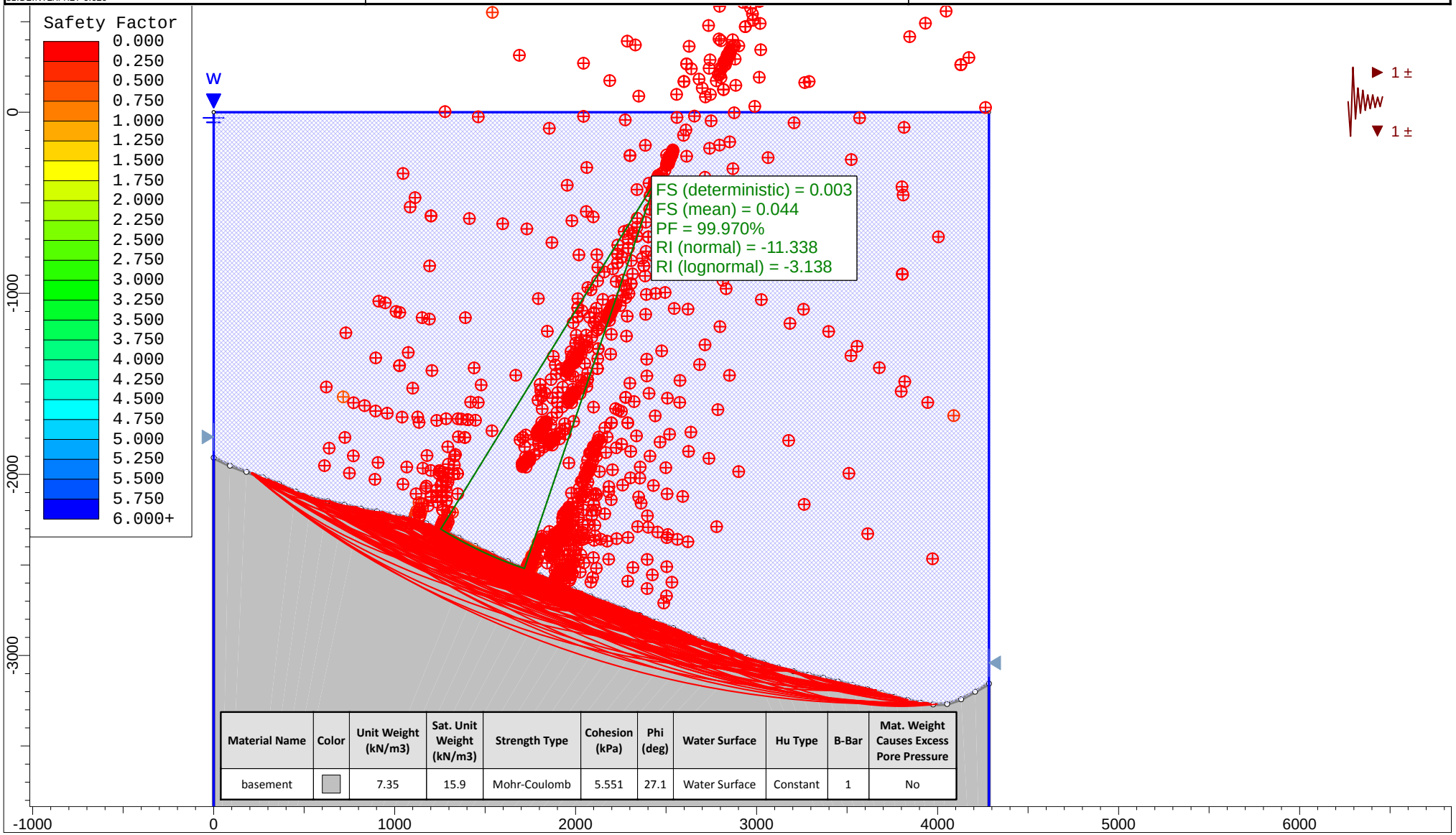
Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	*Project*	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 05		
	Drawn By Jason R. Patton	*Scale* 1:30000	*Company*	Oregon State University
	Date 4/01/2013		*File Name*	RR0705_108_08_0g.sli



Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 05		
	Drawn By: Jason R. Patton	Scale: 1:30000	Company: Oregon State University	
	Date: 4/01/2013		File Name: RR0705_108_08_1g.sli	



Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	B-Bar	Mat. Weight Causes Excess Pore Pressure
basement		7.35	15.9	Mohr-Coulomb	5.551	27.1	Water Surface	Constant	1	No

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 03PC Site 100		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/25/2013		File Name: RR0705_03_100_0g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_03_100_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 03PC Site 100
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/25/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364849222
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 100
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 03PC Site 100		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/25/2013		File Name: RR0705_03_100_0g.sli

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Global Minimums

Method: spencer

FS: 1.477150
Center: 3241.163, -1180.289
Radius: 2155.579
Left Slip Surface Endpoint: 2030.812, -2963.984
Right Slip Surface Endpoint: 3006.900, -3323.100
Left Slope Intercept: 2030.812 -0.000
Right Slope Intercept: 3006.900 -0.000
Resisting Moment=2.74367e+008 kN-m
Driving Moment=1.85742e+008 kN-m
Resisting Horizontal Force=119023 kN
Driving Horizontal Force=80576.6 kN
Total Slice Area=3.11258e+006 m2

Method: gle/morgenstern-price

FS: 1.478400
Center: 3216.883, -1201.482
Radius: 2127.319
Left Slip Surface Endpoint: 2021.132, -2960.933
Right Slip Surface Endpoint: 2983.408, -3315.950
Left Slope Intercept: 2021.132 -0.000
Right Slope Intercept: 2983.408 -0.000
Resisting Moment=2.69239e+008 kN-m
Driving Moment=1.82116e+008 kN-m
Resisting Horizontal Force=118301 kN

Driving Horizontal Force=80019.5 kN
Total Slice Area=3.063e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 21170
Number of Invalid Surfaces: 148

Error Codes:

Error Code -108 reported for 148 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 21317
Number of Invalid Surfaces: 1

Error Codes:

Error Code -108 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.47715

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	39.0435	1.19865e+006	basement	5.551	27.1	9.50578	14.0415	30678.8	30662.3	16.5022
2	39.0435	1.21165e+006	basement	5.551	27.1	30.5865	45.1808	31000.2	30922.7	77.5413
3	39.0435	1.22365e+006	basement	5.551	27.1	48.7967	72.08	31300.9	31171	129.949
4	39.0435	1.23473e+006	basement	5.551	27.1	63.1033	93.213	31579.1	31407.7	171.4
5	39.0435	1.24507e+006	basement	5.551	27.1	75.6443	111.738	31840.7	31633.3	207.429
6	39.0435	1.25459e+006	basement	5.551	27.1	85.1924	125.842	32083.2	31848	235.173
7	39.0435	1.26347e+006	basement	5.551	27.1	93.0014	137.377	32310	32052.3	257.66

8	39.0435	1.27179e+006	basement	5.551	27.1	99.5505	147.051	32523	32246.5	276.547
9	39.0435	1.27952e+006	basement	5.551	27.1	104.698	154.654	32722.3	32430.8	291.462
10	39.0435	1.28684e+006	basement	5.551	27.1	109.141	161.218	32909.7	32605.6	304.103
11	39.0435	1.29375e+006	basement	5.551	27.1	113.724	167.988	33088.4	32771	317.41
12	39.0435	1.3002e+006	basement	5.551	27.1	117.086	172.953	33254.5	32927.3	327.196
13	39.0435	1.30637e+006	basement	5.551	27.1	121.3	179.178	33414	33074.8	339.223
14	39.0435	1.31204e+006	basement	5.551	27.1	124.441	183.818	33561.7	33213.5	348.246
15	39.0435	1.31717e+006	basement	5.551	27.1	126.003	186.126	33696.6	33343.7	352.926
16	39.0435	1.32179e+006	basement	5.551	27.1	126.047	186.19	33818.5	33465.4	353.137
17	39.0435	1.32543e+006	basement	5.551	27.1	122.43	180.848	33921.6	33579	342.635
18	39.0435	1.32808e+006	basement	5.551	27.1	111.538	164.758	33995.5	33684.4	311.057
19	39.0435	1.33021e+006	basement	5.551	27.1	99.0096	146.252	34056.8	33781.9	274.879
20	39.0435	1.33177e+006	basement	5.551	27.1	84.0524	124.158	34103.1	33871.5	231.631
21	39.0435	1.33289e+006	basement	5.551	27.1	67.2273	99.3048	34136.5	33953.2	183.308
22	39.0435	1.3341e+006	basement	5.551	27.1	52.8966	78.1362	34169.3	34027.3	141.957
23	39.0435	1.33505e+006	basement	5.551	27.1	39.6384	58.5518	34197.4	34093.8	103.609
24	39.0435	1.33574e+006	basement	5.551	27.1	25.7858	38.0895	34216.1	34152.7	63.4477
25	39.0435	1.33624e+006	basement	5.551	27.1	13.3584	19.7323	34231.8	34204.1	27.668

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.4784

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	38.491	1.1804e+006	basement	5.551	27.1	12.9094	19.0852	30655.7	30629.2	26.5083
2	38.491	1.19306e+006	basement	5.551	27.1	32.0985	47.4544	30968.3	30886.3	81.9748
3	38.491	1.20487e+006	basement	5.551	27.1	49.1886	72.7205	31262.8	31131.5	131.31
4	38.491	1.21567e+006	basement	5.551	27.1	62.5482	92.4713	31535.1	31365.3	169.797
5	38.491	1.22579e+006	basement	5.551	27.1	74.4284	110.035	31792.2	31588.1	204.081
6	38.491	1.2351e+006	basement	5.551	27.1	83.8203	123.92	32031.4	31800.2	231.204
7	38.491	1.24375e+006	basement	5.551	27.1	91.4441	135.191	32255.2	32002	253.22
8	38.491	1.25184e+006	basement	5.551	27.1	97.8754	144.699	32465.6	32193.8	271.814
9	38.491	1.25938e+006	basement	5.551	27.1	103.27	152.674	32663.4	32375.9	287.464
10	38.491	1.26642e+006	basement	5.551	27.1	107.412	158.798	32848	32548.6	299.39
11	38.491	1.27314e+006	basement	5.551	27.1	112.097	165.724	33024.9	32712.1	312.847
12	38.491	1.27936e+006	basement	5.551	27.1	115.681	171.023	33189.8	32866.6	323.224
13	38.491	1.2853e+006	basement	5.551	27.1	119.48	176.639	33346.6	33012.3	334.275
14	38.491	1.29084e+006	basement	5.551	27.1	123.3	182.287	33494.8	33149.5	345.268
15	38.491	1.29586e+006	basement	5.551	27.1	125.687	185.816	33630.4	33278.2	352.233
16	38.491	1.30037e+006	basement	5.551	27.1	126.428	186.911	33753.2	33398.7	354.492
17	38.491	1.30428e+006	basement	5.551	27.1	125.623	185.721	33863.1	33511	352.127
18	38.491	1.30699e+006	basement	5.551	27.1	117.025	173.01	33942.7	33615.4	327.26

19	38.491	1.30912e+006	basement	5.551	27.1	104.665	154.737	34003.5	33711.8	291.665
20	38.491	1.3107e+006	basement	5.551	27.1	89.9621	133	34049.6	33800.5	249.055
21	38.491	1.31178e+006	basement	5.551	27.1	72.7523	107.557	34080.9	33881.6	199.311
22	38.491	1.31262e+006	basement	5.551	27.1	54.9605	81.2536	34102.9	33955	147.87
23	38.491	1.31354e+006	basement	5.551	27.1	40.5368	59.9296	34127.2	34021	106.24
24	38.491	1.31407e+006	basement	5.551	27.1	24.9955	36.9534	34140.7	34079.5	61.2053
25	38.491	1.31449e+006	basement	5.551	27.1	10.7217	15.8509	34150.7	34130.6	20.0758

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.47715

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	2030.81	-2963.98	4.52438e+007	0	0
2	2069.86	-2989.86	417045	589.838	0.0810349
3	2108.9	-3014.55	799537	1130.81	0.0810351
4	2147.94	-3038.08	1.08413e+006	1533.31	0.0810347
5	2186.99	-3060.51	1.33762e+006	1891.83	0.0810348
6	2226.03	-3081.87	1.53536e+006	2171.5	0.0810349
7	2265.07	-3102.21	1.69254e+006	2393.8	0.0810347
8	2304.12	-3121.54	1.82216e+006	2577.13	0.0810349
9	2343.16	-3139.91	1.92684e+006	2725.18	0.0810349
10	2382.2	-3157.33	2.00313e+006	2833.08	0.0810349
11	2421.25	-3173.84	2.09465e+006	2962.51	0.0810346
12	2460.29	-3189.46	2.15732e+006	3051.15	0.0810348
13	2499.33	-3204.2	2.22838e+006	3151.66	0.081035
14	2538.38	-3218.08	2.2893e+006	3237.82	0.0810349
15	2577.42	-3231.13	2.32109e+006	3282.78	0.0810349
16	2616.46	-3243.36	2.32232e+006	3284.51	0.0810347
17	2655.51	-3254.78	2.29616e+006	3247.51	0.0810346
18	2694.55	-3265.41	2.09525e+006	2963.37	0.081035
19	2733.6	-3275.26	1.86415e+006	2636.52	0.081035
20	2772.64	-3284.33	1.59199e+006	2251.59	0.0810348
21	2811.68	-3292.65	1.28417e+006	1816.24	0.0810351
22	2850.73	-3300.21	984746	1392.75	0.0810347
23	2889.77	-3307.03	742848	1050.63	0.0810349
24	2928.81	-3313.12	474456	671.036	0.0810349
25	2967.86	-3318.47	248054	350.83	0.081035
26	3006.9	-3323.1	5.68714e+007	0	0

rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 03PC Site 100		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
SLIDEINTERPRET 6.020	Date	3/25/2013		File Name: RR0705_03_100_0g.sli

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.4784

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	2021.13	-2960.93	4.51507e+007	0	0
2	2059.62	-2986.49	412045	98.4009	0.0136829
3	2098.11	-3010.86	793301	375.91	0.0271499
4	2136.61	-3034.1	1.09077e+006	765.093	0.0401887
5	2175.1	-3056.25	1.3416e+006	1231.5	0.0525937
6	2213.59	-3077.35	1.54824e+006	1733.98	0.0641694
7	2252.08	-3097.44	1.70426e+006	2222.94	0.0747333
8	2290.57	-3116.54	1.8304e+006	2687.28	0.0841181
9	2329.06	-3134.68	1.93473e+006	3112.57	0.0921767
10	2367.55	-3151.9	2.00973e+006	3464.91	0.0987817
11	2406.04	-3168.21	2.08523e+006	3778.75	0.103828
12	2444.53	-3183.64	2.14816e+006	4020.62	0.107238
13	2483.02	-3198.21	2.19701e+006	4177.95	0.108957
14	2521.52	-3211.94	2.25815e+006	4294.21	0.108956
15	2560.01	-3224.85	2.29202e+006	4289.87	0.107238
16	2598.5	-3236.94	2.29502e+006	4158.92	0.103828
17	2636.99	-3248.24	2.27052e+006	3914.53	0.0987817
18	2675.48	-3258.75	2.14488e+006	3450.66	0.0921768
19	2713.97	-3268.5	1.91911e+006	2817.52	0.0841181
20	2752.46	-3277.49	1.66336e+006	2169.59	0.0747332
21	2790.95	-3285.73	1.36224e+006	1525.67	0.0641696
22	2829.44	-3293.22	1.0337e+006	948.871	0.0525939
23	2867.93	-3299.99	767679	538.471	0.0401888
24	2906.43	-3306.03	505155	239.371	0.02715
25	2944.92	-3311.34	242532	57.9194	0.0136829
26	2983.41	-3315.95	5.6627e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.486447
Factor of Safety, standard deviation: 0.249275
Factor of Safety, minimum: 0.769392
Factor of Safety, maximum: 2.358000
Probability of Failure: 2.030% (= 203 failed surfaces / 10000 valid surfaces)
Reliability index: 1.95145 (assuming normal distribution)

Reliability index: 2.29692 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 1.488201
Factor of Safety, standard deviation: 0.249675
Factor of Safety, minimum: 0.772398
Factor of Safety, maximum: 2.361860
Probability of Failure: 1.980% (= 198 failed surfaces / 10000 valid surfaces)
Reliability index: 1.95535 (assuming normal distribution)
Reliability index: 2.30297 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-8000
15333	-8000
15333	0
0	0

External Boundary

X	Y
15333	-8000
15333	-4361
15240	-4358
15147	-4356
15055	-4354
14962	-4353
14869	-4352
14776	-4353
14684	-4355
14591	-4353
14498	-4348
14405	-4339
14312	-4331
14220	-4325
14127	-4320

14034	-4316
13941	-4313
13849	-4311
13756	-4309
13663	-4308
13570	-4307
13478	-4305
13385	-4304
13292	-4301
13199	-4296
13107	-4290
13014	-4284
12921	-4280
12828	-4275
12736	-4272
12643	-4270
12550	-4267
12457	-4264
12365	-4261
12272	-4257
12179	-4252
12086	-4248
11993	-4245
11901	-4240
11808	-4234
11715	-4228
11622	-4221
11530	-4213
11437	-4206
11344	-4198
11251	-4188
11159	-4180
11066	-4172
10973	-4165
10880	-4160
10788	-4155
10695	-4150
10602	-4147
10509	-4145
10417	-4143

10324	-4142
10231	-4139
10138	-4135
10045	-4130
9953	-4126
9860	-4120
9767	-4112
9674	-4104
9582	-4098
9489	-4093
9396	-4091
9303	-4092
9211	-4093
9118	-4095
9025	-4095
8932	-4094
8840	-4091
8747	-4089
8654	-4086
8561	-4083
8469	-4081
8376	-4079
8283	-4076
8190	-4071
8098	-4066
8005	-4060
7912	-4054
7819	-4048
7726	-4041
7634	-4034
7541	-4028
7448	-4023
7355	-4018
7263	-4013
7170	-4007
7077	-4003
6984	-3997
6892	-3990
6799	-3983
6706	-3976

6613	-3970
6521	-3963
6428	-3957
6335	-3950
6242	-3943
6150	-3937
6057	-3927
5964	-3919
5871	-3912
5778	-3904
5686	-3896
5593	-3888
5500	-3887
5407	-3882
5316	-3875
5224	-3869
5132	-3864
5041	-3858
4949	-3852
4857	-3846
4765	-3838
4674	-3829
4582	-3813
4490	-3792
4398	-3768
4307	-3745
4215	-3721
4123	-3694
4032	-3663
3940	-3631
3848	-3600
3756	-3570
3665	-3542
3573	-3512
3481	-3484
3389	-3453
3298	-3420
3206	-3386
3114	-3355
3023	-3328

2931	-3300
2839	-3267
2748	-3226
2656	-3186
2565	-3157
2473	-3128
2381	-3095
2290	-3059
2198	-3022
2107	-2988
2015	-2959
1923	-2934
1832	-2914
1740	-2894
1649	-2873
1557	-2846
1465	-2817
1374	-2788
1282	-2758
1191	-2728
1099	-2697
1008	-2670
916	-2647
824	-2623
733	-2596
641	-2566
550	-2531
458	-2498
366	-2472
275	-2456
183	-2446
92	-2441
0	-2441
0	-8000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 03PC Site 100		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/25/2013		File Name: RR0705_03_100_1g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_03_100_1g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 03PC Site 100
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/25/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364849082
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 100
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.005818
Center: 7572.662, 10883.712
Radius: 14945.603
Left Slip Surface Endpoint: 1824.897, -2912.456
Right Slip Surface Endpoint: 3665.000, -3542.000
Left Slope Intercept: 1824.897 -0.000
Right Slope Intercept: 3665.000 -0.000
Resisting Moment=9.26226e+007 kN-m
Driving Moment=1.59191e+010 kN-m
Resisting Horizontal Force=6009.62 kN

Driving Horizontal Force=1.03288e+006 kN
Total Slice Area=5.97944e+006 m2

Method: gle/morgenstern-price

FS: 0.005779
Center: 7503.635, 10663.429
Radius: 14710.193
Left Slip Surface Endpoint: 1855.219, -2919.103
Right Slip Surface Endpoint: 3569.203, -3510.844
Left Slope Intercept: 1855.219 -0.000
Right Slope Intercept: 3569.203 -0.000
Resisting Moment=7.36719e+007 kN-m
Driving Moment=1.27487e+010 kN-m
Resisting Horizontal Force=4855.21 kN
Driving Horizontal Force=840175 kN
Total Slice Area=5.54417e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 3852
Number of Invalid Surfaces: 3

Error Codes:

Error Code -108 reported for 1 surface
Error Code -112 reported for 2 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 3853
Number of Invalid Surfaces: 2

Error Codes:

Error Code -112 reported for 2 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with

many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.00581833

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	73.6041	2.22248e+006	basement	5.551	27.1	300.09	1.74602	30261.3	30268.6	-7.33681
2	73.6041	2.25081e+006	basement	5.551	27.1	507.017	2.94999	30784.2	30789.3	-5.10444
3	73.6041	2.27736e+006	basement	5.551	27.1	656.542	3.81998	31246.3	31249.7	-3.39601
4	73.6041	2.30228e+006	basement	5.551	27.1	753.813	4.38593	31653.7	31656	-2.27056
5	73.6041	2.32532e+006	basement	5.551	27.1	773.481	4.50037	31996.2	31998.2	-1.98167
6	73.6041	2.34684e+006	basement	5.551	27.1	757.76	4.4089	32288.3	32290.5	-2.18339
7	73.6041	2.3674e+006	basement	5.551	27.1	736.825	4.28709	32551.7	32554.1	-2.40461
8	73.6041	2.3877e+006	basement	5.551	27.1	732.341	4.261	32813.3	32815.8	-2.49602
9	73.6041	2.40835e+006	basement	5.551	27.1	769.944	4.47979	33097.5	33099.6	-2.10112
10	73.6041	2.42953e+006	basement	5.551	27.1	855.911	4.97998	33410.9	33412	-1.08082
11	73.6041	2.45058e+006	basement	5.551	27.1	919.093	5.34759	33727.3	33727.7	-0.376992
12	73.6041	2.47018e+006	basement	5.551	27.1	852.622	4.96084	33994.6	33995.7	-1.09962
13	73.6041	2.48674e+006	basement	5.551	27.1	685.918	3.9909	34151.5	34154.5	-2.97658
14	73.6041	2.50236e+006	basement	5.551	27.1	534.645	3.11074	34280.4	34285.2	-4.75204
15	73.6041	2.51929e+006	basement	5.551	27.1	525.039	3.05485	34469.5	34474.4	-4.91585
16	73.6041	2.53735e+006	basement	5.551	27.1	573.422	3.33636	34710.8	34715.1	-4.30169
17	73.6041	2.55584e+006	basement	5.551	27.1	615.183	3.57934	34976.7	34980.6	-3.91589
18	73.6041	2.57386e+006	basement	5.551	27.1	622.718	3.62318	35232	35235.8	-3.81818
19	73.6041	2.59046e+006	basement	5.551	27.1	556.111	3.23564	35439.6	35444.1	-4.48671
20	73.6041	2.60573e+006	basement	5.551	27.1	433.673	2.52325	35603.4	35609.3	-5.92355
21	73.6041	2.62034e+006	basement	5.551	27.1	323.791	1.88392	35749.4	35756.5	-7.11941
22	73.6041	2.6348e+006	basement	5.551	27.1	234.727	1.36572	35897.4	35905.5	-8.12317
23	73.6041	2.64943e+006	basement	5.551	27.1	176.32	1.02589	36060.4	36069.3	-8.85879
24	73.6041	2.66433e+006	basement	5.551	27.1	135.886	0.79063	36241.8	36251.1	-9.32071
25	73.6041	2.67843e+006	basement	5.551	27.1	0	0	36377.4	36409.6	-32.206

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.0057788

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	68.5593	2.07389e+006	basement	5.551	27.1	198.161	1.14513	30309.2	30317.8	-8.58418
2	68.5593	2.09805e+006	basement	5.551	27.1	470.925	2.72138	30780.1	30785.7	-5.56635
3	68.5593	2.12084e+006	basement	5.551	27.1	673.598	3.89259	31201.5	31204.7	-3.24299

4	68.5593	2.14229e+006	basement	5.551	27.1	797.188	4.60679	31573.8	31575.6	-1.79724
5	68.5593	2.16213e+006	basement	5.551	27.1	818.783	4.73159	31886.1	31887.7	-1.58401
6	68.5593	2.18082e+006	basement	5.551	27.1	777.696	4.49415	32157.5	32159.5	-2.00234
7	68.5593	2.19875e+006	basement	5.551	27.1	743.466	4.29634	32404.5	32407	-2.52128
8	68.5593	2.21643e+006	basement	5.551	27.1	727.514	4.20416	32649.1	32651.6	-2.54655
9	68.5593	2.23439e+006	basement	5.551	27.1	766.054	4.42687	32913.4	32915.6	-2.21695
10	68.5593	2.25271e+006	basement	5.551	27.1	888.325	5.13345	33200.7	33201.6	-0.879259
11	68.5593	2.27118e+006	basement	5.551	27.1	933.257	5.3931	33500.6	33500.9	-0.304084
12	68.5593	2.28901e+006	basement	5.551	27.1	856.455	4.94928	33779.9	33781	-1.11737
13	68.5593	2.30423e+006	basement	5.551	27.1	531.427	3.07101	33955.3	33960.1	-4.79621
14	68.5593	2.31813e+006	basement	5.551	27.1	311.624	1.80081	34084.5	34091.8	-7.32238
15	68.5593	2.33191e+006	basement	5.551	27.1	307.529	1.77715	34218.5	34225.9	-7.39413
16	68.5593	2.34711e+006	basement	5.551	27.1	370.672	2.14204	34419.2	34425.9	-6.67439
17	68.5593	2.36308e+006	basement	5.551	27.1	455.52	2.63236	34658.6	34664.4	-5.75998
18	68.5593	2.37907e+006	basement	5.551	27.1	474.01	2.73921	34905.8	34911.3	-5.51664
19	68.5593	2.39456e+006	basement	5.551	27.1	406.685	2.35015	35137.7	35144	-6.29255
20	68.5593	2.40883e+006	basement	5.551	27.1	307.225	1.77539	35326	35333.4	-7.37517
21	68.5593	2.42203e+006	basement	5.551	27.1	188.022	1.08654	35476.4	35485.2	-8.80069
22	68.5593	2.4347e+006	basement	5.551	27.1	120.219	0.69472	35612.6	35622.1	-9.52223
23	68.5593	2.44721e+006	basement	5.551	27.1	70.3658	0.40663	35749.1	35759.2	-10.1349
24	68.5593	2.45985e+006	basement	5.551	27.1	37.2967	0.21553	35898.3	35908.8	-10.4543
25	68.5593	2.47276e+006	basement	5.551	27.1	22.7037	0.1312	36065.4	36075.9	-10.5119

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.00581833

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	1824.9	-2912.46	4.36844e+007	0	0
2	1898.5	-2942.89	426339	-3435.28	-0.461658
3	1972.11	-2972.87	777637	-6265.9	-0.461657
4	2045.71	-3002.39	1.04815e+006	-8445.58	-0.461657
5	2119.31	-3031.46	1.23429e+006	-9945.44	-0.461658
6	2192.92	-3060.08	1.30104e+006	-10483.3	-0.461658
7	2266.52	-3088.26	1.29339e+006	-10421.7	-0.46166
8	2340.13	-3115.99	1.27502e+006	-10273.6	-0.461656
9	2413.73	-3143.28	1.28286e+006	-10336.8	-0.461658
10	2487.33	-3170.13	1.34297e+006	-10821.1	-0.461656
11	2560.94	-3196.55	1.47184e+006	-11859.5	-0.461657

12	2634.54	-3222.53	1.58082e+006	-12737.7	-0.46166
13	2708.15	-3248.08	1.48002e+006	-11925.4	-0.461656
14	2781.75	-3273.2	1.2606e+006	-10157.4	-0.461656
15	2855.35	-3297.9	1.04762e+006	-8441.31	-0.461657
16	2928.96	-3322.17	989105	-7969.83	-0.461657
17	3002.56	-3346.02	1.04451e+006	-8416.25	-0.461657
18	3076.17	-3369.45	1.10343e+006	-8891.01	-0.461657
19	3149.77	-3392.46	1.10487e+006	-8902.65	-0.461659
20	3223.38	-3415.06	1.01958e+006	-8215.38	-0.461657
21	3296.98	-3437.24	854145	-6882.37	-0.461657
22	3370.58	-3459.01	687817	-5542.16	-0.461657
23	3444.19	-3480.37	553228	-4457.69	-0.461656
24	3517.79	-3501.32	460357	-3709.38	-0.461657
25	3591.4	-3521.86	379759	-3059.95	-0.461657
26	3665	-3542	6.46107e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.0057788

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	1855.22	-2919.1	4.3884e+007	0	0
2	1923.78	-2947.41	399567	-1080.59	-0.15495
3	1992.34	-2975.32	688810	-3696.26	-0.307455
4	2060.9	-3002.82	911341	-7239.04	-0.455107
5	2129.46	-3029.93	1.05606e+006	-10977.9	-0.595577
6	2198.02	-3056.64	1.10869e+006	-14061.6	-0.726648
7	2266.58	-3082.95	1.08973e+006	-16096.4	-0.846254
8	2335.13	-3108.88	1.06644e+006	-17730.5	-0.952505
9	2403.69	-3134.41	1.06023e+006	-19316	-1.04374
10	2472.25	-3159.56	1.09368e+006	-21353.1	-1.11851
11	2540.81	-3184.32	1.2067e+006	-24763.4	-1.17564
12	2609.37	-3208.7	1.30639e+006	-27689.5	-1.21423
13	2677.93	-3232.7	1.31469e+006	-28311.9	-1.23368
14	2746.49	-3256.32	1.14073e+006	-24565.8	-1.23368
15	2815.05	-3279.56	916190	-19419.1	-1.21423
16	2883.61	-3302.43	803075	-16480.4	-1.17564
17	2952.17	-3324.92	782897	-15285.4	-1.11851
18	3020.73	-3347.04	834096	-15196.1	-1.04374
19	3089.29	-3368.8	891322	-14819	-0.952504
20	3157.85	-3390.18	879940	-12997.6	-0.846255
21	3226.41	-3411.2	799736	-10143.1	-0.726647

22	3294.97	-3431.85	650493	-6761.97	-0.595577
23	3363.52	-3452.14	499047	-3964.07	-0.455107
24	3432.08	-3472.07	369107	-1980.69	-0.307456
25	3500.64	-3491.64	267969	-724.697	-0.154951
26	3569.2	-3510.84	6.3479e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.061450
Factor of Safety, standard deviation: 0.096753
Factor of Safety, minimum: 0.000661
Factor of Safety, maximum: 1.696340
Probability of Failure: 99.930% (= 9964 failed surfaces / 9971 valid surfaces), 29 invalid surfaces
Reliability index: -9.70052 (assuming normal distribution)
Reliability index: -3.05657 (assuming lognormal distribution)
* best fit = Beta

Method: gle/morgenstern-price
Factor of Safety, mean: 0.055207
Factor of Safety, standard deviation: 0.095044
Factor of Safety, minimum: 0.000638
Factor of Safety, maximum: 1.702020
Probability of Failure: 99.930% (= 9978 failed surfaces / 9985 valid surfaces), 15 invalid surfaces
Reliability index: -9.94060 (assuming normal distribution)
Reliability index: -3.05507 (assuming lognormal distribution)
* best fit = Beta

List Of Coordinates

Water Table

X	Y
0	0
0	-8000
15333	-8000
15333	0
0	0

External Boundary

X	Y

15333	-8000
15333	-4361
15240	-4358
15147	-4356
15055	-4354
14962	-4353
14869	-4352
14776	-4353
14684	-4355
14591	-4353
14498	-4348
14405	-4339
14312	-4331
14220	-4325
14127	-4320
14034	-4316
13941	-4313
13849	-4311
13756	-4309
13663	-4308
13570	-4307
13478	-4305
13385	-4304
13292	-4301
13199	-4296
13107	-4290
13014	-4284
12921	-4280
12828	-4275
12736	-4272
12643	-4270
12550	-4267
12457	-4264
12365	-4261
12272	-4257
12179	-4252
12086	-4248
11993	-4245
11901	-4240
11808	-4234

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 03PC Site 100		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 3/25/2013		File Name: RR0705_03_100_1g.sli

11715	-4228
11622	-4221
11530	-4213
11437	-4206
11344	-4198
11251	-4188
11159	-4180
11066	-4172
10973	-4165
10880	-4160
10788	-4155
10695	-4150
10602	-4147
10509	-4145
10417	-4143
10324	-4142
10231	-4139
10138	-4135
10045	-4130
9953	-4126
9860	-4120
9767	-4112
9674	-4104
9582	-4098
9489	-4093
9396	-4091
9303	-4092
9211	-4093
9118	-4095
9025	-4095
8932	-4094
8840	-4091
8747	-4089
8654	-4086
8561	-4083
8469	-4081
8376	-4079
8283	-4076
8190	-4071
8098	-4066

8005	-4060
7912	-4054
7819	-4048
7726	-4041
7634	-4034
7541	-4028
7448	-4023
7355	-4018
7263	-4013
7170	-4007
7077	-4003
6984	-3997
6892	-3990
6799	-3983
6706	-3976
6613	-3970
6521	-3963
6428	-3957
6335	-3950
6242	-3943
6150	-3937
6057	-3927
5964	-3919
5871	-3912
5778	-3904
5686	-3896
5593	-3888
5500	-3887
5407	-3882
5316	-3875
5224	-3869
5132	-3864
5041	-3858
4949	-3852
4857	-3846
4765	-3838
4674	-3829
4582	-3813
4490	-3792
4398	-3768

4307	-3745
4215	-3721
4123	-3694
4032	-3663
3940	-3631
3848	-3600
3756	-3570
3665	-3542
3573	-3512
3481	-3484
3389	-3453
3298	-3420
3206	-3386
3114	-3355
3023	-3328
2931	-3300
2839	-3267
2748	-3226
2656	-3186
2565	-3157
2473	-3128
2381	-3095
2290	-3059
2198	-3022
2107	-2988
2015	-2959
1923	-2934
1832	-2914
1740	-2894
1649	-2873
1557	-2846
1465	-2817
1374	-2788
1282	-2758
1191	-2728
1099	-2697
1008	-2670
916	-2647
824	-2623
733	-2596

rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 03PC Site 100		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/25/2013		File Name: RR0705_03_100_1g.sli

SLIDEINTERPRET 6.020

641	-2566
550	-2531
458	-2498
366	-2472
275	-2456
183	-2446
92	-2441
0	-2441
0	-8000

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_03_33_0g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 03PC Site 33
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/14/2013, 11:40:16 PM
Comments:

http://activetectonics.coas.oregonstate.edu/
http://earthjay.com/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 100
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364848894
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	Basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 03PC Site 33		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/14/2013, 11:40:16 PM		File Name: RR0705_03_33_0g.slim

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
Basement	Cohesion	Normal	5.551	0.551	10.551	2.6
Basement	Phi	Normal	27.1	14.8	39.4	4.1
Basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Global Minimums

Method: spencer

FS: 1.095010
Center: 1164.858, -2371.138
Radius: 591.073
Left Slip Surface Endpoint: 736.983, -2778.925
Right Slip Surface Endpoint: 1072.537, -2954.957
Left Slope Intercept: 736.983 -0.000
Right Slope Intercept: 1072.537 -0.000
Resisting Moment=1.35062e+007 kN-m
Driving Moment=1.23343e+007 kN-m
Resisting Horizontal Force=20126 kN
Driving Horizontal Force=18379.7 kN
Total Slice Area=969935 m2

Method: gle/morgenstern-price

FS: 1.094020
Center: 1164.858, -2371.138
Radius: 591.073
Left Slip Surface Endpoint: 736.983, -2778.925
Right Slip Surface Endpoint: 1072.537, -2954.957
Left Slope Intercept: 736.983 -0.000
Right Slope Intercept: 1072.537 -0.000
Resisting Moment=1.3494e+007 kN-m
Driving Moment=1.23343e+007 kN-m
Resisting Horizontal Force=20119.1 kN

Driving Horizontal Force=18390.1 kN
Total Slice Area=969935 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2583
Number of Invalid Surfaces: 342

Error Codes:

Error Code -108 reported for 321 surfaces
Error Code -112 reported for 21 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2925
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.09501

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	3.35554	96124	Basement	5.551	27.1	0.465685	0.50993	28631	28640.9	-9.87947
2	3.35554	96279.3	Basement	5.551	27.1	3.95512	4.3309	28674.1	28676.6	-2.4935
3	3.35554	96431.7	Basement	5.551	27.1	7.37876	8.07982	28716.7	28711.7	5.0208
4	3.35554	96581.2	Basement	5.551	27.1	10.7368	11.757	28758.4	28746.2	12.1531
5	3.35554	96727.9	Basement	5.551	27.1	14.0296	15.3626	28799.3	28780.2	19.1076
6	3.35554	96871.8	Basement	5.551	27.1	17.2574	18.897	28839.7	28813.7	25.9624
7	3.35554	97012.9	Basement	5.551	27.1	20.4203	22.3604	28879.5	28846.6	32.8791

8	3.35554	97151.5	Basement	5.551	27.1	23.5187	25.7532	28918.6	28879	39.585
9	3.35554	97287.4	Basement	5.551	27.1	26.5528	29.0756	28957	28911	46.0057
10	3.35554	97420.8	Basement	5.551	27.1	29.523	32.328	28994.8	28942.4	52.352
11	3.35554	97551.7	Basement	5.551	27.1	32.4295	35.5106	29031.8	28973.4	58.4214
12	3.35554	97680.2	Basement	5.551	27.1	35.2726	38.6238	29068.4	29003.8	64.6219
13	3.35554	97806.3	Basement	5.551	27.1	38.0524	41.6678	29104.5	29033.9	70.6292
14	3.35554	97930	Basement	5.551	27.1	40.7695	44.643	29139.9	29063.4	76.4797
15	3.35554	98051.5	Basement	5.551	27.1	43.424	47.5497	29174.6	29092.6	82.0492
16	3.35554	98170.7	Basement	5.551	27.1	46.0161	50.3881	29208.8	29121.2	87.5782
17	3.35554	98287.7	Basement	5.551	27.1	48.5461	53.1585	29242.7	29149.5	93.1588
18	3.35554	98402.5	Basement	5.551	27.1	51.0144	55.8613	29275.8	29177.4	98.353
19	3.35554	98515.2	Basement	5.551	27.1	53.4212	58.4967	29308.2	29204.8	103.404
20	3.35554	98625.7	Basement	5.551	27.1	55.7666	61.065	29340.4	29231.8	108.585
21	3.35554	98734.3	Basement	5.551	27.1	58.051	63.5664	29371.7	29258.5	113.226
22	3.35554	98840.6	Basement	5.551	27.1	60.4498	66.1931	29403.3	29284.7	118.6
23	3.35554	98941.1	Basement	5.551	27.1	62.812	68.7798	29434	29310.6	123.447
24	3.35554	99038.1	Basement	5.551	27.1	64.3357	70.4482	29462.9	29336	126.874
25	3.35554	99133.1	Basement	5.551	27.1	65.7948	72.046	29491.1	29361.1	129.981
26	3.35554	99226.2	Basement	5.551	27.1	67.1898	73.5735	29518.8	29385.9	132.874
27	3.35554	99317.4	Basement	5.551	27.1	68.5209	75.0311	29546.1	29410.2	135.855
28	3.35554	99406.7	Basement	5.551	27.1	69.7883	76.4189	29572.8	29434.3	138.478
29	3.35554	99494.3	Basement	5.551	27.1	70.9924	77.7374	29599	29457.9	141.138
30	3.35554	99580	Basement	5.551	27.1	72.1333	78.9867	29624.7	29481.2	143.477
31	3.35554	99664	Basement	5.551	27.1	73.2113	80.1671	29650	29504.2	145.829
32	3.35554	99746.3	Basement	5.551	27.1	74.2266	81.2789	29674.9	29526.9	148.031
33	3.35554	99826.8	Basement	5.551	27.1	75.1795	82.3223	29699.2	29549.2	150.011
34	3.35554	99905.6	Basement	5.551	27.1	76.0701	83.2975	29722.9	29571.1	151.845
35	3.35554	99982.7	Basement	5.551	27.1	76.8987	84.2048	29746.5	29592.8	153.659
36	3.35554	100058	Basement	5.551	27.1	77.6654	85.0444	29769.6	29614.1	155.474
37	3.35554	100132	Basement	5.551	27.1	78.3704	85.8164	29792.1	29635.1	157.002
38	3.35554	100204	Basement	5.551	27.1	79.014	86.5211	29814.1	29655.8	158.308
39	3.35554	100275	Basement	5.551	27.1	79.5963	87.1587	29835.7	29676.2	159.455
40	3.35554	100344	Basement	5.551	27.1	80.1174	87.7294	29856.8	29696.3	160.503
41	3.35554	100411	Basement	5.551	27.1	80.5776	88.2333	29877.6	29716.1	161.513
42	3.35554	100477	Basement	5.551	27.1	80.9769	88.6705	29898.1	29735.6	162.542
43	3.35554	100542	Basement	5.551	27.1	81.3156	89.0414	29917.9	29754.8	163.124
44	3.35554	100604	Basement	5.551	27.1	81.5937	89.3459	29937.5	29773.7	163.832
45	3.35554	100666	Basement	5.551	27.1	81.8114	89.5843	29956.5	29792.3	164.194
46	3.35554	100726	Basement	5.551	27.1	81.9687	89.7566	29975.1	29810.6	164.522
47	3.35554	100784	Basement	5.551	27.1	82.066	89.8631	29993.5	29828.7	164.762

48	3.35554	100841	Basement	5.551	27.1	82.1031	89.9037	30011.3	29846.4	164.898
49	3.35554	100897	Basement	5.551	27.1	82.1763	89.9839	30028.9	29863.9	165.038
50	3.35554	100949	Basement	5.551	27.1	82.0919	89.8915	30045.9	29881.1	164.792
51	3.35554	101000	Basement	5.551	27.1	81.7579	89.5257	30062.2	29898.1	164.1
52	3.35554	101050	Basement	5.551	27.1	81.3629	89.0932	30077.9	29914.7	163.199
53	3.35554	101098	Basement	5.551	27.1	80.9072	88.5942	30093.3	29931.1	162.195
54	3.35554	101145	Basement	5.551	27.1	80.3908	88.0287	30108.4	29947.3	161.128
55	3.35554	101190	Basement	5.551	27.1	79.8137	87.3968	30123.1	29963.1	159.962
56	3.35554	101235	Basement	5.551	27.1	79.176	86.6985	30137.2	29978.7	158.532
57	3.35554	101277	Basement	5.551	27.1	78.4777	85.9339	30151.2	29994.1	157.144
58	3.35554	101319	Basement	5.551	27.1	77.719	85.1031	30164.6	30009.2	155.386
59	3.35554	101359	Basement	5.551	27.1	76.8998	84.2061	30177.8	30024	153.836
60	3.35554	101398	Basement	5.551	27.1	76.0202	83.2429	30190.5	30038.6	151.876
61	3.35554	101435	Basement	5.551	27.1	75.0801	82.2135	30202.8	30053	149.81
62	3.35554	101472	Basement	5.551	27.1	74.0797	81.118	30214.9	30067.1	147.768
63	3.35554	101507	Basement	5.551	27.1	73.0188	79.9563	30226.4	30080.9	145.501
64	3.35554	101540	Basement	5.551	27.1	71.8975	78.7285	30237.4	30094.5	142.935
65	3.35554	101573	Basement	5.551	27.1	70.7159	77.4346	30248.3	30107.9	140.374
66	3.35554	101604	Basement	5.551	27.1	69.4737	76.0744	30258.9	30121	137.944
67	3.35554	101634	Basement	5.551	27.1	68.1712	74.6481	30268.9	30133.9	135.013
68	3.35554	101663	Basement	5.551	27.1	66.8081	73.1555	30278.8	30146.5	132.262
69	3.35554	101691	Basement	5.551	27.1	65.3845	71.5967	30288	30158.9	129.053
70	3.35554	101717	Basement	5.551	27.1	63.9003	69.9715	30297.1	30171.1	125.972
71	3.35554	101742	Basement	5.551	27.1	62.3555	68.2799	30305.6	30183	122.576
72	3.35554	101766	Basement	5.551	27.1	60.7501	66.522	30313.8	30194.7	119.069
73	3.35554	101789	Basement	5.551	27.1	59.0839	64.6975	30321.7	30206.2	115.47
74	3.35554	101810	Basement	5.551	27.1	57.3569	62.8064	30329.3	30217.5	111.8
75	3.35554	101831	Basement	5.551	27.1	55.569	60.8486	30336.7	30228.5	108.179
76	3.35554	101850	Basement	5.551	27.1	53.411	58.4856	30342.7	30239.3	103.387
77	3.35554	101873	Basement	5.551	27.1	51.2968	56.1705	30348.8	30249.9	98.8618
78	3.35554	101896	Basement	5.551	27.1	50.1301	54.893	30356.6	30260.2	96.4385
79	3.35554	101919	Basement	5.551	27.1	48.9065	53.5531	30364.1	30270.3	93.7552
80	3.35554	101940	Basement	5.551	27.1	47.6257	52.1506	30371.3	30280.2	91.1142
81	3.35554	101960	Basement	5.551	27.1	46.2877	50.6855	30378.1	30289.9	88.2448
82	3.35554	101979	Basement	5.551	27.1	44.8923	49.1575	30384.6	30299.4	85.162
83	3.35554	101997	Basement	5.551	27.1	43.4392	47.5664	30390.6	30308.6	81.98
84	3.35554	102013	Basement	5.551	27.1	41.9287	45.9123	30396.5	30317.6	78.9015
85	3.35554	102029	Basement	5.551	27.1	40.3602	44.1948	30402.1	30326.5	75.5523
86	3.35554	102043	Basement	5.551	27.1	38.7338	42.4139	30407	30335	71.9564
87	3.35554	102056	Basement	5.551	27.1	37.0493	40.5693	30411.8	30343.4	68.4049

88	3.35554	102069	Basement	5.551	27.1	35.3063	38.6608	30416.3	30351.6	64.7214
89	3.35554	102080	Basement	5.551	27.1	33.505	36.6883	30420.5	30359.6	60.9181
90	3.35554	102090	Basement	5.551	27.1	31.645	34.6516	30424.1	30367.3	56.8158
91	3.35554	102099	Basement	5.551	27.1	29.7261	32.5504	30427.7	30374.8	52.9074
92	3.35554	102106	Basement	5.551	27.1	27.7481	30.3845	30430.7	30382.2	48.5219
93	3.35554	102113	Basement	5.551	27.1	25.7109	28.1537	30433.5	30389.3	44.161
94	3.35554	102119	Basement	5.551	27.1	23.6142	25.8578	30435.9	30396.2	39.7352
95	3.35554	102123	Basement	5.551	27.1	21.4578	23.4965	30437.9	30402.9	34.9619
96	3.35554	102127	Basement	5.551	27.1	19.2415	21.0696	30439.8	30409.4	30.436
97	3.35554	102129	Basement	5.551	27.1	16.965	18.5768	30441	30415.6	25.3881
98	3.35554	102131	Basement	5.551	27.1	14.628	16.0178	30442.2	30421.7	20.5063
99	3.35554	102131	Basement	5.551	27.1	12.2303	13.3923	30442.9	30427.6	15.3126
100	3.35554	102130	Basement	5.551	27.1	9.7739	10.7025	30443.4	30433.3	10.109

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.09402

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	3.35554	96124	Basement	5.551	27.1	4.92507	5.38813	28640.5	28640.9	-0.381153
2	3.35554	96279.3	Basement	5.551	27.1	7.95269	8.7004	28682.6	28676.6	6.04399
3	3.35554	96431.7	Basement	5.551	27.1	10.9279	11.9553	28724.3	28711.7	12.579
4	3.35554	96581.2	Basement	5.551	27.1	13.8514	15.1537	28764.9	28746.2	18.714
5	3.35554	96727.9	Basement	5.551	27.1	16.7239	18.2963	28805.1	28780.2	24.8668
6	3.35554	96871.8	Basement	5.551	27.1	19.5461	21.3838	28844.6	28813.7	30.9061
7	3.35554	97012.9	Basement	5.551	27.1	22.3187	24.4171	28883.6	28846.6	36.9937
8	3.35554	97151.5	Basement	5.551	27.1	25.0424	27.3969	28921.6	28879	42.639
9	3.35554	97287.4	Basement	5.551	27.1	27.7177	30.3237	28959.4	28911	48.4224
10	3.35554	97420.8	Basement	5.551	27.1	30.3452	33.1983	28996.5	28942.4	54.122
11	3.35554	97551.7	Basement	5.551	27.1	32.9255	36.0212	29032.9	28973.4	59.5352
12	3.35554	97680.2	Basement	5.551	27.1	35.4592	38.7931	29068.9	29003.8	65.0704
13	3.35554	97806.3	Basement	5.551	27.1	37.9467	41.5145	29104.1	29033.9	70.1778
14	3.35554	97930	Basement	5.551	27.1	40.3885	44.1858	29139	29063.4	75.571
15	3.35554	98051.5	Basement	5.551	27.1	42.7849	46.8075	29173.3	29092.6	80.6776
16	3.35554	98170.7	Basement	5.551	27.1	45.1364	49.3801	29206.9	29121.2	85.7382
17	3.35554	98287.7	Basement	5.551	27.1	47.4433	51.9039	29240.1	29149.5	90.6136
18	3.35554	98402.5	Basement	5.551	27.1	49.7059	54.3793	29272.7	29177.4	95.3274
19	3.35554	98515.2	Basement	5.551	27.1	51.9246	56.8065	29304.9	29204.8	100.127
20	3.35554	98625.7	Basement	5.551	27.1	54.0994	59.1858	29336.6	29231.8	104.819
21	3.35554	98734.3	Basement	5.551	27.1	56.2305	61.5173	29367.9	29258.5	109.438
22	3.35554	98840.6	Basement	5.551	27.1	58.4562	63.9523	29398.8	29284.7	114.078
23	3.35554	98941.1	Basement	5.551	27.1	60.6109	66.3095	29429.3	29310.6	118.661

24	3.35554	99038.1	Basement	5.551	27.1	62.079	67.9157	29457.8	29336	121.823
25	3.35554	99133.1	Basement	5.551	27.1	63.4979	69.468	29486	29361.1	124.905
26	3.35554	99226.2	Basement	5.551	27.1	64.8675	70.9663	29513.7	29385.9	127.772
27	3.35554	99317.4	Basement	5.551	27.1	66.1875	72.4105	29540.9	29410.2	130.728
28	3.35554	99406.7	Basement	5.551	27.1	67.458	73.8004	29567.6	29434.3	133.326
29	3.35554	99494.3	Basement	5.551	27.1	68.6786	75.1358	29593.9	29457.9	135.962
30	3.35554	99580	Basement	5.551	27.1	69.8493	76.4165	29619.7	29481.2	138.524
31	3.35554	99664	Basement	5.551	27.1	70.9696	77.6422	29645.1	29504.2	140.854
32	3.35554	99746.3	Basement	5.551	27.1	72.0395	78.8126	29669.9	29526.9	143.034
33	3.35554	99826.8	Basement	5.551	27.1	73.0583	79.9272	29694.4	29549.2	145.243
34	3.35554	99905.6	Basement	5.551	27.1	74.0258	80.9857	29718.7	29571.1	147.561
35	3.35554	99982.7	Basement	5.551	27.1	74.9417	81.9877	29742.2	29592.8	149.357
36	3.35554	100058	Basement	5.551	27.1	75.8054	82.9326	29765.3	29614.1	151.153
37	3.35554	100132	Basement	5.551	27.1	76.6166	83.8201	29788	29635.1	152.919
38	3.35554	100204	Basement	5.551	27.1	77.3748	84.6496	29810.5	29655.8	154.721
39	3.35554	100275	Basement	5.551	27.1	78.0796	85.4206	29832.3	29676.2	156.112
40	3.35554	100344	Basement	5.551	27.1	78.7302	86.1324	29853.7	29696.3	157.406
41	3.35554	100411	Basement	5.551	27.1	79.3262	86.7845	29874.8	29716.1	158.663
42	3.35554	100477	Basement	5.551	27.1	79.8672	87.3763	29895.5	29735.6	159.941
43	3.35554	100542	Basement	5.551	27.1	80.3524	87.9071	29915.8	29754.8	161.035
44	3.35554	100604	Basement	5.551	27.1	80.7812	88.3762	29935.4	29773.7	161.736
45	3.35554	100666	Basement	5.551	27.1	81.1531	88.7831	29954.9	29792.3	162.617
46	3.35554	100726	Basement	5.551	27.1	81.4673	89.1269	29974.1	29810.6	163.467
47	3.35554	100784	Basement	5.551	27.1	81.7235	89.4071	29992.4	29828.7	163.704
48	3.35554	100841	Basement	5.551	27.1	81.9206	89.6228	30010.8	29846.4	164.367
49	3.35554	100897	Basement	5.551	27.1	82.184	89.9109	30028.7	29863.9	164.771
50	3.35554	100949	Basement	5.551	27.1	82.3014	90.0394	30046.2	29881.1	165.059
51	3.35554	101000	Basement	5.551	27.1	82.126	89.8475	30062.7	29898.1	164.636
52	3.35554	101050	Basement	5.551	27.1	81.8869	89.5859	30079	29914.7	164.274
53	3.35554	101098	Basement	5.551	27.1	81.5833	89.2538	30094.6	29931.1	163.544
54	3.35554	101145	Basement	5.551	27.1	81.2145	88.8503	30110.1	29947.3	162.75
55	3.35554	101190	Basement	5.551	27.1	80.7799	88.3748	30125	29963.1	161.861
56	3.35554	101235	Basement	5.551	27.1	80.2788	87.8266	30139.4	29978.7	160.708
57	3.35554	101277	Basement	5.551	27.1	79.7104	87.2048	30153.7	29994.1	159.599
58	3.35554	101319	Basement	5.551	27.1	79.0741	86.5087	30167.3	30009.2	158.121
59	3.35554	101359	Basement	5.551	27.1	78.3692	85.7375	30180.9	30024	156.852
60	3.35554	101398	Basement	5.551	27.1	77.5951	84.8906	30193.8	30038.6	155.174
61	3.35554	101435	Basement	5.551	27.1	76.7512	83.9673	30206.1	30053	153.117
62	3.35554	101472	Basement	5.551	27.1	75.8365	82.9667	30218.5	30067.1	151.359
63	3.35554	101507	Basement	5.551	27.1	74.8509	81.8884	30230	30080.9	149.101

64	3.35554	101540	Basement	5.551	27.1	73.7933	80.7314	30241.3	30094.5	146.822
65	3.35554	101573	Basement	5.551	27.1	72.6635	79.4953	30252.4	30107.9	144.548
66	3.35554	101604	Basement	5.551	27.1	71.4607	78.1794	30262.8	30121	141.849
67	3.35554	101634	Basement	5.551	27.1	70.1843	76.783	30273.1	30133.9	139.206
68	3.35554	101663	Basement	5.551	27.1	68.8338	75.3056	30283	30146.5	136.464
69	3.35554	101691	Basement	5.551	27.1	67.4088	73.7466	30292.2	30158.9	133.265
70	3.35554	101717	Basement	5.551	27.1	65.9088	72.1055	30301.3	30171.1	130.193
71	3.35554	101742	Basement	5.551	27.1	64.3331	70.3817	30309.8	30183	126.806
72	3.35554	101766	Basement	5.551	27.1	62.6814	68.5747	30318	30194.7	123.307
73	3.35554	101789	Basement	5.551	27.1	60.9533	66.6841	30325.6	30206.2	119.434
74	3.35554	101810	Basement	5.551	27.1	59.1483	64.7094	30333	30217.5	115.488
75	3.35554	101831	Basement	5.551	27.1	57.2661	62.6503	30340.1	30228.5	111.59
76	3.35554	101850	Basement	5.551	27.1	55.0438	60.219	30346.1	30239.3	106.803
77	3.35554	101873	Basement	5.551	27.1	52.9558	57.9347	30352.2	30249.9	102.285
78	3.35554	101896	Basement	5.551	27.1	51.7164	56.5788	30359.8	30260.2	99.5818
79	3.35554	101919	Basement	5.551	27.1	50.4061	55.1453	30367.2	30270.3	96.9039
80	3.35554	101940	Basement	5.551	27.1	49.0246	53.6339	30374.2	30280.2	93.9815
81	3.35554	101960	Basement	5.551	27.1	47.5715	52.0442	30380.7	30289.9	90.8297
82	3.35554	101979	Basement	5.551	27.1	46.0467	50.376	30386.9	30299.4	87.4633
83	3.35554	101997	Basement	5.551	27.1	44.4498	48.629	30392.9	30308.6	84.285
84	3.35554	102013	Basement	5.551	27.1	42.7806	46.8028	30398.2	30317.6	80.6328
85	3.35554	102029	Basement	5.551	27.1	41.0388	44.8973	30403.2	30326.5	76.7083
86	3.35554	102043	Basement	5.551	27.1	39.2245	42.9124	30408.1	30335	73.114
87	3.35554	102056	Basement	5.551	27.1	37.3373	40.8477	30412.4	30343.4	68.9846
88	3.35554	102069	Basement	5.551	27.1	35.377	38.7032	30416.3	30351.6	64.7214
89	3.35554	102080	Basement	5.551	27.1	33.3439	36.4789	30419.9	30359.6	60.3369
90	3.35554	102090	Basement	5.551	27.1	31.2376	34.1746	30423.2	30367.3	55.9428
91	3.35554	102099	Basement	5.551	27.1	29.0582	31.7903	30426.3	30374.8	51.4506
92	3.35554	102106	Basement	5.551	27.1	26.8057	29.326	30428.7	30382.2	46.4799
93	3.35554	102113	Basement	5.551	27.1	24.4801	26.7817	30430.8	30389.3	41.5324
94	3.35554	102119	Basement	5.551	27.1	22.0814	24.1575	30432.4	30396.2	36.2263
95	3.35554	102123	Basement	5.551	27.1	19.6098	21.4535	30434.1	30402.9	31.1564
96	3.35554	102127	Basement	5.551	27.1	17.0653	18.6698	30434.9	30409.4	25.4542
97	3.35554	102129	Basement	5.551	27.1	14.4482	15.8066	30435.7	30415.6	20.1076
98	3.35554	102131	Basement	5.551	27.1	11.7585	12.864	30436	30421.7	14.3395
99	3.35554	102131	Basement	5.551	27.1	8.99641	9.84225	30435.9	30427.6	8.25793
100	3.35554	102130	Basement	5.551	27.1	6.16224	6.74161	30435.5	30433.3	2.16502

Interslice Data

rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 03PC Site 33		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
SLIDEINTERPRET 6.020	Date	3/14/2013, 11:40:16 PM		File Name: RR0705_03_33_0g.slim

Global Minimum Query (spencer) - Safety Factor: 1.09501

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	736.983	-2778.93	3.97705e+007	0	0
2	740.339	-2782.42	55146.5	49.5269	0.0514571
3	743.694	-2785.85	108785	97.6995	0.0514572
4	747.05	-2789.23	160949	144.548	0.0514572
5	750.405	-2792.56	211669	190.099	0.0514571
6	753.761	-2795.83	260976	234.381	0.051457
7	757.116	-2799.06	308897	277.419	0.0514571
8	760.472	-2802.23	355461	319.238	0.0514571
9	763.827	-2805.35	400693	359.86	0.051457
10	767.183	-2808.43	444617	399.309	0.0514571
11	770.538	-2811.46	487259	437.605	0.0514571
12	773.894	-2814.44	528640	474.77	0.0514572
13	777.25	-2817.37	568783	510.822	0.0514571
14	780.605	-2820.27	607709	545.781	0.0514571
15	783.961	-2823.12	645437	579.664	0.0514571
16	787.316	-2825.92	681987	612.489	0.051457
17	790.672	-2828.69	717377	644.273	0.0514571
18	794.027	-2831.41	751626	675.032	0.0514571
19	797.383	-2834.1	784751	704.781	0.051457
20	800.738	-2836.74	816767	733.535	0.0514571
21	804.094	-2839.34	847692	761.309	0.0514571
22	807.449	-2841.91	877540	788.115	0.0514571
23	810.805	-2844.44	904253	812.106	0.0514571
24	814.161	-2846.93	923343	829.25	0.0514571
25	817.516	-2849.39	941387	845.456	0.0514571
26	820.872	-2851.81	958400	860.735	0.0514571
27	824.227	-2854.19	974393	875.098	0.0514571
28	827.583	-2856.54	989379	888.557	0.0514571
29	830.938	-2858.85	1.00337e+006	901.124	0.0514572
30	834.294	-2861.13	1.01638e+006	912.807	0.0514571
31	837.649	-2863.38	1.02842e+006	923.618	0.051457
32	841.005	-2865.59	1.0395e+006	933.567	0.0514569
33	844.36	-2867.78	1.04962e+006	942.662	0.0514572
34	847.716	-2869.93	1.05881e+006	950.913	0.0514571
35	851.071	-2872.04	1.06707e+006	958.33	0.051457
36	854.427	-2874.13	1.07441e+006	964.92	0.0514569
37	857.783	-2876.18	1.08083e+006	970.692	0.0514573

38	861.138	-2878.21	1.08636e+006	975.655	0.0514571
39	864.494	-2880.2	1.09099e+006	979.815	0.0514572
40	867.849	-2882.17	1.09474e+006	983.182	0.0514571
41	871.205	-2884.11	1.09761e+006	985.762	0.0514572
42	874.56	-2886.01	1.09962e+006	987.562	0.051457
43	877.916	-2887.89	1.10076e+006	988.59	0.0514572
44	881.271	-2889.74	1.10105e+006	988.852	0.0514573
45	884.627	-2891.56	1.1005e+006	988.356	0.0514572
46	887.982	-2893.35	1.09911e+006	987.107	0.0514571
47	891.338	-2895.12	1.09689e+006	985.111	0.051457
48	894.694	-2896.86	1.09384e+006	982.376	0.0514572
49	898.049	-2898.57	1.08998e+006	978.906	0.0514571
50	901.405	-2900.25	1.08419e+006	973.709	0.0514572
51	904.76	-2901.91	1.07605e+006	966.398	0.0514572
52	908.116	-2903.54	1.06711e+006	958.367	0.0514571
53	911.471	-2905.14	1.05737e+006	949.621	0.0514572
54	914.827	-2906.72	1.04684e+006	940.164	0.0514572
55	918.182	-2908.28	1.03553e+006	930.003	0.051457
56	921.538	-2909.81	1.02343e+006	919.142	0.0514573
57	924.893	-2911.31	1.01057e+006	907.586	0.0514569
58	928.249	-2912.79	996932	895.34	0.0514571
59	931.605	-2914.24	982532	882.408	0.0514571
60	934.96	-2915.67	967374	868.794	0.0514571
61	938.316	-2917.07	951462	854.504	0.0514571
62	941.671	-2918.45	934801	839.541	0.0514571
63	945.027	-2919.81	917396	823.909	0.0514571
64	948.382	-2921.14	899250	807.613	0.0514571
65	951.738	-2922.45	880369	790.656	0.0514571
66	955.093	-2923.74	860757	773.042	0.0514571
67	958.449	-2925	840417	754.775	0.0514571
68	961.804	-2926.24	819355	735.859	0.0514571
69	965.16	-2927.45	797573	716.297	0.0514571
70	968.516	-2928.65	775077	696.093	0.0514571
71	971.871	-2929.82	751869	675.25	0.0514571
72	975.227	-2930.97	727953	653.771	0.051457
73	978.582	-2932.09	703333	631.66	0.0514571
74	981.938	-2933.19	678012	608.92	0.0514571
75	985.293	-2934.28	651994	585.553	0.0514571
76	988.649	-2935.33	625283	561.564	0.0514571
77	992.004	-2936.37	601038	539.79	0.0514571

78	995.36	-2937.39	583505	524.044	0.0514571
79	998.715	-2938.38	565300	507.694	0.0514571
80	1002.07	-2939.35	546426	490.743	0.0514571
81	1005.43	-2940.3	526885	473.193	0.0514571
82	1008.78	-2941.23	506681	455.048	0.0514571
83	1012.14	-2942.14	485816	436.309	0.051457
84	1015.49	-2943.03	464292	416.979	0.0514571
85	1018.85	-2943.89	442113	397.06	0.0514571
86	1022.2	-2944.74	419281	376.555	0.0514572
87	1025.56	-2945.56	395799	355.465	0.051457
88	1028.92	-2946.37	371668	333.794	0.0514572
89	1032.27	-2947.15	346892	311.542	0.051457
90	1035.63	-2947.91	321472	288.713	0.0514571
91	1038.98	-2948.65	295411	265.308	0.0514572
92	1042.34	-2949.37	268712	241.329	0.0514571
93	1045.69	-2950.07	241375	216.778	0.0514571
94	1049.05	-2950.75	213404	191.657	0.051457
95	1052.4	-2951.42	184800	165.968	0.0514571
96	1055.76	-2952.06	155566	139.713	0.051457
97	1059.12	-2952.68	125703	112.893	0.0514569
98	1062.47	-2953.28	95212.5	85.5099	0.0514571
99	1065.83	-2953.86	64097.4	57.5656	0.0514571
100	1069.18	-2954.42	32359.1	29.0615	0.051457
101	1072.54	-2954.96	4.49686e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.09402

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	736.983	-2778.93	3.97705e+007	0	0
2	740.339	-2782.42	55164.9	1.96586	0.0020418
3	743.694	-2785.85	108819	7.75199	0.00408161
4	747.05	-2789.23	160997	17.1893	0.00611735
5	750.405	-2792.56	211729	30.1064	0.00814706
6	753.761	-2795.83	261045	46.3298	0.0101688
7	757.116	-2799.06	308975	65.6843	0.0121804
8	760.472	-2802.23	355545	87.993	0.01418
9	763.827	-2805.35	400781	113.078	0.0161657
10	767.183	-2808.43	444710	140.76	0.0181353
11	770.538	-2811.46	487354	170.859	0.020087
12	773.894	-2814.44	528736	203.196	0.0220191

13	777.25	-2817.37	568880	237.59	0.0239293
14	780.605	-2820.27	607804	273.86	0.0258159
15	783.961	-2823.12	645531	311.827	0.027677
16	787.316	-2825.92	682079	351.313	0.0295109
17	790.672	-2828.69	717467	392.139	0.0313156
18	794.027	-2831.41	751713	434.128	0.0330894
19	797.383	-2834.1	784834	477.106	0.0348305
20	800.738	-2836.74	816847	520.9	0.0365373
21	804.094	-2839.34	847768	565.338	0.0382079
22	807.449	-2841.91	877612	610.252	0.0398409
23	810.805	-2844.44	904321	653.978	0.0414346
24	814.161	-2846.93	923406	692.805	0.0429874
25	817.516	-2849.39	941446	731.157	0.0444977
26	820.872	-2851.81	958453	768.897	0.0459642
27	824.227	-2854.19	974442	805.893	0.0473853
28	827.583	-2856.54	989425	842.017	0.0487596
29	830.938	-2858.85	1.00341e+006	877.146	0.050086
30	834.294	-2861.13	1.01642e+006	911.165	0.0513625
31	837.649	-2863.38	1.02845e+006	943.961	0.0525888
32	841.005	-2865.59	1.03953e+006	975.429	0.0537627
33	844.36	-2867.78	1.04965e+006	1005.47	0.0548842
34	847.716	-2869.93	1.05884e+006	1033.98	0.0559505
35	851.071	-2872.04	1.06709e+006	1060.89	0.0569629
36	854.427	-2874.13	1.07443e+006	1086.1	0.0579181
37	857.783	-2876.18	1.08085e+006	1109.54	0.0588166
38	861.138	-2878.21	1.08637e+006	1131.15	0.0596575
39	864.494	-2880.2	1.09101e+006	1150.85	0.0604383
40	867.849	-2882.17	1.09475e+006	1168.59	0.0611603
41	871.205	-2884.11	1.09762e+006	1184.33	0.061822
42	874.56	-2886.01	1.09963e+006	1198.01	0.0624218
43	877.916	-2887.89	1.10077e+006	1209.61	0.0629609
44	881.271	-2889.74	1.10106e+006	1219.09	0.0634377
45	884.627	-2891.56	1.10051e+006	1226.43	0.0638515
46	887.982	-2893.35	1.09912e+006	1231.62	0.0642028
47	891.338	-2895.12	1.09689e+006	1234.64	0.0644911
48	894.694	-2896.86	1.09385e+006	1235.49	0.0647148
49	898.049	-2898.57	1.08998e+006	1234.17	0.0648752
50	901.405	-2900.25	1.0842e+006	1229.44	0.0649711
51	904.76	-2901.91	1.07606e+006	1220.81	0.0650031
52	908.116	-2903.54	1.06711e+006	1210.07	0.0649716

53	911.471	-2905.14	1.05737e+006	1197.25	0.0648754
54	914.827	-2906.72	1.04685e+006	1182.4	0.0647146
55	918.182	-2908.28	1.03553e+006	1165.57	0.0644909
56	921.538	-2909.81	1.02344e+006	1146.82	0.064203
57	924.893	-2911.31	1.01057e+006	1126.2	0.0638516
58	928.249	-2912.79	996933	1103.8	0.0634376
59	931.605	-2914.24	982533	1079.68	0.0629608
60	934.96	-2915.67	967375	1053.93	0.0624222
61	938.316	-2917.07	951462	1026.62	0.0618217
62	941.671	-2918.45	934800	997.851	0.0611603
63	945.027	-2919.81	917394	967.713	0.0604384
64	948.382	-2921.14	899247	936.306	0.059657
65	951.738	-2922.45	880365	903.734	0.0588167
66	955.093	-2923.74	860751	870.103	0.0579183
67	958.449	-2925	840410	835.526	0.0569628
68	961.804	-2926.24	819346	800.116	0.055951
69	965.16	-2927.45	797563	763.991	0.054884
70	968.516	-2928.65	775064	727.274	0.0537629
71	971.871	-2929.82	751854	690.087	0.0525887
72	975.227	-2930.97	727937	652.557	0.0513626
73	978.582	-2932.09	703315	614.812	0.0500858
74	981.938	-2933.19	677992	576.982	0.0487596
75	985.293	-2934.28	651972	539.2	0.0473853
76	988.649	-2935.33	625259	501.599	0.0459642
77	992.004	-2936.37	601012	466.766	0.0444978
78	995.36	-2937.39	583477	437.767	0.0429875
79	998.715	-2938.38	565270	408.787	0.0414347
80	1002.07	-2939.35	546394	379.938	0.0398409
81	1005.43	-2940.3	526851	351.333	0.0382079
82	1008.78	-2941.23	506645	323.085	0.0365372
83	1012.14	-2942.14	485778	295.308	0.0348305
84	1015.49	-2943.03	464253	268.114	0.0330893
85	1018.85	-2943.89	442073	241.619	0.0313155
86	1022.2	-2944.74	419240	215.934	0.0295108
87	1025.56	-2945.56	395756	191.172	0.027677
88	1028.92	-2946.37	371625	167.444	0.0258159
89	1032.27	-2947.15	346849	144.86	0.0239293
90	1035.63	-2947.91	321429	123.527	0.0220191
91	1038.98	-2948.65	295369	103.552	0.0200871
92	1042.34	-2949.37	268671	85.0399	0.0181353

93	1045.69	-2950.07	241336	68.0914	0.0161656
94	1049.05	-2950.75	213367	52.8058	0.01418
95	1052.4	-2951.42	184766	39.279	0.0121804
96	1055.76	-2952.06	155535	27.6041	0.0101688
97	1059.12	-2952.68	125676	17.8703	0.00814708
98	1062.47	-2953.28	95191.5	10.1634	0.00611735
99	1065.83	-2953.86	64082.5	4.56505	0.00408158
100	1069.18	-2954.42	32351.1	1.15287	0.0020418
101	1072.54	-2954.96	4.49686e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.102408
Factor of Safety, standard deviation: 0.180035
Factor of Safety, minimum: 0.537816
Factor of Safety, maximum: 1.782090
Probability of Failure: 29.160% (= 2916 failed surfaces / 10000 valid surfaces)
Reliability index: 0.56883 (assuming normal distribution)
Reliability index: 0.51984 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 1.101617
Factor of Safety, standard deviation: 0.180390
Factor of Safety, minimum: 0.540257
Factor of Safety, maximum: 1.781190
Probability of Failure: 29.370% (= 2937 failed surfaces / 10000 valid surfaces)
Reliability index: 0.56332 (assuming normal distribution)
Reliability index: 0.51361 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-8000
11171	-8000
11171	0
0	0

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 03PC Site 33		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/14/2013, 11:40:16 PM		File Name: RR0705_03_33_0g.slim

External Boundary

X	Y
11171	-8000
11171	-3923
11084	-3926
10996	-3929
10909	-3930
10822	-3929
10734	-3927
10647	-3924
10560	-3922
10472	-3919
10385	-3915
10298	-3910
10210	-3905
10121	-3900
10033	-3895
9945	-3891
9857	-3886
9769	-3881
9681	-3877
9593	-3873
9505	-3869
9417	-3865
9328	-3861
9240	-3857
9152	-3853
9059	-3848
8967	-3843
8874	-3839
8781	-3836
8688	-3831
8595	-3825
8502	-3820
8409	-3815
8317	-3812
8224	-3809
8131	-3806
8038	-3804

7945	-3802
7855	-3797
7766	-3791
7676	-3783
7586	-3772
7496	-3759
7406	-3749
7316	-3742
7226	-3738
7137	-3735
7047	-3731
6957	-3727
6867	-3720
6777	-3710
6693	-3700
6609	-3687
6525	-3675
6441	-3666
6356	-3660
6272	-3656
6188	-3653
6104	-3648
6020	-3641
5935	-3640
5850	-3632
5765	-3622
5680	-3615
5595	-3608
5510	-3600
5424	-3587
5339	-3572
5254	-3555
5169	-3538
5084	-3520
4998	-3503
4913	-3490
4828	-3479
4743	-3472
4658	-3464
4572	-3457

4487	-3447
4402	-3436
4317	-3427
4224	-3414
4132	-3399
4040	-3385
3948	-3373
3855	-3362
3763	-3346
3671	-3327
3579	-3306
3488	-3292
3397	-3286
3306	-3286
3215	-3282
3124	-3279
3033	-3272
2942	-3259
2851	-3244
2760	-3229
2677	-3223
2593	-3218
2509	-3207
2425	-3195
2342	-3175
2258	-3158
2174	-3144
2083	-3129
1992	-3115
1900	-3102
1809	-3089
1718	-3079
1626	-3070
1535	-3060
1443	-3049
1352	-3036
1261	-3017
1171	-2993
1081	-2959
991	-2916

900	-2863
810	-2813
720	-2771
630	-2746
540	-2741
450	-2750
360	-2764
270	-2778
180	-2794
90	-2813
0	-2837
0	-8000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 03PC Site 33		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/14/2013, 11:40:16 PM		File Name: RR0705_03_33_1g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_03_33_1g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 03PC Site 33
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/14/2013, 11:40:16 PM
Comments:

http://activetectonics.coas.oregonstate.edu/
http://earthjay.com/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 100
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364842777
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	Basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
Basement	Cohesion	Normal	5.551	0.551	10.551	2.6
Basement	Phi	Normal	27.1	14.8	39.4	4.1
Basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.001463
Center: 1272.006, -2174.812
Radius: 802.190
Left Slip Surface Endpoint: 752.782, -2786.298
Right Slip Surface Endpoint: 1057.592, -2947.816
Left Slope Intercept: 752.782 -0.000
Right Slope Intercept: 1057.592 -0.000
Resisting Moment=124610 kN-m
Driving Moment=8.51569e+007 kN-m
Resisting Horizontal Force=157.094 kN

Driving Horizontal Force=107356 kN
Total Slice Area=878233 m2

Method: gle/morgenstern-price

FS: 0.001315
Center: 1140.461, -2461.589
Radius: 493.239
Left Slip Surface Endpoint: 781.221, -2799.570
Right Slip Surface Endpoint: 1057.592, -2947.816
Left Slope Intercept: 781.221 -0.000
Right Slope Intercept: 1057.592 -0.000
Resisting Moment=79820.2 kN-m
Driving Moment=6.0685e+007 kN-m
Resisting Horizontal Force=167.596 kN
Driving Horizontal Force=127419 kN
Total Slice Area=799586 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 892
Number of Invalid Surfaces: 3

Error Codes:

Error Code -111 reported for 1 surface
Error Code -112 reported for 2 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 889
Number of Invalid Surfaces: 6

Error Codes:

Error Code -108 reported for 1 surface
Error Code -111 reported for 1 surface
Error Code -112 reported for 4 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.0014633

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	3.0481	87527.4	Basement	5.551	27.1	236.507	0.34608	28711.1	28721.3	-10.1659
2	3.0481	87627.3	Basement	5.551	27.1	251.473	0.36798	28755.7	28765.8	-10.1098
3	3.0481	87725.9	Basement	5.551	27.1	266.357	0.38976	28799.7	28809.7	-10.015
4	3.0481	87823.4	Basement	5.551	27.1	281.159	0.41142	28842.9	28852.8	-9.89587
5	3.0481	87919.6	Basement	5.551	27.1	295.886	0.43297	28885.4	28895.4	-10.0167
6	3.0481	88014.6	Basement	5.551	27.1	310.524	0.45439	28927.2	28937.2	-10.0428
7	3.0481	88108.4	Basement	5.551	27.1	325.067	0.47567	28968.5	28978.5	-9.98313
8	3.0481	88201.1	Basement	5.551	27.1	339.527	0.49683	29009.2	29019.1	-9.8592
9	3.0481	88292.6	Basement	5.551	27.1	353.885	0.51784	29049.1	29059	-9.89702
10	3.0481	88382.9	Basement	5.551	27.1	368.147	0.53871	29088.7	29098.4	-9.74815
11	3.0481	88472.2	Basement	5.551	27.1	382.3	0.55942	29127.4	29137.1	-9.69961
12	3.0481	88560.3	Basement	5.551	27.1	396.358	0.57999	29165.6	29175.3	-9.66196
13	3.0481	88647.3	Basement	5.551	27.1	410.299	0.60039	29203.1	29212.8	-9.66761
14	3.0481	88733.2	Basement	5.551	27.1	424.137	0.62064	29240.2	29249.8	-9.62638
15	3.0481	88818	Basement	5.551	27.1	437.853	0.64071	29276.5	29286.1	-9.57371
16	3.0481	88901.7	Basement	5.551	27.1	451.452	0.66061	29312.2	29321.9	-9.68394
17	3.0481	88984.4	Basement	5.551	27.1	464.929	0.68033	29347.5	29357.1	-9.56575
18	3.0481	89066	Basement	5.551	27.1	478.282	0.69987	29382.2	29391.7	-9.45888
19	3.0481	89146.5	Basement	5.551	27.1	478.391	0.70003	29416.4	29425.7	-9.3392
20	3.0481	89222.8	Basement	5.551	27.1	443.627	0.64916	29446.7	29456.2	-9.50905
21	3.0481	89296.7	Basement	5.551	27.1	451.111	0.66011	29475.4	29484.9	-9.51882
22	3.0481	89369.6	Basement	5.551	27.1	458.361	0.67072	29503.5	29513	-9.47347
23	3.0481	89441.6	Basement	5.551	27.1	465.373	0.68098	29531.1	29540.5	-9.35024
24	3.0481	89512.5	Basement	5.551	27.1	472.125	0.69086	29558	29567.6	-9.59906
25	3.0481	89582.4	Basement	5.551	27.1	478.63	0.70038	29584.6	29594.1	-9.45433
26	3.0481	89651.4	Basement	5.551	27.1	484.877	0.70952	29610.6	29620.1	-9.53988
27	3.0481	89719.3	Basement	5.551	27.1	490.856	0.71827	29636	29645.5	-9.46231
28	3.0481	89786.4	Basement	5.551	27.1	496.563	0.72662	29661.1	29670.5	-9.40088
29	3.0481	89852.5	Basement	5.551	27.1	502.002	0.73458	29685.5	29694.9	-9.41154
30	3.0481	89917.6	Basement	5.551	27.1	507.148	0.74211	29709.5	29718.8	-9.29956

31	3.0481	89981.8	Basement	5.551	27.1	512.014	0.74923	29732.9	29742.2	-9.32318
32	3.0481	90045.1	Basement	5.551	27.1	516.579	0.75591	29755.9	29765.2	-9.28673
33	3.0481	90107.5	Basement	5.551	27.1	520.85	0.76216	29778.3	29787.6	-9.25071
34	3.0481	90169	Basement	5.551	27.1	524.807	0.76795	29800.2	29809.5	-9.29874
35	3.0481	90229.6	Basement	5.551	27.1	528.456	0.77329	29821.5	29831	-9.51476
36	3.0481	90289.2	Basement	5.551	27.1	531.784	0.77816	29842.5	29851.9	-9.40124
37	3.0481	90348	Basement	5.551	27.1	534.784	0.78255	29863	29872.4	-9.42292
38	3.0481	90405.9	Basement	5.551	27.1	537.45	0.78645	29883.2	29892.4	-9.18137
39	3.0481	90463	Basement	5.551	27.1	539.773	0.78985	29902.7	29912	-9.32731
40	3.0481	90519.2	Basement	5.551	27.1	541.748	0.79274	29921.6	29931	-9.36356
41	3.0481	90574.5	Basement	5.551	27.1	543.361	0.7951	29940.4	29949.6	-9.1903
42	3.0481	90628.9	Basement	5.551	27.1	544.611	0.79693	29958.4	29967.8	-9.36334
43	3.0481	90682.5	Basement	5.551	27.1	545.493	0.79822	29976.3	29985.5	-9.1973
44	3.0481	90735.3	Basement	5.551	27.1	545.992	0.79895	29993.4	30002.7	-9.25129
45	3.0481	90787.3	Basement	5.551	27.1	546.101	0.79911	30010.2	30019.5	-9.32572
46	3.0481	90838.4	Basement	5.551	27.1	545.807	0.79868	30026.5	30035.8	-9.30734
47	3.0481	90888.7	Basement	5.551	27.1	545.11	0.79766	30042.4	30051.7	-9.28308
48	3.0481	90938.1	Basement	5.551	27.1	543.99	0.79602	30058	30067.1	-9.14011
49	3.0481	90986.4	Basement	5.551	27.1	525.415	0.76884	30072.6	30081.8	-9.24741
50	3.0481	91033	Basement	5.551	27.1	514.276	0.75254	30085.6	30095.1	-9.47934
51	3.0481	91078.6	Basement	5.551	27.1	509.602	0.7457	30098.6	30108	-9.37092
52	3.0481	91123.5	Basement	5.551	27.1	504.428	0.73813	30111	30120.4	-9.39357
53	3.0481	91167.6	Basement	5.551	27.1	498.736	0.7298	30123.1	30132.4	-9.34393
54	3.0481	91210.8	Basement	5.551	27.1	492.524	0.72071	30134.5	30143.9	-9.40423
55	3.0481	91253.3	Basement	5.551	27.1	485.765	0.71082	30145.6	30155	-9.37021
56	3.0481	91295.1	Basement	5.551	27.1	478.466	0.70014	30156.2	30165.8	-9.62569
57	3.0481	91336	Basement	5.551	27.1	470.594	0.68862	30166.4	30176.1	-9.66551
58	3.0481	91376.2	Basement	5.551	27.1	462.147	0.67626	30176.4	30185.9	-9.47865
59	3.0481	91415.6	Basement	5.551	27.1	453.106	0.66303	30185.8	30195.4	-9.55126
60	3.0481	91454.3	Basement	5.551	27.1	443.463	0.64892	30195	30204.5	-9.47688
61	3.0481	91492.2	Basement	5.551	27.1	433.192	0.63389	30203.7	30213.1	-9.44312
62	3.0481	91529.4	Basement	5.551	27.1	422.285	0.61793	30211.8	30221.4	-9.64137
63	3.0481	91565.8	Basement	5.551	27.1	410.722	0.60101	30219.6	30229.2	-9.56389
64	3.0481	91601.5	Basement	5.551	27.1	398.49	0.58311	30227	30236.7	-9.70044
65	3.0481	91636.5	Basement	5.551	27.1	385.567	0.5642	30233.9	30243.7	-9.84283
66	3.0481	91670.7	Basement	5.551	27.1	371.933	0.54425	30240.5	30250.4	-9.88204
67	3.0481	91704.2	Basement	5.551	27.1	357.582	0.52325	30246.7	30256.6	-9.90994
68	3.0481	91737	Basement	5.551	27.1	342.479	0.50115	30252.7	30262.5	-9.81672
69	3.0481	91769	Basement	5.551	27.1	326.611	0.47793	30258.2	30268	-9.79558
70	3.0481	91800.4	Basement	5.551	27.1	309.957	0.45356	30263.1	30273.1	-9.96017

71	3.0481	91831	Basement	5.551	27.1	292.49	0.428	30267.8	30277.8	-10.0001
72	3.0481	91860.9	Basement	5.551	27.1	274.202	0.40124	30272.1	30282.1	-10.0287
73	3.0481	91890.1	Basement	5.551	27.1	255.047	0.37321	30276	30286.1	-10.1384
74	3.0481	91918.6	Basement	5.551	27.1	235.024	0.34391	30279.5	30289.6	-10.1218
75	3.0481	91946.4	Basement	5.551	27.1	214.091	0.31328	30282.6	30292.8	-10.2022
76	3.0481	91973.6	Basement	5.551	27.1	192.223	0.28128	30285.4	30295.7	-10.3418
77	3.0481	92000	Basement	5.551	27.1	169.405	0.24789	30287.7	30298.1	-10.3643
78	3.0481	92025.7	Basement	5.551	27.1	145.596	0.21305	30289.7	30300.2	-10.4628
79	3.0481	92052.7	Basement	5.551	27.1	235.249	0.34424	30293.5	30303.7	-10.2091
80	3.0481	92082.5	Basement	5.551	27.1	241.441	0.3533	30299.8	30310	-10.1558
81	3.0481	92111.6	Basement	5.551	27.1	226.987	0.33215	30305.9	30316	-10.1436
82	3.0481	92140.1	Basement	5.551	27.1	211.72	0.30981	30311.5	30321.7	-10.228
83	3.0481	92167.9	Basement	5.551	27.1	195.613	0.28624	30316.7	30327	-10.2725
84	3.0481	92195	Basement	5.551	27.1	178.63	0.26139	30321.6	30332	-10.371
85	3.0481	92221.4	Basement	5.551	27.1	160.753	0.23523	30326.2	30336.5	-10.349
86	3.0481	92247.2	Basement	5.551	27.1	141.953	0.20772	30330.3	30340.8	-10.4697
87	3.0481	92272.3	Basement	5.551	27.1	122.19	0.1788	30334.1	30344.6	-10.4588
88	3.0481	92296.8	Basement	5.551	27.1	101.435	0.14843	30337.6	30348.1	-10.5109
89	3.0481	92320.6	Basement	5.551	27.1	79.6556	0.11656	30340.7	30351.3	-10.6206
90	3.0481	92343.7	Basement	5.551	27.1	56.8236	0.08315	30343.4	30354.1	-10.714
91	3.0481	92366.2	Basement	5.551	27.1	32.8846	0.04812	30345.8	30356.5	-10.7237
92	3.0481	92388.1	Basement	5.551	27.1	7.81795	0.01144	30347.8	30358.6	-10.8069
93	3.0481	92409.3	Basement	5.551	27.1	0	0	30346.8	30360.4	-13.5601
94	3.0481	92429.9	Basement	5.551	27.1	0	0	30344.3	30361.8	-17.476
95	3.0481	92449.8	Basement	5.551	27.1	0	0	30341.4	30362.8	-21.4231
96	3.0481	92469.1	Basement	5.551	27.1	0	0	30338	30363.5	-25.4969
97	3.0481	92487.7	Basement	5.551	27.1	0	0	30334.2	30363.9	-29.6612
98	3.0481	92505.7	Basement	5.551	27.1	0	0	30330.1	30363.9	-33.8431
99	3.0481	92523.1	Basement	5.551	27.1	0	0	30325.5	30363.6	-38.1381
100	3.0481	92539.8	Basement	5.551	27.1	0	0	30190.5	30362.9	-172.366

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00131532

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	2.76372	79747.4	Basement	5.551	27.1	51.8429	0.06819	28852.8	28863.5	-10.7328
2	2.76372	79854.5	Basement	5.551	27.1	103.731	0.13644	28908.1	28918.7	-10.6164
3	2.76372	79959.5	Basement	5.551	27.1	155.43	0.20444	28962.4	28972.7	-10.3237
4	2.76372	80062.5	Basement	5.551	27.1	206.855	0.27208	29015.2	29025.5	-10.3006
5	2.76372	80163.6	Basement	5.551	27.1	257.937	0.33927	29067.1	29077.2	-10.0999
6	2.76372	80262.8	Basement	5.551	27.1	308.587	0.40589	29117.6	29127.7	-10.1141

7	2.76372	80360.1	Basement	5.551	27.1	358.734	0.47185	29167.2	29177.2	-10.0242
8	2.76372	80455.7	Basement	5.551	27.1	408.304	0.53705	29215.6	29225.5	-9.902
9	2.76372	80549.4	Basement	5.551	27.1	457.22	0.60139	29263.1	29272.8	-9.71333
10	2.76372	80641.5	Basement	5.551	27.1	505.406	0.66477	29309.6	29319.1	-9.49879
11	2.76372	80731.1	Basement	5.551	27.1	535.634	0.70453	29354.3	29363.7	-9.42029
12	2.76372	80816.3	Basement	5.551	27.1	562.487	0.73985	29394.9	29404.4	-9.52878
13	2.76372	80899.6	Basement	5.551	27.1	598.44	0.78714	29434.5	29443.7	-9.19816
14	2.76372	80981.2	Basement	5.551	27.1	633.184	0.83284	29473.1	29482.2	-9.11883
15	2.76372	81061.3	Basement	5.551	27.1	666.667	0.87688	29510.5	29519.7	-9.19405
16	2.76372	81139.9	Basement	5.551	27.1	698.841	0.9192	29547.2	29556.3	-9.08416
17	2.76372	81216.9	Basement	5.551	27.1	729.64	0.95971	29583.1	29592	-8.90642
18	2.76372	81292.5	Basement	5.551	27.1	759.024	0.99836	29618	29626.8	-8.78966
19	2.76372	81366.6	Basement	5.551	27.1	786.942	1.03508	29651.8	29660.7	-8.87395
20	2.76372	81439.3	Basement	5.551	27.1	813.361	1.06983	29685	29693.8	-8.84175
21	2.76372	81510.6	Basement	5.551	27.1	838.229	1.10254	29717.3	29726.1	-8.84469
22	2.76372	81580.4	Basement	5.551	27.1	861.509	1.13316	29748.8	29757.5	-8.65731
23	2.76372	81649	Basement	5.551	27.1	883.162	1.16164	29779.6	29788.1	-8.5467
24	2.76372	81716.2	Basement	5.551	27.1	903.172	1.18796	29809.5	29817.9	-8.39916
25	2.76372	81782.1	Basement	5.551	27.1	921.487	1.21205	29838.5	29847	-8.49617
26	2.76372	81846.6	Basement	5.551	27.1	938.099	1.2339	29866.7	29875.2	-8.53489
27	2.76372	81909.9	Basement	5.551	27.1	952.97	1.25346	29894.4	29902.7	-8.32063
28	2.76372	81972	Basement	5.551	27.1	966.092	1.27072	29921.2	29929.5	-8.34443
29	2.76372	82032.8	Basement	5.551	27.1	977.45	1.28566	29947.1	29955.5	-8.41616
30	2.76372	82092.4	Basement	5.551	27.1	987.015	1.29824	29972.6	29980.8	-8.24918
31	2.76372	82150.8	Basement	5.551	27.1	994.792	1.30847	29997	30005.3	-8.28499
32	2.76372	82207.9	Basement	5.551	27.1	1000.77	1.31633	30020.9	30029.2	-8.31325
33	2.76372	82264	Basement	5.551	27.1	1004.94	1.32182	30044.1	30052.3	-8.23514
34	2.76372	82318.8	Basement	5.551	27.1	1007.31	1.32494	30066.5	30074.8	-8.26581
35	2.76372	82372.5	Basement	5.551	27.1	1007.89	1.3257	30088.3	30096.6	-8.29342
36	2.76372	82425.1	Basement	5.551	27.1	1006.68	1.3241	30109.4	30117.7	-8.27841
37	2.76372	82476.6	Basement	5.551	27.1	1003.68	1.32016	30129.9	30138.1	-8.24516
38	2.76372	82527	Basement	5.551	27.1	998.928	1.31391	30149.6	30157.9	-8.25945
39	2.76372	82576.2	Basement	5.551	27.1	992.428	1.30536	30168.7	30177	-8.25136
40	2.76372	82624.5	Basement	5.551	27.1	984.202	1.29454	30187.2	30195.5	-8.26048
41	2.76372	82671.6	Basement	5.551	27.1	974.288	1.2815	30205.1	30213.4	-8.32184
42	2.76372	82717.7	Basement	5.551	27.1	962.701	1.26626	30222.3	30230.6	-8.34196
43	2.76372	82762.7	Basement	5.551	27.1	948.613	1.24773	30238.9	30247.3	-8.4351
44	2.76372	82806.2	Basement	5.551	27.1	893.06	1.17466	30254.1	30262.7	-8.60263
45	2.76372	82848	Basement	5.551	27.1	873.574	1.14903	30268.3	30276.9	-8.61586
46	2.76372	82888.9	Basement	5.551	27.1	852.621	1.12147	30281.8	30290.5	-8.67943

47	2.76372	82928.7	Basement	5.551	27.1	830.239	1.09203	30294.8	30303.5	-8.68212
48	2.76372	82967.6	Basement	5.551	27.1	806.496	1.0608	30307.2	30316	-8.80554
49	2.76372	83005.5	Basement	5.551	27.1	781.445	1.02785	30319	30327.8	-8.83757
50	2.76372	83042.5	Basement	5.551	27.1	755.139	0.99325	30330.2	30339.1	-8.90296
51	2.76372	83078.4	Basement	5.551	27.1	727.656	0.9571	30340.8	30349.8	-8.9891
52	2.76372	83113.5	Basement	5.551	27.1	699.054	0.91948	30350.9	30359.9	-9.02352
53	2.76372	83147.5	Basement	5.551	27.1	669.419	0.8805	30360.4	30369.5	-9.09951
54	2.76372	83180.7	Basement	5.551	27.1	638.81	0.84024	30369.4	30378.6	-9.24438
55	2.76372	83212.9	Basement	5.551	27.1	607.312	0.79881	30377.7	30387	-9.25434
56	2.76372	83244.3	Basement	5.551	27.1	575.001	0.75631	30385.6	30395	-9.39394
57	2.76372	83274.7	Basement	5.551	27.1	541.967	0.71286	30392.9	30402.4	-9.49456
58	2.76372	83304.2	Basement	5.551	27.1	508.287	0.66856	30399.7	30409.2	-9.52297
59	2.76372	83332.8	Basement	5.551	27.1	474.06	0.62354	30405.9	30415.5	-9.57989
60	2.76372	83360.5	Basement	5.551	27.1	439.361	0.5779	30411.6	30421.3	-9.66716
61	2.76372	83387.4	Basement	5.551	27.1	404.297	0.53178	30416.8	30426.6	-9.78772
62	2.76372	83413.4	Basement	5.551	27.1	368.952	0.48529	30421.5	30431.4	-9.94554
63	2.76372	83438.5	Basement	5.551	27.1	333.432	0.43857	30425.6	30435.6	-9.97864
64	2.76372	83462.8	Basement	5.551	27.1	297.836	0.39175	30429.2	30439.3	-10.0597
65	2.76372	83486.2	Basement	5.551	27.1	262.263	0.34496	30432.4	30442.6	-10.2284
66	2.76372	83508.8	Basement	5.551	27.1	226.804	0.29832	30435	30445.3	-10.2921
67	2.76372	83530.5	Basement	5.551	27.1	191.581	0.25199	30437.1	30447.5	-10.3592
68	2.76372	83551.4	Basement	5.551	27.1	156.692	0.2061	30438.8	30449.2	-10.4391
69	2.76372	83571.5	Basement	5.551	27.1	122.236	0.16078	30439.9	30450.4	-10.5079
70	2.76372	83590.7	Basement	5.551	27.1	88.3359	0.11619	30440.6	30451.2	-10.6423
71	2.76372	83609.1	Basement	5.551	27.1	55.0893	0.07246	30440.7	30451.4	-10.6878
72	2.76372	83626.7	Basement	5.551	27.1	22.6105	0.02974	30440.4	30451.2	-10.8228
73	2.76372	83643.6	Basement	5.551	27.1	0	0	30438.4	30450.5	-12.0906
74	2.76372	83659.6	Basement	5.551	27.1	0	0	30433.1	30449.3	-16.1593
75	2.76372	83674.8	Basement	5.551	27.1	0	0	30427.7	30447.6	-19.8612
76	2.76372	83689.2	Basement	5.551	27.1	0	0	30424.5	30445.5	-20.9659
77	2.76372	83705.5	Basement	5.551	27.1	72.1497	0.0949	30434.9	30445.6	-10.6818
78	2.76372	83722.8	Basement	5.551	27.1	50.0639	0.06585	30436.4	30447.1	-10.7308
79	2.76372	83739.3	Basement	5.551	27.1	29.0348	0.03819	30437.4	30448.1	-10.7194
80	2.76372	83755.1	Basement	5.551	27.1	9.16127	0.01205	30437.9	30448.7	-10.8
81	2.76372	83770.1	Basement	5.551	27.1	0	0	30436.9	30448.9	-11.9648
82	2.76372	83784.3	Basement	5.551	27.1	0	0	30434.7	30448.5	-13.8288
83	2.76372	83797.8	Basement	5.551	27.1	0	0	30432.2	30447.8	-15.5647
84	2.76372	83810.5	Basement	5.551	27.1	0	0	30429.6	30446.5	-16.9256
85	2.76372	83822.5	Basement	5.551	27.1	0	0	30426.7	30444.8	-18.0959
86	2.76372	83833.7	Basement	5.551	27.1	0	0	30423.7	30442.7	-19.0251

87	2.76372	83844.1	Basement	5.551	27.1	0	0	30420.4	30440.1	-19.7035
88	2.76372	83853.8	Basement	5.551	27.1	0	0	30417	30437.1	-20.1465
89	2.76372	83862.8	Basement	5.551	27.1	0	0	30413.3	30433.6	-20.3456
90	2.76372	83871	Basement	5.551	27.1	0	0	30409.4	30429.7	-20.317
91	2.76372	83878.5	Basement	5.551	27.1	0	0	30405.3	30425.4	-20.1179
92	2.76372	83885.2	Basement	5.551	27.1	0	0	30401	30420.6	-19.6005
93	2.76372	83891.2	Basement	5.551	27.1	0	0	30396.4	30415.4	-18.9585
94	2.76372	83896.5	Basement	5.551	27.1	0	0	30391.7	30409.7	-18.0094
95	2.76372	83901.1	Basement	5.551	27.1	0	0	30386.7	30403.6	-16.9481
96	2.76372	83904.9	Basement	5.551	27.1	0	0	30381.4	30397.1	-15.6928
97	2.76372	83908.1	Basement	5.551	27.1	0	0	30375.9	30390.1	-14.2036
98	2.76372	83910.5	Basement	5.551	27.1	0	0	30370.1	30382.8	-12.7061
99	2.76372	83912.1	Basement	5.551	27.1	0	0	30364	30375	-10.9548
100	2.76372	83913.1	Basement	5.551	27.1	25.279	0.03325	30355.9	30366.7	-10.7583

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.0014633

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	752.782	-2786.3	3.99818e+007	0	0
2	755.83	-2788.87	32797.5	-239.031	-0.417569
3	758.878	-2791.42	64980.4	-473.584	-0.41757
4	761.926	-2793.95	96552.9	-703.688	-0.41757
5	764.975	-2796.45	127519	-929.371	-0.41757
6	768.023	-2798.92	157882	-1150.66	-0.41757
7	771.071	-2801.37	187647	-1367.59	-0.41757
8	774.119	-2803.79	216816	-1580.18	-0.417571
9	777.167	-2806.19	245393	-1788.45	-0.41757
10	780.215	-2808.57	273383	-1992.44	-0.417569
11	783.263	-2810.92	300787	-2192.17	-0.417571
12	786.311	-2813.26	327610	-2387.65	-0.417569
13	789.359	-2815.56	353854	-2578.93	-0.417571
14	792.407	-2817.85	379523	-2766.01	-0.417571
15	795.456	-2820.11	404621	-2948.92	-0.41757
16	798.504	-2822.35	429149	-3127.68	-0.41757
17	801.552	-2824.57	453111	-3302.32	-0.41757
18	804.6	-2826.76	476509	-3472.85	-0.417571
19	807.648	-2828.94	499347	-3639.29	-0.41757

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 03PC Site 33		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 3/14/2013, 11:40:16 PM		File Name: RR0705_03_33_1g.sli

20	810.696	-2831.09	519852	-3788.74	-0.417571
21	813.744	-2833.22	533790	-3890.32	-0.417571
22	816.792	-2835.33	547152	-3987.7	-0.41757
23	819.84	-2837.42	559942	-4080.92	-0.417571
24	822.889	-2839.49	572162	-4169.97	-0.41757
25	825.937	-2841.54	583814	-4254.9	-0.41757
26	828.985	-2843.57	594902	-4335.71	-0.41757
27	832.033	-2845.58	605429	-4412.43	-0.41757
28	835.081	-2847.57	615396	-4485.07	-0.41757
29	838.129	-2849.54	624807	-4553.66	-0.41757
30	841.177	-2851.49	633664	-4618.21	-0.41757
31	844.225	-2853.42	641970	-4678.74	-0.41757
32	847.273	-2855.33	649726	-4735.27	-0.41757
33	850.321	-2857.23	656936	-4787.82	-0.41757
34	853.37	-2859.1	663602	-4836.4	-0.41757
35	856.418	-2860.96	669727	-4881.04	-0.41757
36	859.466	-2862.79	675311	-4921.74	-0.41757
37	862.514	-2864.61	680359	-4958.53	-0.41757
38	865.562	-2866.41	684872	-4991.42	-0.41757
39	868.61	-2868.2	688852	-5020.43	-0.417571
40	871.658	-2869.96	692302	-5045.57	-0.41757
41	874.706	-2871.71	695224	-5066.86	-0.41757
42	877.754	-2873.44	697619	-5084.32	-0.41757
43	880.802	-2875.15	699491	-5097.96	-0.41757
44	883.851	-2876.84	700840	-5107.8	-0.417571
45	886.899	-2878.52	701670	-5113.85	-0.417571
46	889.947	-2880.18	701983	-5116.12	-0.41757
47	892.995	-2881.82	701780	-5114.64	-0.41757
48	896.043	-2883.45	701063	-5109.42	-0.41757
49	899.091	-2885.05	699834	-5100.47	-0.417571
50	902.139	-2886.65	696424	-5075.61	-0.41757
51	905.187	-2888.22	691790	-5041.83	-0.41757
52	908.235	-2889.78	686644	-5004.33	-0.41757
53	911.284	-2891.32	680989	-4963.12	-0.41757
54	914.332	-2892.85	674828	-4918.21	-0.41757
55	917.38	-2894.36	668160	-4869.62	-0.41757
56	920.428	-2895.85	660990	-4817.37	-0.417571
57	923.476	-2897.33	653319	-4761.45	-0.41757
58	926.524	-2898.79	645148	-4701.91	-0.417571
59	929.572	-2900.24	636480	-4638.74	-0.417571

SLIDEINTERPRET 6.020

Project	Sumatra Submarine Slide		
Analysis Description	RR0705 03PC Site 33		
Drawn By	Jason R. Patton	Scale	Company: Oregon State University
Date	3/14/2013, 11:40:16 PM		File Name: RR0705_03_33_1g.sli

60	932.62	-2901.67	627318	-4571.96	-0.41757
61	935.668	-2903.09	617662	-4501.58	-0.41757
62	938.716	-2904.49	607515	-4427.63	-0.41757
63	941.765	-2905.87	596879	-4350.11	-0.41757
64	944.813	-2907.24	585756	-4269.05	-0.41757
65	947.861	-2908.6	574147	-4184.45	-0.417571
66	950.909	-2909.93	562056	-4096.32	-0.41757
67	953.957	-2911.26	549484	-4004.7	-0.417571
68	957.005	-2912.57	536433	-3909.58	-0.41757
69	960.053	-2913.86	522905	-3810.98	-0.41757
70	963.101	-2915.14	508902	-3708.93	-0.41757
71	966.149	-2916.41	494426	-3603.43	-0.41757
72	969.197	-2917.66	479479	-3494.5	-0.417571
73	972.246	-2918.89	464064	-3382.15	-0.417571
74	975.294	-2920.11	448182	-3266.4	-0.417571
75	978.342	-2921.32	431836	-3147.27	-0.417571
76	981.39	-2922.51	415028	-3024.76	-0.417569
77	984.438	-2923.69	397759	-2898.91	-0.41757
78	987.486	-2924.85	380032	-2769.72	-0.417571
79	990.534	-2926	361850	-2637.2	-0.41757
80	993.582	-2927.13	351180	-2559.44	-0.417571
81	996.63	-2928.26	341509	-2488.95	-0.41757
82	999.678	-2929.36	331403	-2415.3	-0.41757
83	1002.73	-2930.46	320864	-2338.49	-0.41757
84	1005.77	-2931.54	309894	-2258.54	-0.41757
85	1008.82	-2932.6	298494	-2175.45	-0.417569
86	1011.87	-2933.65	286666	-2089.25	-0.41757
87	1014.92	-2934.69	274412	-1999.95	-0.417572
88	1017.97	-2935.71	261735	-1907.55	-0.41757
89	1021.02	-2936.73	248635	-1812.08	-0.417571
90	1024.06	-2937.72	235115	-1713.55	-0.417572
91	1027.11	-2938.71	221178	-1611.97	-0.417571
92	1030.16	-2939.68	206824	-1507.36	-0.417572
93	1033.21	-2940.63	192056	-1399.73	-0.417572
94	1036.26	-2941.58	176849	-1288.89	-0.417569
95	1039.3	-2942.51	161189	-1174.76	-0.417569
96	1042.35	-2943.43	145078	-1057.35	-0.417573
97	1045.4	-2944.33	128516	-936.641	-0.417572
98	1048.45	-2945.22	111504	-812.655	-0.417571
99	1051.5	-2946.1	94042.4	-685.391	-0.41757

100	1054.54	-2946.96	76131	-554.851	-0.41757
101	1057.59	-2947.82	4.47516e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00131532

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	781.221	-2799.57	4.03636e+007	0	0
2	783.984	-2802.48	46849.2	-16.7854	-0.0205283
3	786.748	-2805.35	92500.8	-66.2507	-0.0410362
4	789.512	-2808.17	136978	-147.038	-0.0615037
5	792.275	-2810.95	180303	-257.763	-0.0819106
6	795.039	-2813.68	222497	-397.016	-0.102237
7	797.803	-2816.37	263580	-563.366	-0.122462
8	800.567	-2819.02	303573	-755.364	-0.142566
9	803.33	-2821.63	342493	-971.541	-0.162529
10	806.094	-2824.2	380359	-1210.42	-0.182332
11	808.858	-2826.72	417187	-1470.5	-0.201955
12	811.622	-2829.22	448833	-1734.2	-0.221378
13	814.385	-2831.67	476528	-2000.94	-0.240583
14	817.149	-2834.09	503217	-2279.6	-0.259551
15	819.913	-2836.47	528917	-2568.76	-0.278263
16	822.676	-2838.81	553640	-2866.99	-0.2967
17	825.44	-2841.12	577403	-3172.89	-0.314843
18	828.204	-2843.4	600218	-3485.09	-0.332677
19	830.968	-2845.64	622100	-3802.21	-0.350181
20	833.731	-2847.85	643062	-4122.92	-0.36734
21	836.495	-2850.03	663115	-4445.9	-0.384138
22	839.259	-2852.18	682274	-4769.85	-0.400554
23	842.022	-2854.3	700549	-5093.52	-0.416576
24	844.786	-2856.38	717952	-5415.68	-0.432187
25	847.55	-2858.44	734495	-5735.14	-0.447372
26	850.314	-2860.46	750189	-6050.72	-0.462114
27	853.077	-2862.46	765044	-6361.31	-0.476401
28	855.841	-2864.42	779071	-6665.83	-0.490218
29	858.605	-2866.36	792280	-6963.22	-0.50355
30	861.368	-2868.27	804681	-7252.49	-0.516386
31	864.132	-2870.16	816283	-7532.69	-0.528713
32	866.896	-2872.01	827097	-7802.89	-0.540516
33	869.66	-2873.84	837130	-8062.24	-0.551788
34	872.423	-2875.64	846392	-8309.91	-0.562514

SLIDEINTERPRET 6.020

Project	Sumatra Submarine Slide		
Analysis Description	RR0705 03PC Site 33		
Drawn By	Jason R. Patton	Scale	Company: Oregon State University
Date	3/14/2013, 11:40:16 PM		File Name: RR0705_03_33_1g.sli

35	875.187	-2877.42	854893	-8545.14	-0.572685
36	877.951	-2879.17	862639	-8767.21	-0.582291
37	880.714	-2880.89	869640	-8975.45	-0.591322
38	883.478	-2882.59	875903	-9169.25	-0.59977
39	886.242	-2884.27	881436	-9348.05	-0.607626
40	889.006	-2885.92	886248	-9511.33	-0.614882
41	891.769	-2887.54	890344	-9658.64	-0.621532
42	894.533	-2889.14	893734	-9789.57	-0.627568
43	897.297	-2890.72	896423	-9903.79	-0.632985
44	900.061	-2892.28	898371	-10000.5	-0.63778
45	902.824	-2893.81	897531	-10056.3	-0.641938
46	905.588	-2895.32	896007	-10094.4	-0.645466
47	908.352	-2896.8	893804	-10114.8	-0.648364
48	911.115	-2898.26	890929	-10117.3	-0.650617
49	913.879	-2899.7	887388	-10102	-0.652225
50	916.643	-2901.12	883186	-10069.1	-0.653194
51	919.407	-2902.52	878329	-10018.6	-0.653512
52	922.17	-2903.89	872823	-9950.92	-0.653192
53	924.934	-2905.25	866672	-9866.16	-0.652225
54	927.698	-2906.58	859881	-9764.68	-0.650614
55	930.461	-2907.89	852455	-9646.84	-0.648362
56	933.225	-2909.18	844399	-9513.04	-0.64547
57	935.989	-2910.45	835717	-9363.74	-0.64194
58	938.753	-2911.7	826414	-9199.45	-0.637777
59	941.516	-2912.93	816493	-9020.71	-0.632985
60	944.28	-2914.13	805958	-8828.11	-0.627568
61	947.044	-2915.32	794812	-8622.28	-0.621532
62	949.807	-2916.49	783060	-8403.91	-0.614883
63	952.571	-2917.64	770705	-8173.69	-0.607626
64	955.335	-2918.77	757749	-7932.38	-0.59977
65	958.099	-2919.88	744195	-7680.76	-0.591323
66	960.862	-2920.97	730047	-7419.65	-0.582291
67	963.626	-2922.04	715307	-7149.9	-0.572685
68	966.39	-2923.09	699977	-6872.39	-0.562513
69	969.153	-2924.12	684059	-6588.04	-0.551788
70	971.917	-2925.14	667555	-6297.76	-0.540516
71	974.681	-2926.13	650467	-6002.53	-0.528712
72	977.445	-2927.11	632797	-5703.33	-0.516387
73	980.208	-2928.07	614547	-5401.15	-0.50355
74	982.972	-2929.01	595705	-5096.93	-0.490218

75	985.736	-2929.93	576249	-4791.49	-0.476401
76	988.499	-2930.84	556180	-4485.92	-0.462114
77	991.263	-2931.72	536330	-4187.81	-0.447372
78	994.027	-2932.59	523679	-3950.24	-0.432188
79	996.791	-2933.44	510474	-3711.54	-0.416577
80	999.554	-2934.27	496716	-3472.59	-0.400554
81	1002.32	-2935.09	482404	-3234.3	-0.384136
82	1005.08	-2935.89	467527	-2997.5	-0.367341
83	1007.85	-2936.67	452077	-2763.05	-0.350182
84	1010.61	-2937.43	436056	-2531.9	-0.332676
85	1013.37	-2938.17	419466	-2305.01	-0.314843
86	1016.14	-2938.9	402307	-2083.32	-0.2967
87	1018.9	-2939.61	384582	-1867.78	-0.278263
88	1021.66	-2940.31	366292	-1659.32	-0.259551
89	1024.43	-2940.99	347438	-1458.89	-0.240583
90	1027.19	-2941.65	328022	-1267.41	-0.221378
91	1029.96	-2942.29	308046	-1085.8	-0.201955
92	1032.72	-2942.92	287510	-914.945	-0.182332
93	1035.48	-2943.53	266416	-755.737	-0.162529
94	1038.25	-2944.12	244766	-609.037	-0.142565
95	1041.01	-2944.7	222559	-475.689	-0.122462
96	1043.77	-2945.26	199798	-356.513	-0.102237
97	1046.54	-2945.8	176483	-252.303	-0.0819109
98	1049.3	-2946.33	152616	-163.825	-0.0615039
99	1052.07	-2946.84	128197	-91.8171	-0.0410363
100	1054.83	-2947.34	103227	-36.9849	-0.0205283
101	1057.59	-2947.82	4.47516e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.023460
Factor of Safety, standard deviation: 0.062104
Factor of Safety, minimum: 0.000097
Factor of Safety, maximum: 0.997532
Probability of Failure: 100.000% (= 9838 failed surfaces / 9838 valid surfaces), 162 invalid surfaces
Reliability index: -15.72426 (assuming normal distribution)
Reliability index: -3.32278 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price

Factor of Safety, mean: 0.023735
Factor of Safety, standard deviation: 0.064062
Factor of Safety, minimum: 0.000096
Factor of Safety, maximum: 0.973840
Probability of Failure: 100.000% (= 9982 failed surfaces / 9982 valid surfaces), 18 invalid surfaces
Reliability index: -15.23942 (assuming normal distribution)
Reliability index: -3.29963 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-8000
11171	-8000
11171	0
0	0

External Boundary

X	Y
11171	-8000
11171	-3923
11084	-3926
10996	-3929
10909	-3930
10822	-3929
10734	-3927
10647	-3924
10560	-3922
10472	-3919
10385	-3915
10298	-3910
10210	-3905
10121	-3900
10033	-3895
9945	-3891
9857	-3886
9769	-3881

9681	-3877
9593	-3873
9505	-3869
9417	-3865
9328	-3861
9240	-3857
9152	-3853
9059	-3848
8967	-3843
8874	-3839
8781	-3836
8688	-3831
8595	-3825
8502	-3820
8409	-3815
8317	-3812
8224	-3809
8131	-3806
8038	-3804
7945	-3802
7855	-3797
7766	-3791
7676	-3783
7586	-3772
7496	-3759
7406	-3749
7316	-3742
7226	-3738
7137	-3735
7047	-3731
6957	-3727
6867	-3720
6777	-3710
6693	-3700
6609	-3687
6525	-3675
6441	-3666
6356	-3660
6272	-3656
6188	-3653

6104	-3648
6020	-3641
5935	-3640
5850	-3632
5765	-3622
5680	-3615
5595	-3608
5510	-3600
5424	-3587
5339	-3572
5254	-3555
5169	-3538
5084	-3520
4998	-3503
4913	-3490
4828	-3479
4743	-3472
4658	-3464
4572	-3457
4487	-3447
4402	-3436
4317	-3427
4224	-3414
4132	-3399
4040	-3385
3948	-3373
3855	-3362
3763	-3346
3671	-3327
3579	-3306
3488	-3292
3397	-3286
3306	-3286
3215	-3282
3124	-3279
3033	-3272
2942	-3259
2851	-3244
2760	-3229
2677	-3223

2593	-3218
2509	-3207
2425	-3195
2342	-3175
2258	-3158
2174	-3144
2083	-3129
1992	-3115
1900	-3102
1809	-3089
1718	-3079
1626	-3070
1535	-3060
1443	-3049
1352	-3036
1261	-3017
1171	-2993
1081	-2959
991	-2916
900	-2863
810	-2813
720	-2771
630	-2746
540	-2741
450	-2750
360	-2764
270	-2778
180	-2794
90	-2813
0	-2837
0	-8000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 45PC Site 85		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/25/2013		File Name: RR0705_45_85_0g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_45_85_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 45PC Site 85
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/25/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364849604
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 45PC Site 85		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/25/2013		File Name: RR0705_45_85_0g.sli

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Global Minimums

Method: spencer

FS: 1.533380
Center: 3978.853, 2167.613
Radius: 7708.856
Left Slip Surface Endpoint: 1062.763, -4968.414
Right Slip Surface Endpoint: 1392.344, -5094.372
Left Slope Intercept: 1062.763 0.000
Right Slope Intercept: 1392.344 0.000
Resisting Moment=1.2033e+008 kN-m
Driving Moment=7.84735e+007 kN-m
Resisting Horizontal Force=14577.5 kN
Driving Horizontal Force=9506.76 kN
Total Slice Area=1.65872e+006 m2

Method: gle/morgenstern-price

FS: 1.537060
Center: 3978.853, 2167.613
Radius: 7708.856
Left Slip Surface Endpoint: 1062.763, -4968.414
Right Slip Surface Endpoint: 1392.344, -5094.372
Left Slope Intercept: 1062.763 0.000
Right Slope Intercept: 1392.344 0.000
Resisting Moment=1.20619e+008 kN-m
Driving Moment=7.84735e+007 kN-m
Resisting Horizontal Force=14581 kN

Driving Horizontal Force=9486.26 kN
Total Slice Area=1.65872e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1618
Number of Invalid Surfaces: 807

Error Codes:

Error Code -108 reported for 807 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2418
Number of Invalid Surfaces: 7

Error Codes:

Error Code -108 reported for 7 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.53338

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	13.1832	675142	basement	5.551	27.1	5.6224	8.62128	51208.3	51202.3	6.02842
2	13.1832	676129	basement	5.551	27.1	11.418	17.5082	51280.9	51257.5	23.3631
3	13.1832	677110	basement	5.551	27.1	17.1743	26.3348	51353	51312.4	40.6344
4	13.1832	678085	basement	5.551	27.1	22.9001	35.1145	51424.8	51367	57.8419
5	13.1832	678957	basement	5.551	27.1	26.6541	40.8709	51490.4	51421.4	68.9671
6	13.1832	679762	basement	5.551	27.1	28.7405	44.0701	51550.7	51475.4	75.2543
7	13.1832	680560	basement	5.551	27.1	30.783	47.2021	51610.6	51529.1	81.4607

8	13.1832	681353	basement	5.551	27.1	32.7818	50.267	51670	51582.6	87.4155
9	13.1832	682141	basement	5.551	27.1	34.7369	53.2648	51729	51635.8	93.2183
10	13.1832	682922	basement	5.551	27.1	36.6481	56.1955	51787.6	51688.7	98.9393
11	13.1832	683697	basement	5.551	27.1	38.5208	59.0671	51845.8	51741.2	104.608
12	13.1832	684426	basement	5.551	27.1	39.5569	60.6557	51901.3	51793.6	107.657
13	13.1832	685120	basement	5.551	27.1	39.7652	60.9751	51953.9	51845.6	108.311
14	13.1832	685808	basement	5.551	27.1	39.9277	61.2244	52006.1	51897.3	108.804
15	13.1832	686491	basement	5.551	27.1	40.0447	61.4037	52057.9	51948.8	109.108
16	13.1832	687167	basement	5.551	27.1	40.116	61.513	52109.3	51999.9	109.421
17	13.1832	687838	basement	5.551	27.1	40.1416	61.5524	52160.3	52050.8	109.473
18	13.1832	688503	basement	5.551	27.1	40.1336	61.54	52210.8	52101.4	109.435
19	13.1832	689043	basement	5.551	27.1	37.78	57.9311	52254.1	52151.7	102.404
20	13.1832	689475	basement	5.551	27.1	32.6757	50.1043	52288.9	52201.8	87.0564
21	13.1832	689901	basement	5.551	27.1	27.5197	42.1982	52323.1	52251.5	71.6262
22	13.1832	690322	basement	5.551	27.1	22.312	34.2128	52357.1	52301	56.0559
23	13.1832	690737	basement	5.551	27.1	17.0526	26.1481	52390.5	52350.2	40.3029
24	13.1832	691146	basement	5.551	27.1	11.7415	18.0042	52423.5	52399.1	24.3672
25	13.1832	691550	basement	5.551	27.1	6.37872	9.781	52456	52447.8	8.21998

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.53706

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	13.1832	675142	basement	5.551	27.1	5.59423	8.59867	51208.3	51202.3	5.95818
2	13.1832	676129	basement	5.551	27.1	10.4297	16.0311	51278	51257.5	20.4809
3	13.1832	677110	basement	5.551	27.1	15.279	23.4848	51347.5	51312.4	35.0768
4	13.1832	678085	basement	5.551	27.1	20.2812	31.1734	51417.1	51367	50.0978
5	13.1832	678957	basement	5.551	27.1	24.3476	37.4237	51483.7	51421.4	62.2741
6	13.1832	679762	basement	5.551	27.1	26.3111	40.4418	51543.6	51475.4	68.2038
7	13.1832	680560	basement	5.551	27.1	28.3064	43.5087	51603.3	51529.1	74.1934
8	13.1832	681353	basement	5.551	27.1	30.3368	46.6295	51662.9	51582.6	80.2842
9	13.1832	682141	basement	5.551	27.1	32.4034	49.8059	51722.2	51635.8	86.4351
10	13.1832	682922	basement	5.551	27.1	34.5052	53.0365	51781.4	51688.7	92.7169
11	13.1832	683697	basement	5.551	27.1	36.7162	56.435	51840.7	51741.2	99.5129
12	13.1832	684426	basement	5.551	27.1	38.9404	59.8537	51899.7	51793.6	106.099
13	13.1832	685120	basement	5.551	27.1	39.5562	60.8002	51953.6	51845.6	107.956
14	13.1832	685808	basement	5.551	27.1	40.133	61.6869	52007	51897.3	109.726
15	13.1832	686491	basement	5.551	27.1	40.662	62.5	52060	51948.8	111.236
16	13.1832	687167	basement	5.551	27.1	41.1342	63.2257	52112.7	51999.9	112.759
17	13.1832	687838	basement	5.551	27.1	41.5406	63.8504	52164.7	52050.8	113.95
18	13.1832	688503	basement	5.551	27.1	41.9676	64.5067	52216.7	52101.4	115.265

19	13.1832	689043	basement	5.551	27.1	41.7304	64.1422	52266.3	52151.7	114.571
20	13.1832	689475	basement	5.551	27.1	36.2661	55.7432	52299.9	52201.8	98.0922
21	13.1832	689901	basement	5.551	27.1	30.6045	47.041	52332.6	52251.5	81.1019
22	13.1832	690322	basement	5.551	27.1	24.7628	38.0619	52364.5	52301	63.5417
23	13.1832	690737	basement	5.551	27.1	18.7616	28.8377	52395.7	52350.2	45.5108
24	13.1832	691146	basement	5.551	27.1	12.6244	19.4045	52426.2	52399.1	27.0799
25	13.1832	691550	basement	5.551	27.1	6.37743	9.8025	52456.1	52447.8	8.29141

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.53338

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	1062.76	-4968.41	1.27128e+008	0	0
2	1075.95	-4973.79	180792	21.0231	0.00666255
3	1089.13	-4979.13	360409	41.9095	0.00666253
4	1102.31	-4984.45	538847	62.6589	0.00666254
5	1115.5	-4989.74	702834	81.7278	0.00666254
6	1128.68	-4995	768539	89.3683	0.00666255
7	1141.86	-5000.23	832921	96.8548	0.00666254
8	1155.05	-5005.43	895978	104.187	0.00666252
9	1168.23	-5010.61	957707	111.365	0.00666252
10	1181.41	-5015.76	1.01811e+006	118.389	0.00666253
11	1194.6	-5020.88	1.07718e+006	125.258	0.00666254
12	1207.78	-5025.97	1.13102e+006	131.519	0.00666256
13	1220.96	-5031.03	1.13851e+006	132.389	0.00666251
14	1234.15	-5036.07	1.14456e+006	133.093	0.00666253
15	1247.33	-5041.08	1.14919e+006	133.631	0.00666251
16	1260.51	-5046.06	1.15239e+006	134.003	0.00666251
17	1273.69	-5051.01	1.15415e+006	134.209	0.00666257
18	1286.88	-5055.94	1.15449e+006	134.248	0.00666255
19	1300.06	-5060.84	1.14747e+006	133.432	0.00666256
20	1313.24	-5065.71	989071	115.012	0.00666252
21	1326.43	-5070.56	828827	96.3788	0.00666255
22	1339.61	-5075.37	666743	77.5311	0.00666254
23	1352.79	-5080.16	502819	58.4694	0.00666254
24	1365.98	-5084.93	337053	39.1936	0.00666254
25	1379.16	-5089.66	169445	19.7037	0.00666257
26	1392.34	-5094.37	1.33656e+008	0	0

rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 45PC Site 85		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
SLIDEINTERPRET 6.020	Date	3/25/2013		File Name: RR0705_45_85_0g.sli

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.53706

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	1062.76	-4968.41	1.27128e+008	0	0
2	1075.95	-4973.79	180792	21.6848	0.00687225
3	1089.13	-4979.13	360406	85.7749	0.0136361
4	1102.31	-4984.45	538839	189.83	0.020185
5	1115.5	-4989.74	702819	324.025	0.0264154
6	1128.68	-4995	768519	432.298	0.0322293
7	1141.86	-5000.23	832895	545.637	0.037535
8	1155.05	-5005.43	895945	660.65	0.0422486
9	1168.23	-5010.61	957669	773.814	0.046296
10	1181.41	-5015.76	1.01806e+006	881.558	0.0496135
11	1194.6	-5020.88	1.07713e+006	980.357	0.0521481
12	1207.78	-5025.97	1.13097e+006	1063.17	0.053861
13	1220.96	-5031.03	1.13845e+006	1087.35	0.054724
14	1234.15	-5036.07	1.14451e+006	1093.13	0.0547236
15	1247.33	-5041.08	1.14914e+006	1080.24	0.0538604
16	1260.51	-5046.06	1.15234e+006	1048.81	0.0521481
17	1273.69	-5051.01	1.15411e+006	999.358	0.0496131
18	1286.88	-5055.94	1.15444e+006	932.812	0.0462962
19	1300.06	-5060.84	1.14743e+006	846.091	0.0422487
20	1313.24	-5065.71	989033	647.924	0.037535
21	1326.43	-5070.56	828795	466.204	0.0322293
22	1339.61	-5075.37	666715	307.38	0.0264154
23	1352.79	-5080.16	502793	177.131	0.020185
24	1365.98	-5084.93	337029	80.2113	0.0136361
25	1379.16	-5089.66	169423	20.3211	0.00687223
26	1392.34	-5094.37	1.33656e+008	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.544808
Factor of Safety, standard deviation: 0.249609
Factor of Safety, minimum: 0.760403
Factor of Safety, maximum: 2.451520
Probability of Failure: 0.960% (= 96 failed surfaces / 10000 valid surfaces)
Reliability index: 2.18264 (assuming normal distribution)

Reliability index: 2.62872 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 1.543445
Factor of Safety, standard deviation: 0.249381
Factor of Safety, minimum: 0.759796
Factor of Safety, maximum: 2.449380
Probability of Failure: 0.970% (= 97 failed surfaces / 10000 valid surfaces)
Reliability index: 2.17917 (assuming normal distribution)
Reliability index: 2.62330 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-8000
5383.89	-8000
5383.89	0
0	0

External Boundary

X	Y
5383.89	-8000
5383.89	-5541.4
5291.07	-5539.97
5198.24	-5539.23
5105.41	-5538.27
5012.59	-5537.55
4919.76	-5536.98
4826.94	-5536.01
4734.11	-5535.69
4641.29	-5534.32
4548.46	-5533
4455.63	-5531.48
4362.81	-5529.47
4269.98	-5527.92
4177.16	-5525.79

4084.33	-5523.63
3991.51	-5522.47
3898.68	-5521.38
3805.85	-5519.37
3713.03	-5518.18
3620.2	-5518.12
3527.38	-5517.16
3434.55	-5517.34
3341.73	-5516.37
3248.9	-5515.42
3156.07	-5513.82
3063.25	-5510.79
2970.42	-5504.72
2877.6	-5491.13
2784.77	-5472.06
2691.95	-5446.33
2599.12	-5420.3
2506.29	-5392.2
2413.47	-5371.12
2320.64	-5353.88
2227.82	-5333.7
2134.99	-5317.54
2042.17	-5288.15
1949.34	-5260.44
1856.51	-5228.89
1763.69	-5198.12
1670.86	-5163.5
1578.04	-5130.82
1485.21	-5127.84
1392.39	-5094.4
1299.56	-5038.48
1206.73	-5003.68
1113.91	-4975.56
1021.08	-4962.59
928.26	-4945.5
835.43	-4920.56
742.61	-4916
649.78	-4908.23
556.95	-4925.69
464.13	-4948.2

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 45PC Site 85		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 3/25/2013		File Name: RR0705_45_85_0g.sli

371.3	-4955.61
278.48	-4974.52
185.65	-5016.42
92.83	-5035.25
0	-5047.43
0	-8000

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_45_85_1g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 45PC Site 85
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/25/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364849474
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.000514
Center: 1406.085, -4975.240
Radius: 124.676
Left Slip Surface Endpoint: 1298.378, -5038.037
Right Slip Surface Endpoint: 1407.675, -5099.907
Left Slope Intercept: 1298.378 0.000
Right Slope Intercept: 1407.675 0.000
Resisting Moment=1869.02 kN-m
Driving Moment=3.63307e+006 kN-m
Resisting Horizontal Force=16.328 kN

Driving Horizontal Force=31739 kN
Total Slice Area=555460 m2

Method: gle/morgenstern-price

FS: 0.002099
Center: 1433.294, -4901.955
Radius: 196.814
Left Slip Surface Endpoint: 1287.216, -5033.853
Right Slip Surface Endpoint: 1392.871, -5094.573
Left Slope Intercept: 1287.216 0.000
Right Slope Intercept: 1392.871 0.000
Resisting Moment=8985.6 kN-m
Driving Moment=4.2817e+006 kN-m
Resisting Horizontal Force=47.1522 kN
Driving Horizontal Force=22468.3 kN
Total Slice Area=535847 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1138
Number of Invalid Surfaces: 49

Error Codes:

Error Code -108 reported for 27 surfaces
Error Code -111 reported for 7 surfaces
Error Code -112 reported for 15 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1171
Number of Invalid Surfaces: 16

Error Codes:

Error Code -108 reported for 3 surfaces
Error Code -111 reported for 4 surfaces
Error Code -112 reported for 9 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving

force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.000514445

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	4.37186	227079	basement	5.551	27.1	325.321	0.16736	51955.2	51965.7	-10.4933
2	4.37186	227468	basement	5.551	27.1	331.814	0.1707	52084.7	52095.2	-10.5033
3	4.37186	227802	basement	5.551	27.1	355.509	0.18289	52193	52203.5	-10.5452
4	4.37186	228093	basement	5.551	27.1	378.991	0.19497	52284.9	52295.5	-10.5517
5	4.37186	228348	basement	5.551	27.1	401.501	0.20655	52363.6	52374	-10.4482
6	4.37186	228573	basement	5.551	27.1	422.378	0.21729	52430.7	52441.1	-10.4194
7	4.37186	228771	basement	5.551	27.1	441.038	0.22689	52488	52498.3	-10.3209
8	4.37186	228946	basement	5.551	27.1	456.9	0.23505	52536.4	52546.8	-10.3945
9	4.37186	229100	basement	5.551	27.1	469.302	0.24143	52576.9	52587.3	-10.3906
10	4.37186	229235	basement	5.551	27.1	477.544	0.24567	52610.2	52620.6	-10.4002
11	4.37186	229353	basement	5.551	27.1	480.693	0.24729	52636.9	52647.3	-10.3679
12	4.37186	229454	basement	5.551	27.1	477.641	0.24572	52657.6	52667.8	-10.2255
13	4.37186	229540	basement	5.551	27.1	466.969	0.24023	52672.3	52682.6	-10.3403
14	4.37186	229611	basement	5.551	27.1	446.753	0.22983	52681.6	52692	-10.3882
15	4.37186	229669	basement	5.551	27.1	414.369	0.21317	52685.8	52696.2	-10.4171
16	4.37186	229714	basement	5.551	27.1	366.084	0.18833	52684.9	52695.5	-10.5517
17	4.37186	229746	basement	5.551	27.1	296.417	0.15249	52679.6	52690	-10.4211
18	4.37186	229766	basement	5.551	27.1	196.911	0.1013	52669.4	52680	-10.5688
19	4.37186	229774	basement	5.551	27.1	53.7472	0.02765	52654.8	52665.6	-10.8026
20	4.37186	229771	basement	5.551	27.1	0	0	52624.2	52646.8	-22.5719
21	4.37186	229757	basement	5.551	27.1	0	0	52584.1	52623.8	-39.7437
22	4.37186	229735	basement	5.551	27.1	0	0	52562.5	52598.8	-36.2619
23	4.37186	229721	basement	5.551	27.1	0	0	52553.5	52582.2	-28.7445
24	4.37186	229700	basement	5.551	27.1	0	0	52521.4	52563.8	-42.3541
25	4.37186	229668	basement	5.551	27.1	0	0	52470	52541.3	-71.331

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00209861

Slice	Width	Weight	Base	Base Cohesion	Base Friction Angle	Shear Stress	Shear Strength	Base Normal Stress	Pore Pressure	Effective Normal Stress

				[kPa]	[degrees]	[kPa]	[kPa]	[kPa]	[kPa]	[kPa]
1	4.22619	219256	basement	5.551	27.1	35.5426	0.07459	51884.9	51895.5	-10.6379
2	4.22619	219514	basement	5.551	27.1	70.8374	0.14866	51975	51985.5	-10.4697
3	4.22619	219755	basement	5.551	27.1	106.494	0.22349	52058.3	52068.7	-10.3679
4	4.22619	219966	basement	5.551	27.1	133.526	0.28022	52126.5	52136.9	-10.3947
5	4.22619	220153	basement	5.551	27.1	156.06	0.32751	52182.6	52192.8	-10.2491
6	4.22619	220326	basement	5.551	27.1	177.27	0.37202	52233.3	52243.3	-10.0176
7	4.22619	220487	basement	5.551	27.1	197.002	0.41343	52278.9	52288.9	-9.96356
8	4.22619	220635	basement	5.551	27.1	215.133	0.45148	52319.7	52329.8	-10.0672
9	4.22619	220772	basement	5.551	27.1	231.539	0.48591	52356.4	52366.2	-9.77469
10	4.22619	220899	basement	5.551	27.1	246.12	0.51651	52388.7	52398.5	-9.78378
11	4.22619	221015	basement	5.551	27.1	258.776	0.54307	52417	52426.8	-9.78694
12	4.22619	221121	basement	5.551	27.1	269.426	0.56542	52441.6	52451.3	-9.71294
13	4.22619	221218	basement	5.551	27.1	277.96	0.58333	52462.4	52472.2	-9.79536
14	4.22619	221306	basement	5.551	27.1	284.288	0.59661	52479.9	52489.6	-9.65399
15	4.22619	221386	basement	5.551	27.1	288.286	0.605	52493.9	52503.6	-9.69228
16	4.22619	221457	basement	5.551	27.1	289.797	0.60817	52504.8	52514.4	-9.60002
17	4.22619	221520	basement	5.551	27.1	288.62	0.6057	52512.4	52522.1	-9.74459
18	4.22619	221576	basement	5.551	27.1	284.488	0.59703	52517.1	52526.7	-9.58205
19	4.22619	221624	basement	5.551	27.1	277.041	0.5814	52518.8	52528.4	-9.62252
20	4.22619	221664	basement	5.551	27.1	265.785	0.55778	52517.5	52527.2	-9.66482
21	4.22619	221698	basement	5.551	27.1	250.042	0.52474	52513.3	52523.2	-9.92668
22	4.22619	221724	basement	5.551	27.1	228.894	0.48036	52506.5	52516.4	-9.90624
23	4.22619	221743	basement	5.551	27.1	201.057	0.42194	52497	52507	-9.99753
24	4.22619	221756	basement	5.551	27.1	164.742	0.34573	52484.8	52494.9	-10.0641
25	4.22619	221762	basement	5.551	27.1	117.721	0.24705	52470.1	52480.3	-10.2377

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.000514445

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	1298.38	-5038.04	1.30716e+008	0	0
2	1302.75	-5045	238512	-781.349	-0.187696
3	1307.12	-5051.07	418025	-1369.42	-0.187696
4	1311.49	-5056.46	562455	-1842.57	-0.187697
5	1315.87	-5061.29	678283	-2222.01	-0.187696
6	1320.24	-5065.65	769997	-2522.46	-0.187697
7	1324.61	-5069.61	840859	-2754.6	-0.187697

8	1328.98	-5073.22	893321	-2926.46	-0.187696
9	1333.35	-5076.5	929286	-3044.28	-0.187697
10	1337.72	-5079.5	950259	-3112.99	-0.187697
11	1342.1	-5082.24	957453	-3136.56	-0.187697
12	1346.47	-5084.74	951864	-3118.25	-0.187697
13	1350.84	-5087.01	934314	-3060.75	-0.187696
14	1355.21	-5089.07	905494	-2966.34	-0.187697
15	1359.58	-5090.92	865989	-2836.93	-0.187697
16	1363.96	-5092.58	816297	-2674.14	-0.187697
17	1368.33	-5094.06	756847	-2479.38	-0.187696
18	1372.7	-5095.36	688016	-2253.9	-0.187697
19	1377.07	-5096.49	610140	-1998.78	-0.187697
20	1381.44	-5097.46	523533	-1715.06	-0.187697
21	1385.82	-5098.26	428227	-1402.84	-0.187696
22	1390.19	-5098.9	324289	-1062.35	-0.187697
23	1394.56	-5099.38	239433	-784.366	-0.187696
24	1398.93	-5099.71	174273	-570.908	-0.187697
25	1403.3	-5099.89	100891	-330.514	-0.187698
26	1407.67	-5099.91	1.33947e+008	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00209861

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	1287.22	-5033.85	1.30499e+008	0	0
2	1291.44	-5038.39	153156	-4.34229	-0.00162445
3	1295.67	-5042.65	292624	-16.4622	-0.0032233
4	1299.89	-5046.66	415614	-34.6102	-0.0047713
5	1304.12	-5050.45	481024	-52.4217	-0.00624406
6	1308.35	-5054.02	535568	-71.2119	-0.00761834
7	1312.57	-5057.4	579957	-89.8087	-0.00887248
8	1316.8	-5060.59	614802	-107.16	-0.00998666
9	1321.03	-5063.61	640634	-122.36	-0.0109434
10	1325.25	-5066.46	657920	-134.666	-0.0117276
11	1329.48	-5069.16	667069	-143.515	-0.0123268
12	1333.7	-5071.71	668444	-148.533	-0.0127315
13	1337.93	-5074.12	662367	-149.541	-0.0129355
14	1342.16	-5076.4	649126	-146.552	-0.0129356
15	1346.38	-5078.54	628979	-139.764	-0.0127316
16	1350.61	-5080.56	602158	-129.55	-0.0123268
17	1354.84	-5082.45	568871	-116.439	-0.0117276

18	1359.06	-5084.23	529306	-101.097	-0.0109434
19	1363.29	-5085.9	483637	-84.2983	-0.0099867
20	1367.51	-5087.45	432017	-66.8996	-0.00887249
21	1371.74	-5088.9	374589	-49.8073	-0.00761834
22	1375.97	-5090.23	311484	-33.9453	-0.00624405
23	1380.19	-5091.47	242821	-20.2209	-0.0047713
24	1384.42	-5092.6	168713	-9.49131	-0.0032233
25	1388.64	-5093.64	89265.7	-2.53087	-0.00162446
26	1392.87	-5094.57	1.33667e+008	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.097462
Factor of Safety, standard deviation: 0.061646
Factor of Safety, minimum: 0.000225
Factor of Safety, maximum: 0.514456
Probability of Failure: 100.000% (= 9815 failed surfaces / 9815 valid surfaces), 185 invalid surfaces
Reliability index: -14.64056 (assuming normal distribution) * best fit = Normal
Reliability index: -4.30359 (assuming lognormal distribution)

Method: gle/morgenstern-price
Factor of Safety, mean: 0.032165
Factor of Safety, standard deviation: 0.070866
Factor of Safety, minimum: 0.000084
Factor of Safety, maximum: 0.964448
Probability of Failure: 100.000% (= 9993 failed surfaces / 9993 valid surfaces), 7 invalid surfaces
Reliability index: -13.65716 (assuming normal distribution)
Reliability index: -3.25006 (assuming lognormal distribution)
* best fit = Beta

List Of Coordinates

Water Table

X	Y
0	0
0	-8000
5383.89	-8000
5383.89	0
0	0

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 45PC Site 85		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University	
	Date: 3/25/2013		File Name: RR0705_45_85_1g.sli	

External Boundary

X	Y
5383.89	-8000
5383.89	-5541.4
5291.07	-5539.97
5198.24	-5539.23
5105.41	-5538.27
5012.59	-5537.55
4919.76	-5536.98
4826.94	-5536.01
4734.11	-5535.69
4641.29	-5534.32
4548.46	-5533
4455.63	-5531.48
4362.81	-5529.47
4269.98	-5527.92
4177.16	-5525.79
4084.33	-5523.63
3991.51	-5522.47
3898.68	-5521.38
3805.85	-5519.37
3713.03	-5518.18
3620.2	-5518.12
3527.38	-5517.16
3434.55	-5517.34
3341.73	-5516.37
3248.9	-5515.42
3156.07	-5513.82
3063.25	-5510.79
2970.42	-5504.72
2877.6	-5491.13
2784.77	-5472.06
2691.95	-5446.33
2599.12	-5420.3
2506.29	-5392.2
2413.47	-5371.12
2320.64	-5353.88
2227.82	-5333.7
2134.99	-5317.54
2042.17	-5288.15

rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 45PC Site 85		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/25/2013		File Name: RR0705_45_85_1g.sli

SLIDEINTERPRET 6.020

1949.34	-5260.44
1856.51	-5228.89
1763.69	-5198.12
1670.86	-5163.5
1578.04	-5130.82
1485.21	-5127.84
1392.39	-5094.4
1299.56	-5038.48
1206.73	-5003.68
1113.91	-4975.56
1021.08	-4962.59
928.26	-4945.5
835.43	-4920.56
742.61	-4916
649.78	-4908.23
556.95	-4925.69
464.13	-4948.2
371.3	-4955.61
278.48	-4974.52
185.65	-5016.42
92.83	-5035.25
0	-5047.43
0	-8000

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_49_67_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 49PC Site 67
Author: Jason R. Patton
Company: Oregon State
Date Created: 3/25/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364849962
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 49PC Site 67		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State
	Date	3/25/2013		File Name: RR0705_49_67_0g.sli

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Global Minimums

Method: spencer

FS: 1.635520
Center: 1120.676, -5160.418
Radius: 482.988
Left Slip Surface Endpoint: 806.051, -5526.873
Right Slip Surface Endpoint: 1134.612, -5643.206
Left Slope Intercept: 806.051 0.000
Right Slope Intercept: 1134.612 0.000
Resisting Moment=1.1139e+007 kN-m
Driving Moment=6.81069e+006 kN-m
Resisting Horizontal Force=21502.8 kN
Driving Horizontal Force=13147.4 kN
Total Slice Area=1.84263e+006 m2

Method: gle/morgenstern-price

FS: 1.635300
Center: 1120.184, -5161.549
Radius: 481.667
Left Slip Surface Endpoint: 806.383, -5526.970
Right Slip Surface Endpoint: 1133.992, -5643.018
Left Slope Intercept: 806.383 0.000
Right Slope Intercept: 1133.992 0.000
Resisting Moment=1.1048e+007 kN-m
Driving Moment=6.75596e+006 kN-m
Resisting Horizontal Force=21387.4 kN

Driving Horizontal Force=13078.6 kN
Total Slice Area=1.83725e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 912
Number of Invalid Surfaces: 451

Error Codes:

Error Code -108 reported for 451 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1363
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.63552

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	13.1424	749154	basement	5.551	27.1	4.51426	7.38316	56986.5	56982.9	3.55393
2	13.1424	751065	basement	5.551	27.1	14.4095	23.567	57126.3	57091.1	35.2014
3	13.1424	752783	basement	5.551	27.1	22.7722	37.2444	57253.9	57191.9	61.9785
4	13.1424	754350	basement	5.551	27.1	29.8851	48.8777	57370.6	57285.9	84.659
5	13.1424	755786	basement	5.551	27.1	36.2176	59.2346	57478.3	57373.4	104.86
6	13.1424	757099	basement	5.551	27.1	41.7896	68.3477	57577.6	57454.8	122.765
7	13.1424	758297	basement	5.551	27.1	46.6184	76.2454	57668.7	57530.6	138.138
8	13.1424	759385	basement	5.551	27.1	50.7193	82.9525	57752.2	57601	151.231
9	13.1424	760367	basement	5.551	27.1	54.1332	88.536	57828.3	57666.1	162.24
10	13.1424	761228	basement	5.551	27.1	56.466	92.3513	57896	57726.4	169.641
11	13.1424	761987	basement	5.551	27.1	57.8651	94.6396	57956	57781.9	174.129

12	13.1424	762654	basement	5.551	27.1	58.5656	95.7852	58009.2	57832.9	176.334
13	13.1424	763231	basement	5.551	27.1	58.5731	95.7974	58055.7	57879.4	176.35
14	13.1424	763721	basement	5.551	27.1	57.8914	94.6826	58095.8	57921.6	174.225
15	13.1424	764126	basement	5.551	27.1	56.5229	92.4444	58129.5	57959.7	169.799
16	13.1424	764449	basement	5.551	27.1	54.4527	89.0585	58156.8	57993.6	163.243
17	13.1424	764701	basement	5.551	27.1	51.9001	84.8837	58178.7	58023.6	155.054
18	13.1424	764877	basement	5.551	27.1	48.7849	79.7887	58194.7	58049.6	145.141
19	13.1424	764974	basement	5.551	27.1	44.98	73.5657	58204.7	58071.8	132.911
20	13.1424	764994	basement	5.551	27.1	40.4791	66.2043	58208.7	58090.2	118.489
21	13.1424	764937	basement	5.551	27.1	35.274	57.6913	58206.7	58104.8	101.888
22	13.1424	764805	basement	5.551	27.1	29.3547	48.0102	58198.6	58115.7	82.9317
23	13.1424	764602	basement	5.551	27.1	22.6381	37.0251	58184.3	58122.8	61.5036
24	13.1424	764368	basement	5.551	27.1	16.1264	26.3751	58166.9	58126.3	40.6366
25	13.1424	764071	basement	5.551	27.1	9.44105	15.441	58145.4	58126.1	19.2889

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.6353

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	13.1043	746992	basement	5.551	27.1	7.09493	11.6023	56995.5	56983.7	11.828
2	13.1043	748892	basement	5.551	27.1	15.6762	25.6353	57130.9	57091.7	39.2086
3	13.1043	750600	basement	5.551	27.1	22.9106	37.4657	57254.6	57192.2	62.4005
4	13.1043	752158	basement	5.551	27.1	29.2879	47.8945	57368.6	57285.9	82.7265
5	13.1043	753586	basement	5.551	27.1	35.0767	57.361	57474.4	57373.2	101.241
6	13.1043	754892	basement	5.551	27.1	40.2932	65.8914	57572.3	57454.4	117.914
7	13.1043	756083	basement	5.551	27.1	44.9451	73.4988	57662.8	57530	132.771
8	13.1043	757166	basement	5.551	27.1	49.0332	80.184	57746	57600.2	145.8
9	13.1043	758142	basement	5.551	27.1	52.5911	86.0023	57822.4	57665.2	157.162
10	13.1043	758999	basement	5.551	27.1	55.2138	90.2911	57890.9	57725.3	165.597
11	13.1043	759754	basement	5.551	27.1	56.9747	93.1708	57951.9	57780.7	171.173
12	13.1043	760417	basement	5.551	27.1	58.0896	94.9939	58006.3	57831.5	174.78
13	13.1043	760991	basement	5.551	27.1	58.5318	95.7171	58054.1	57877.9	176.225
14	13.1043	761479	basement	5.551	27.1	58.2727	95.2934	58095.4	57920	175.426
15	13.1043	761882	basement	5.551	27.1	57.2825	93.6741	58130.2	57958	172.203
16	13.1043	762204	basement	5.551	27.1	55.509	90.7739	58158.4	57991.9	166.54
17	13.1043	762455	basement	5.551	27.1	53.1493	86.9151	58180.8	58021.8	158.972
18	13.1043	762630	basement	5.551	27.1	50.1266	81.972	58197.1	58047.8	149.268
19	13.1043	762727	basement	5.551	27.1	46.2716	75.668	58206.9	58069.9	137.022
20	13.1043	762747	basement	5.551	27.1	41.5623	67.9668	58210.2	58088.2	122.025
21	13.1043	762691	basement	5.551	27.1	35.9798	58.8378	58206.9	58102.8	104.106
22	13.1043	762560	basement	5.551	27.1	29.5098	48.2574	58197.1	58113.7	83.4135

23	13.1043	762357	basement	5.551	27.1	22.1731	36.2597	58180.9	58120.8	60.0582
24	13.1043	762124	basement	5.551	27.1	15.0231	24.5673	58161.5	58124.3	37.1624
25	13.1043	761830	basement	5.551	27.1	7.45496	12.1911	58137.1	58124.1	12.9994

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.63552

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	806.051	-5526.87	1.57314e+008	0	0
2	819.194	-5537.76	403044	164.004	0.0233144
3	832.336	-5547.9	747774	304.28	0.0233145
4	845.479	-5557.34	1.02517e+006	417.158	0.0233146
5	858.621	-5566.13	1.26636e+006	515.301	0.0233145
6	871.763	-5574.33	1.47349e+006	599.584	0.0233145
7	884.906	-5581.95	1.6484e+006	670.756	0.0233144
8	898.048	-5589.04	1.79268e+006	729.466	0.0233144
9	911.191	-5595.61	1.90771e+006	776.274	0.0233145
10	924.333	-5601.7	1.98671e+006	808.419	0.0233144
11	937.476	-5607.31	2.02517e+006	824.068	0.0233144
12	950.618	-5612.48	2.03751e+006	829.092	0.0233145
13	963.76	-5617.21	2.02456e+006	823.821	0.0233144
14	976.903	-5621.51	1.98702e+006	808.545	0.0233144
15	990.045	-5625.41	1.92552e+006	783.52	0.0233144
16	1003.19	-5628.9	1.84061e+006	748.968	0.0233144
17	1016.33	-5632	1.7369e+006	706.769	0.0233145
18	1029.47	-5634.72	1.61756e+006	658.209	0.0233145
19	1042.62	-5637.06	1.47609e+006	600.642	0.0233145
20	1055.76	-5639.02	1.31279e+006	534.193	0.0233145
21	1068.9	-5640.62	1.12793e+006	458.969	0.0233144
22	1082.04	-5641.86	921707	375.055	0.0233144
23	1095.18	-5642.73	694299	282.52	0.0233145
24	1108.33	-5643.25	463988	188.803	0.0233144
25	1121.47	-5643.41	242432	98.6487	0.0233144
26	1134.61	-5643.21	1.64006e+008	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.6353

Slice	X coordinate	Y coordinate - Bottom	Interslice Normal Force	Interslice Shear Force	Interslice Force Angle

	[m]	[m]	[kN]	[kN]	[degrees]
1	806.383	-5526.97	1.57319e+008	0	0
2	819.488	-5537.83	402066	26.7851	0.00381697
3	832.592	-5547.93	745020	98.4816	0.00757373
4	845.696	-5557.35	1.02174e+006	199.924	0.0112111
5	858.801	-5566.13	1.26234e+006	323.244	0.0146716
6	871.905	-5574.3	1.46897e+006	458.944	0.0179007
7	885.009	-5581.9	1.64346e+006	597.989	0.0208476
8	898.114	-5588.97	1.78742e+006	732.043	0.0234656
9	911.218	-5595.53	1.90222e+006	853.691	0.0257136
10	924.322	-5601.6	1.98108e+006	952.789	0.0275561
11	937.427	-5607.2	2.01953e+006	1020.91	0.0289641
12	950.531	-5612.35	2.03195e+006	1060.92	0.0299152
13	963.635	-5617.07	2.01915e+006	1071.12	0.0303943
14	976.74	-5621.36	1.98183e+006	1051.33	0.0303945
15	989.844	-5625.25	1.92062e+006	1002.79	0.0299151
16	1002.95	-5628.73	1.83607e+006	928.166	0.028964
17	1016.05	-5631.83	1.73256e+006	833.268	0.0275562
18	1029.16	-5634.54	1.61369e+006	724.203	0.0257136
19	1042.26	-5636.87	1.47274e+006	603.166	0.0234657
20	1055.37	-5638.83	1.31004e+006	476.67	0.0208476
21	1068.47	-5640.43	1.12583e+006	351.741	0.0179008
22	1081.57	-5641.67	920341	235.669	0.0146716
23	1094.68	-5642.54	693731	135.742	0.011211
24	1107.78	-5643.06	462307	61.1108	0.00757374
25	1120.89	-5643.22	241552	16.0918	0.00381695
26	1133.99	-5643.02	1.63995e+008	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.646155
Factor of Safety, standard deviation: 0.269924
Factor of Safety, minimum: 0.831038
Factor of Safety, maximum: 2.614010
Probability of Failure: 0.391% (= 39 failed surfaces / 9987 valid surfaces), 13 invalid surfaces
Reliability index: 2.39384 (assuming normal distribution)
Reliability index: 2.97863 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price

Factor of Safety, mean: 1.646064
Factor of Safety, standard deviation: 0.269979
Factor of Safety, minimum: 0.830032
Factor of Safety, maximum: 2.613630
Probability of Failure: 0.380% (= 38 failed surfaces / 10000 valid surfaces)
Reliability index: 2.39301 (assuming normal distribution)
Reliability index: 2.97748 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-8000
5563.63	-8000
5563.63	0
0	0

External Boundary

X	Y
5563.63	-8000
5563.63	-5784.34
5474.24	-5785.31
5384.84	-5785.93
5295.44	-5784.92
5206.05	-5784.56
5116.65	-5784.24
5027.25	-5783.7
4937.86	-5783.07
4848.46	-5784
4759.06	-5784.82
4669.66	-5784.72
4580.27	-5784.13
4490.87	-5783.34
4401.47	-5781.43
4312.08	-5778.19
4222.68	-5774.05
4133.28	-5770.07

4043.89	-5767.6
3954.49	-5764.64
3865.09	-5761.88
3773.01	-5759.37
3680.93	-5757.67
3588.85	-5757
3496.77	-5757
3404.69	-5756.77
3312.61	-5756.48
3220.52	-5757.24
3128.44	-5757.87
3036.36	-5758.66
2944.28	-5759.59
2852.2	-5760.37
2760.12	-5760.61
2668.04	-5761.72
2575.96	-5761.24
2483.87	-5760.64
2391.79	-5759.77
2299.71	-5759.98
2207.63	-5758.8
2115.55	-5756.82
2023.47	-5752.88
1931.39	-5747.37
1839.31	-5736.81
1747.22	-5724.62
1655.14	-5714.75
1563.06	-5710.23
1471.12	-5707.26
1379.17	-5698.11
1287.23	-5682.61
1195.28	-5661.53
1103.34	-5633.76
1011.39	-5600.22
919.45	-5565.35
827.5	-5533.1
735.56	-5506.41
643.61	-5483.33
551.67	-5465.26
459.72	-5455.37

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 49PC Site 67		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State
	Date: 3/25/2013		File Name: RR0705_49_67_0g.sli

367.78	-5451.72
275.83	-5450.4
183.89	-5447.47
91.94	-5442.83
0	-5437.13
0	-8000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 49PC Site 67		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State
	Date	3/25/2013		File Name: RR0705_49_67_1g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_49_67_1g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 49PC Site 67
Author: Jason R. Patton
Company: Oregon State
Date Created: 3/25/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 49PC Site 67		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State
	Date	3/25/2013		File Name: RR0705_49_67_1g.sli

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364849857
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.011140
Center: 1478.231, -3936.747
Radius: 1739.993
Left Slip Surface Endpoint: 718.545, -5502.139
Right Slip Surface Endpoint: 1127.164, -5640.956
Left Slope Intercept: 718.545 0.000
Right Slope Intercept: 1127.164 0.000
Resisting Moment=2.14621e+006 kN-m
Driving Moment=1.92657e+008 kN-m
Resisting Horizontal Force=1195.75 kN

Driving Horizontal Force=107338 kN
Total Slice Area=2.2805e+006 m2

Method: gle/morgenstern-price

FS: 0.011361
Center: 1590.295, -3686.032
Radius: 2014.496
Left Slip Surface Endpoint: 718.545, -5502.139
Right Slip Surface Endpoint: 1194.197, -5661.203
Left Slope Intercept: 718.545 0.000
Right Slope Intercept: 1194.197 0.000
Resisting Moment=2.96548e+006 kN-m
Driving Moment=2.61016e+008 kN-m
Resisting Horizontal Force=1426.94 kN
Driving Horizontal Force=125597 kN
Total Slice Area=2.66017e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 769
Number of Invalid Surfaces: 20

Error Codes:

Error Code -108 reported for 17 surfaces
Error Code -112 reported for 3 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 779
Number of Invalid Surfaces: 10

Error Codes:

Error Code -112 reported for 10 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with

many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.0111401

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	16.3448	927121	basement	5.551	27.1	83.7641	0.93314	56732.9	56742	-9.1166
2	16.3448	928726	basement	5.551	27.1	124.481	1.38673	56866.2	56874.4	-8.15112
3	16.3448	930245	basement	5.551	27.1	164.921	1.83724	56988.5	56995.9	-7.36026
4	16.3448	931711	basement	5.551	27.1	204.75	2.28093	57105.5	57112.1	-6.6155
5	16.3448	933126	basement	5.551	27.1	243.666	2.71446	57217.3	57223	-5.7147
6	16.3448	934489	basement	5.551	27.1	281.596	3.13701	57324.1	57328.7	-4.56379
7	16.3448	935796	basement	5.551	27.1	314.184	3.50004	57424.5	57428.5	-3.97747
8	16.3448	936987	basement	5.551	27.1	330.329	3.6799	57508.4	57511.8	-3.44529
9	16.3448	938110	basement	5.551	27.1	347.662	3.87299	57583.7	57586.7	-3.03333
10	16.3448	939183	basement	5.551	27.1	362.674	4.04023	57653.5	57656.6	-3.14857
11	16.3448	940207	basement	5.551	27.1	375.187	4.17962	57719	57721.7	-2.6874
12	16.3448	941184	basement	5.551	27.1	385.001	4.28895	57779.5	57781.9	-2.43145
13	16.3448	942103	basement	5.551	27.1	385.628	4.29594	57833	57835.5	-2.45244
14	16.3448	942945	basement	5.551	27.1	378.82	4.22009	57876.6	57879.2	-2.64867
15	16.3448	943738	basement	5.551	27.1	369.315	4.11421	57915	57917.8	-2.83614
16	16.3448	944486	basement	5.551	27.1	355.458	3.95984	57948.7	57951.8	-3.09687
17	16.3448	945188	basement	5.551	27.1	336.863	3.75269	57977.7	57981.2	-3.54237
18	16.3448	945845	basement	5.551	27.1	313.402	3.49133	58002	58006.1	-4.0971
19	16.3448	946469	basement	5.551	27.1	290.396	3.23504	58024	58028.6	-4.56411
20	16.3448	947058	basement	5.551	27.1	260.581	2.9029	58043.1	58048.2	-5.14636
21	16.3448	947604	basement	5.551	27.1	224.351	2.49929	58057.4	58063.4	-5.95052
22	16.3448	948105	basement	5.551	27.1	181.031	2.0167	58067.3	58074.2	-6.93921
23	16.3448	948563	basement	5.551	27.1	129.847	1.44651	58072.5	58080.5	-7.97929
24	16.3448	948988	basement	5.551	27.1	81.4679	0.90756	58075.2	58084.3	-9.07022
25	16.3448	949440	basement	5.551	27.1	41.7213	0.46478	58086	58095.9	-9.93855

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.0113613

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	19.0261	1.07936e+006	basement	5.551	27.1	59.5381	0.67643	56742.4	56752	-9.55101
2	19.0261	1.08149e+006	basement	5.551	27.1	119.597	1.35878	56893.5	56901.9	-8.40659
3	19.0261	1.08352e+006	basement	5.551	27.1	173.944	1.97623	57034	57040.7	-6.7495

4	19.0261	1.08547e+006	basement	5.551	27.1	226.275	2.57078	57167.3	57173.3	-5.9796
5	19.0261	1.08736e+006	basement	5.551	27.1	276.283	3.13893	57295.2	57299.8	-4.57687
6	19.0261	1.08917e+006	basement	5.551	27.1	320.706	3.64364	57415.9	57419.6	-3.70478
7	19.0261	1.09083e+006	basement	5.551	27.1	344.032	3.90865	57517.3	57520.6	-3.31452
8	19.0261	1.09239e+006	basement	5.551	27.1	364.238	4.13822	57608.2	57611	-2.78988
9	19.0261	1.09388e+006	basement	5.551	27.1	380.59	4.324	57693.2	57695.5	-2.30135
10	19.0261	1.0953e+006	basement	5.551	27.1	393.012	4.46513	57772.4	57774.3	-1.89924
11	19.0261	1.09665e+006	basement	5.551	27.1	397.584	4.51707	57844.5	57846.6	-2.1259
12	19.0261	1.0979e+006	basement	5.551	27.1	389.528	4.42554	57904.6	57906.8	-2.23038
13	19.0261	1.09907e+006	basement	5.551	27.1	379.29	4.30923	57957.7	57960.1	-2.355
14	19.0261	1.10018e+006	basement	5.551	27.1	364.773	4.1443	58005.1	58007.9	-2.78217
15	19.0261	1.10122e+006	basement	5.551	27.1	345.97	3.93067	58046.8	58050.2	-3.38978
16	19.0261	1.10221e+006	basement	5.551	27.1	326.14	3.70537	58084.5	58087.9	-3.44938
17	19.0261	1.10316e+006	basement	5.551	27.1	305.274	3.46831	58119.7	58123.6	-3.91922
18	19.0261	1.10405e+006	basement	5.551	27.1	278.996	3.16976	58149.6	58154.2	-4.60374
19	19.0261	1.10487e+006	basement	5.551	27.1	248.183	2.81968	58174.3	58179.6	-5.29885
20	19.0261	1.10564e+006	basement	5.551	27.1	212.538	2.41471	58193.9	58199.8	-5.90426
21	19.0261	1.10639e+006	basement	5.551	27.1	188.379	2.14023	58214.1	58220.5	-6.40953
22	19.0261	1.10716e+006	basement	5.551	27.1	170.132	1.93292	58241.7	58248.9	-7.23206
23	19.0261	1.10788e+006	basement	5.551	27.1	144.942	1.64673	58265	58272.6	-7.5932
24	19.0261	1.10853e+006	basement	5.551	27.1	114.218	1.29766	58283.2	58291.2	-8.03628
25	19.0261	1.10913e+006	basement	5.551	27.1	77.1311	0.87631	58295.7	58304.8	-9.10166

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.0111401

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	718.545	-5502.14	1.55909e+008	0	0
2	734.889	-5509.97	210825	-222.644	-0.0605078
3	751.234	-5517.59	376066	-397.148	-0.0605077
4	767.579	-5525	529020	-558.676	-0.0605077
5	783.924	-5532.21	671211	-708.839	-0.0605078
6	800.269	-5539.23	802671	-847.668	-0.0605077
7	816.613	-5546.04	923431	-975.199	-0.0605078
8	832.958	-5552.67	1.01475e+006	-1071.64	-0.0605079
9	849.303	-5559.1	1.05784e+006	-1117.14	-0.0605076
10	865.648	-5565.34	1.09009e+006	-1151.2	-0.0605077
11	881.992	-5571.4	1.11155e+006	-1173.86	-0.0605076

12	898.337	-5577.26	1.12226e+006	-1185.18	-0.0605081
13	914.682	-5582.95	1.12229e+006	-1185.21	-0.060508
14	931.027	-5588.46	1.09278e+006	-1154.04	-0.0605077
15	947.372	-5593.78	1.04481e+006	-1103.38	-0.0605076
16	963.716	-5598.93	986235	-1041.52	-0.0605076
17	980.061	-5603.9	917122	-968.536	-0.0605078
18	996.406	-5608.7	837546	-884.499	-0.0605078
19	1012.75	-5613.32	748722	-790.695	-0.0605077
20	1029.1	-5617.77	662114	-699.232	-0.0605077
21	1045.44	-5622.06	565330	-597.022	-0.0605077
22	1061.78	-5626.17	458460	-484.161	-0.0605077
23	1078.13	-5630.11	341606	-360.757	-0.0605079
24	1094.47	-5633.89	214878	-226.924	-0.0605077
25	1110.82	-5637.51	105509	-111.424	-0.0605078
26	1127.16	-5640.96	1.63875e+008	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.0113613

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	718.545	-5502.14	1.55909e+008	0	0
2	737.571	-5511.15	235744	-38.7451	-0.0094167
3	756.597	-5519.92	421062	-137.314	-0.0186849
4	775.623	-5528.45	593797	-286.644	-0.0276584
5	794.649	-5536.75	753977	-476.313	-0.0361957
6	813.675	-5544.81	901638	-694.961	-0.0441622
7	832.701	-5552.65	1.01892e+006	-914.649	-0.0514324
8	851.727	-5560.25	1.07602e+006	-1087.2	-0.0578911
9	870.753	-5567.64	1.12042e+006	-1240.51	-0.0634369
10	889.779	-5574.81	1.15219e+006	-1367.09	-0.0679822
11	908.806	-5581.76	1.17139e+006	-1460.89	-0.071456
12	927.832	-5588.49	1.16441e+006	-1499.87	-0.0738023
13	946.858	-5595.01	1.12751e+006	-1475.61	-0.0749849
14	965.884	-5601.31	1.07811e+006	-1410.96	-0.0749849
15	984.91	-5607.41	1.01626e+006	-1309.04	-0.0738024
16	1003.94	-5613.3	942036	-1174.85	-0.0714558
17	1022.96	-5618.99	865163	-1026.53	-0.0679823
18	1041.99	-5624.47	782318	-866.173	-0.0634372
19	1061.01	-5629.75	687358	-694.501	-0.0578912
20	1080.04	-5634.84	580348	-520.957	-0.0514323
21	1099.07	-5639.72	461360	-355.606	-0.0441623

22	1118.09	-5644.4	384082	-242.638	-0.0361957
23	1137.12	-5648.89	310680	-149.974	-0.0276583
24	1156.14	-5653.19	225711	-73.6073	-0.0186849
25	1175.17	-5657.29	129249	-21.2423	-0.00941666
26	1194.2	-5661.2	1.65053e+008	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.071768
Factor of Safety, standard deviation: 0.099928
Factor of Safety, minimum: 0.000611
Factor of Safety, maximum: 1.684010
Probability of Failure: 99.880% (= 9972 failed surfaces / 9984 valid surfaces), 16 invalid surfaces
Reliability index: -9.28903 (assuming normal distribution)
Reliability index: -3.05639 (assuming lognormal distribution)
* best fit = Beta

Method: gle/morgenstern-price
Factor of Safety, mean: 0.078073
Factor of Safety, standard deviation: 0.100560
Factor of Safety, minimum: 0.000616
Factor of Safety, maximum: 1.685930
Probability of Failure: 99.890% (= 9976 failed surfaces / 9987 valid surfaces), 13 invalid surfaces
Reliability index: -9.16795 (assuming normal distribution)
Reliability index: -3.07316 (assuming lognormal distribution)
* best fit = Beta

List Of Coordinates

Water Table

X	Y
0	0
0	-8000
5563.63	-8000
5563.63	0
0	0

External Boundary

X	Y

5563.63	-8000
5563.63	-5784.34
5474.24	-5785.31
5384.84	-5785.93
5295.44	-5784.92
5206.05	-5784.56
5116.65	-5784.24
5027.25	-5783.7
4937.86	-5783.07
4848.46	-5784
4759.06	-5784.82
4669.66	-5784.72
4580.27	-5784.13
4490.87	-5783.34
4401.47	-5781.43
4312.08	-5778.19
4222.68	-5774.05
4133.28	-5770.07
4043.89	-5767.6
3954.49	-5764.64
3865.09	-5761.88
3773.01	-5759.37
3680.93	-5757.67
3588.85	-5757
3496.77	-5757
3404.69	-5756.77
3312.61	-5756.48
3220.52	-5757.24
3128.44	-5757.87
3036.36	-5758.66
2944.28	-5759.59
2852.2	-5760.37
2760.12	-5760.61
2668.04	-5761.72
2575.96	-5761.24
2483.87	-5760.64
2391.79	-5759.77
2299.71	-5759.98
2207.63	-5758.8
2115.55	-5756.82

2023.47	-5752.88
1931.39	-5747.37
1839.31	-5736.81
1747.22	-5724.62
1655.14	-5714.75
1563.06	-5710.23
1471.12	-5707.26
1379.17	-5698.11
1287.23	-5682.61
1195.28	-5661.53
1103.34	-5633.76
1011.39	-5600.22
919.45	-5565.35
827.5	-5533.1
735.56	-5506.41
643.61	-5483.33
551.67	-5465.26
459.72	-5455.37
367.78	-5451.72
275.83	-5450.4
183.89	-5447.47
91.94	-5442.83
0	-5437.13
0	-8000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 55PC Site 82		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	4/01/2013		File Name: RR0705_55_82_0g.slim

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_55_82_0g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 55PC Site 82
Author: Jason R. Patton
Company: Oregon State University
Date Created: 4/01/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364837069
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 55PC Site 82		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	4/01/2013		File Name: RR0705_55_82_0g.slim

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Global Minimums

Method: spencer

FS: 1.352270
Center: 1639.658, -4147.787
Radius: 1439.803
Left Slip Surface Endpoint: 799.188, -5316.823
Right Slip Surface Endpoint: 1425.078, -5571.511
Left Slope Intercept: 799.188 -0.000
Right Slope Intercept: 1425.078 -0.000
Resisting Moment=7.65983e+007 kN-m
Driving Moment=5.66441e+007 kN-m
Resisting Horizontal Force=49128 kN
Driving Horizontal Force=36329.9 kN
Total Slice Area=3.42558e+006 m2

Method: gle/morgenstern-price

FS: 1.354640
Center: 1646.421, -4135.513
Radius: 1454.136
Left Slip Surface Endpoint: 797.834, -5316.364
Right Slip Surface Endpoint: 1430.159, -5573.477
Left Slope Intercept: 797.834 -0.000
Right Slope Intercept: 1430.159 -0.000
Resisting Moment=7.90057e+007 kN-m
Driving Moment=5.83224e+007 kN-m
Resisting Horizontal Force=50111.3 kN

Driving Horizontal Force=36992.4 kN
Total Slice Area=3.46147e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1909
Number of Invalid Surfaces: 646

Error Codes:

Error Code -108 reported for 646 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2555
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.35227

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	25.0356	1.37394e+006	basement	5.551	27.1	8.10703	10.9629	54864.5	54853.9	10.5503
2	25.0356	1.37957e+006	basement	5.551	27.1	23.0098	31.1154	55081.1	55031.2	49.9481
3	25.0356	1.38475e+006	basement	5.551	27.1	35.017	47.3525	55282.2	55200.6	81.6313
4	25.0356	1.38962e+006	basement	5.551	27.1	45.5797	61.636	55471.9	55362.5	109.441
5	25.0356	1.39421e+006	basement	5.551	27.1	55.0849	74.4897	55651.8	55517.1	134.708
6	25.0356	1.39851e+006	basement	5.551	27.1	63.4251	85.7679	55821.6	55664.7	156.889
7	25.0356	1.40253e+006	basement	5.551	27.1	70.3436	95.1235	55980.6	55805.7	174.935
8	25.0356	1.4063e+006	basement	5.551	27.1	76.2094	103.056	56130.4	55940	190.421
9	25.0356	1.40982e+006	basement	5.551	27.1	81.06	109.615	56271.5	56068.1	203.37
10	25.0356	1.41306e+006	basement	5.551	27.1	84.3663	114.086	56401.9	56189.9	211.989
11	25.0356	1.41603e+006	basement	5.551	27.1	86.1707	116.526	56522.8	56305.8	216.98

12	25.0356	1.41878e+006	basement	5.551	27.1	86.9434	117.571	56634.7	56415.9	218.82
13	25.0356	1.42131e+006	basement	5.551	27.1	86.6632	117.192	56738.5	56520.2	218.297
14	25.0356	1.42355e+006	basement	5.551	27.1	84.5726	114.365	56831.8	56619	212.772
15	25.0356	1.42558e+006	basement	5.551	27.1	81.1998	109.804	56916.1	56712.4	203.746
16	25.0356	1.4274e+006	basement	5.551	27.1	76.7904	103.841	56992.4	56800.4	191.978
17	25.0356	1.42906e+006	basement	5.551	27.1	71.6221	96.8524	57061.5	56883.1	178.42
18	25.0356	1.4306e+006	basement	5.551	27.1	66.8188	90.357	57126.5	56960.7	165.757
19	25.0356	1.43196e+006	basement	5.551	27.1	61.1177	82.6476	57183.9	57033.3	150.574
20	25.0356	1.43312e+006	basement	5.551	27.1	54.379	73.5351	57233.8	57100.8	132.983
21	25.0356	1.43415e+006	basement	5.551	27.1	47.2092	63.8396	57277.3	57163.5	113.788
22	25.0356	1.43504e+006	basement	5.551	27.1	39.9078	53.9661	57315.8	57221.2	94.6301
23	25.0356	1.43574e+006	basement	5.551	27.1	31.5869	42.714	57346.9	57274.2	72.6836
24	25.0356	1.43626e+006	basement	5.551	27.1	22.2391	30.0733	57370.2	57322.4	47.7853
25	25.0356	1.43659e+006	basement	5.551	27.1	11.7116	15.8372	57386.2	57366	20.2025

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.35464

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	25.293	1.38798e+006	basement	5.551	27.1	10.3996	14.0878	54866.6	54850.1	16.5464
2	25.293	1.39372e+006	basement	5.551	27.1	24.1224	32.6772	55082.1	55029.1	53.0252
3	25.293	1.39901e+006	basement	5.551	27.1	35.2523	47.7542	55282.6	55200.1	82.4995
4	25.293	1.40398e+006	basement	5.551	27.1	45.1961	61.2244	55472.3	55363.6	108.733
5	25.293	1.40866e+006	basement	5.551	27.1	54.2531	73.4934	55652.6	55519.8	132.76
6	25.293	1.41305e+006	basement	5.551	27.1	62.3215	84.4232	55823.1	55668.9	154.182
7	25.293	1.41715e+006	basement	5.551	27.1	69.1529	93.6773	55983.3	55811.1	172.196
8	25.293	1.42099e+006	basement	5.551	27.1	75.0853	101.714	56134.7	55946.8	187.899
9	25.293	1.42458e+006	basement	5.551	27.1	80.1527	108.578	56277.5	56076.1	201.387
10	25.293	1.42788e+006	basement	5.551	27.1	83.806	113.527	56410.2	56199.1	211.063
11	25.293	1.43091e+006	basement	5.551	27.1	86.0192	116.525	56533.1	56316.1	217.025
12	25.293	1.43372e+006	basement	5.551	27.1	87.2453	118.186	56647.3	56427.2	220.115
13	25.293	1.43629e+006	basement	5.551	27.1	87.4594	118.476	56753.2	56532.6	220.562
14	25.293	1.43858e+006	basement	5.551	27.1	85.7888	116.213	56848.7	56632.3	216.428
15	25.293	1.44064e+006	basement	5.551	27.1	82.7681	112.121	56934.9	56726.5	208.364
16	25.293	1.44249e+006	basement	5.551	27.1	78.6069	106.484	57012.7	56815.4	197.296
17	25.293	1.44419e+006	basement	5.551	27.1	73.5976	99.6982	57082.9	56898.9	183.993
18	25.293	1.44577e+006	basement	5.551	27.1	68.9016	93.3368	57148.7	56977.2	171.489
19	25.293	1.44715e+006	basement	5.551	27.1	63.0959	85.4722	57206.4	57050.4	156.025
20	25.293	1.44834e+006	basement	5.551	27.1	56.077	75.9642	57256.1	57118.6	137.513
21	25.293	1.4494e+006	basement	5.551	27.1	48.7589	66.0508	57300	57181.8	118.2
22	25.293	1.4503e+006	basement	5.551	27.1	40.9246	55.4381	57337.6	57240.1	97.494

23	25.293	1.45102e+006	basement	5.551	27.1	31.8958	43.2073	57367.2	57293.5	73.6617
24	25.293	1.45155e+006	basement	5.551	27.1	21.6428	29.3182	57388.4	57342.2	46.2433
25	25.293	1.45187e+006	basement	5.551	27.1	10.0265	13.5823	57401.9	57386	15.9023

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.35227

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	799.188	-5316.82	1.45583e+008	0	0
2	824.224	-5334.42	500957	232.259	0.0265641
3	849.26	-5351.24	916168	424.764	0.0265641
4	874.295	-5367.32	1.26059e+006	584.449	0.0265641
5	899.331	-5382.68	1.56705e+006	726.531	0.026564
6	924.366	-5397.34	1.83661e+006	851.508	0.0265641
7	949.402	-5411.35	2.05595e+006	953.201	0.0265641
8	974.437	-5424.7	2.23839e+006	1037.78	0.0265639
9	999.473	-5437.44	2.38658e+006	1106.49	0.026564
10	1024.51	-5449.56	2.49578e+006	1157.12	0.0265641
11	1049.54	-5461.1	2.54756e+006	1181.13	0.0265641
12	1074.58	-5472.07	2.56707e+006	1190.17	0.026564
13	1099.62	-5482.47	2.55493e+006	1184.54	0.026564
14	1124.65	-5492.33	2.49634e+006	1157.38	0.0265641
15	1149.69	-5501.66	2.39043e+006	1108.28	0.0265642
16	1174.72	-5510.46	2.25427e+006	1045.15	0.0265641
17	1199.76	-5518.74	2.08831e+006	968.205	0.0265641
18	1224.79	-5526.53	1.93445e+006	896.869	0.026564
19	1249.83	-5533.81	1.76375e+006	817.727	0.026564
20	1274.86	-5540.61	1.5646e+006	725.396	0.0265641
21	1299.9	-5546.93	1.34043e+006	621.465	0.0265641
22	1324.94	-5552.77	1.12829e+006	523.108	0.026564
23	1349.97	-5558.15	888748	412.051	0.0265641
24	1375.01	-5563.06	622076	288.414	0.0265641
25	1400.04	-5567.51	326285	151.276	0.0265641
26	1425.08	-5571.51	1.59865e+008	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.35464

Slice	X coordinate	Y coordinate - Bottom	Interslice Normal Force	Interslice Shear Force	Interslice Force Angle

	[m]	[m]	[kN]	[kN]	[degrees]
1	797.834	-5316.36	1.45558e+008	0	0
2	823.127	-5334.14	505687	45.5921	0.00516571
3	848.42	-5351.12	927812	165.982	0.01025
4	873.713	-5367.35	1.27537e+006	337.733	0.0151726
5	899.006	-5382.86	1.58458e+006	549.137	0.0198559
6	924.299	-5397.67	1.85652e+006	784.983	0.0242261
7	949.592	-5411.81	2.07776e+006	1023.15	0.0282141
8	974.885	-5425.3	2.2617e+006	1253.59	0.0317573
9	1000.18	-5438.16	2.41104e+006	1464.39	0.0347997
10	1025.47	-5450.4	2.5199e+006	1640.18	0.0372933
11	1050.76	-5462.05	2.57184e+006	1759.51	0.0391986
12	1076.06	-5473.12	2.59118e+006	1830.95	0.0404857
13	1101.35	-5483.63	2.57852e+006	1851.21	0.0411346
14	1126.64	-5493.58	2.51656e+006	1806.72	0.0411345
15	1151.94	-5502.99	2.40914e+006	1702.32	0.0404857
16	1177.23	-5511.87	2.27114e+006	1553.79	0.0391986
17	1202.52	-5520.24	2.10302e+006	1368.84	0.0372934
18	1227.82	-5528.09	1.95314e+006	1186.28	0.0347998
19	1253.11	-5535.45	1.78022e+006	986.723	0.0317573
20	1278.4	-5542.31	1.57853e+006	777.318	0.0282142
21	1303.69	-5548.68	1.35802e+006	574.203	0.024226
22	1328.99	-5554.58	1.14318e+006	396.172	0.019856
23	1354.28	-5560	900662	238.506	0.0151726
24	1379.57	-5564.95	630713	112.832	0.01025
25	1404.87	-5569.45	330194	29.7699	0.00516572
26	1430.16	-5573.48	1.59978e+008	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.362742
Factor of Safety, standard deviation: 0.225641
Factor of Safety, minimum: 0.713001
Factor of Safety, maximum: 2.156760
Probability of Failure: 4.760% (= 476 failed surfaces / 10000 valid surfaces)
Reliability index: 1.60761 (assuming normal distribution)
Reliability index: 1.79968 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price

Factor of Safety, mean: 1.363286
Factor of Safety, standard deviation: 0.224645
Factor of Safety, minimum: 0.714429
Factor of Safety, maximum: 2.155160
Probability of Failure: 4.650% (= 465 failed surfaces / 10000 valid surfaces)
Reliability index: 1.61715 (assuming normal distribution)
Reliability index: 1.81148 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-10000
3430.67	-10000
3430.67	0
0	0

External Boundary

X	Y
3430.67	-10000
3430.67	-5805.57
3337.95	-5804.19
3245.23	-5803.52
3152.51	-5802.2
3059.79	-5801.27
2967.07	-5800.27
2874.35	-5798.66
2781.63	-5796.46
2688.91	-5794.69
2596.19	-5792.17
2503.47	-5787.92
2410.74	-5782.22
2318.02	-5776.12
2225.3	-5770.36
2132.58	-5765.11
2039.86	-5756.8
1947.14	-5742.89

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 55PC Site 82		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	4/01/2013		File Name: RR0705_55_82_0g.slim

1854.42	-5720.43
1761.7	-5693.12
1668.98	-5662.12
1576.26	-5629.71
1483.53	-5594.13
1390.81	-5558.25
1298.09	-5522.76
1205.37	-5484.48
1112.65	-5442.7
1019.93	-5403.03
927.21	-5365.36
834.49	-5328.77
741.77	-5297.39
649.05	-5267.94
556.33	-5234.8
463.6	-5207.45
370.88	-5198.33
278.16	-5201.72
185.44	-5205.03
92.72	-5217.16
0	-5230.36
0	-10000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 55PC Site 82		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	4/01/2013		File Name: RR0705_55_82_1g.slim

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_55_82_1g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 55PC Site 82
Author: Jason R. Patton
Company: Oregon State University
Date Created: 4/01/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364837266
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.003948
Center: 1782.485, -3898.412
Radius: 1732.841
Left Slip Surface Endpoint: 775.963, -5308.962
Right Slip Surface Endpoint: 1533.369, -5613.253
Left Slope Intercept: 775.963 -0.000
Right Slope Intercept: 1533.369 -0.000
Resisting Moment=4.12855e+006 kN-m
Driving Moment=1.04584e+009 kN-m
Resisting Horizontal Force=2365.56 kN

Driving Horizontal Force=599243 kN
Total Slice Area=4.16283e+006 m2

Method: gle/morgenstern-price

FS: 0.003796
Center: 2517.881, -1987.351
Radius: 3759.774
Left Slip Surface Endpoint: 724.764, -5291.988
Right Slip Surface Endpoint: 1556.547, -5622.146
Left Slope Intercept: 724.764 -0.000
Right Slope Intercept: 1556.547 -0.000
Resisting Moment=5.6564e+006 kN-m
Driving Moment=1.49026e+009 kN-m
Resisting Horizontal Force=1471.54 kN
Driving Horizontal Force=387699 kN
Total Slice Area=4.55502e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1094
Number of Invalid Surfaces: 53

Error Codes:

Error Code -108 reported for 44 surfaces
Error Code -112 reported for 9 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1141
Number of Invalid Surfaces: 6

Error Codes:

Error Code -108 reported for 2 surfaces
Error Code -112 reported for 4 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This

screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.00394758

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	30.2962	1.66089e+006	basement	5.551	27.1	679.999	2.68435	54872	54877.7	-5.70488
2	30.2962	1.6691e+006	basement	5.551	27.1	802.269	3.16702	55251.3	55256	-4.74806
3	30.2962	1.67671e+006	basement	5.551	27.1	821.486	3.24288	55590.5	55595	-4.51901
4	30.2962	1.68377e+006	basement	5.551	27.1	913.983	3.60802	55895.2	55899	-3.7546
5	30.2962	1.69041e+006	basement	5.551	27.1	1000.83	3.95087	56177.6	56180.8	-3.17265
6	30.2962	1.69664e+006	basement	5.551	27.1	1055.01	4.16474	56435.5	56438.3	-2.76649
7	30.2962	1.70245e+006	basement	5.551	27.1	1121.46	4.42704	56670	56672.3	-2.32468
8	30.2962	1.70789e+006	basement	5.551	27.1	1179.57	4.65643	56884.4	56886.2	-1.79545
9	30.2962	1.71293e+006	basement	5.551	27.1	1174.12	4.63491	57074.1	57075.9	-1.75383
10	30.2962	1.71755e+006	basement	5.551	27.1	1193.5	4.71145	57239.3	57241	-1.74505
11	30.2962	1.72184e+006	basement	5.551	27.1	1202.31	4.74622	57386	57387.6	-1.61429
12	30.2962	1.72575e+006	basement	5.551	27.1	1133.95	4.47636	57510	57511.9	-1.9346
13	30.2962	1.72926e+006	basement	5.551	27.1	1083.66	4.27783	57609.6	57612.2	-2.57903
14	30.2962	1.73247e+006	basement	5.551	27.1	1019.1	4.02299	57692.2	57695.2	-2.99383
15	30.2962	1.73542e+006	basement	5.551	27.1	1043.47	4.1192	57764.8	57767.7	-2.93951
16	30.2962	1.73821e+006	basement	5.551	27.1	987.846	3.8996	57832.2	57835.3	-3.1024
17	30.2962	1.74069e+006	basement	5.551	27.1	883.192	3.48647	57883	57887.2	-4.18012
18	30.2962	1.74293e+006	basement	5.551	27.1	846.498	3.34162	57923.1	57927.4	-4.25987
19	30.2962	1.74499e+006	basement	5.551	27.1	737.67	2.91201	57956.6	57961.8	-5.19739
20	30.2962	1.74677e+006	basement	5.551	27.1	560.888	2.21415	57974.6	57981.2	-6.57075
21	30.2962	1.74827e+006	basement	5.551	27.1	318.97	1.25916	57976.6	57985	-8.4234
22	30.2962	1.74947e+006	basement	5.551	27.1	19.6829	0.0777	57961.7	57972.3	-10.5642
23	30.2962	1.7504e+006	basement	5.551	27.1	0	0	57890.8	57944.8	-54.0431
24	30.2962	1.75107e+006	basement	5.551	27.1	0	0	57801.8	57902.9	-101.097
25	30.2962	1.75148e+006	basement	5.551	27.1	0	0	57615.1	57847.7	-232.593

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00379558

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	33.2713	1.81725e+006	basement	5.551	27.1	164.32	0.62369	54646.1	54655.8	-9.73644
2	33.2713	1.8245e+006	basement	5.551	27.1	410.074	1.55647	54932.2	54940	-7.81734

3	33.2713	1.8315e+006	basement	5.551	27.1	641.075	2.43325	55205.4	55211.6	-6.21559
4	33.2713	1.83819e+006	basement	5.551	27.1	789.07	2.99498	55460	55465	-4.96034
5	33.2713	1.84442e+006	basement	5.551	27.1	888.668	3.37301	55682.3	55686.5	-4.20084
6	33.2713	1.85043e+006	basement	5.551	27.1	979.913	3.71934	55892.6	55896.1	-3.54943
7	33.2713	1.85619e+006	basement	5.551	27.1	1014.69	3.85135	56089.5	56092.7	-3.22708
8	33.2713	1.8617e+006	basement	5.551	27.1	1035.05	3.92863	56272.3	56275.4	-3.13184
9	33.2713	1.867e+006	basement	5.551	27.1	1022.36	3.88045	56444.5	56447.8	-3.27191
10	33.2713	1.87202e+006	basement	5.551	27.1	919.475	3.48994	56599.1	56603.2	-4.0742
11	33.2713	1.87678e+006	basement	5.551	27.1	843.816	3.20277	56739.6	56744.4	-4.7606
12	33.2713	1.88135e+006	basement	5.551	27.1	720.372	2.73423	56869.4	56875	-5.57153
13	33.2713	1.88561e+006	basement	5.551	27.1	540.753	2.05247	56980.4	56987.2	-6.76182
14	33.2713	1.88965e+006	basement	5.551	27.1	405.682	1.5398	57079.4	57087.2	-7.82992
15	33.2713	1.89353e+006	basement	5.551	27.1	355.245	1.34836	57172.7	57180.9	-8.15546
16	33.2713	1.8974e+006	basement	5.551	27.1	309.847	1.17605	57271.4	57280	-8.58818
17	33.2713	1.90111e+006	basement	5.551	27.1	203.363	0.77188	57362.5	57371.9	-9.36227
18	33.2713	1.90468e+006	basement	5.551	27.1	192.094	0.72911	57449.9	57459.3	-9.40284
19	33.2713	1.9082e+006	basement	5.551	27.1	138.685	0.52639	57538.7	57548.4	-9.66364
20	33.2713	1.91154e+006	basement	5.551	27.1	71.1565	0.27008	57618.6	57629	-10.3869
21	33.2713	1.91469e+006	basement	5.551	27.1	6.94229	0.02635	57688.7	57699.5	-10.783
22	33.2713	1.91765e+006	basement	5.551	27.1	0	0	57743.9	57760	-16.092
23	33.2713	1.92043e+006	basement	5.551	27.1	0	0	57793.4	57811.8	-18.3742
24	33.2713	1.92305e+006	basement	5.551	27.1	0	0	57839.7	57856	-16.3383
25	33.2713	1.9255e+006	basement	5.551	27.1	0	0	57880.4	57892.2	-11.8151

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.00394758

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	775.963	-5308.96	1.45153e+008	0	0
2	806.26	-5330.1	588581	-7506.48	-0.730683
3	836.556	-5350.29	1.12857e+006	-14393.3	-0.730686
4	866.852	-5369.59	1.54072e+006	-19649.7	-0.730687
5	897.148	-5388.01	1.91051e+006	-24365.7	-0.730682
6	927.444	-5405.61	2.23833e+006	-28546.7	-0.730686
7	957.741	-5422.4	2.50583e+006	-31958.1	-0.730682
8	988.037	-5438.41	2.73231e+006	-34846.6	-0.730684
9	1018.33	-5453.66	2.91825e+006	-37218	-0.730684
10	1048.63	-5468.19	3.03038e+006	-38648.1	-0.730685

11	1078.93	-5482	3.10069e+006	-39544.8	-0.730685
12	1109.22	-5495.11	3.13155e+006	-39938.3	-0.730684
13	1139.52	-5507.55	3.09004e+006	-39409	-0.730685
14	1169.81	-5519.33	3.00556e+006	-38331.5	-0.730684
15	1200.11	-5530.46	2.88291e+006	-36767.3	-0.730684
16	1230.41	-5540.95	2.77439e+006	-35383.3	-0.730685
17	1260.7	-5550.83	2.6401e+006	-33670.6	-0.730684
18	1291	-5560.09	2.46985e+006	-31499.4	-0.730686
19	1321.3	-5568.75	2.30245e+006	-29364.3	-0.730682
20	1351.59	-5576.82	2.11224e+006	-26938.5	-0.730683
21	1381.89	-5584.31	1.88841e+006	-24083.8	-0.730681
22	1412.18	-5591.22	1.62702e+006	-20750.3	-0.730686
23	1442.48	-5597.57	1.33209e+006	-16988.9	-0.730686
24	1472.78	-5603.35	1.00041e+006	-12758.8	-0.730686
25	1503.07	-5608.58	635360	-8103.08	-0.730684
26	1533.37	-5613.25	1.62269e+008	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00379558

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	724.764	-5291.99	1.44226e+008	0	0
2	758.035	-5309.83	378223	-798.037	-0.120892
3	791.306	-5327.24	715947	-2997.42	-0.239876
4	824.578	-5344.23	1.0324e+006	-6398.12	-0.355076
5	857.849	-5360.8	1.25646e+006	-10190.2	-0.464673
6	891.12	-5376.97	1.42892e+006	-14139.5	-0.566937
7	924.392	-5392.74	1.5802e+006	-18210.6	-0.660261
8	957.663	-5408.11	1.69143e+006	-21940.4	-0.743171
9	990.934	-5423.09	1.78025e+006	-25304.7	-0.814355
10	1024.21	-5437.69	1.84378e+006	-28085.6	-0.872697
11	1057.48	-5451.9	1.8535e+006	-29676.2	-0.917279
12	1090.75	-5465.74	1.84321e+006	-30480.4	-0.94739
13	1124.02	-5479.21	1.79912e+006	-30228.1	-0.96257
14	1157.29	-5492.3	1.7082e+006	-28700.4	-0.962567
15	1190.56	-5505.04	1.59714e+006	-26411.4	-0.947396
16	1223.83	-5517.41	1.50367e+006	-24075.2	-0.917282
17	1257.1	-5529.43	1.42069e+006	-21640.8	-0.872696
18	1290.38	-5541.1	1.31781e+006	-18731.5	-0.814354
19	1323.65	-5552.42	1.237e+006	-16045.7	-0.743168
20	1356.92	-5563.39	1.14907e+006	-13242.2	-0.660263

21	1390.19	-5574.02	1.04098e+006	-10300.8	-0.56694
22	1423.46	-5584.31	904581	-7336.37	-0.464672
23	1456.73	-5594.27	746160	-4624.19	-0.355076
24	1490	-5603.89	566843	-2373.18	-0.239877
25	1523.28	-5613.18	370440	-781.614	-0.120892
26	1556.55	-5622.15	1.62784e+008	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.046749
Factor of Safety, standard deviation: 0.080244
Factor of Safety, minimum: 0.000359
Factor of Safety, maximum: 1.495530
Probability of Failure: 99.990% (= 9993 failed surfaces / 9994 valid surfaces), 6 invalid surfaces
Reliability index: -11.87942 (assuming normal distribution)
Reliability index: -3.20004 (assuming lognormal distribution)
* best fit = Beta

Method: gle/morgenstern-price
Factor of Safety, mean: 0.047001
Factor of Safety, standard deviation: 0.082749
Factor of Safety, minimum: 0.000346
Factor of Safety, maximum: 1.526190
Probability of Failure: 99.990% (= 9999 failed surfaces / 10000 valid surfaces)
Reliability index: -11.51679 (assuming normal distribution)
Reliability index: -3.16804 (assuming lognormal distribution)
* best fit = Beta

List Of Coordinates

Water Table

X	Y
0	0
0	-10000
3430.67	-10000
3430.67	0
0	0

External Boundary

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 55PC Site 82		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	4/01/2013		File Name: RR0705_55_82_1g.slim

X	Y
3430.67	-10000
3430.67	-5805.57
3337.95	-5804.19
3245.23	-5803.52
3152.51	-5802.2
3059.79	-5801.27
2967.07	-5800.27
2874.35	-5798.66
2781.63	-5796.46
2688.91	-5794.69
2596.19	-5792.17
2503.47	-5787.92
2410.74	-5782.22
2318.02	-5776.12
2225.3	-5770.36
2132.58	-5765.11
2039.86	-5756.8
1947.14	-5742.89
1854.42	-5720.43
1761.7	-5693.12
1668.98	-5662.12
1576.26	-5629.71
1483.53	-5594.13
1390.81	-5558.25
1298.09	-5522.76
1205.37	-5484.48
1112.65	-5442.7
1019.93	-5403.03
927.21	-5365.36
834.49	-5328.77
741.77	-5297.39
649.05	-5267.94
556.33	-5234.8
463.6	-5207.45
370.88	-5198.33
278.16	-5201.72
185.44	-5205.03
92.72	-5217.16
0	-5230.36

rocscience SLIDEINTERPRET 6.020	*Project*	Sumatra Submarine Slide		
	Analysis Description	RR0705 55PC Site 82		
	Drawn By Jason R. Patton		*Scale*	*Company* Oregon State University
	Date 4/01/2013			*File Name* RR0705_55_82_1g.slim

0 -10000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 57PC Site 81		
	Drawn By	Jason R. Patton	Company	Oregon State University
	Date	3/25/2013	File Name	RR0705_57_81_0g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_57_81_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 57PC Site 81
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/25/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364852399
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 57PC Site 81		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/25/2013	File Name: RR0705_57_81_0g.sli	

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Global Minimums

Method: spencer

FS: 1.008140
Center: 1901.729, -3601.844
Radius: 1894.640
Left Slip Surface Endpoint: 661.157, -5033.850
Right Slip Surface Endpoint: 1368.239, -5419.823
Left Slope Intercept: 661.157 0.000
Right Slope Intercept: 1368.239 0.000
Resisting Moment=1.25395e+008 kN-m
Driving Moment=1.24382e+008 kN-m
Resisting Horizontal Force=57985.4 kN
Driving Horizontal Force=57517.2 kN
Total Slice Area=3.71908e+006 m2

Method: gle/morgenstern-price

FS: 1.009620
Center: 1908.398, -3591.328
Radius: 1907.322
Left Slip Surface Endpoint: 659.889, -5033.237
Right Slip Surface Endpoint: 1372.036, -5421.680
Left Slope Intercept: 659.889 0.000
Right Slope Intercept: 1372.036 0.000
Resisting Moment=1.27864e+008 kN-m
Driving Moment=1.26646e+008 kN-m
Resisting Horizontal Force=58688.4 kN

Driving Horizontal Force=58129.4 kN
Total Slice Area=3.74633e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2404
Number of Invalid Surfaces: 577

Error Codes:

Error Code -108 reported for 576 surfaces
Error Code -112 reported for 1 surface

Method: gle/morgenstern-price

Number of Valid Surfaces: 2980
Number of Invalid Surfaces: 1

Error Codes:

Error Code -108 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.00814

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	28.2833	1.47077e+006	basement	5.551	27.1	9.47746	9.55461	51980.1	51972.4	7.72736
2	28.2833	1.47919e+006	basement	5.551	27.1	29.8132	30.0559	52263	52215	47.9782
3	28.2833	1.4872e+006	basement	5.551	27.1	48.8337	49.2312	52533.5	52448.3	85.1916
4	28.2833	1.49465e+006	basement	5.551	27.1	64.6048	65.1307	52789	52672.6	116.428

5	28.2833	1.50163e+006	basement	5.551	27.1	77.2427	77.8715	53029.7	52888.3	141.383
6	28.2833	1.50826e+006	basement	5.551	27.1	88.4309	89.1507	53259.2	53095.9	163.261
7	28.2833	1.51453e+006	basement	5.551	27.1	98.1083	98.9069	53478	53295.5	182.528
8	28.2833	1.52046e+006	basement	5.551	27.1	106.131	106.995	53685.9	53487.6	198.334
9	28.2833	1.52607e+006	basement	5.551	27.1	112.721	113.639	53883.4	53672.3	211.108
10	28.2833	1.53133e+006	basement	5.551	27.1	117.77	118.729	54071	53849.8	221.24
11	28.2833	1.53621e+006	basement	5.551	27.1	120.026	121.003	54246.2	54020.5	225.651
12	28.2833	1.54079e+006	basement	5.551	27.1	120.618	121.6	54411.3	54184.6	226.721
13	28.2833	1.5451e+006	basement	5.551	27.1	119.763	120.738	54567.2	54342.1	225.083
14	28.2833	1.54919e+006	basement	5.551	27.1	118.239	119.201	54715.5	54493.4	222.093
15	28.2833	1.55302e+006	basement	5.551	27.1	115.63	116.571	54855.4	54638.5	216.881
16	28.2833	1.55658e+006	basement	5.551	27.1	111.621	112.53	54986.8	54777.6	209.179
17	28.2833	1.55988e+006	basement	5.551	27.1	106.029	106.892	55108.9	54910.9	197.956
18	28.2833	1.56292e+006	basement	5.551	27.1	98.79	99.5942	55222.3	55038.4	183.881
19	28.2833	1.56571e+006	basement	5.551	27.1	90.1337	90.8674	55327	55160.3	166.698
20	28.2833	1.56824e+006	basement	5.551	27.1	79.8753	80.5255	55423.2	55276.8	146.393
21	28.2833	1.57048e+006	basement	5.551	27.1	67.3694	67.9178	55509.7	55387.9	121.762
22	28.2833	1.5725e+006	basement	5.551	27.1	53.3805	53.815	55588.1	55493.7	94.4029
23	28.2833	1.57436e+006	basement	5.551	27.1	38.1395	38.45	55658.5	55594.3	64.2164
24	28.2833	1.57631e+006	basement	5.551	27.1	26.4084	26.6234	55731	55689.7	41.2531
25	28.2833	1.57807e+006	basement	5.551	27.1	14.4561	14.5738	55797.7	55780.2	17.4687

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.00962

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	28.4859	1.48115e+006	basement	5.551	27.1	13.2852	13.413	51982.2	51966.9	15.3043
2	28.4859	1.48969e+006	basement	5.551	27.1	31.779	32.0847	52263	52211.1	51.9386
3	28.4859	1.49781e+006	basement	5.551	27.1	49.1358	49.6085	52532	52445.9	86.1483
4	28.4859	1.50536e+006	basement	5.551	27.1	63.5406	64.1519	52786.1	52671.7	114.408
5	28.4859	1.51244e+006	basement	5.551	27.1	75.4002	76.1255	53026.8	52888.9	137.86
6	28.4859	1.51916e+006	basement	5.551	27.1	86.1022	86.9305	53256.9	53097.8	159.105
7	28.4859	1.52552e+006	basement	5.551	27.1	95.588	96.5076	53476.6	53298.8	177.764
8	28.4859	1.53152e+006	basement	5.551	27.1	103.689	104.686	53685.7	53492	193.704
9	28.4859	1.53721e+006	basement	5.551	27.1	110.591	111.655	53885.2	53677.9	207.277
10	28.4859	1.54254e+006	basement	5.551	27.1	116.25	117.368	54075.3	53856.7	218.605
11	28.4859	1.54749e+006	basement	5.551	27.1	119.221	120.368	54252.8	54028.5	224.341
12	28.4859	1.55213e+006	basement	5.551	27.1	120.578	121.738	54420.7	54193.6	227.06
13	28.4859	1.55649e+006	basement	5.551	27.1	120.455	121.614	54579.1	54352.1	226.992
14	28.4859	1.56063e+006	basement	5.551	27.1	119.654	120.805	54729.6	54504.3	225.272
15	28.4859	1.56451e+006	basement	5.551	27.1	117.718	118.85	54871.9	54650.4	221.462

16	28.4859	1.56813e+006	basement	5.551	27.1	114.254	115.353	55005	54790.4	214.55
17	28.4859	1.57147e+006	basement	5.551	27.1	108.997	110.046	55128.6	54924.5	204.142
18	28.4859	1.57454e+006	basement	5.551	27.1	101.853	102.833	55243	55052.8	190.16
19	28.4859	1.57737e+006	basement	5.551	27.1	93.017	93.9118	55348.2	55175.5	172.661
20	28.4859	1.57992e+006	basement	5.551	27.1	82.1814	82.972	55444.1	55292.7	151.402
21	28.4859	1.58219e+006	basement	5.551	27.1	68.7568	69.4182	55529.2	55404.4	124.847
22	28.4859	1.58424e+006	basement	5.551	27.1	53.5429	54.058	55605.6	55510.8	94.8016
23	28.4859	1.58615e+006	basement	5.551	27.1	37.7186	38.0815	55675.5	55612	63.4889
24	28.4859	1.58813e+006	basement	5.551	27.1	25.3775	25.6216	55747.2	55708.1	39.1475
25	28.4859	1.58991e+006	basement	5.551	27.1	11.9466	12.0616	55811.8	55799.1	12.7457

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.00814

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	661.157	-5033.85	1.30499e+008	0	0
2	689.44	-5057.87	537838	369.6	0.0393734
3	717.724	-5080.96	1.03132e+006	708.721	0.0393735
4	746.007	-5103.17	1.46324e+006	1005.53	0.0393733
5	774.29	-5124.52	1.78393e+006	1225.91	0.0393734
6	802.573	-5145.06	2.06382e+006	1418.25	0.0393735
7	830.857	-5164.82	2.30404e+006	1583.33	0.0393735
8	859.14	-5183.83	2.49861e+006	1717.03	0.0393733
9	887.423	-5202.11	2.65517e+006	1824.62	0.0393734
10	915.707	-5219.69	2.77492e+006	1906.91	0.0393733
11	943.99	-5236.59	2.83059e+006	1945.17	0.0393734
12	972.273	-5252.84	2.83705e+006	1949.61	0.0393734
13	1000.56	-5268.44	2.80872e+006	1930.14	0.0393734
14	1028.84	-5283.43	2.75707e+006	1894.65	0.0393735
15	1057.12	-5297.81	2.68704e+006	1846.52	0.0393734
16	1085.41	-5311.6	2.58422e+006	1775.86	0.0393733
17	1113.69	-5324.82	2.44793e+006	1682.21	0.0393735
18	1141.97	-5337.48	2.27174e+006	1561.13	0.0393734
19	1170.26	-5349.59	2.06422e+006	1418.52	0.0393733
20	1198.54	-5361.16	1.82582e+006	1254.7	0.0393735
21	1226.82	-5372.2	1.53589e+006	1055.46	0.0393735
22	1255.11	-5382.73	1.21282e+006	833.445	0.0393734
23	1283.39	-5392.74	859930	590.94	0.0393734

24	1311.67	-5402.26	562325	386.427	0.0393734
25	1339.96	-5411.28	295201	202.861	0.0393734
26	1368.24	-5419.82	1.51279e+008	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.00962

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	659.889	-5033.24	1.30467e+008	0	0
2	688.375	-5057.42	541057	70.4108	0.00745622
3	716.861	-5080.66	1.03744e+006	267.887	0.0147949
4	745.346	-5103.01	1.47401e+006	563.411	0.0219002
5	773.832	-5124.51	1.79637e+006	898.569	0.0286601
6	802.318	-5145.18	2.07765e+006	1268.01	0.0349682
7	830.804	-5165.07	2.31899e+006	1648.29	0.0407246
8	859.29	-5184.2	2.51437e+006	2011.59	0.0458388
9	887.776	-5202.6	2.67147e+006	2342.03	0.0502302
10	916.262	-5220.3	2.7915e+006	2622.61	0.0538293
11	944.748	-5237.31	2.84607e+006	2810.49	0.0565795
12	973.233	-5253.66	2.852e+006	2908.83	0.0584375
13	1001.72	-5269.37	2.82288e+006	2925.27	0.059374
14	1030.21	-5284.45	2.77144e+006	2871.96	0.0593739
15	1058.69	-5298.92	2.7003e+006	2754.11	0.0584375
16	1087.18	-5312.8	2.59613e+006	2563.68	0.0565796
17	1115.66	-5326.1	2.45759e+006	2308.9	0.0538292
18	1144.15	-5338.84	2.27947e+006	1998.37	0.0502302
19	1172.63	-5351.02	2.06978e+006	1655.91	0.045839
20	1201.12	-5362.66	1.82897e+006	1299.99	0.0407245
21	1229.61	-5373.77	1.53401e+006	936.218	0.034968
22	1258.09	-5384.36	1.20786e+006	604.19	0.0286602
23	1286.58	-5394.44	851668	325.534	0.0219002
24	1315.06	-5404.01	567798	146.616	0.0147948
25	1343.55	-5413.09	298041	38.7858	0.00745623
26	1372.04	-5421.68	1.51382e+008	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.015199
Factor of Safety, standard deviation: 0.167942
Factor of Safety, minimum: 0.519259

Factor of Safety, maximum: 1.615470
Probability of Failure: 48.400% (= 4840 failed surfaces / 10000 valid surfaces)
Reliability index: 0.09050 (assuming normal distribution)
Reliability index: 0.00965 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 1.016815
Factor of Safety, standard deviation: 0.168272
Factor of Safety, minimum: 0.520206
Factor of Safety, maximum: 1.618420
Probability of Failure: 47.950% (= 4795 failed surfaces / 10000 valid surfaces)
Reliability index: 0.09993 (assuming normal distribution)
Reliability index: 0.01926 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-8000
5228	-8000
5228	0
0	0

External Boundary

X	Y
5228	-8000
5228	-5902
5136	-5904
5043	-5905
4951	-5905
4859	-5904
4767	-5903
4675	-5903
4583	-5902
4491	-5900
4399	-5899
4307	-5898
4215	-5896

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 57PC Site 81		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/25/2013	File Name: RR0705_57_81_0g.sli	

4123	-5893
4031	-5891
3939	-5888
3846	-5885
3756	-5881
3666	-5873
3575	-5861
3485	-5847
3395	-5838
3304	-5834
3214	-5837
3123	-5844
3033	-5846
2943	-5843
2852	-5838
2761	-5830
2670	-5823
2578	-5811
2487	-5794
2396	-5772
2305	-5747
2213	-5721
2122	-5695
2031	-5667
1939	-5639
1848	-5609
1757	-5578
1664	-5545
1572	-5510
1479	-5471
1387	-5429
1295	-5384
1202	-5330
1110	-5278
1017	-5226
925	-5173
832	-5122
740	-5072
647	-5027
555	-4992

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 57PC Site 81		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/25/2013	File Name: RR0705_57_81_0g.sli	

462	-4975
370	-4972
277	-4980
185	-4992
92	-5007
0	-5025
0	-8000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 57PC Site 81	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/25/2013	File Name: RR0705_57_81_1g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_57_81_1g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 57PC Site 81
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/25/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 57PC Site 81		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/25/2013	File Name: RR0705_57_81_1g.sli	

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364851929
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.000858
Center: 1778.009, -3848.966
Radius: 1611.494
Left Slip Surface Endpoint: 714.419, -5059.622
Right Slip Surface Endpoint: 1308.197, -5390.455
Left Slope Intercept: 714.419 0.000
Right Slope Intercept: 1308.197 0.000
Resisting Moment=587115 kN-m
Driving Moment=6.84369e+008 kN-m
Resisting Horizontal Force=372.328 kN

Driving Horizontal Force=434003 kN
Total Slice Area=3.11894e+006 m2

Method: gle/morgenstern-price

FS: 0.000915
Center: 1815.559, -3786.649
Radius: 1685.729
Left Slip Surface Endpoint: 705.542, -5055.327
Right Slip Surface Endpoint: 1329.008, -5400.634
Left Slope Intercept: 705.542 0.000
Right Slope Intercept: 1329.008 0.000
Resisting Moment=708693 kN-m
Driving Moment=7.74608e+008 kN-m
Resisting Horizontal Force=430.871 kN
Driving Horizontal Force=470946 kN
Total Slice Area=3.27758e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1446
Number of Invalid Surfaces: 91

Error Codes:

Error Code -108 reported for 81 surfaces
Error Code -111 reported for 2 surfaces
Error Code -112 reported for 8 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1528
Number of Invalid Surfaces: 9

Error Codes:

Error Code -108 reported for 2 surfaces
Error Code -111 reported for 1 surface
Error Code -112 reported for 6 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving

force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.000857893

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	23.7511	1.24087e+006	basement	5.551	27.1	466.352	0.40008	52280.7	52290.8	-10.0999
2	23.7511	1.24684e+006	basement	5.551	27.1	526.814	0.45195	52614.4	52624.2	-9.84916
3	23.7511	1.25241e+006	basement	5.551	27.1	618.492	0.5306	52914.9	52924.7	-9.75874
4	23.7511	1.2577e+006	basement	5.551	27.1	709.506	0.60868	53196.3	53205.9	-9.60451
5	23.7511	1.26273e+006	basement	5.551	27.1	794.493	0.68159	53459.4	53468.8	-9.42547
6	23.7511	1.2675e+006	basement	5.551	27.1	866.682	0.74352	53703.7	53713	-9.27036
7	23.7511	1.27202e+006	basement	5.551	27.1	936.236	0.80319	53930.3	53939.5	-9.24463
8	23.7511	1.2763e+006	basement	5.551	27.1	998.131	0.85629	54140.6	54149.7	-9.07254
9	23.7511	1.28035e+006	basement	5.551	27.1	1046.6	0.89787	54334.9	54344	-9.10209
10	23.7511	1.28414e+006	basement	5.551	27.1	1048.23	0.89927	54507.5	54516.7	-9.21992
11	23.7511	1.28767e+006	basement	5.551	27.1	1065.96	0.91448	54661.8	54670.7	-8.91073
12	23.7511	1.291e+006	basement	5.551	27.1	1071.73	0.91943	54801.6	54810.5	-8.92554
13	23.7511	1.29413e+006	basement	5.551	27.1	1071.88	0.91956	54927.6	54936.6	-8.99564
14	23.7511	1.29711e+006	basement	5.551	27.1	1079.11	0.92576	55044.6	55053.7	-9.06563
15	23.7511	1.29991e+006	basement	5.551	27.1	1054.54	0.90468	55150.3	55159.3	-9.01302
16	23.7511	1.30253e+006	basement	5.551	27.1	1013.98	0.86989	55243.1	55252.2	-9.08569
17	23.7511	1.30496e+006	basement	5.551	27.1	951.669	0.81643	55323	55332.5	-9.45718
18	23.7511	1.3072e+006	basement	5.551	27.1	862.742	0.74014	55389.5	55398.8	-9.28502
19	23.7511	1.30927e+006	basement	5.551	27.1	758.649	0.65084	55443	55452.7	-9.6635
20	23.7511	1.31117e+006	basement	5.551	27.1	630.358	0.54078	55485.2	55494.9	-9.67709
21	23.7511	1.3129e+006	basement	5.551	27.1	457.085	0.39213	55514.9	55525	-10.0909
22	23.7511	1.31443e+006	basement	5.551	27.1	239.785	0.20571	55528.9	55539.5	-10.6405
23	23.7511	1.31579e+006	basement	5.551	27.1	3.95154	0.00339	55531.3	55542	-10.7344
24	23.7511	1.317e+006	basement	5.551	27.1	0	0	55484	55533.7	-49.7147
25	23.7511	1.3181e+006	basement	5.551	27.1	0	0	55380.2	55520	-139.791

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.000914906

Slice	Width	Weight	Base	Base Cohesion	Base Friction Angle	Shear Stress	Shear Strength	Base Normal Stress	Pore Pressure	Effective Normal Stress

				[kPa]	[degrees]	[kPa]	[kPa]	[kPa]	[kPa]	[kPa]
1	24.9386	1.30195e+006	basement	5.551	27.1	88.2167	0.08071	52243.6	52254.2	-10.6254
2	24.9386	1.30854e+006	basement	5.551	27.1	209.803	0.19195	52597	52607.6	-10.5614
3	24.9386	1.31467e+006	basement	5.551	27.1	314.513	0.28775	52912.1	52922.4	-10.3064
4	24.9386	1.32047e+006	basement	5.551	27.1	414.676	0.37939	53205.3	53215.5	-10.2345
5	24.9386	1.32598e+006	basement	5.551	27.1	512.074	0.4685	53479.4	53489.3	-9.90071
6	24.9386	1.33121e+006	basement	5.551	27.1	606.029	0.55446	53734.1	53743.7	-9.5666
7	24.9386	1.33616e+006	basement	5.551	27.1	695.066	0.63592	53969.7	53979.3	-9.58064
8	24.9386	1.34084e+006	basement	5.551	27.1	780.113	0.71373	54188.5	54197.8	-9.34043
9	24.9386	1.34528e+006	basement	5.551	27.1	861.214	0.78793	54390.5	54399.6	-9.14302
10	24.9386	1.34941e+006	basement	5.551	27.1	930.872	0.85166	54569.1	54578.2	-9.13916
11	24.9386	1.35328e+006	basement	5.551	27.1	985.861	0.90197	54728.6	54737.8	-9.2274
12	24.9386	1.35692e+006	basement	5.551	27.1	1032.44	0.94459	54873.3	54882.4	-9.09755
13	24.9386	1.36034e+006	basement	5.551	27.1	1068.91	0.97795	55004.4	55013.3	-8.91122
14	24.9386	1.3636e+006	basement	5.551	27.1	1101.8	1.00804	55126.4	55135.1	-8.67536
15	24.9386	1.36666e+006	basement	5.551	27.1	1125.68	1.02989	55235	55244	-8.95917
16	24.9386	1.36951e+006	basement	5.551	27.1	1136.08	1.03941	55330.7	55339.4	-8.73381
17	24.9386	1.37215e+006	basement	5.551	27.1	1130.79	1.03457	55412.2	55420.9	-8.72308
18	24.9386	1.37459e+006	basement	5.551	27.1	1104.22	1.01026	55479.1	55488	-8.94374
19	24.9386	1.37684e+006	basement	5.551	27.1	1056.92	0.96698	55533.7	55542.5	-8.84845
20	24.9386	1.3789e+006	basement	5.551	27.1	986.768	0.9028	55575.7	55584.7	-9.00884
21	24.9386	1.38075e+006	basement	5.551	27.1	885.064	0.80975	55601.8	55611.2	-9.37235
22	24.9386	1.3824e+006	basement	5.551	27.1	745.312	0.68189	55613.9	55623.4	-9.54925
23	24.9386	1.38387e+006	basement	5.551	27.1	571.009	0.52242	55614.3	55624	-9.70139
24	24.9386	1.38519e+006	basement	5.551	27.1	361.961	0.33116	55605.3	55615.5	-10.1666
25	24.9386	1.38657e+006	basement	5.551	27.1	178.827	0.16361	55611.7	55622.3	-10.5904

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.000857893

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	714.419	-5059.62	1.31839e+008	0	0
2	738.17	-5080.08	467026	-3215.3	-0.394454
3	761.922	-5099.76	832172	-5729.2	-0.394454
4	785.673	-5118.68	1.15768e+006	-7970.18	-0.394453
5	809.424	-5136.89	1.44992e+006	-9982.18	-0.394455
6	833.175	-5154.42	1.70927e+006	-11767.7	-0.394454
7	856.926	-5171.28	1.93082e+006	-13293	-0.394455

8	880.677	-5187.51	2.12088e+006	-14601.5	-0.394455
9	904.428	-5203.13	2.28e+006	-15696.9	-0.394453
10	928.179	-5218.16	2.40402e+006	-16550.8	-0.394454
11	951.93	-5232.62	2.46778e+006	-16989.8	-0.394455
12	975.681	-5246.53	2.50161e+006	-17222.7	-0.394455
13	999.432	-5259.9	2.50597e+006	-17252.7	-0.394455
14	1023.18	-5272.75	2.48686e+006	-17121.1	-0.394454
15	1046.93	-5285.09	2.45512e+006	-16902.6	-0.394454
16	1070.69	-5296.93	2.39538e+006	-16491.3	-0.394454
17	1094.44	-5308.29	2.30805e+006	-15890.1	-0.394455
18	1118.19	-5319.19	2.19083e+006	-15083.1	-0.394455
19	1141.94	-5329.62	2.04168e+006	-14056.2	-0.394454
20	1165.69	-5339.6	1.86605e+006	-12847.1	-0.394455
21	1189.44	-5349.13	1.66436e+006	-11458.5	-0.394454
22	1213.19	-5358.24	1.4277e+006	-9829.2	-0.394455
23	1236.94	-5366.91	1.1553e+006	-7953.83	-0.394455
24	1260.69	-5375.17	858083	-5907.59	-0.394454
25	1284.45	-5383.02	533522	-3673.11	-0.394455
26	1308.2	-5390.45	1.49644e+008	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.000914906

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	705.542	-5055.33	1.31615e+008	0	0
2	730.481	-5076.72	489475	55.0451	0.00644334
3	755.42	-5097.29	895645	199.856	0.0127851
4	780.358	-5117.08	1.23672e+006	408.495	0.0189251
5	805.297	-5136.11	1.54293e+006	666.951	0.0247668
6	830.235	-5154.43	1.81492e+006	957.189	0.0302178
7	855.174	-5172.05	2.04719e+006	1257.43	0.0351923
8	880.113	-5189.01	2.24578e+006	1552.64	0.0396119
9	905.051	-5205.33	2.41162e+006	1827.01	0.0434065
10	929.99	-5221.03	2.53778e+006	2060.35	0.0465168
11	954.928	-5236.13	2.60225e+006	2220.64	0.0488936
12	979.867	-5250.65	2.6348e+006	2322.25	0.0504991
13	1004.81	-5264.61	2.63582e+006	2360.37	0.0513082
14	1029.74	-5278.02	2.61741e+006	2343.89	0.0513083
15	1054.68	-5290.89	2.57965e+006	2273.64	0.0504991
16	1079.62	-5303.25	2.5118e+006	2143.45	0.0488935
17	1104.56	-5315.1	2.41425e+006	1960.06	0.0465168

18	1129.5	-5326.45	2.28088e+006	1727.97	0.0434067
19	1154.44	-5337.33	2.1167e+006	1463.4	0.039612
20	1179.38	-5347.72	1.9239e+006	1181.71	0.0351926
21	1204.31	-5357.66	1.70096e+006	897.086	0.0302178
22	1229.25	-5367.13	1.43098e+006	618.557	0.0247667
23	1254.19	-5376.16	1.13357e+006	374.426	0.0189252
24	1279.13	-5384.75	809270	180.582	0.0127851
25	1304.07	-5392.9	504739	56.7618	0.00644335
26	1329.01	-5400.63	1.50209e+008	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.018376
Factor of Safety, standard deviation: 0.052630
Factor of Safety, minimum: 0.000080
Factor of Safety, maximum: 0.775535
Probability of Failure: 100.000% (= 9697 failed surfaces / 9697 valid surfaces), 303 invalid surfaces
Reliability index: -18.65125 (assuming normal distribution)
Reliability index: -3.42760 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 0.016634
Factor of Safety, standard deviation: 0.051142
Factor of Safety, minimum: 0.000094
Factor of Safety, maximum: 0.774895
Probability of Failure: 100.000% (= 9985 failed surfaces / 9985 valid surfaces), 15 invalid surfaces
Reliability index: -19.22802 (assuming normal distribution)
Reliability index: -3.43989 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-8000
5228	-8000
5228	0
0	0

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 57PC Site 81	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/25/2013	File Name: RR0705_57_81_1g.sli

External Boundary

X	Y
5228	-8000
5228	-5902
5136	-5904
5043	-5905
4951	-5905
4859	-5904
4767	-5903
4675	-5903
4583	-5902
4491	-5900
4399	-5899
4307	-5898
4215	-5896
4123	-5893
4031	-5891
3939	-5888
3846	-5885
3756	-5881
3666	-5873
3575	-5861
3485	-5847
3395	-5838
3304	-5834
3214	-5837
3123	-5844
3033	-5846
2943	-5843
2852	-5838
2761	-5830
2670	-5823
2578	-5811
2487	-5794
2396	-5772
2305	-5747
2213	-5721
2122	-5695
2031	-5667

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 57PC Site 81	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/25/2013	File Name: RR0705_57_81_1g.sli

1939	-5639
1848	-5609
1757	-5578
1664	-5545
1572	-5510
1479	-5471
1387	-5429
1295	-5384
1202	-5330
1110	-5278
1017	-5226
925	-5173
832	-5122
740	-5072
647	-5027
555	-4992
462	-4975
370	-4972
277	-4980
185	-4992
92	-5007
0	-5025
0	-8000

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_59_76_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 59PC Site 76
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/25/2013, 3:32:59 PM
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364852755
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 59PC Site 76		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/25/2013, 3:32:59 PM	File Name: RR0705_59_76_0g.sli	

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Global Minimums

Method: spencer

FS: 1.278980
Center: 847.429, -5392.341
Radius: 475.690
Left Slip Surface Endpoint: 515.794, -5733.367
Right Slip Surface Endpoint: 806.440, -5866.261
Left Slope Intercept: 515.794 0.000
Right Slope Intercept: 806.440 0.000
Resisting Moment=8.54935e+006 kN-m
Driving Moment=6.68451e+006 kN-m
Resisting Horizontal Force=16211.8 kN
Driving Horizontal Force=12675.6 kN
Total Slice Area=1.69161e+006 m2

Method: gle/morgenstern-price

FS: 1.278940
Center: 847.429, -5392.341
Radius: 475.690
Left Slip Surface Endpoint: 515.794, -5733.367
Right Slip Surface Endpoint: 806.440, -5866.261
Left Slope Intercept: 515.794 0.000
Right Slope Intercept: 806.440 0.000
Resisting Moment=8.54911e+006 kN-m
Driving Moment=6.68451e+006 kN-m
Resisting Horizontal Force=16211.6 kN

Driving Horizontal Force=12675.8 kN
Total Slice Area=1.69161e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1076
Number of Invalid Surfaces: 450

Error Codes:

Error Code -108 reported for 450 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1526
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.27898

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	11.6258	687415	basement	5.551	27.1	4.46999	5.71703	59110.3	59110	0.304343
2	11.6258	689084	basement	5.551	27.1	15.3077	19.5783	59246.4	59219	27.4006
3	11.6258	690596	basement	5.551	27.1	24.7237	31.6211	59371.9	59321	50.9253
4	11.6258	691981	basement	5.551	27.1	32.6637	41.7762	59487.5	59416.7	70.785
5	11.6258	693260	basement	5.551	27.1	39.7876	50.8875	59595	59506.4	88.6221
6	11.6258	694440	basement	5.551	27.1	46.1132	58.9779	59695.1	59590.6	104.452
7	11.6258	695526	basement	5.551	27.1	51.6568	66.068	59787.9	59669.6	118.297
8	11.6258	696525	basement	5.551	27.1	56.4327	72.1763	59873.9	59743.7	130.214
9	11.6258	697440	basement	5.551	27.1	60.4536	77.3189	59953.5	59813.2	140.276
10	11.6258	698265	basement	5.551	27.1	63.8081	81.6093	60026.9	59878.3	148.614
11	11.6258	698970	basement	5.551	27.1	65.0273	83.1686	60090.8	59939.1	151.669

12	11.6258	699598	basement	5.551	27.1	65.0973	83.2582	60147.7	59995.9	151.827
13	11.6258	700156	basement	5.551	27.1	64.4087	82.3774	60198.9	60048.8	150.101
14	11.6258	700646	basement	5.551	27.1	62.9663	80.5327	60244.5	60097.9	146.574
15	11.6258	701072	basement	5.551	27.1	60.7741	77.7288	60284.5	60143.4	141.051
16	11.6258	701433	basement	5.551	27.1	57.8338	73.9683	60319.1	60185.4	133.715
17	11.6258	701733	basement	5.551	27.1	54.146	69.2516	60348.4	60223.9	124.498
18	11.6258	702000	basement	5.551	27.1	49.8727	63.7862	60372.9	60259.1	113.771
19	11.6258	702241	basement	5.551	27.1	46.5085	59.4835	60396.3	60291	105.337
20	11.6258	702424	basement	5.551	27.1	42.4612	54.307	60414.9	60319.6	95.3088
21	11.6258	702550	basement	5.551	27.1	37.6882	48.2025	60428.5	60345.1	83.3668
22	11.6258	702621	basement	5.551	27.1	32.1822	41.1604	60437.2	60367.6	69.5702
23	11.6258	702636	basement	5.551	27.1	25.934	33.1691	60440.9	60386.9	54.0019
24	11.6258	702598	basement	5.551	27.1	18.9329	24.2148	60439.7	60403.2	36.5163
25	11.6258	702508	basement	5.551	27.1	11.041	14.1212	60433.4	60416.6	16.7513

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.27894

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	11.6258	687415	basement	5.551	27.1	7.81665	9.99703	59118.6	59110	8.63843
2	11.6258	689084	basement	5.551	27.1	17.0257	21.7748	59250.7	59219	31.6626
3	11.6258	690596	basement	5.551	27.1	24.9854	31.9548	59372.6	59321	51.5889
4	11.6258	691981	basement	5.551	27.1	31.9805	40.9011	59485.8	59416.7	69.0838
5	11.6258	693260	basement	5.551	27.1	38.4049	49.1176	59591.5	59506.4	85.1411
6	11.6258	694440	basement	5.551	27.1	44.273	56.6225	59690.4	59590.6	99.8301
7	11.6258	695526	basement	5.551	27.1	49.5899	63.4225	59782.8	59669.6	113.15
8	11.6258	696525	basement	5.551	27.1	54.3524	69.5134	59868.7	59743.7	125.049
9	11.6258	697440	basement	5.551	27.1	58.5486	74.8801	59948.7	59813.2	135.476
10	11.6258	698265	basement	5.551	27.1	62.3358	79.7237	60023.3	59878.3	144.959
11	11.6258	698970	basement	5.551	27.1	64.1229	82.0093	60088.5	59939.1	149.429
12	11.6258	699598	basement	5.551	27.1	64.7611	82.8256	60146.9	59995.9	151.045
13	11.6258	700156	basement	5.551	27.1	64.646	82.6783	60199.5	60048.8	150.734
14	11.6258	700646	basement	5.551	27.1	63.74	81.5196	60246.4	60097.9	148.494
15	11.6258	701072	basement	5.551	27.1	62.005	79.3007	60287.5	60143.4	144.122
16	11.6258	701433	basement	5.551	27.1	59.4043	75.9745	60323	60185.4	137.629
17	11.6258	701733	basement	5.551	27.1	55.903	71.4966	60352.8	60223.9	128.856
18	11.6258	702000	basement	5.551	27.1	51.624	66.024	60377.3	60259.1	118.162
19	11.6258	702241	basement	5.551	27.1	48.2131	61.6617	60400.6	60291	109.59
20	11.6258	702424	basement	5.551	27.1	43.9333	56.188	60418.6	60319.6	99.0003
21	11.6258	702550	basement	5.551	27.1	38.724	49.5257	60431.1	60345.1	85.9814
22	11.6258	702621	basement	5.551	27.1	32.5712	41.6566	60438.1	60367.6	70.5023

23	11.6258	702636	basement	5.551	27.1	25.4668	32.5705	60439.7	60386.9	52.8108
24	11.6258	702598	basement	5.551	27.1	17.4089	22.2649	60435.9	60403.2	32.6749
25	11.6258	702508	basement	5.551	27.1	8.48041	10.8459	60426.9	60416.6	10.3315

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.27898

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	515.794	-5733.37	1.69288e+008	0	0
2	527.42	-5744.3	386699	160.261	0.0237453
3	539.045	-5754.53	722057	299.245	0.0237453
4	550.671	-5764.11	989420	410.05	0.0237454
5	562.297	-5773.1	1.22209e+006	506.475	0.0237453
6	573.923	-5781.54	1.42232e+006	589.46	0.0237454
7	585.549	-5789.45	1.59207e+006	659.809	0.0237454
8	597.175	-5796.88	1.733e+006	718.216	0.0237454
9	608.8	-5803.85	1.84657e+006	765.284	0.0237454
10	620.426	-5810.37	1.93406e+006	801.541	0.0237453
11	632.052	-5816.48	1.96353e+006	813.755	0.0237454
12	643.678	-5822.19	1.9475e+006	807.113	0.0237454
13	655.304	-5827.51	1.90826e+006	790.847	0.0237453
14	666.93	-5832.46	1.84657e+006	765.281	0.0237453
15	678.555	-5837.05	1.76313e+006	730.701	0.0237453
16	690.181	-5841.29	1.65856e+006	687.363	0.0237453
17	701.807	-5845.19	1.5334e+006	635.494	0.0237454
18	713.433	-5848.77	1.38815e+006	575.298	0.0237454
19	725.059	-5852.02	1.27548e+006	528.605	0.0237454
20	736.685	-5854.96	1.14632e+006	475.075	0.0237454
21	748.31	-5857.59	998327	413.741	0.0237453
22	759.936	-5859.92	831801	344.727	0.0237453
23	771.562	-5861.94	647006	268.142	0.0237454
24	783.188	-5863.67	444171	184.08	0.0237454
25	794.814	-5865.11	223491	92.6223	0.0237453
26	806.44	-5866.26	1.77227e+008	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.27894

Slice	X coordinate	Y coordinate - Bottom	Interslice Normal Force	Interslice Shear Force	Interslice Force Angle

	[m]	[m]	[kN]	[kN]	[degrees]
1	515.794	-5733.37	1.69288e+008	0	0
2	527.42	-5744.3	386751	26.4361	0.00391641
3	539.045	-5754.53	722133	97.9434	0.00777107
4	550.671	-5764.11	989499	198.66	0.0115032
5	562.297	-5773.1	1.22216e+006	321.109	0.0150538
6	573.923	-5781.54	1.42238e+006	455.968	0.0183671
7	585.549	-5789.45	1.59211e+006	594.398	0.0213908
8	597.175	-5796.88	1.73303e+006	728.26	0.024077
9	608.8	-5803.85	1.84659e+006	850.319	0.0263836
10	620.426	-5810.37	1.93407e+006	954.414	0.028274
11	632.052	-5816.48	1.96354e+006	1018.46	0.0297185
12	643.678	-5822.19	1.9475e+006	1043.32	0.0306946
13	655.304	-5827.51	1.90826e+006	1038.67	0.0311862
14	666.93	-5832.46	1.84657e+006	1005.09	0.0311862
15	678.555	-5837.05	1.76313e+006	944.544	0.0306945
16	690.181	-5841.29	1.65856e+006	860.272	0.0297185
17	701.807	-5845.19	1.5334e+006	756.693	0.028274
18	713.433	-5848.77	1.38814e+006	639.212	0.0263836
19	725.059	-5852.02	1.27547e+006	535.982	0.024077
20	736.685	-5854.96	1.1463e+006	427.958	0.0213907
21	748.31	-5857.59	998298	320.021	0.0183671
22	759.936	-5859.92	831765	218.537	0.0150538
23	771.562	-5861.94	646968	129.89	0.0115031
24	783.188	-5863.67	444136	60.2384	0.00777106
25	794.814	-5865.11	223468	15.275	0.00391641
26	806.44	-5866.26	1.77227e+008	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.287238
Factor of Safety, standard deviation: 0.209323
Factor of Safety, minimum: 0.666892
Factor of Safety, maximum: 2.038960
Probability of Failure: 8.113% (= 811 failed surfaces / 9996 valid surfaces), 4 invalid surfaces
Reliability index: 1.37223 (assuming normal distribution)
Reliability index: 1.48216 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price

Factor of Safety, mean: 1.287207
Factor of Safety, standard deviation: 0.209477
Factor of Safety, minimum: 0.666243
Factor of Safety, maximum: 2.038900
Probability of Failure: 8.130% (= 813 failed surfaces / 10000 valid surfaces)
Reliability index: 1.37107 (assuming normal distribution)
Reliability index: 1.48078 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-10000
2067	-10000
2067	0
0	0

External Boundary

X	Y
2067	-10000
2067	-6068
1988	-6068
1910	-6065
1832	-6057
1753	-6049
1675	-6039
1597	-6032
1509	-6022
1422	-6013
1335	-6003
1248	-5992
1160	-5978
1071	-5955
982	-5926
893	-5898
803	-5865
714	-5826

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 59PC Site 76		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/25/2013, 3:32:59 PM	File Name: RR0705_59_76_0g.sli	

625	-5780
536	-5741
446	-5707
357	-5687
268	-5678
179	-5676
89	-5679
0	-5687
0	-10000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 59PC Site 76	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/25/2013, 3:32:59 PM	File Name: RR0705_59_76_1g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_59_76_1g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 59PC Site 76
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/25/2013, 3:32:59 PM
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 59PC Site 76	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/25/2013, 3:32:59 PM	File Name: RR0705_59_76_1g.sli

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364852541
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.2
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	Yes
B_bar value	

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.2	5.7	8.7	0.5

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.132634
Center: 1850.498, -2904.401
Radius: 3137.647
Left Slip Surface Endpoint: 434.695, -5704.459
Right Slip Surface Endpoint: 764.252, -5848.020
Left Slope Intercept: 434.695 0.000
Right Slope Intercept: 764.252 0.000
Resisting Moment=2.60329e+007 kN-m
Driving Moment=1.96276e+008 kN-m
Resisting Horizontal Force=7614.96 kN

Driving Horizontal Force=57413.2 kN
Total Slice Area=1.90483e+006 m2

Method: gle/morgenstern-price

FS: 0.127287
Center: 1833.439, -2952.903
Radius: 3089.279
Left Slip Surface Endpoint: 424.451, -5702.158
Right Slip Surface Endpoint: 819.439, -5871.028
Left Slope Intercept: 424.451 0.000
Right Slope Intercept: 819.439 0.000
Resisting Moment=3.47822e+007 kN-m
Driving Moment=2.73259e+008 kN-m
Resisting Horizontal Force=10360.7 kN
Driving Horizontal Force=81396.3 kN
Total Slice Area=2.28777e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1704
Number of Invalid Surfaces: 50

Error Codes:

Error Code -108 reported for 50 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1754
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.132634

				Base	Base	Shear	Shear	Base	Pore	Effective

Number	[m]	[kN]	Material	Cohesion [kPa]	Friction Angle [degrees]	Stress [kPa]	Strength [kPa]	Normal Stress [kPa]	Pressure [kPa]	Normal Stress [kPa]
1	13.1823	775121	basement	5.551	27.1	103.678	13.7512	58820.5	58804.5	15.9848
2	13.1823	776189	basement	5.551	27.1	116.338	15.4304	58910.3	58891	19.2712
3	13.1823	777186	basement	5.551	27.1	143.852	19.0796	58996.6	58970.2	26.4492
4	13.1823	778167	basement	5.551	27.1	170.382	22.5985	59081.4	59048.1	33.2975
5	13.1823	779132	basement	5.551	27.1	195.913	25.9847	59164.5	59124.5	39.9643
6	13.1823	780081	basement	5.551	27.1	220.425	29.2358	59245.9	59199.6	46.2651
7	13.1823	781014	basement	5.551	27.1	243.901	32.3495	59325.6	59273.3	52.3153
8	13.1823	781929	basement	5.551	27.1	261.084	34.6286	59402.1	59345.3	56.8464
9	13.1823	782786	basement	5.551	27.1	260.907	34.6051	59468.2	59411.4	56.8181
10	13.1823	783615	basement	5.551	27.1	265.616	35.2297	59532.7	59474.7	58.0091
11	13.1823	784427	basement	5.551	27.1	268.973	35.6749	59595.6	59536.7	58.8658
12	13.1823	785225	basement	5.551	27.1	270.954	35.9377	59656.7	59597.4	59.3335
13	13.1823	786007	basement	5.551	27.1	271.536	36.0149	59716.2	59656.7	59.5265
14	13.1823	786775	basement	5.551	27.1	270.695	35.9034	59774	59714.7	59.2889
15	13.1823	787515	basement	5.551	27.1	253.997	33.6887	59825.1	59770.1	54.9754
16	13.1823	788183	basement	5.551	27.1	222.515	29.5131	59864.9	59818.1	46.8218
17	13.1823	788829	basement	5.551	27.1	195.831	25.9739	59903.9	59864	39.8636
18	13.1823	789461	basement	5.551	27.1	167.286	22.1878	59941.1	59908.6	32.4763
19	13.1823	790077	basement	5.551	27.1	136.847	18.1505	59976.5	59951.9	24.603
20	13.1823	790680	basement	5.551	27.1	104.479	13.8575	60010.2	59994	16.2271
21	13.1823	791268	basement	5.551	27.1	70.1503	9.30432	60042.1	60034.8	7.32046
22	13.1823	791866	basement	5.551	27.1	58.1161	7.70817	60081.3	60077.1	4.15074
23	13.1823	792501	basement	5.551	27.1	45.6546	6.05536	60124.5	60123.5	0.987847
24	13.1823	793122	basement	5.551	27.1	27.9201	3.70316	60165.2	60168.8	-3.60002
25	13.1823	793729	basement	5.551	27.1	8.29237	1.09985	60204.2	60212.9	-8.72398

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.127287

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	15.7995	928794	basement	5.551	27.1	86.9394	11.0663	58802.1	58791.5	10.6081
2	15.7995	930442	basement	5.551	27.1	199.789	25.4305	58943.8	58905.1	38.6541
3	15.7995	931905	basement	5.551	27.1	257.054	32.7196	59055.6	59002.5	53.0864
4	15.7995	933326	basement	5.551	27.1	311.988	39.712	59163.6	59096.6	66.9712
5	15.7995	934719	basement	5.551	27.1	360.651	45.9062	59267.7	59188.7	79.0257
6	15.7995	936084	basement	5.551	27.1	402.542	51.2384	59368.1	59278.8	89.2671
7	15.7995	937421	basement	5.551	27.1	437.329	55.6663	59464.6	59366.9	97.7121
8	15.7995	938694	basement	5.551	27.1	411.062	52.3229	59541.3	59449.7	91.5756
9	15.7995	939893	basement	5.551	27.1	402.205	51.1955	59615.2	59526.2	89.0459

10	15.7995	941065	basement	5.551	27.1	390.933	49.7607	59687.1	59600.8	86.3274
11	15.7995	942211	basement	5.551	27.1	375.243	47.7635	59755.8	59673.5	82.2917
12	15.7995	943329	basement	5.551	27.1	355.855	45.2957	59821.8	59744.2	77.6407
13	15.7995	944417	basement	5.551	27.1	308.215	39.2318	59878.3	59812.6	65.7129
14	15.7995	945400	basement	5.551	27.1	210.486	26.7921	59913.5	59872	41.5113
15	15.7995	946331	basement	5.551	27.1	163.263	20.7812	59957.2	59927.2	29.9638
16	15.7995	947235	basement	5.551	27.1	118.938	15.1393	59999.4	59980.5	18.9057
17	15.7995	948115	basement	5.551	27.1	78.1793	9.95121	60040.9	60032	8.85716
18	15.7995	948969	basement	5.551	27.1	41.4791	5.27975	60081	60081.6	-0.635048
19	15.7995	949823	basement	5.551	27.1	54.1256	6.88949	60134.5	60131.6	2.91355
20	15.7995	950730	basement	5.551	27.1	57.7064	7.34527	60190.4	60186.9	3.4906
21	15.7995	951619	basement	5.551	27.1	43.4974	5.53665	60240.9	60241	-0.0574193
22	15.7995	952483	basement	5.551	27.1	31.3334	3.98834	60290.3	60293.2	-2.87187
23	15.7995	953323	basement	5.551	27.1	21.12	2.6883	60338	60343.6	-5.62066
24	15.7995	954138	basement	5.551	27.1	13.0111	1.65615	60384.5	60392.3	-7.78463
25	15.7995	954983	basement	5.551	27.1	18.8656	2.40134	60437.7	60444.1	-6.37294

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.132634

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	434.695	-5704.46	1.67585e+008	0	0
2	447.877	-5711.09	197817	-565.023	-0.163653
3	461.059	-5717.64	290088	-828.576	-0.163653
4	474.241	-5724.11	378099	-1079.96	-0.163653
5	487.424	-5730.5	461852	-1319.19	-0.163654
6	500.606	-5736.82	541354	-1546.26	-0.163652
7	513.788	-5743.07	616608	-1761.21	-0.163653
8	526.971	-5749.24	687618	-1964.04	-0.163653
9	540.153	-5755.33	739598	-2112.51	-0.163653
10	553.335	-5761.36	755106	-2156.8	-0.163653
11	566.517	-5767.31	766273	-2188.7	-0.163653
12	579.7	-5773.18	773111	-2208.23	-0.163653
13	592.882	-5778.98	775628	-2215.42	-0.163653
14	606.064	-5784.72	773837	-2210.3	-0.163653
15	619.247	-5790.38	767748	-2192.91	-0.163653
16	632.429	-5795.96	722690	-2064.21	-0.163653
17	645.611	-5801.48	646381	-1846.25	-0.163653

18	658.793	-5806.93	565662	-1615.7	-0.163653
19	671.976	-5812.31	480553	-1372.6	-0.163653
20	685.158	-5817.61	391072	-1117.02	-0.163654
21	698.34	-5822.85	297238	-849	-0.163653
22	711.522	-5828.02	199071	-568.606	-0.163653
23	724.705	-5833.12	146960	-419.762	-0.163654
24	737.887	-5838.16	102332	-292.29	-0.163653
25	751.069	-5843.12	53556.6	-152.973	-0.163653
26	764.252	-5848.02	1.76127e+008	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.127287

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	424.451	-5702.16	1.6745e+008	0	0
2	440.251	-5710.2	263411	-368.902	-0.0802416
3	456.05	-5718.12	429918	-1194.69	-0.159218
4	471.85	-5725.94	538217	-2213.92	-0.235681
5	487.649	-5733.64	639986	-3445.13	-0.308428
6	503.449	-5741.23	735298	-4829.39	-0.37631
7	519.248	-5748.71	824231	-6304.68	-0.438256
8	535.048	-5756.08	906871	-7807.94	-0.493291
9	550.847	-5763.35	930797	-8781.66	-0.540544
10	566.647	-5770.51	945177	-9556.3	-0.579275
11	582.446	-5777.56	953440	-10132.4	-0.608871
12	598.246	-5784.5	955636	-10489.2	-0.628862
13	614.045	-5791.34	951809	-10614.6	-0.638938
14	629.845	-5798.08	919625	-10255.7	-0.638939
15	645.645	-5804.71	830750	-9118.42	-0.628861
16	661.444	-5811.24	735644	-7817.81	-0.608869
17	677.244	-5817.66	634265	-6412.79	-0.579274
18	693.043	-5823.99	526556	-4967.83	-0.540545
19	708.843	-5830.22	412458	-3551.16	-0.49329
20	724.642	-5836.34	341638	-2613.25	-0.438257
21	740.442	-5842.37	288734	-1896.39	-0.37631
22	756.241	-5848.29	229672	-1236.36	-0.308429
23	772.041	-5854.12	164414	-676.309	-0.235682
24	787.84	-5859.86	92925.7	-258.229	-0.159217
25	803.64	-5865.49	17932.6	-25.1142	-0.0802414
26	819.439	-5871.03	1.77515e+008	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.183060
Factor of Safety, standard deviation: 0.122049
Factor of Safety, minimum: 0.000000
Factor of Safety, maximum: 0.967390
Probability of Failure: 100.000% (= 9986 failed surfaces / 9986 valid surfaces), 14 invalid surfaces
Reliability index: -6.69353 (assuming normal distribution)
Reliability index: -3.10307 (assuming lognormal distribution)
* best fit = Beta

Method: gle/morgenstern-price
Factor of Safety, mean: 0.176486
Factor of Safety, standard deviation: 0.121136
Factor of Safety, minimum: 0.000000
Factor of Safety, maximum: 0.957289
Probability of Failure: 100.000% (= 9993 failed surfaces / 9993 valid surfaces), 7 invalid surfaces
Reliability index: -6.79824 (assuming normal distribution)
Reliability index: -3.10238 (assuming lognormal distribution)
* best fit = Beta

List Of Coordinates

Water Table

X	Y
0	0
0	-10000
2067	-10000
2067	0
0	0

External Boundary

X	Y
2067	-10000
2067	-6068
1988	-6068
1910	-6065
1832	-6057
1753	-6049
1675	-6039

1597	-6032
1509	-6022
1422	-6013
1335	-6003
1248	-5992
1160	-5978
1071	-5955
982	-5926
893	-5898
803	-5865
714	-5826
625	-5780
536	-5741
446	-5707
357	-5687
268	-5678
179	-5676
89	-5679
0	-5687
0	-10000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 61PC Site 78		
	Drawn By	Jason R. Patton	Company	Oregon State University
	Date	3/25/2013	File Name	RR0705_61_78_0g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_61_78_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 61PC Site 78
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/25/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364853050
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 61PC Site 78		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/25/2013	File Name: RR0705_61_78_0g.sli	

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Global Minimums

Method: spencer

FS: 1.280150
Center: 896.938, -3564.854
Radius: 402.171
Left Slip Surface Endpoint: 615.490, -3852.132
Right Slip Surface Endpoint: 859.525, -3965.281
Left Slope Intercept: 615.490 -0.000
Right Slope Intercept: 859.525 -0.000
Resisting Moment=5.20882e+006 kN-m
Driving Moment=4.0689e+006 kN-m
Resisting Horizontal Force=11654 kN
Driving Horizontal Force=9103.56 kN
Total Slice Area=958029 m2

Method: gle/morgenstern-price

FS: 1.275350
Center: 898.645, -3556.636
Radius: 410.953
Left Slip Surface Endpoint: 611.327, -3850.457
Right Slip Surface Endpoint: 861.128, -3965.873
Left Slope Intercept: 611.327 -0.000
Right Slope Intercept: 861.128 -0.000
Resisting Moment=5.54846e+006 kN-m
Driving Moment=4.35053e+006 kN-m
Resisting Horizontal Force=12187.6 kN

Driving Horizontal Force=9556.28 kN
Total Slice Area=980635 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1417
Number of Invalid Surfaces: 805

Error Codes:

Error Code -108 reported for 805 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2222
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.28015

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	9.76138	387912	basement	5.551	27.1	4.33413	5.54833	39724.6	39724.6	0.011355
2	9.76138	389087	basement	5.551	27.1	13.0625	16.7219	39838.6	39816.8	21.8102
3	9.76138	390174	basement	5.551	27.1	21.0951	27.0049	39945.1	39903.2	41.871
4	9.76138	391166	basement	5.551	27.1	28.3375	36.2763	40044.2	39984.2	60.0313
5	9.76138	392068	basement	5.551	27.1	34.1148	43.672	40134.6	40060.2	74.4207
6	9.76138	392899	basement	5.551	27.1	39.2081	50.1922	40218.8	40131.5	87.274
7	9.76138	393665	basement	5.551	27.1	43.6394	55.865	40296.8	40198.5	98.3103
8	9.76138	394368	basement	5.551	27.1	47.4212	60.7063	40369.1	40261.3	107.8
9	9.76138	395013	basement	5.551	27.1	50.5647	64.7304	40436	40320.3	115.674
10	9.76138	395602	basement	5.551	27.1	53.0792	67.9493	40497.5	40375.5	121.956
11	9.76138	396138	basement	5.551	27.1	54.9727	70.3733	40553.9	40427.2	126.688

12	9.76138	396622	basement	5.551	27.1	56.2522	72.0112	40605.4	40475.5	129.927
13	9.76138	397051	basement	5.551	27.1	56.984	72.9481	40652.3	40520.6	131.702
14	9.76138	397407	basement	5.551	27.1	56.1487	71.8788	40692	40562.4	129.604
15	9.76138	397714	basement	5.551	27.1	54.3644	69.5946	40726.4	40601.2	125.164
16	9.76138	397976	basement	5.551	27.1	51.9548	66.5099	40756.2	40637.1	119.144
17	9.76138	398194	basement	5.551	27.1	48.9204	62.6254	40781.6	40670.1	111.547
18	9.76138	398370	basement	5.551	27.1	45.2606	57.9404	40802.6	40700.2	102.426
19	9.76138	398505	basement	5.551	27.1	40.9736	52.4523	40819.3	40727.6	91.7295
20	9.76138	398599	basement	5.551	27.1	36.0559	46.1569	40831.7	40752.3	79.4459
21	9.76138	398653	basement	5.551	27.1	30.5028	39.0482	40839.9	40774.4	65.5329
22	9.76138	398669	basement	5.551	27.1	24.1872	30.9633	40843.5	40793.9	49.6411
23	9.76138	398695	basement	5.551	27.1	18.2643	23.3811	40845.7	40810.8	34.8745
24	9.76138	398715	basement	5.551	27.1	13.9292	17.8315	40849.2	40825.2	24.0136
25	9.76138	398697	basement	5.551	27.1	8.98626	11.5038	40848.8	40837.1	11.659

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.27535

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	9.99206	396920	basement	5.551	27.1	7.13123	9.09482	39715.3	39708.4	6.87741
2	9.99206	398149	basement	5.551	27.1	14.9637	19.0839	39829.1	39802.6	26.4542
3	9.99206	399285	basement	5.551	27.1	22.2438	28.3686	39935.4	39890.8	44.5881
4	9.99206	400330	basement	5.551	27.1	28.9277	36.893	40034.8	39973.5	61.3094
5	9.99206	401274	basement	5.551	27.1	34.4316	43.9124	40126.1	40051.2	74.9082
6	9.99206	402143	basement	5.551	27.1	39.2955	50.1155	40211.1	40124	87.105
7	9.99206	402943	basement	5.551	27.1	43.6402	55.6565	40290.3	40192.4	97.9201
8	9.99206	403677	basement	5.551	27.1	47.4651	60.5346	40364.1	40256.6	107.477
9	9.99206	404350	basement	5.551	27.1	50.7639	64.7417	40432.4	40316.8	115.646
10	9.99206	404965	basement	5.551	27.1	53.5248	68.2628	40495.8	40373.2	122.568
11	9.99206	405524	basement	5.551	27.1	55.7313	71.0769	40554	40426	127.971
12	9.99206	406028	basement	5.551	27.1	57.3632	73.1582	40607.3	40475.2	132.11
13	9.99206	406478	basement	5.551	27.1	58.501	74.6092	40656.1	40521.2	134.893
14	9.99206	406851	basement	5.551	27.1	58.148	74.159	40697.9	40563.9	134.048
15	9.99206	407170	basement	5.551	27.1	56.5932	72.1761	40733.6	40603.4	130.206
16	9.99206	407442	basement	5.551	27.1	54.3121	69.267	40764.5	40640	124.509
17	9.99206	407668	basement	5.551	27.1	51.2803	65.4003	40790.5	40673.5	117.011
18	9.99206	407850	basement	5.551	27.1	47.4753	60.5476	40811.7	40704.3	107.396
19	9.99206	407988	basement	5.551	27.1	42.8776	54.6839	40828.1	40732.1	96.0418
20	9.99206	408084	basement	5.551	27.1	37.4713	47.789	40839.9	40757.3	82.5619
21	9.99206	408139	basement	5.551	27.1	31.2446	39.8478	40846.7	40779.7	67.038
22	9.99206	408154	basement	5.551	27.1	24.1596	30.8119	40848.8	40799.5	49.3389

23	9.99206	408185	basement	5.551	27.1	18.31	23.3517	40851.4	40816.6	34.7934
24	9.99206	408203	basement	5.551	27.1	13.1963	16.8299	40853.2	40831.2	21.9853
25	9.99206	408181	basement	5.551	27.1	7.33704	9.3573	40850.6	40843.1	7.5237

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.28015

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	615.49	-3852.13	7.64204e+007	0	0
2	625.251	-3861.38	211511	105.446	0.028564
3	635.013	-3870.04	400252	199.541	0.0285641
4	644.774	-3878.15	567992	283.166	0.0285642
5	654.536	-3885.76	695571	346.768	0.0285641
6	664.297	-3892.91	804356	401.002	0.0285641
7	674.058	-3899.62	895917	446.649	0.0285641
8	683.82	-3905.91	971189	484.175	0.0285641
9	693.581	-3911.82	1.03098e+006	513.984	0.0285642
10	703.342	-3917.36	1.07601e+006	536.432	0.0285641
11	713.104	-3922.55	1.10689e+006	551.829	0.0285642
12	722.865	-3927.4	1.12419e+006	560.449	0.028564
13	732.627	-3931.93	1.12837e+006	562.537	0.0285642
14	742.388	-3936.14	1.10574e+006	551.254	0.0285642
15	752.149	-3940.06	1.0593e+006	528.099	0.028564
16	761.911	-3943.68	1.00085e+006	498.96	0.028564
17	771.672	-3947.02	930706	463.992	0.0285641
18	781.433	-3950.08	849149	423.333	0.0285641
19	791.195	-3952.87	756422	377.105	0.0285641
20	800.956	-3955.4	652747	325.419	0.0285641
21	810.718	-3957.67	538317	268.372	0.0285642
22	820.479	-3959.69	413308	206.05	0.0285642
23	830.24	-3961.46	285561	142.363	0.0285641
24	840.002	-3962.97	200407	99.9104	0.0285641
25	849.763	-3964.25	105188	52.4401	0.0285641
26	859.525	-3965.28	8.09758e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.27535

Slice	X coordinate	Y coordinate - Bottom	Interslice Normal Force	Interslice Shear Force	Interslice Force Angle

	[m]	[m]	[kN]	[kN]	[degrees]
1	611.327	-3850.46	7.6354e+007	0	0
2	621.319	-3859.91	215744	15.3499	0.00407652
3	631.311	-3868.75	408207	57.6286	0.00808873
4	641.303	-3877.04	579197	121.038	0.0119734
5	651.295	-3884.81	716609	195.978	0.0156692
6	661.287	-3892.11	827309	276.049	0.0191179
7	671.279	-3898.96	920394	357.665	0.0222651
8	681.271	-3905.39	996818	436.009	0.0250612
9	691.263	-3911.43	1.05741e+006	506.82	0.027462
10	701.255	-3917.08	1.10289e+006	566.498	0.0294299
11	711.247	-3922.37	1.1339e+006	612.184	0.0309336
12	721.239	-3927.32	1.151e+006	641.822	0.0319493
13	731.231	-3931.94	1.15469e+006	654.194	0.0324611
14	741.223	-3936.24	1.13431e+006	642.651	0.0324613
15	751.215	-3940.23	1.08617e+006	605.669	0.0319492
16	761.207	-3943.93	1.02573e+006	553.782	0.0309335
17	771.2	-3947.33	953312	489.667	0.0294299
18	781.192	-3950.45	869198	416.61	0.0274621
19	791.184	-3953.29	773638	338.39	0.0250612
20	801.176	-3955.86	666857	259.141	0.0222652
21	811.168	-3958.17	549056	183.204	0.0191179
22	821.16	-3960.22	420413	114.974	0.0156692
23	831.152	-3962.01	294424	61.5273	0.0119734
24	841.144	-3963.55	206562	29.1614	0.00808873
25	851.136	-3964.83	108388	7.71163	0.0040765
26	861.128	-3965.87	8.1e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.288533
Factor of Safety, standard deviation: 0.207958
Factor of Safety, minimum: 0.642170
Factor of Safety, maximum: 2.064820
Probability of Failure: 7.920% (= 792 failed surfaces / 10000 valid surfaces)
Reliability index: 1.38746 (assuming normal distribution)
Reliability index: 1.50072 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price

Factor of Safety, mean: 1.286720
Factor of Safety, standard deviation: 0.208909
Factor of Safety, minimum: 0.640947
Factor of Safety, maximum: 2.064100
Probability of Failure: 8.260% (= 826 failed surfaces / 10000 valid surfaces)
Reliability index: 1.37246 (assuming normal distribution)
Reliability index: 1.48223 (assuming lognormal distribution)
* best fit = Beta

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
1794	-6000
1794	0
0	0

External Boundary

X	Y
1794	-6000
1794	-4105
1708	-4104
1622	-4099
1536	-4096
1449	-4093
1363	-4089
1277	-4083
1191	-4071
1105	-4044
1013	-4011
921	-3988
829	-3954
737	-3906
645	-3864
553	-3827
461	-3804
368	-3796

SLIDEINTERPRET 6.020	*Project* Sumatra Submarine Slide		
	Analysis Description RR0705 61PC Site 78		
	Drawn By Jason R. Patton	*Company*	Oregon State University
	Date 3/25/2013	*File Name*	RR0705_61_78_0g.sli

276	-3805
184	-3811
92	-3817
0	-3820
0	-6000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 61PC Site 78		
	Drawn By	Jason R. Patton	Company	Oregon State University
	Date	3/25/2013	File Name	RR0705_61_78_1g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_61_78_1g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 61PC Site 78
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/25/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 61PC Site 78		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/25/2013	File Name: RR0705_61_78_1g.sli	

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364852942
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.001350
Center: 854.002, -3746.946
Radius: 216.558
Left Slip Surface Endpoint: 684.881, -3882.206
Right Slip Surface Endpoint: 854.714, -3963.503
Left Slope Intercept: 684.881 -0.000
Right Slope Intercept: 854.714 -0.000
Resisting Moment=17336 kN-m
Driving Moment=1.28432e+007 kN-m
Resisting Horizontal Force=83.8467 kN

Driving Horizontal Force=62117 kN
Total Slice Area=668958 m2

Method: gle/morgenstern-price

FS: 0.002860
Center: 922.955, -3577.158
Radius: 388.734
Left Slip Surface Endpoint: 678.174, -3879.145
Right Slip Surface Endpoint: 831.939, -3955.086
Left Slope Intercept: 678.174 -0.000
Right Slope Intercept: 831.939 -0.000
Resisting Moment=32432 kN-m
Driving Moment=1.13386e+007 kN-m
Resisting Horizontal Force=82.65 kN
Driving Horizontal Force=28895.5 kN
Total Slice Area=603410 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1226
Number of Invalid Surfaces: 35

Error Codes:

Error Code -108 reported for 28 surfaces
Error Code -112 reported for 7 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1240
Number of Invalid Surfaces: 21

Error Codes:

Error Code -108 reported for 8 surfaces
Error Code -111 reported for 1 surface
Error Code -112 reported for 12 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.00134982

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	6.79333	272021	basement	5.551	27.1	309.856	0.41825	40057.9	40067.9	-10.026
2	6.79333	272736	basement	5.551	27.1	347.713	0.46935	40210.8	40220.7	-9.8729
3	6.79333	273377	basement	5.551	27.1	386.103	0.52117	40345.6	40355.5	-9.86767
4	6.79333	273953	basement	5.551	27.1	424.538	0.57305	40464.9	40474.7	-9.77328
5	6.79333	274473	basement	5.551	27.1	462.58	0.6244	40570.5	40580.1	-9.64731
6	6.79333	274942	basement	5.551	27.1	499.859	0.67472	40663.7	40673.1	-9.43795
7	6.79333	275365	basement	5.551	27.1	536.012	0.72352	40745.5	40755	-9.4566
8	6.79333	275744	basement	5.551	27.1	556.067	0.75059	40816.7	40826.1	-9.38437
9	6.79333	276072	basement	5.551	27.1	549.458	0.74167	40873.3	40882.7	-9.38079
10	6.79333	276360	basement	5.551	27.1	566.009	0.76401	40919.5	40928.8	-9.27024
11	6.79333	276613	basement	5.551	27.1	577.603	0.77966	40957.4	40966.6	-9.24342
12	6.79333	276834	basement	5.551	27.1	583.181	0.78719	40987.2	40996.5	-9.27781
13	6.79333	277024	basement	5.551	27.1	581.411	0.7848	41009.6	41019	-9.38762
14	6.79333	277184	basement	5.551	27.1	570.521	0.7701	41024.9	41034.2	-9.27578
15	6.79333	277317	basement	5.551	27.1	548.095	0.73983	41033.3	41042.7	-9.40097
16	6.79333	277421	basement	5.551	27.1	510.779	0.68946	41034.9	41044.5	-9.59192
17	6.79333	277500	basement	5.551	27.1	453.698	0.61241	41030.2	41039.8	-9.61374
18	6.79333	277553	basement	5.551	27.1	369.457	0.4987	41019.2	41029	-9.83737
19	6.79333	277581	basement	5.551	27.1	246.351	0.33253	41001.9	41012.1	-10.2302
20	6.79333	277584	basement	5.551	27.1	64.5197	0.08709	40978.6	40989.3	-10.7013
21	6.79333	277563	basement	5.551	27.1	0	0	40934.1	40960.6	-26.5008
22	6.79333	277531	basement	5.551	27.1	0	0	40909.9	40931.2	-21.2626
23	6.79333	277501	basement	5.551	27.1	0	0	40875.2	40907.2	-32.0235
24	6.79333	277450	basement	5.551	27.1	0	0	40826.9	40877.9	-50.9684
25	6.79333	277375	basement	5.551	27.1	0	0	40746.4	40842.9	-96.5175

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00286031

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]

1	6.15059	245938	basement	5.551	27.1	42.3066	0.12101	39986.2	39996.8	-10.5849
2	6.15059	246309	basement	5.551	27.1	81.7184	0.23374	40067.1	40077.5	-10.3943
3	6.15059	246662	basement	5.551	27.1	119.183	0.3409	40142.9	40153.2	-10.2514
4	6.15059	246996	basement	5.551	27.1	154.172	0.44098	40214	40224	-9.95748
5	6.15059	247313	basement	5.551	27.1	186.214	0.53263	40280.4	40290.1	-9.73735
6	6.15059	247613	basement	5.551	27.1	214.914	0.61472	40342.2	40351.8	-9.63992
7	6.15059	247897	basement	5.551	27.1	239.957	0.68635	40399.6	40409.1	-9.47346
8	6.15059	248165	basement	5.551	27.1	261.122	0.74689	40452.9	40462.3	-9.35882
9	6.15059	248419	basement	5.551	27.1	278.285	0.79598	40502.2	40511.5	-9.3292
10	6.15059	248656	basement	5.551	27.1	284.127	0.81269	40547	40556.2	-9.18584
11	6.15059	248870	basement	5.551	27.1	277.222	0.79294	40583.1	40592.4	-9.33082
12	6.15059	249067	basement	5.551	27.1	273.656	0.78274	40614.5	40623.8	-9.33324
13	6.15059	249251	basement	5.551	27.1	266.691	0.76282	40642.4	40651.8	-9.39048
14	6.15059	249422	basement	5.551	27.1	256.734	0.73434	40666.8	40676.2	-9.37848
15	6.15059	249581	basement	5.551	27.1	244.246	0.69862	40687.8	40697.2	-9.4012
16	6.15059	249727	basement	5.551	27.1	229.727	0.65709	40705.3	40715	-9.66966
17	6.15059	249861	basement	5.551	27.1	213.676	0.61118	40719.8	40729.4	-9.64028
18	6.15059	249983	basement	5.551	27.1	196.587	0.5623	40731	40740.8	-9.75292
19	6.15059	250094	basement	5.551	27.1	178.907	0.51173	40739.1	40749	-9.9286
20	6.15059	250193	basement	5.551	27.1	160.997	0.4605	40744.1	40754.1	-10.0015
21	6.15059	250281	basement	5.551	27.1	143.093	0.40929	40746.2	40756.2	-10.0199
22	6.15059	250358	basement	5.551	27.1	125.266	0.3583	40745.3	40755.4	-10.0906
23	6.15059	250424	basement	5.551	27.1	107.349	0.30705	40741.4	40751.7	-10.275
24	6.15059	250479	basement	5.551	27.1	88.889	0.25425	40734.7	40745.1	-10.3709
25	6.15059	250527	basement	5.551	27.1	72.9641	0.2087	40727	40737.4	-10.4407

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.00134982

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	684.881	-3882.21	7.76184e+007	0	0
2	691.674	-3890.29	198923	-1063.66	-0.306363
3	698.467	-3897.63	369682	-1976.72	-0.306362
4	705.261	-3904.34	516026	-2759.24	-0.306363
5	712.054	-3910.49	640785	-3426.34	-0.306363
6	718.847	-3916.15	746157	-3989.77	-0.306363
7	725.641	-3921.36	833888	-4458.87	-0.306362
8	732.434	-3926.16	905388	-4841.19	-0.306363

9	739.227	-3930.59	956014	-5111.89	-0.306363
10	746.021	-3934.66	980598	-5243.34	-0.306362
11	752.814	-3938.41	991825	-5303.38	-0.306363
12	759.607	-3941.85	990392	-5295.71	-0.306362
13	766.401	-3945	976897	-5223.55	-0.306362
14	773.194	-3947.86	951859	-5089.67	-0.306362
15	779.987	-3950.46	915730	-4896.49	-0.306363
16	786.781	-3952.81	868913	-4646.16	-0.306363
17	793.574	-3954.9	811767	-4340.59	-0.306363
18	800.367	-3956.76	744624	-3981.57	-0.306363
19	807.161	-3958.38	667801	-3570.79	-0.306363
20	813.954	-3959.77	581619	-3109.97	-0.306363
21	820.747	-3960.94	486431	-2600.99	-0.306363
22	827.541	-3961.88	381965	-2042.4	-0.306363
23	834.334	-3962.61	301245	-1610.78	-0.306362
24	841.127	-3963.12	220450	-1178.76	-0.306361
25	847.921	-3963.42	130588	-698.268	-0.306364
26	854.714	-3963.5	8.09032e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00286031

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	678.174	-3879.14	7.7496e+007	0	0
2	684.325	-3884.03	82984.8	-20.7951	-0.0143577
3	690.475	-3888.71	158405	-78.763	-0.0284889
4	696.626	-3893.21	226546	-166.743	-0.042171
5	702.776	-3897.53	287671	-277.088	-0.0551879
6	708.927	-3901.67	342018	-401.942	-0.0673344
7	715.078	-3905.64	389807	-533.519	-0.0784192
8	721.228	-3909.45	431242	-664.35	-0.088267
9	727.379	-3913.11	466508	-787.529	-0.096723
10	733.529	-3916.62	495779	-896.912	-0.103653
11	739.68	-3919.98	512201	-973.964	-0.108949
12	745.83	-3923.19	513816	-1009.12	-0.112527
13	751.981	-3926.27	509828	-1017.33	-0.11433
14	758.132	-3929.22	500365	-998.448	-0.11433
15	764.282	-3932.03	485543	-953.592	-0.112527
16	770.433	-3934.72	465470	-885.104	-0.108949
17	776.583	-3937.28	440242	-796.441	-0.103654
18	782.734	-3939.72	409950	-692.051	-0.0967229

19	788.885	-3942.04	374673	-577.203	-0.088267
20	795.035	-3944.24	334486	-457.802	-0.0784191
21	801.186	-3946.33	289455	-340.17	-0.0673345
22	807.336	-3948.3	239642	-230.826	-0.055188
23	813.487	-3950.16	185103	-136.24	-0.042171
24	819.638	-3951.91	125890	-62.5959	-0.028489
25	825.788	-3953.55	62053.2	-15.5499	-0.0143577
26	831.939	-3955.09	8.05599e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.090332
Factor of Safety, standard deviation: 0.082287
Factor of Safety, minimum: 0.000323
Factor of Safety, maximum: 1.107640
Probability of Failure: 99.990% (= 9981 failed surfaces / 9982 valid surfaces), 18 invalid surfaces
Reliability index: -11.05482 (assuming normal distribution)
Reliability index: -3.48171 (assuming lognormal distribution)
* best fit = Exponential

Method: gle/morgenstern-price
Factor of Safety, mean: 0.037196
Factor of Safety, standard deviation: 0.077977
Factor of Safety, minimum: 0.000172
Factor of Safety, maximum: 1.048500
Probability of Failure: 99.990% (= 9998 failed surfaces / 9999 valid surfaces), 1 invalid surfaces
Reliability index: -12.34724 (assuming normal distribution)
Reliability index: -3.18451 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
1794	-6000
1794	0
0	0

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 61PC Site 78		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/25/2013	File Name: RR0705_61_78_1g.sli	

External Boundary

X	Y
1794	-6000
1794	-4105
1708	-4104
1622	-4099
1536	-4096
1449	-4093
1363	-4089
1277	-4083
1191	-4071
1105	-4044
1013	-4011
921	-3988
829	-3954
737	-3906
645	-3864
553	-3827
461	-3804
368	-3796
276	-3805
184	-3811
92	-3817
0	-3820
0	-6000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 63PC Site 75	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/25/2013	File Name: RR0705_63_75_0g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_63_75_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 63PC Site 75
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/25/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364853318
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 63PC Site 75		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/25/2013	File Name: RR0705_63_75_0g.sli	

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Global Minimums

Method: spencer

FS: 1.051210
Center: 1227.324, -2756.902
Radius: 477.238
Left Slip Surface Endpoint: 876.714, -3080.674
Right Slip Surface Endpoint: 1139.036, -3225.902
Left Slope Intercept: 876.714 0.000
Right Slope Intercept: 1139.036 0.000
Resisting Moment=6.99916e+006 kN-m
Driving Moment=6.65822e+006 kN-m
Resisting Horizontal Force=12762.3 kN
Driving Horizontal Force=12140.6 kN
Total Slice Area=832026 m2

Method: gle/morgenstern-price

FS: 1.051410
Center: 1239.636, -2742.684
Radius: 496.684
Left Slip Surface Endpoint: 875.246, -3080.196
Right Slip Surface Endpoint: 1149.114, -3231.049
Left Slope Intercept: 875.246 0.000
Right Slope Intercept: 1149.114 0.000
Resisting Moment=7.85969e+006 kN-m
Driving Moment=7.47538e+006 kN-m
Resisting Horizontal Force=13782.4 kN

Driving Horizontal Force=13108.5 kN
Total Slice Area=869502 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1823
Number of Invalid Surfaces: 691

Error Codes:

Error Code -108 reported for 691 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2514
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.05121

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	10.4929	333768	basement	5.551	27.1	5.58884	5.87505	31788.3	31787.6	0.681594
2	10.4929	335313	basement	5.551	27.1	19.4191	20.4136	31926.5	31897.5	29.0486
3	10.4929	336661	basement	5.551	27.1	29.0093	30.4949	32049.6	32000.9	48.7188
4	10.4929	337907	basement	5.551	27.1	37.2327	39.1394	32163.8	32098.1	65.6596
5	10.4929	339062	basement	5.551	27.1	44.6222	46.9073	32270.6	32189.8	80.827
6	10.4929	340134	basement	5.551	27.1	51.193	53.8146	32370.7	32276.4	94.2615
7	10.4929	341128	basement	5.551	27.1	56.9593	59.8762	32464.2	32358	106.244
8	10.4929	342047	basement	5.551	27.1	61.9341	65.1057	32551.6	32435.2	116.352
9	10.4929	342898	basement	5.551	27.1	66.1287	69.5152	32633	32508	125.041
10	10.4929	343672	basement	5.551	27.1	69.6611	73.2284	32709.1	32576.8	132.255
11	10.4929	344334	basement	5.551	27.1	70.5592	74.1725	32775.9	32641.8	134.063

12	10.4929	344929	basement	5.551	27.1	69.997	73.5815	32836	32703	132.988
13	10.4929	345467	basement	5.551	27.1	68.6267	72.1411	32890.9	32760.7	130.165
14	10.4929	345950	basement	5.551	27.1	66.4545	69.8576	32940.7	32815	125.69
15	10.4929	346380	basement	5.551	27.1	63.4847	66.7358	32985.6	32866	119.639
16	10.4929	346758	basement	5.551	27.1	59.7207	62.779	33025.8	32913.9	111.87
17	10.4929	347087	basement	5.551	27.1	55.1637	57.9886	33061.2	32958.7	102.463
18	10.4929	347370	basement	5.551	27.1	49.6284	52.1699	33091.7	33000.6	91.1025
19	10.4929	347663	basement	5.551	27.1	44.9204	47.2208	33120.9	33039.5	81.3974
20	10.4929	347932	basement	5.551	27.1	41.2549	43.3676	33149.5	33075.6	73.9201
21	10.4929	348157	basement	5.551	27.1	36.8581	38.7456	33173.9	33109	64.8701
22	10.4929	348339	basement	5.551	27.1	31.7241	33.3487	33194	33139.7	54.3186
23	10.4929	348477	basement	5.551	27.1	25.8461	27.1697	33209.9	33167.7	42.1935
24	10.4929	348574	basement	5.551	27.1	19.2156	20.1996	33221.8	33193.1	28.6582
25	10.4929	348629	basement	5.551	27.1	11.8232	12.4286	33229.4	33216	13.3922

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.05141

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	10.9547	348437	basement	5.551	27.1	9.7881	10.2913	31794.3	31785	9.25402
2	10.9547	350123	basement	5.551	27.1	21.7796	22.8993	31933.3	31899.4	33.8926
3	10.9547	351590	basement	5.551	27.1	30.353	31.9134	32058.5	32006.9	51.5621
4	10.9547	352942	basement	5.551	27.1	37.9413	39.8919	32175.3	32108.2	67.0528
5	10.9547	354196	basement	5.551	27.1	44.9074	47.2161	32285	32203.6	81.4
6	10.9547	355359	basement	5.551	27.1	51.2647	53.9002	32388.1	32293.6	94.4869
7	10.9547	356436	basement	5.551	27.1	57.0181	59.9494	32484.8	32378.5	106.319
8	10.9547	357433	basement	5.551	27.1	62.1634	65.3592	32575.6	32458.8	116.804
9	10.9547	358355	basement	5.551	27.1	66.6884	70.1168	32660.7	32534.5	126.198
10	10.9547	359181	basement	5.551	27.1	70.6741	74.3075	32740.4	32606	134.421
11	10.9547	359891	basement	5.551	27.1	71.7088	75.3954	32810	32673.5	136.466
12	10.9547	360535	basement	5.551	27.1	71.6665	75.3509	32873.5	32737.1	136.442
13	10.9547	361116	basement	5.551	27.1	70.7693	74.4075	32931.6	32797.1	134.539
14	10.9547	361637	basement	5.551	27.1	68.9776	72.5237	32984.3	32853.5	130.809
15	10.9547	362100	basement	5.551	27.1	66.2522	69.6582	33031.7	32906.4	125.33
16	10.9547	362507	basement	5.551	27.1	62.555	65.771	33073.8	32956.1	117.685
17	10.9547	362861	basement	5.551	27.1	57.8513	60.8254	33110.6	33002.6	108.015
18	10.9547	363195	basement	5.551	27.1	52.2768	54.9644	33142.5	33046	96.514
19	10.9547	363532	basement	5.551	27.1	48.9009	51.4149	33175.9	33086.3	89.6266
20	10.9547	363821	basement	5.551	27.1	44.7996	47.1028	33204.9	33123.7	81.2356
21	10.9547	364061	basement	5.551	27.1	39.7312	41.7738	33229	33158.2	70.8247
22	10.9547	364253	basement	5.551	27.1	33.6816	35.4132	33248.3	33190	58.2943

23	10.9547	364399	basement	5.551	27.1	26.6434	28.0131	33262.8	33218.9	43.8938
24	10.9547	364499	basement	5.551	27.1	18.6156	19.5726	33272.5	33245.1	27.4362
25	10.9547	364553	basement	5.551	27.1	9.60458	10.0984	33277.6	33268.7	8.90065

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.05121

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	876.714	-3080.67	4.88763e+007	0	0
2	887.206	-3091.68	241328	154.818	0.0367567
3	897.699	-3102.02	411282	263.849	0.0367569
4	908.192	-3111.74	543934	348.948	0.0367567
5	918.685	-3120.9	659212	422.902	0.0367568
6	929.178	-3129.55	758274	486.453	0.0367568
7	939.671	-3137.71	842107	540.234	0.0367568
8	950.164	-3145.41	911565	584.794	0.0367568
9	960.657	-3152.69	967391	620.607	0.0367568
10	971.15	-3159.56	1.01023e+006	648.093	0.036757
11	981.643	-3166.04	1.02085e+006	654.903	0.0367568
12	992.136	-3172.16	1.00241e+006	643.074	0.0367568
13	1002.63	-3177.93	972373	623.803	0.0367568
14	1013.12	-3183.37	931141	597.352	0.0367568
15	1023.61	-3188.48	879079	563.953	0.0367568
16	1034.11	-3193.28	816515	523.817	0.0367568
17	1044.6	-3197.77	743745	477.132	0.0367567
18	1055.09	-3201.98	661034	424.071	0.0367568
19	1065.59	-3205.9	579840	371.983	0.0367568
20	1076.08	-3209.54	523561	335.878	0.0367567
21	1086.57	-3212.91	458161	293.923	0.0367568
22	1097.06	-3216.02	383819	246.23	0.0367567
23	1107.56	-3218.87	300694	192.903	0.0367567
24	1118.05	-3221.46	208930	134.034	0.0367567
25	1128.54	-3223.81	108659	69.7079	0.0367569
26	1139.04	-3225.9	5.35932e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.05141

Slice	X coordinate	Y coordinate - Bottom	Interslice Normal Force	Interslice Shear Force	Interslice Force Angle

	[m]	[m]	[kN]	[kN]	[degrees]
1	875.246	-3080.2	4.88612e+007	0	0
2	886.201	-3091.65	250872	28.352	0.00647521
3	897.156	-3102.41	433156	97.1335	0.0128483
4	908.11	-3112.53	570672	189.429	0.0190188
5	919.065	-3122.06	690083	299.773	0.0248894
6	930.02	-3131.06	792590	420.081	0.0303674
7	940.974	-3139.54	879218	542.708	0.0353665
8	951.929	-3147.55	950854	660.633	0.0398079
9	962.884	-3155.12	1.00827e+006	767.631	0.0436213
10	973.839	-3162.26	1.05213e+006	858.421	0.046747
11	984.793	-3169.01	1.05213e+006	902.282	0.0491355
12	995.748	-3175.37	1.03196e+006	914.043	0.0507489
13	1006.7	-3181.36	999658	899.621	0.0515621
14	1017.66	-3187	955650	860.018	0.0515622
15	1028.61	-3192.31	900312	797.439	0.0507489
16	1039.57	-3197.29	833981	715.202	0.0491355
17	1050.52	-3201.96	756963	617.599	0.0467471
18	1061.48	-3206.31	669535	509.743	0.0436215
19	1072.43	-3210.38	612897	425.828	0.0398079
20	1083.39	-3214.15	553110	341.414	0.0353665
21	1094.34	-3217.64	483771	256.404	0.0303674
22	1105.29	-3220.85	405065	175.961	0.0248894
23	1116.25	-3223.8	317159	105.278	0.0190188
24	1127.2	-3226.47	220205	49.38	0.0128483
25	1138.16	-3228.89	114341	12.9221	0.00647521
26	1149.11	-3231.05	5.37643e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.061026
Factor of Safety, standard deviation: 0.173137
Factor of Safety, minimum: 0.568634
Factor of Safety, maximum: 1.661990
Probability of Failure: 37.440% (= 3744 failed surfaces / 10000 valid surfaces)
Reliability index: 0.35247 (assuming normal distribution)
Reliability index: 0.28436 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price

Factor of Safety, mean: 1.060750
Factor of Safety, standard deviation: 0.173164
Factor of Safety, minimum: 0.570202
Factor of Safety, maximum: 1.660910
Probability of Failure: 37.550% (= 3755 failed surfaces / 10000 valid surfaces)
Reliability index: 0.35082 (assuming normal distribution)
Reliability index: 0.28257 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
2543	-6000
2543	0
0	0

External Boundary

X	Y
2543	-6000
2543	-3387
2456	-3387
2368	-3390
2281	-3388
2193	-3378
2106	-3363
2018	-3351
1931	-3349
1843	-3346
1756	-3345
1668	-3343
1581	-3342
1494	-3337
1408	-3324
1322	-3300
1235	-3268
1149	-3231

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 63PC Site 75		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/25/2013	File Name: RR0705_63_75_0g.sli	

1063	-3187
976	-3131
890	-3085
804	-3057
718	-3034
628	-2999
538	-2964
448	-2934
359	-2909
269	-2893
179	-2880
90	-2880
0	-2882
0	-6000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 63PC Site 75	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/25/2013	File Name: RR0705_63_75_1g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_63_75_1g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 63PC Site 75
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/25/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 63PC Site 75	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/25/2013	File Name: RR0705_63_75_1g.sli

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364853210
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.000984
Center: 1181.750, -2823.576
Radius: 391.283
Left Slip Surface Endpoint: 891.184, -3085.633
Right Slip Surface Endpoint: 1100.980, -3206.432
Left Slope Intercept: 891.184 0.000
Right Slope Intercept: 1100.980 0.000
Resisting Moment=29915.3 kN-m
Driving Moment=3.04114e+007 kN-m
Resisting Horizontal Force=79.4545 kN

Driving Horizontal Force=80772 kN
Total Slice Area=663133 m2

Method: gle/morgenstern-price

FS: 0.000925
Center: 1181.288, -2846.555
Radius: 369.662
Left Slip Surface Endpoint: 906.504, -3093.828
Right Slip Surface Endpoint: 1104.236, -3208.098
Left Slope Intercept: 906.504 0.000
Right Slope Intercept: 1104.236 0.000
Resisting Moment=23091.5 kN-m
Driving Moment=2.49579e+007 kN-m
Resisting Horizontal Force=65.0559 kN
Driving Horizontal Force=70314.2 kN
Total Slice Area=625809 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1392
Number of Invalid Surfaces: 85

Error Codes:

Error Code -108 reported for 65 surfaces
Error Code -111 reported for 1 surface
Error Code -112 reported for 19 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1466
Number of Invalid Surfaces: 11

Error Codes:

Error Code -108 reported for 4 surfaces
Error Code -111 reported for 1 surface
Error Code -112 reported for 6 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving

force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.000983688

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	8.39183	267205	basement	5.551	27.1	365.075	0.35912	31854.3	31864.4	-10.1153
2	8.39183	268161	basement	5.551	27.1	412.041	0.40532	32012.1	32022.2	-10.0859
3	8.39183	269048	basement	5.551	27.1	457.777	0.45031	32156.4	32166.3	-9.93971
4	8.39183	269871	basement	5.551	27.1	501.907	0.49372	32288.1	32298.1	-9.96692
5	8.39183	270636	basement	5.551	27.1	544.034	0.53516	32408.5	32418.3	-9.80714
6	8.39183	271347	basement	5.551	27.1	583.793	0.57427	32518.2	32528	-9.78766
7	8.39183	272008	basement	5.551	27.1	620.776	0.61065	32618	32627.7	-9.66809
8	8.39183	272621	basement	5.551	27.1	654.598	0.64392	32708.5	32718.1	-9.56424
9	8.39183	273189	basement	5.551	27.1	684.811	0.67364	32790.3	32799.8	-9.54586
10	8.39183	273715	basement	5.551	27.1	710.947	0.69935	32863.6	32873.1	-9.53052
11	8.39183	274184	basement	5.551	27.1	623.897	0.61372	32923.1	32932.7	-9.56882
12	8.39183	274588	basement	5.551	27.1	598.025	0.58827	32966.5	32976.2	-9.68203
13	8.39183	274956	basement	5.551	27.1	574.867	0.56549	33002.6	33012.4	-9.77373
14	8.39183	275289	basement	5.551	27.1	541.422	0.53259	33031.8	33041.6	-9.7829
15	8.39183	275587	basement	5.551	27.1	496.285	0.48819	33054.3	33064.2	-9.87392
16	8.39183	275853	basement	5.551	27.1	437.771	0.43063	33070.4	33080.4	-9.96031
17	8.39183	276087	basement	5.551	27.1	363.865	0.35793	33080.2	33090.3	-10.07
18	8.39183	276291	basement	5.551	27.1	272.078	0.26764	33083.9	33094.2	-10.273
19	8.39183	276465	basement	5.551	27.1	159.329	0.15673	33081.7	33092.3	-10.5562
20	8.39183	276609	basement	5.551	27.1	21.7752	0.02142	33073.8	33084.6	-10.8018
21	8.39183	276732	basement	5.551	27.1	0	0	33062.7	33073.8	-11.0515
22	8.39183	276867	basement	5.551	27.1	0	0	33058.6	33070.8	-12.206
23	8.39183	276980	basement	5.551	27.1	0	0	33035.1	33064.4	-29.3297
24	8.39183	277067	basement	5.551	27.1	0	0	33005.3	33052.7	-47.4057
25	8.39183	277127	basement	5.551	27.1	0	0	32930.5	33035.9	-105.422

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.000925217

Slice	Width	Weight	Base	Base Cohesion	Base Friction Angle	Shear Stress	Shear Strength	Base Normal Stress	Pore Pressure	Effective Normal Stress

				[kPa]	[degrees]	[kPa]	[kPa]	[kPa]	[kPa]	[kPa]
1	7.90929	252483	basement	5.551	27.1	101.111	0.09355	31933.7	31944.4	-10.7089
2	7.90929	253334	basement	5.551	27.1	249.39	0.23074	32083.1	32093.5	-10.4
3	7.90929	254124	basement	5.551	27.1	388.655	0.35959	32219.7	32229.9	-10.1646
4	7.90929	254858	basement	5.551	27.1	515.479	0.47693	32344.6	32354.5	-9.91838
5	7.90929	255540	basement	5.551	27.1	626.815	0.57994	32458.6	32468.3	-9.74982
6	7.90929	256173	basement	5.551	27.1	720.069	0.66622	32562.6	32572.1	-9.52755
7	7.90929	256762	basement	5.551	27.1	793.165	0.73385	32657.1	32666.5	-9.43364
8	7.90929	257309	basement	5.551	27.1	844.645	0.78148	32742.9	32752.2	-9.34249
9	7.90929	257815	basement	5.551	27.1	851.595	0.78791	32820	32829.2	-9.23368
10	7.90929	258258	basement	5.551	27.1	751.337	0.69515	32879.9	32889.3	-9.42942
11	7.90929	258653	basement	5.551	27.1	698.798	0.64654	32928.2	32937.8	-9.59127
12	7.90929	259014	basement	5.551	27.1	627.874	0.58092	32969.3	32979.1	-9.75037
13	7.90929	259343	basement	5.551	27.1	541.484	0.50099	33003.7	33013.6	-9.89298
14	7.90929	259641	basement	5.551	27.1	443.15	0.41001	33031.5	33041.6	-10.1044
15	7.90929	259908	basement	5.551	27.1	336.959	0.31176	33053	33063.3	-10.2597
16	7.90929	260146	basement	5.551	27.1	227.514	0.2105	33068.5	33078.9	-10.3867
17	7.90929	260356	basement	5.551	27.1	119.734	0.11078	33078.1	33088.7	-10.5959
18	7.90929	260539	basement	5.551	27.1	18.8496	0.01744	33082.1	33092.8	-10.729
19	7.90929	260695	basement	5.551	27.1	0	0	33070.9	33091.4	-20.4532
20	7.90929	260827	basement	5.551	27.1	0	0	33060.4	33085	-24.5659
21	7.90929	260964	basement	5.551	27.1	0	0	33071.1	33084.4	-13.2656
22	7.90929	261091	basement	5.551	27.1	0	0	33067.8	33083.8	-16.0338
23	7.90929	261193	basement	5.551	27.1	0	0	33062.3	33078.2	-15.8507
24	7.90929	261272	basement	5.551	27.1	0	0	33054.6	33067.7	-13.1319
25	7.90929	261328	basement	5.551	27.1	33.4516	0.03095	33041.5	33052.3	-10.7915

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.000983688

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	891.184	-3085.63	4.90338e+007	0	0
2	899.576	-3094.65	143509	-1096.12	-0.437616
3	907.968	-3103.12	271292	-2072.12	-0.437615
4	916.36	-3111.1	384545	-2937.14	-0.437614
5	924.752	-3118.63	484270	-3698.83	-0.437614
6	933.144	-3125.73	571313	-4363.67	-0.437615
7	941.535	-3132.44	646400	-4937.18	-0.437615

8	949.927	-3138.79	710156	-5424.14	-0.437614
9	958.319	-3144.79	763124	-5828.71	-0.437614
10	966.711	-3150.47	805782	-6154.54	-0.437615
11	975.103	-3155.84	838553	-6404.84	-0.437615
12	983.495	-3160.91	835758	-6383.49	-0.437615
13	991.886	-3165.71	820497	-6266.92	-0.437614
14	1000.28	-3170.23	796196	-6081.32	-0.437615
15	1008.67	-3174.5	763151	-5828.92	-0.437615
16	1017.06	-3178.51	721633	-5511.81	-0.437615
17	1025.45	-3182.29	671895	-5131.91	-0.437615
18	1033.85	-3185.83	614175	-4691.04	-0.437614
19	1042.24	-3189.14	548702	-4190.96	-0.437614
20	1050.63	-3192.24	475697	-3633.36	-0.437615
21	1059.02	-3195.11	395381	-3019.91	-0.437615
22	1067.41	-3197.78	326666	-2495.06	-0.437614
23	1075.8	-3200.24	267934	-2046.47	-0.437615
24	1084.2	-3202.5	202031	-1543.1	-0.437613
25	1092.59	-3204.56	129044	-985.632	-0.437614
26	1100.98	-3206.43	5.29482e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.000925217

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	906.504	-3093.83	4.92946e+007	0	0
2	914.413	-3102.34	137021	-138.384	-0.0578657
3	922.323	-3110.35	258792	-518.61	-0.114819
4	930.232	-3117.89	366486	-1087.14	-0.169961
5	938.141	-3125	461099	-1789.99	-0.222422
6	946.05	-3131.71	543484	-2574.18	-0.271376
7	953.96	-3138.05	614385	-3389.04	-0.316049
8	961.869	-3144.05	674453	-4187.59	-0.355737
9	969.778	-3149.73	724265	-4927.67	-0.389816
10	977.688	-3155.1	758473	-5530.17	-0.417747
11	985.597	-3160.17	761700	-5837.45	-0.43909
12	993.506	-3164.97	755910	-5983.31	-0.453508
13	1001.42	-3169.5	741470	-5963.05	-0.460774
14	1009.32	-3173.78	718706	-5779.98	-0.460774
15	1017.23	-3177.82	687903	-5445	-0.453507
16	1025.14	-3181.62	649306	-4976.09	-0.439089
17	1033.05	-3185.19	603127	-4397.52	-0.417748

18	1040.96	-3188.55	549543	-3738.91	-0.389816
19	1048.87	-3191.69	488695	-3034.24	-0.355737
20	1056.78	-3194.62	420463	-2319.34	-0.316049
21	1064.69	-3197.35	352276	-1668.53	-0.271375
22	1072.6	-3199.88	304109	-1180.56	-0.222423
23	1080.51	-3202.21	249153	-739.083	-0.169961
24	1088.42	-3204.36	187504	-375.753	-0.114819
25	1096.33	-3206.32	119251	-120.437	-0.0578656
26	1104.24	-3208.1	5.30032e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.021089
Factor of Safety, standard deviation: 0.057610
Factor of Safety, minimum: 0.000109
Factor of Safety, maximum: 0.792384
Probability of Failure: 100.000% (= 9987 failed surfaces / 9987 valid surfaces), 13 invalid surfaces
Reliability index: -16.99214 (assuming normal distribution)
Reliability index: -3.37135 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 0.020611
Factor of Safety, standard deviation: 0.057997
Factor of Safety, minimum: 0.000119
Factor of Safety, maximum: 0.804102
Probability of Failure: 100.000% (= 9989 failed surfaces / 9989 valid surfaces), 11 invalid surfaces
Reliability index: -16.88691 (assuming normal distribution)
Reliability index: -3.36393 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
2543	-6000
2543	0
0	0

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 63PC Site 75		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/25/2013	File Name: RR0705_63_75_1g.sli	

External Boundary

X	Y
2543	-6000
2543	-3387
2456	-3387
2368	-3390
2281	-3388
2193	-3378
2106	-3363
2018	-3351
1931	-3349
1843	-3346
1756	-3345
1668	-3343
1581	-3342
1494	-3337
1408	-3324
1322	-3300
1235	-3268
1149	-3231
1063	-3187
976	-3131
890	-3085
804	-3057
718	-3034
628	-2999
538	-2964
448	-2934
359	-2909
269	-2893
179	-2880
90	-2880
0	-2882
0	-6000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 65PC Site 70		
	Drawn By	Jason R. Patton	Company	Oregon State University
	Date	3/25/2013	File Name	RR0705_65_70_0g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_65_70_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 65PC Site 70
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/25/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364853615
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 65PC Site 70		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/25/2013	File Name: RR0705_65_70_0g.sli	

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Global Minimums

Method: spencer

FS: 1.673930
Center: 1096.249, -1751.540
Radius: 906.552
Left Slip Surface Endpoint: 602.736, -2511.988
Right Slip Surface Endpoint: 1025.532, -2655.330
Left Slope Intercept: 602.736 -0.000
Right Slope Intercept: 1025.532 -0.000
Resisting Moment=2.40269e+007 kN-m
Driving Moment=1.43536e+007 kN-m
Resisting Horizontal Force=25008.1 kN
Driving Horizontal Force=14939.8 kN
Total Slice Area=1.10068e+006 m2

Method: gle/morgenstern-price

FS: 1.675850
Center: 1096.288, -1749.846
Radius: 908.244
Left Slip Surface Endpoint: 601.906, -2511.747
Right Slip Surface Endpoint: 1025.532, -2655.330
Left Slope Intercept: 601.906 -0.000
Right Slope Intercept: 1025.532 -0.000
Resisting Moment=2.42068e+007 kN-m
Driving Moment=1.44445e+007 kN-m
Resisting Horizontal Force=25125.4 kN

Driving Horizontal Force=14992.7 kN
Total Slice Area=1.10281e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2156
Number of Invalid Surfaces: 650

Error Codes:

Error Code -108 reported for 650 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2806
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.67393

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	16.9119	438776	basement	5.551	27.1	5.54541	9.28263	25936	25928.6	7.35117
2	16.9119	441123	basement	5.551	27.1	13.7196	22.9657	26070.4	26036.3	34.0594
3	16.9119	443333	basement	5.551	27.1	21.2918	35.6409	26197.6	26138.8	58.8483
4	16.9119	445382	basement	5.551	27.1	27.8542	46.6259	26316.6	26236.4	80.2267
5	16.9119	447286	basement	5.551	27.1	33.4036	55.9153	26427.5	26329.1	98.4209
6	16.9119	449068	basement	5.551	27.1	38.3501	64.1953	26531.8	26417.2	114.574
7	16.9119	450733	basement	5.551	27.1	42.6997	71.4763	26629.6	26500.7	128.86
8	16.9119	452284	basement	5.551	27.1	46.4578	77.7671	26721	26579.9	141.13
9	16.9119	453703	basement	5.551	27.1	49.4647	82.8004	26805.8	26654.9	150.946
10	16.9119	454938	basement	5.551	27.1	50.5905	84.6849	26880.3	26725.7	154.607
11	16.9119	456061	basement	5.551	27.1	50.9134	85.2254	26948.2	26792.5	155.658

12	16.9119	457081	basement	5.551	27.1	50.6389	84.766	27010.1	26855.3	154.76
13	16.9119	458000	basement	5.551	27.1	49.7694	83.3105	27066.2	26914.2	151.974
14	16.9119	458821	basement	5.551	27.1	48.2845	80.8248	27116.5	26969.4	147.086
15	16.9119	459603	basement	5.551	27.1	46.9765	78.6353	27163.7	27020.8	142.854
16	16.9119	460322	basement	5.551	27.1	45.8675	76.779	27207.8	27068.6	139.226
17	16.9119	460948	basement	5.551	27.1	44.184	73.961	27246.5	27112.8	133.715
18	16.9119	461481	basement	5.551	27.1	41.9251	70.1796	27279.8	27153.5	126.295
19	16.9119	461923	basement	5.551	27.1	39.0887	65.4318	27307.7	27190.7	117.003
20	16.9119	462271	basement	5.551	27.1	35.645	59.6673	27330.1	27224.4	105.724
21	16.9119	462512	basement	5.551	27.1	31.3139	52.4172	27346.2	27254.7	91.5114
22	16.9119	462664	basement	5.551	27.1	26.3309	44.0761	27356.8	27281.6	75.2331
23	16.9119	462727	basement	5.551	27.1	20.7528	34.7388	27362.1	27305.1	57.0376
24	16.9119	462704	basement	5.551	27.1	14.5746	24.3969	27362.2	27325.3	36.8906
25	16.9119	462596	basement	5.551	27.1	7.74717	12.9682	27356.7	27342.3	14.4397

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.67585

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	16.9451	439598	basement	5.551	27.1	6.68726	11.2068	25937.3	25926.3	11.031
2	16.9451	441953	basement	5.551	27.1	14.3024	23.9686	26070.1	26034.1	36.021
3	16.9451	444172	basement	5.551	27.1	21.3832	35.835	26196	26136.8	59.2274
4	16.9451	446230	basement	5.551	27.1	27.551	46.1714	26313.9	26234.5	79.4289
5	16.9451	448141	basement	5.551	27.1	32.8349	55.0263	26424.1	26327.4	96.7204
6	16.9451	449930	basement	5.551	27.1	37.6059	63.0219	26528	26415.7	112.253
7	16.9451	451601	basement	5.551	27.1	41.8685	70.1653	26625.7	26499.4	126.265
8	16.9451	453158	basement	5.551	27.1	45.6229	76.4572	26717.3	26578.7	138.559
9	16.9451	454584	basement	5.551	27.1	48.7792	81.7467	26802.7	26653.8	148.875
10	16.9451	455824	basement	5.551	27.1	50.1344	84.0177	26878.1	26724.7	153.368
11	16.9451	456951	basement	5.551	27.1	50.6681	84.9121	26946.7	26791.6	155.086
12	16.9451	457975	basement	5.551	27.1	50.6226	84.8359	27009.5	26854.5	154.964
13	16.9451	458897	basement	5.551	27.1	49.9835	83.7648	27066.4	26913.6	152.85
14	16.9451	459721	basement	5.551	27.1	48.7007	81.615	27117.5	26968.8	148.661
15	16.9451	460503	basement	5.551	27.1	47.4584	79.5332	27165	27020.4	144.577
16	16.9451	461225	basement	5.551	27.1	46.5202	77.9609	27209.8	27068.3	141.468
17	16.9451	461853	basement	5.551	27.1	44.9624	75.3502	27248.9	27112.5	136.397
18	16.9451	462388	basement	5.551	27.1	42.7704	71.6768	27282.5	27153.2	129.292
19	16.9451	462831	basement	5.551	27.1	39.9314	66.919	27310.4	27190.5	119.857
20	16.9451	463180	basement	5.551	27.1	36.4019	61.0042	27332.6	27224.2	108.407
21	16.9451	463422	basement	5.551	27.1	31.8856	53.4355	27348.1	27254.5	93.6039
22	16.9451	463574	basement	5.551	27.1	26.6249	44.6194	27357.8	27281.5	76.3282

23	16.9451	463637	basement	5.551	27.1	20.6798	34.6563	27361.9	27305.1	56.8268
24	16.9451	463614	basement	5.551	27.1	14.0496	23.5451	27360.5	27325.3	35.1644
25	16.9451	463504	basement	5.551	27.1	6.7516	11.3147	27353.5	27342.3	11.2416

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.67393

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	602.736	-2511.99	3.24969e+007	0	0
2	619.648	-2522.7	150570	92.0162	0.0350145
3	636.56	-2532.9	288825	176.507	0.0350146
4	653.472	-2542.61	413016	252.403	0.0350147
5	670.383	-2551.84	513345	313.716	0.0350147
6	687.295	-2560.61	602176	368.003	0.0350147
7	704.207	-2568.94	679753	415.411	0.0350146
8	721.119	-2576.84	746300	456.08	0.0350147
9	738.031	-2584.32	802023	490.134	0.0350147
10	754.943	-2591.39	828498	506.313	0.0350147
11	771.855	-2598.06	834240	509.822	0.0350147
12	788.766	-2604.35	829545	506.952	0.0350146
13	805.678	-2610.26	814564	497.797	0.0350146
14	822.59	-2615.8	789440	482.444	0.0350147
15	839.502	-2620.98	758133	463.311	0.0350146
16	856.414	-2625.79	739058	451.654	0.0350147
17	873.326	-2630.26	710323	434.094	0.0350147
18	890.238	-2634.37	672028	410.691	0.0350147
19	907.149	-2638.15	624268	381.504	0.0350147
20	924.061	-2641.59	567130	346.585	0.0350146
21	940.973	-2644.69	496837	303.628	0.0350147
22	957.885	-2647.47	414618	253.382	0.0350147
23	974.797	-2649.92	323222	197.528	0.0350147
24	991.709	-2652.04	222712	136.104	0.0350147
25	1008.62	-2653.85	113151	69.1488	0.0350146
26	1025.53	-2655.33	3.63115e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.67585

Slice	X coordinate	Y coordinate - Bottom	Interslice Normal Force	Interslice Shear Force	Interslice Force Angle

	[m]	[m]	[kN]	[kN]	[degrees]
1	601.906	-2511.75	3.24907e+007	0	0
2	618.851	-2522.48	150830	16.6977	0.00634295
3	635.796	-2532.7	289314	63.5522	0.0125859
4	652.741	-2542.42	414317	134.719	0.0186303
5	669.686	-2551.67	514795	219.059	0.0243809
6	686.631	-2560.46	603750	313.457	0.029747
7	703.576	-2568.8	681429	412.028	0.0346441
8	720.522	-2576.71	748059	509.119	0.0389947
9	737.467	-2584.2	803847	599.497	0.0427303
10	754.412	-2591.29	831271	664.372	0.0457922
11	771.357	-2597.98	836989	703.119	0.0481317
12	788.302	-2604.28	832250	722.096	0.0497123
13	805.247	-2610.2	817206	720.404	0.0505088
14	822.192	-2615.74	791998	698.183	0.0505089
15	839.137	-2620.93	760028	659.433	0.0497123
16	856.082	-2625.75	740878	622.38	0.0481317
17	873.027	-2630.22	712046	569.084	0.0457921
18	889.972	-2634.35	673634	502.387	0.0427304
19	906.917	-2638.13	625737	425.867	0.0389946
20	923.862	-2641.57	568441	343.709	0.034644
21	940.807	-2644.68	498035	258.572	0.0297471
22	957.752	-2647.46	415608	176.853	0.024381
23	974.697	-2649.91	323986	105.347	0.0186302
24	991.642	-2652.04	223236	49.037	0.0125858
25	1008.59	-2653.85	113418	12.556	0.00634296
26	1025.53	-2655.33	3.63115e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.686616
Factor of Safety, standard deviation: 0.276447
Factor of Safety, minimum: 0.839051
Factor of Safety, maximum: 2.741210
Probability of Failure: 0.270% (= 27 failed surfaces / 10000 valid surfaces)
Reliability index: 2.48372 (assuming normal distribution)
Reliability index: 3.12901 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price

Factor of Safety, mean: 1.686941
Factor of Safety, standard deviation: 0.275316
Factor of Safety, minimum: 0.840131
Factor of Safety, maximum: 2.738070
Probability of Failure: 0.270% (= 27 failed surfaces / 10000 valid surfaces)
Reliability index: 2.49510 (assuming normal distribution)
Reliability index: 3.14417 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-5000
3686	-5000
3686	0
0	0

External Boundary

X	Y
3686	-5000
3686	-2752
3601	-2751
3515	-2755
3430	-2757
3344	-2755
3258	-2754
3173	-2750
3084	-2749
2996	-2754
2908	-2754
2819	-2752
2731	-2751
2643	-2750
2555	-2748
2466	-2746
2378	-2739
2290	-2730

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 65PC Site 70		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/25/2013	File Name: RR0705_65_70_0g.sli	

2201	-2722
2113	-2717
2024	-2707
1936	-2712
1847	-2717
1759	-2720
1670	-2721
1582	-2720
1489	-2717
1396	-2712
1303	-2704
1210	-2693
1117	-2675
1024	-2655
931	-2623
837	-2592
744	-2556
651	-2526
558	-2499
465	-2469
372	-2436
279	-2414
186	-2403
93	-2401
0	-2398
0	-5000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 65PC Site 70		
	Drawn By	Jason R. Patton	Company	Oregon State University
	Date	3/25/2013	File Name	RR0705_65_70_1g.slim

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_65_70_1g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 65PC Site 70
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/25/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 65PC Site 70		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/25/2013	File Name: RR0705_65_70_1g.slim	

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364853503
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.011529
Center: 1829.289, 1155.228
Radius: 3894.397
Left Slip Surface Endpoint: 268.612, -2412.771
Right Slip Surface Endpoint: 1024.195, -2655.042
Left Slope Intercept: 268.612 -0.000
Right Slope Intercept: 1024.195 -0.000
Resisting Moment=1.47901e+007 kN-m
Driving Moment=1.28283e+009 kN-m
Resisting Horizontal Force=3686.56 kN

Driving Horizontal Force=319757 kN
Total Slice Area=1.92528e+006 m2

Method: gle/morgenstern-price

FS: 0.011405
Center: 1829.289, 1155.228
Radius: 3894.397
Left Slip Surface Endpoint: 268.612, -2412.771
Right Slip Surface Endpoint: 1024.195, -2655.042
Left Slope Intercept: 268.612 -0.000
Right Slope Intercept: 1024.195 -0.000
Resisting Moment=1.46304e+007 kN-m
Driving Moment=1.28283e+009 kN-m
Resisting Horizontal Force=3646.93 kN
Driving Horizontal Force=319771 kN
Total Slice Area=1.92528e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 903
Number of Invalid Surfaces: 5

Error Codes:

Error Code -108 reported for 1 surface
Error Code -112 reported for 4 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 905
Number of Invalid Surfaces: 3

Error Codes:

Error Code -112 reported for 3 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with

many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.0115293

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	30.2233	753803	basement	5.551	27.1	155.713	1.79526	24974.7	24982.1	-7.35592
2	30.2233	758836	basement	5.551	27.1	234.758	2.70659	25204.6	25210.2	-5.58052
3	30.2233	763690	basement	5.551	27.1	321.698	3.70895	25423.5	25427.1	-3.62961
4	30.2233	768299	basement	5.551	27.1	376.8	4.34424	25624.3	25626.7	-2.39249
5	30.2233	772316	basement	5.551	27.1	392.497	4.52521	25774.2	25776.3	-2.05045
6	30.2233	776141	basement	5.551	27.1	415.098	4.78579	25911.7	25913.2	-1.49742
7	30.2233	779847	basement	5.551	27.1	441.389	5.0889	26043.7	26044.6	-0.934498
8	30.2233	783540	basement	5.551	27.1	476.541	5.49419	26179.9	26180.1	-0.16692
9	30.2233	787118	basement	5.551	27.1	504.682	5.81863	26310.6	26310.1	0.48908
10	30.2233	790576	basement	5.551	27.1	535.68	6.17602	26435.4	26434.1	1.25423
11	30.2233	794023	basement	5.551	27.1	578.316	6.66758	26564.6	26562.4	2.20856
12	30.2233	797365	basement	5.551	27.1	613.589	7.07425	26689.1	26686.1	2.97058
13	30.2233	800566	basement	5.551	27.1	639.506	7.37306	26805.2	26801.7	3.52032
14	30.2233	803516	basement	5.551	27.1	642.864	7.41177	26902.5	26898.8	3.68666
15	30.2233	806302	basement	5.551	27.1	645.392	7.44092	26989.4	26985.7	3.6963
16	30.2233	808947	basement	5.551	27.1	633.016	7.29823	27067.8	27064.4	3.40133
17	30.2233	811235	basement	5.551	27.1	570.892	6.58198	27116.5	27114.5	2.02765
18	30.2233	813309	basement	5.551	27.1	509.624	5.87561	27150.1	27149.5	0.637791
19	30.2233	815262	basement	5.551	27.1	444.867	5.12901	27177.3	27178.2	-0.877366
20	30.2233	817283	basement	5.551	27.1	414.748	4.78175	27216.6	27218.1	-1.53979
21	30.2233	819275	basement	5.551	27.1	366.236	4.22244	27257.6	27260.2	-2.64791
22	30.2233	821143	basement	5.551	27.1	307.487	3.54511	27291.6	27295.5	-3.9151
23	30.2233	822846	basement	5.551	27.1	225.139	2.59569	27314.4	27320.2	-5.77835
24	30.2233	824397	basement	5.551	27.1	133.228	1.53602	27327.5	27335.4	-7.88869
25	30.2233	825827	basement	5.551	27.1	0	0	27330.9	27343.9	-12.9744

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.0114048

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	30.2233	753803	basement	5.551	27.1	105.218	1.19999	24973.6	24982.1	-8.54034
2	30.2233	758836	basement	5.551	27.1	226.591	2.58423	25204.4	25210.2	-5.82436
3	30.2233	763690	basement	5.551	27.1	342.551	3.90673	25423.9	25427.1	-3.23198

4	30.2233	768299	basement	5.551	27.1	424.364	4.83979	25625.3	25626.7	-1.44106
5	30.2233	772316	basement	5.551	27.1	449.548	5.127	25775.4	25776.3	-0.880295
6	30.2233	776141	basement	5.551	27.1	474.278	5.40904	25912.9	25913.2	-0.261693
7	30.2233	779847	basement	5.551	27.1	502.394	5.7297	26044.9	26044.6	0.30512
8	30.2233	783540	basement	5.551	27.1	538.889	6.14592	26181.2	26180.1	1.10758
9	30.2233	787118	basement	5.551	27.1	562.391	6.41396	26311.7	26310.1	1.64265
10	30.2233	790576	basement	5.551	27.1	589.987	6.72868	26436.4	26434.1	2.31733
11	30.2233	794023	basement	5.551	27.1	629.396	7.17813	26565.6	26562.4	3.21194
12	30.2233	797365	basement	5.551	27.1	651.946	7.43531	26689.8	26686.1	3.69372
13	30.2233	800566	basement	5.551	27.1	657.238	7.49567	26805.5	26801.7	3.77251
14	30.2233	803516	basement	5.551	27.1	633.332	7.22303	26902.1	26898.8	3.30741
15	30.2233	806302	basement	5.551	27.1	617.102	7.03793	26988.6	26985.7	2.90422
16	30.2233	808947	basement	5.551	27.1	580.154	6.61654	27066.5	27064.4	2.06745
17	30.2233	811235	basement	5.551	27.1	487.666	5.56174	27114.6	27114.5	0.0540062
18	30.2233	813309	basement	5.551	27.1	421.53	4.80747	27148.1	27149.5	-1.43601
19	30.2233	815262	basement	5.551	27.1	361.211	4.11954	27175.3	27178.2	-2.85976
20	30.2233	817283	basement	5.551	27.1	344.321	3.92691	27214.9	27218.1	-3.20594
21	30.2233	819275	basement	5.551	27.1	302.514	3.45011	27256	27260.2	-4.15691
22	30.2233	821143	basement	5.551	27.1	257.628	2.9382	27290.4	27295.5	-5.10537
23	30.2233	822846	basement	5.551	27.1	200.374	2.28523	27313.8	27320.2	-6.39072
24	30.2233	824397	basement	5.551	27.1	141.689	1.61593	27327.7	27335.4	-7.72725
25	30.2233	825827	basement	5.551	27.1	77.9637	0.88916	27334.8	27343.9	-9.09299

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.0115293

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	268.612	-2412.77	2.99805e+007	0	0
2	298.835	-2425.84	177039	-791.993	-0.256314
3	329.058	-2438.61	319307	-1428.44	-0.256315
4	359.282	-2451.07	456694	-2043.05	-0.256315
5	389.505	-2463.25	537238	-2403.36	-0.256314
6	419.728	-2475.13	573582	-2565.95	-0.256314
7	449.952	-2486.72	602789	-2696.61	-0.256314
8	480.175	-2498.02	637090	-2850.06	-0.256314
9	510.398	-2509.04	676569	-3026.67	-0.256314
10	540.622	-2519.78	708934	-3171.45	-0.256314
11	570.845	-2530.24	744633	-3331.16	-0.256314

12	601.068	-2540.42	787530	-3523.06	-0.256314
13	631.292	-2550.33	823299	-3683.07	-0.256314
14	661.515	-2559.96	843088	-3771.6	-0.256314
15	691.738	-2569.33	838962	-3753.14	-0.256314
16	721.962	-2578.42	827121	-3700.17	-0.256314
17	752.185	-2587.26	793791	-3551.07	-0.256314
18	782.408	-2595.82	715368	-3200.24	-0.256314
19	812.632	-2604.13	628670	-2812.39	-0.256314
20	842.855	-2612.17	542618	-2427.43	-0.256314
21	873.078	-2619.95	485467	-2171.76	-0.256314
22	903.302	-2627.48	420702	-1882.04	-0.256315
23	933.525	-2634.75	347454	-1554.35	-0.256313
24	963.748	-2641.77	256239	-1146.3	-0.256314
25	993.972	-2648.53	157714	-705.541	-0.256314
26	1024.19	-2655.04	3.63036e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.0114048

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	268.612	-2412.77	2.99805e+007	0	0
2	298.835	-2425.84	178323	-202.213	-0.0649717
3	329.058	-2438.61	320856	-721.943	-0.128918
4	359.282	-2451.07	457816	-1524.83	-0.190832
5	389.505	-2463.25	537289	-2341.9	-0.249735
6	419.728	-2475.13	572334	-3043.71	-0.3047
7	449.952	-2486.72	600194	-3717.32	-0.354859
8	480.175	-2498.02	633110	-4413.61	-0.399421
9	510.398	-2509.04	671180	-5127.26	-0.437684
10	540.622	-2519.78	702258	-5749.06	-0.469043
11	570.845	-2530.24	736762	-6339.69	-0.493007
12	601.068	-2540.42	778554	-6919.3	-0.509196
13	631.292	-2550.33	813542	-7346.1	-0.517354
14	661.515	-2559.96	833066	-7522.4	-0.517354
15	691.738	-2569.33	829348	-7370.72	-0.509195
16	721.962	-2578.42	818380	-7042	-0.493007
17	752.185	-2587.26	786526	-6438.93	-0.469044
18	782.408	-2595.82	710314	-5426.2	-0.437683
19	812.632	-2604.13	625930	-4363.56	-0.399421
20	842.855	-2612.17	542067	-3357.3	-0.354858
21	873.078	-2619.95	486768	-2588.66	-0.304699

22	903.302	-2627.48	423679	-1846.7	-0.249735
23	933.525	-2634.75	351747	-1171.55	-0.190832
24	963.748	-2641.77	261206	-587.727	-0.128918
25	993.972	-2648.53	162507	-184.278	-0.0649716
26	1024.19	-2655.04	3.63036e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.075533
Factor of Safety, standard deviation: 0.098596
Factor of Safety, minimum: 0.000705
Factor of Safety, maximum: 1.438920
Probability of Failure: 99.940% (= 9992 failed surfaces / 9998 valid surfaces), 2 invalid surfaces
Reliability index: -9.37628 (assuming normal distribution)
Reliability index: -3.08873 (assuming lognormal distribution)
* best fit = Beta

Method: gle/morgenstern-price
Factor of Safety, mean: 0.078603
Factor of Safety, standard deviation: 0.099178
Factor of Safety, minimum: 0.000699
Factor of Safety, maximum: 1.442560
Probability of Failure: 99.940% (= 9994 failed surfaces / 10000 valid surfaces)
Reliability index: -9.29039 (assuming normal distribution)
Reliability index: -3.09404 (assuming lognormal distribution)
* best fit = Beta

List Of Coordinates

Water Table

X	Y
0	0
0	-5000
3686	-5000
3686	0
0	0

External Boundary

X	Y

3686	-5000
3686	-2752
3601	-2751
3515	-2755
3430	-2757
3344	-2755
3258	-2754
3173	-2750
3084	-2749
2996	-2754
2908	-2754
2819	-2752
2731	-2751
2643	-2750
2555	-2748
2466	-2746
2378	-2739
2290	-2730
2201	-2722
2113	-2717
2024	-2707
1936	-2712
1847	-2717
1759	-2720
1670	-2721
1582	-2720
1489	-2717
1396	-2712
1303	-2704
1210	-2693
1117	-2675
1024	-2655
931	-2623
837	-2592
744	-2556
651	-2526
558	-2499
465	-2469
372	-2436
279	-2414

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 65PC Site 70		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/25/2013	File Name: RR0705_65_70_1g.slim	

186	-2403
93	-2401
0	-2398
0	-5000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 70PC Site 68	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/14/2013, 11:10:35 PM	File Name: RR0705_70_68_1g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_70_68_1g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 70PC Site 68
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/14/2013, 11:10:35 PM
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364854342
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Enabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	Basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 70PC Site 68		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/14/2013, 11:10:35 PM	File Name: RR0705_70_68_1g.sli	

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 30000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
Basement	Cohesion	Normal	5.551	0.551	10.551	2.6
Basement	Phi	Normal	27.1	14.8	39.4	4.1
Basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Global Minimums

Method: spencer

FS: 2.507550
Center: 1761.934, -5168.988
Radius: 522.285
Left Slip Surface Endpoint: 1512.618, -5627.925
Right Slip Surface Endpoint: 1782.263, -5690.877
Left Slope Intercept: 1512.618 0.000
Right Slope Intercept: 1782.263 0.000
Resisting Moment=6.04495e+006 kN-m
Driving Moment=2.4107e+006 kN-m
Resisting Horizontal Force=11182 kN
Driving Horizontal Force=4459.33 kN
Total Slice Area=1.52948e+006 m2

Method: gle/morgenstern-price

FS: 2.493240
Center: 1738.309, -5323.903
Radius: 377.134
Left Slip Surface Endpoint: 1516.073, -5628.601
Right Slip Surface Endpoint: 1804.378, -5695.204
Left Slope Intercept: 1516.073 0.000
Right Slope Intercept: 1804.378 0.000
Resisting Moment=7.04498e+006 kN-m
Driving Moment=2.82563e+006 kN-m
Resisting Horizontal Force=17917.7 kN

Driving Horizontal Force=7186.52 kN
Total Slice Area=1.63836e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 608
Number of Invalid Surfaces: 334

Error Codes:

Error Code -108 reported for 334 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 942
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 2.50755

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	10.7858	625652	Basement	5.551	27.1	3.29451	8.26116	58002.2	57997	5.24627
2	10.7858	626474	Basement	5.551	27.1	6.91707	17.3449	58077.1	58054	23.0585
3	10.7858	627243	Basement	5.551	27.1	10.2514	25.7058	58147.2	58107.9	39.3367
4	10.7858	627961	Basement	5.551	27.1	13.3021	33.3556	58213	58158.6	54.3606
5	10.7858	628621	Basement	5.551	27.1	16.0001	40.1211	58273.9	58206.4	67.5089
6	10.7858	629211	Basement	5.551	27.1	18.0165	45.1773	58328.6	58251.2	77.4189
7	10.7858	629753	Basement	5.551	27.1	19.7083	49.4195	58378.9	58293.2	85.744
8	10.7858	630248	Basement	5.551	27.1	21.1256	52.9735	58425.1	58332.4	92.6665
9	10.7858	630698	Basement	5.551	27.1	22.2711	55.8458	58467.1	58368.9	98.2471
10	10.7858	631105	Basement	5.551	27.1	23.1469	58.042	58505.4	58402.8	102.56
11	10.7858	631468	Basement	5.551	27.1	23.7548	59.5664	58539.6	58434	105.564

12	10.7858	631788	Basement	5.551	27.1	24.0963	60.4228	58570	58462.7	107.251
13	10.7858	632067	Basement	5.551	27.1	24.1736	60.6166	58596.5	58489	107.534
14	10.7858	632295	Basement	5.551	27.1	23.8455	59.7939	58618.7	58512.7	106.005
15	10.7858	632480	Basement	5.551	27.1	23.165	58.0875	58636.7	58534	102.699
16	10.7858	632625	Basement	5.551	27.1	22.2184	55.7137	58650.9	58552.9	97.9953
17	10.7858	632730	Basement	5.551	27.1	21.0052	52.6716	58661.5	58569.4	92.0597
18	10.7858	632795	Basement	5.551	27.1	19.5248	48.9595	58668.4	58583.5	84.8511
19	10.7858	632822	Basement	5.551	27.1	17.7762	44.5748	58671.6	58595.3	76.3029
20	10.7858	632810	Basement	5.551	27.1	15.758	39.514	58671.1	58604.8	66.3461
21	10.7858	632759	Basement	5.551	27.1	13.4684	33.7726	58667.1	58612	55.0913
22	10.7858	632681	Basement	5.551	27.1	11.0311	27.6611	58660	58616.8	43.2119
23	10.7858	632595	Basement	5.551	27.1	8.93302	22.4	58652.3	58619.4	32.9391
24	10.7858	632472	Basement	5.551	27.1	6.62324	16.6081	58641.2	58619.7	21.5224
25	10.7858	632311	Basement	5.551	27.1	4.0377	10.1247	58626.6	58617.6	8.99407

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.49324

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	11.5322	669242	Basement	5.551	27.1	4.66032	11.6193	58028.1	58016.2	11.9161
2	11.5322	670522	Basement	5.551	27.1	9.92411	24.7432	58133.8	58096.3	37.5383
3	11.5322	671693	Basement	5.551	27.1	14.7504	36.7762	58231.3	58170.3	61.0049
4	11.5322	672760	Basement	5.551	27.1	19.1623	47.7762	58320.9	58238.5	82.4412
5	11.5322	673706	Basement	5.551	27.1	22.8463	56.9614	58401.7	58301.2	100.515
6	11.5322	674552	Basement	5.551	27.1	25.9483	64.6954	58474.5	58358.9	115.564
7	11.5322	675312	Basement	5.551	27.1	28.6622	71.4617	58540.4	58411.7	128.717
8	11.5322	675988	Basement	5.551	27.1	30.9918	77.2699	58599.9	58459.8	140.138
9	11.5322	676585	Basement	5.551	27.1	32.9371	82.1201	58653.1	58503.4	149.651
10	11.5322	677105	Basement	5.551	27.1	34.495	86.0042	58700	58542.7	157.268
11	11.5322	677550	Basement	5.551	27.1	35.659	88.9065	58740.7	58577.9	162.831
12	11.5322	677922	Basement	5.551	27.1	36.43	90.8287	58775.6	58608.9	166.707
13	11.5322	678213	Basement	5.551	27.1	36.6252	91.3153	58803.7	58636	167.658
14	11.5322	678432	Basement	5.551	27.1	36.3004	90.5057	58825.2	58659.2	166.044
15	11.5322	678583	Basement	5.551	27.1	35.5304	88.5859	58840.9	58678.6	162.282
16	11.5322	678668	Basement	5.551	27.1	34.3012	85.5212	58850.6	58694.3	156.263
17	11.5322	678686	Basement	5.551	27.1	32.5986	81.2762	58854.2	58706.2	148.036
18	11.5322	678639	Basement	5.551	27.1	30.4086	75.816	58851.9	58714.5	137.359
19	11.5322	678527	Basement	5.551	27.1	27.7177	69.1069	58843.3	58719.1	124.249
20	11.5322	678354	Basement	5.551	27.1	24.5241	61.1445	58828.8	58720.1	108.684
21	11.5322	678153	Basement	5.551	27.1	21.4621	53.5101	58811.2	58717.5	93.6833
22	11.5322	677895	Basement	5.551	27.1	18.1359	45.2171	58788.7	58711.2	77.5083

23	11.5322	677572	Basement	5.551	27.1	14.2798	35.603	58759.9	58701.2	58.7472
24	11.5322	677184	Basement	5.551	27.1	9.88332	24.6415	58724.9	58687.6	37.3414
25	11.5322	676729	Basement	5.551	27.1	4.93649	12.3079	58683.4	58670.2	13.2259

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 2.50755

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	1512.62	-5627.93	1.63119e+008	0	0
2	1523.4	-5633.62	208068	32.435	0.00893164
3	1534.19	-5639	398097	62.0582	0.00893167
4	1544.98	-5644.08	570646	88.9563	0.00893167
5	1555.76	-5648.86	726219	113.208	0.00893166
6	1566.55	-5653.35	845060	131.734	0.00893168
7	1577.33	-5657.56	939093	146.392	0.00893164
8	1588.12	-5661.5	1.01736e+006	158.593	0.00893166
9	1598.9	-5665.18	1.0802e+006	168.39	0.00893171
10	1609.69	-5668.59	1.12793e+006	175.829	0.00893164
11	1620.48	-5671.75	1.16081e+006	180.956	0.00893171
12	1631.26	-5674.66	1.17911e+006	183.808	0.00893167
13	1642.05	-5677.33	1.18304e+006	184.421	0.00893169
14	1652.83	-5679.75	1.16967e+006	182.336	0.00893165
15	1663.62	-5681.94	1.13344e+006	176.689	0.00893169
16	1674.4	-5683.89	1.0834e+006	168.888	0.00893167
17	1685.19	-5685.6	1.01967e+006	158.954	0.00893171
18	1695.98	-5687.09	942396	146.907	0.00893165
19	1706.76	-5688.35	851674	132.765	0.00893167
20	1717.55	-5689.38	747602	116.541	0.00893163
21	1728.33	-5690.19	630258	98.249	0.00893166
22	1739.12	-5690.77	499702	77.8971	0.00893167
23	1749.91	-5691.13	386170	60.1989	0.00893167
24	1760.69	-5691.27	270532	42.1723	0.00893164
25	1771.48	-5691.19	141807	22.1059	0.00893168
26	1782.26	-5690.88	1.66788e+008	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.49324

Slice	X coordinate	Y coordinate - Bottom	Interslice Normal Force	Interslice Shear Force	Interslice Force Angle

	[m]	[m]	[kN]	[kN]	[degrees]
1	1516.07	-5628.6	1.63158e+008	0	0
2	1527.61	-5636.69	338306	13.7921	0.00233584
3	1539.14	-5644.15	641380	51.8832	0.00463483
4	1550.67	-5651.04	911506	109.146	0.00686074
5	1562.2	-5657.39	1.14204e+006	178.961	0.00897842
6	1573.73	-5663.23	1.32086e+006	252.54	0.0109546
7	1585.27	-5668.59	1.47167e+006	327.693	0.0127579
8	1596.8	-5673.48	1.59567e+006	399.922	0.01436
9	1608.33	-5677.93	1.69389e+006	465.21	0.0157357
10	1619.86	-5681.95	1.76723e+006	520.129	0.0168632
11	1631.4	-5685.56	1.81646e+006	561.934	0.0177248
12	1642.93	-5688.78	1.84225e+006	588.626	0.0183068
13	1654.46	-5691.6	1.8402e+006	597.392	0.0186002
14	1665.99	-5694.04	1.80787e+006	586.898	0.0186002
15	1677.52	-5696.11	1.75356e+006	560.289	0.0183069
16	1689.06	-5697.81	1.67761e+006	518.978	0.0177248
17	1700.59	-5699.15	1.58029e+006	465.109	0.0168632
18	1712.12	-5700.13	1.46183e+006	401.476	0.0157357
19	1723.65	-5700.75	1.32239e+006	331.43	0.01436
20	1735.18	-5701.02	1.16207e+006	258.756	0.0127579
21	1746.72	-5700.94	998961	190.994	0.0109545
22	1758.25	-5700.51	841083	131.8	0.0089784
23	1769.78	-5699.72	662377	79.3146	0.00686073
24	1781.31	-5698.58	462742	37.4326	0.00463483
25	1792.85	-5697.07	242020	9.86668	0.00233584
26	1804.38	-5695.2	1.67042e+008	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 2.511700
Factor of Safety, standard deviation: 0.402168
Factor of Safety, minimum: 1.217640
Factor of Safety, maximum: 3.953160
Probability of Failure: 0.000% (= 0 failed surfaces / 24037 valid surfaces), 5963 invalid surfaces
Reliability index: 3.75888 (assuming normal distribution) * best fit = Normal
Reliability index: 5.70881 (assuming lognormal distribution)

Method: gle/morgenstern-price
Factor of Safety, mean: 2.491351

Factor of Safety, standard deviation: 0.405796
Factor of Safety, minimum: 1.261280
Factor of Safety, maximum: 3.930570
Probability of Failure: 0.000% (= 0 failed surfaces / 14745 valid surfaces), 15255 invalid surfaces
Reliability index: 3.67512 (assuming normal distribution)
Reliability index: 5.56019 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-8000
8080	-8000
8080	0
0	0

External Boundary

X	Y
8080	-8000
8080	-5809
7988	-5810
7896	-5810
7804	-5810
7712	-5810
7620	-5809
7527	-5808
7435	-5807
7343	-5806
7251	-5805
7159	-5804
7067	-5804
6975	-5804
6883	-5803
6791	-5803
6699	-5803
6607	-5802
6515	-5801

6423	-5800
6331	-5798
6239	-5798
6147	-5798
6055	-5797
5963	-5796
5871	-5795
5779	-5793
5687	-5791
5595	-5790
5503	-5789
5411	-5789
5319	-5789
5227	-5789
5135	-5789
5043	-5789
4951	-5790
4859	-5790
4768	-5790
4676	-5791
4584	-5791
4493	-5791
4401	-5790
4309	-5790
4218	-5789
4126	-5790
4034	-5791
3942	-5793
3851	-5794
3759	-5795
3667	-5798
3576	-5800
3484	-5802
3392	-5802
3301	-5801
3209	-5798
3117	-5794
3026	-5789
2934	-5788
2842	-5788

2751	-5786
2659	-5783
2567	-5779
2475	-5777
2384	-5777
2292	-5774
2200	-5768
2109	-5755
2017	-5736
1925	-5717
1834	-5701
1742	-5683
1650	-5659
1559	-5637
1467	-5619
1375	-5601
1284	-5589
1192	-5582
1100	-5586
1009	-5598
917	-5616
825	-5634
733	-5653
642	-5676
550	-5697
458	-5707
367	-5717
275	-5727
183	-5729
92	-5727
0	-5724
0	-8000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 70PC Site 68		
	Drawn By	Jason R. Patton	Company	Oregon State University
	Date	3/14/2013, 11:10:35 PM	File Name	RR0705_70_68_0g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_70_68_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 70PC Site 68
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/14/2013, 11:10:35 PM
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364854216
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Enabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	Basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 30000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
Basement	Cohesion	Normal	5.551	0.551	10.551	2.6
Basement	Phi	Normal	27.1	14.8	39.4	4.1
Basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.057864
Center: 1734.204, -5205.833
Radius: 479.207
Left Slip Surface Endpoint: 1504.324, -5626.303
Right Slip Surface Endpoint: 1750.932, -5684.748
Left Slope Intercept: 1504.324 0.000
Right Slope Intercept: 1750.932 0.000
Resisting Moment=1.77909e+006 kN-m
Driving Moment=3.0746e+007 kN-m
Resisting Horizontal Force=3710.08 kN

Driving Horizontal Force=64117.3 kN
Total Slice Area=1.39759e+006 m2

Method: gle/morgenstern-price

FS: 0.050271
Center: 1735.940, -4758.192
Radius: 938.528
Left Slip Surface Endpoint: 1304.575, -5591.713
Right Slip Surface Endpoint: 1800.692, -5694.483
Left Slope Intercept: 1304.575 0.000
Right Slope Intercept: 1800.692 0.000
Resisting Moment=1.27601e+007 kN-m
Driving Moment=2.53824e+008 kN-m
Resisting Horizontal Force=13638.5 kN
Driving Horizontal Force=271297 kN
Total Slice Area=2.81143e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 920
Number of Invalid Surfaces: 9

Error Codes:

Error Code -108 reported for 9 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 927
Number of Invalid Surfaces: 2

Error Codes:

Error Code -108 reported for 1 surface
Error Code -112 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with

many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.057864

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	9.86432	572004	Basement	5.551	27.1	69.1458	4.00105	58001.2	58004.3	-3.07981
2	9.86432	572698	Basement	5.551	27.1	98.6798	5.71001	58107.5	58107.2	0.317781
3	9.86432	573346	Basement	5.551	27.1	128.248	7.42095	58206.3	58202.7	3.6432
4	9.86432	573952	Basement	5.551	27.1	157.812	9.13162	58297.9	58290.9	7.03063
5	9.86432	574515	Basement	5.551	27.1	187.333	10.8399	58382.5	58372.2	10.3023
6	9.86432	575035	Basement	5.551	27.1	213.272	12.3408	58459.2	58445.9	13.3064
7	9.86432	575497	Basement	5.551	27.1	234.091	13.5454	58523.2	58507.6	15.5813
8	9.86432	575917	Basement	5.551	27.1	256.911	14.8659	58580	58561.8	18.2257
9	9.86432	576299	Basement	5.551	27.1	278.854	16.1356	58630.3	58609.7	20.6181
10	9.86432	576644	Basement	5.551	27.1	299.781	17.3465	58674.4	58651.4	23.006
11	9.86432	576953	Basement	5.551	27.1	319.529	18.4892	58712.3	58687.1	25.2268
12	9.86432	577226	Basement	5.551	27.1	337.904	19.5525	58744.2	58716.9	27.3166
13	9.86432	577465	Basement	5.551	27.1	354.671	20.5227	58770	58740.8	29.2377
14	9.86432	577669	Basement	5.551	27.1	369.535	21.3828	58789.9	58759	30.89
15	9.86432	577839	Basement	5.551	27.1	380.973	22.0446	58803.6	58771.4	32.2313
16	9.86432	577968	Basement	5.551	27.1	384.21	22.2319	58808.8	58776.2	32.5844
17	9.86432	578062	Basement	5.551	27.1	385.85	22.3268	58807.4	58774.6	32.8381
18	9.86432	578122	Basement	5.551	27.1	382.445	22.1298	58800	58767.5	32.4895
19	9.86432	578150	Basement	5.551	27.1	372.624	21.5615	58786.3	58755	31.3334
20	9.86432	578145	Basement	5.551	27.1	354.436	20.5091	58766.4	58737.1	29.2682
21	9.86432	578109	Basement	5.551	27.1	325.017	18.8068	58739.7	58713.8	25.898
22	9.86432	578040	Basement	5.551	27.1	279.982	16.2009	58705.9	58685.2	20.7401
23	9.86432	577939	Basement	5.551	27.1	212.243	12.2812	58664.3	58651.2	13.1243
24	9.86432	577807	Basement	5.551	27.1	109.539	6.33835	58613.4	58611.9	1.49308
25	9.86432	577657	Basement	5.551	27.1	6.8248	0.39491	58561.4	58571.5	-10.0547

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.0502715

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	19.8447	1.14438e+006	Basement	5.551	27.1	79.2389	3.98346	57701.2	57704.5	-3.25492
2	19.8447	1.14714e+006	Basement	5.551	27.1	203.945	10.2526	57925.8	57916.6	9.24377
3	19.8447	1.14973e+006	Basement	5.551	27.1	326.599	16.4186	58135	58113.9	21.0614

4	19.8447	1.15212e+006	Basement	5.551	27.1	434.692	21.8526	58326.6	58294.6	31.9741
5	19.8447	1.15425e+006	Basement	5.551	27.1	516.125	25.9464	58486	58446.4	39.5885
6	19.8447	1.15619e+006	Basement	5.551	27.1	595.481	29.9357	58628.9	58581.4	47.512
7	19.8447	1.15797e+006	Basement	5.551	27.1	665.075	33.4343	58757.5	58703.2	54.2949
8	19.8447	1.15959e+006	Basement	5.551	27.1	724.034	36.3983	58872.3	58812	60.2534
9	19.8447	1.16106e+006	Basement	5.551	27.1	771.767	38.7979	58973	58908.1	64.9027
10	19.8447	1.16238e+006	Basement	5.551	27.1	807.981	40.6184	59060.3	58991.8	68.5212
11	19.8447	1.16355e+006	Basement	5.551	27.1	832.71	41.8616	59134.1	59063.3	70.8294
12	19.8447	1.16458e+006	Basement	5.551	27.1	846.313	42.5454	59195.2	59122.8	72.3672
13	19.8447	1.16546e+006	Basement	5.551	27.1	839.72	42.214	59242.1	59170.3	71.7648
14	19.8447	1.16614e+006	Basement	5.551	27.1	774.455	38.933	59261.9	59196.7	65.1838
15	19.8447	1.16665e+006	Basement	5.551	27.1	738.08	37.1044	59268.3	59206.6	61.6752
16	19.8447	1.16702e+006	Basement	5.551	27.1	694.445	34.9108	59262.5	59205.2	57.3017
17	19.8447	1.16725e+006	Basement	5.551	27.1	645.224	32.4364	59245.2	59192.5	52.7379
18	19.8447	1.16734e+006	Basement	5.551	27.1	574.389	28.8754	59213.1	59167.5	45.5521
19	19.8447	1.16726e+006	Basement	5.551	27.1	498.78	25.0744	59164.9	59126.9	38.0112
20	19.8447	1.16705e+006	Basement	5.551	27.1	432.961	21.7656	59106.2	59074.7	31.5429
21	19.8447	1.16671e+006	Basement	5.551	27.1	366.969	18.4481	59036.9	59011.5	25.3805
22	19.8447	1.16623e+006	Basement	5.551	27.1	300.793	15.1213	58956.1	58937.3	18.7706
23	19.8447	1.16568e+006	Basement	5.551	27.1	337.32	16.9576	58883.6	58861.5	22.139
24	19.8447	1.16508e+006	Basement	5.551	27.1	327.199	16.4488	58807.1	58785.9	21.163
25	19.8447	1.16435e+006	Basement	5.551	27.1	336.696	16.9262	58721.3	58699.3	21.988

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.057864

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	1504.32	-5626.3	1.63025e+008	0	0
2	1514.19	-5631.55	191927	-231.068	-0.0689805
3	1524.05	-5636.5	367753	-442.752	-0.0689806
4	1533.92	-5641.18	527912	-635.573	-0.0689805
5	1543.78	-5645.58	672794	-810.003	-0.0689806
6	1553.65	-5649.72	802750	-966.462	-0.0689806
7	1563.51	-5653.61	906042	-1090.82	-0.0689806
8	1573.37	-5657.25	980652	-1180.64	-0.0689803
9	1583.24	-5660.64	1.04114e+006	-1253.46	-0.0689801
10	1593.1	-5663.8	1.08773e+006	-1309.56	-0.0689806
11	1602.97	-5666.72	1.12066e+006	-1349.21	-0.0689808

12	1612.83	-5669.41	1.14011e+006	-1372.63	-0.0689809
13	1622.7	-5671.89	1.14627e+006	-1380.04	-0.0689806
14	1632.56	-5674.14	1.1393e+006	-1371.64	-0.0689802
15	1642.42	-5676.17	1.11933e+006	-1347.61	-0.0689808
16	1652.29	-5677.99	1.08398e+006	-1305.04	-0.0689803
17	1662.15	-5679.59	1.02748e+006	-1237.03	-0.068981
18	1672.02	-5680.99	958376	-1153.83	-0.0689808
19	1681.88	-5682.17	876772	-1055.58	-0.0689806
20	1691.75	-5683.16	782790	-942.43	-0.0689805
21	1701.61	-5683.93	676552	-814.526	-0.0689805
22	1711.48	-5684.5	558197	-672.035	-0.0689806
23	1721.34	-5684.87	427895	-515.159	-0.0689805
24	1731.2	-5685.03	285870	-344.17	-0.0689806
25	1741.07	-5684.99	132456	-159.469	-0.0689806
26	1750.93	-5684.75	1.66429e+008	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.0502715

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	1304.57	-5591.71	1.61026e+008	0	0
2	1324.42	-5601.69	424361	-319.5	-0.0431378
3	1344.26	-5611.08	817156	-1220.77	-0.0855955
4	1364.11	-5619.92	1.17896e+006	-2607.12	-0.126702
5	1383.95	-5628.21	1.47749e+006	-4275.81	-0.165812
6	1403.8	-5635.98	1.70607e+006	-6023.99	-0.202306
7	1423.64	-5643.24	1.9051e+006	-7834.12	-0.235609
8	1443.49	-5649.99	2.07511e+006	-9604.84	-0.265197
9	1463.33	-5656.26	2.2166e+006	-11242.6	-0.290602
10	1483.18	-5662.04	2.33005e+006	-12664.8	-0.311424
11	1503.02	-5667.36	2.4159e+006	-13802.4	-0.327336
12	1522.87	-5672.21	2.47459e+006	-14601.9	-0.338083
13	1542.71	-5676.61	2.50648e+006	-15027.1	-0.343501
14	1562.56	-5680.56	2.50259e+006	-15003.8	-0.343502
15	1582.4	-5684.08	2.42983e+006	-14337.8	-0.338084
16	1602.24	-5687.15	2.33118e+006	-13318.4	-0.327336
17	1622.09	-5689.79	2.20689e+006	-11995.4	-0.311424
18	1641.93	-5692	2.05712e+006	-10433.7	-0.290601
19	1661.78	-5693.78	1.86918e+006	-8651.69	-0.265197
20	1681.62	-5695.15	1.64721e+006	-6773.64	-0.23561
21	1701.47	-5696.09	1.39999e+006	-4943.25	-0.202306

22	1721.31	-5696.61	1.1275e+006	-3262.96	-0.165812
23	1741.16	-5696.71	829726	-1834.84	-0.126703
24	1761	-5696.38	577346	-862.509	-0.0855953
25	1780.85	-5695.64	302153	-227.49	-0.0431378
26	1800.69	-5694.48	1.67e+008	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.150775
Factor of Safety, standard deviation: 0.128497
Factor of Safety, minimum: 0.011669
Factor of Safety, maximum: 2.750410
Probability of Failure: 99.686% (= 29555 failed surfaces / 29648 valid surfaces), 352 invalid surfaces
Reliability index: -6.60891 (assuming normal distribution)
Reliability index: -2.92993 (assuming lognormal distribution) * best fit = Lognormal

Method: gle/morgenstern-price
Factor of Safety, mean: 0.148741
Factor of Safety, standard deviation: 0.136028
Factor of Safety, minimum: 0.024630
Factor of Safety, maximum: 2.987900
Probability of Failure: 99.668% (= 27885 failed surfaces / 27978 valid surfaces), 2022 invalid surfaces
Reliability index: -6.25795 (assuming normal distribution)
Reliability index: -2.83404 (assuming lognormal distribution) * best fit = Lognormal

List Of Coordinates

Water Table

X	Y
0	0
0	-8000
8080	-8000
8080	0
0	0

External Boundary

X	Y
8080	-8000
8080	-5809

7988	-5810
7896	-5810
7804	-5810
7712	-5810
7620	-5809
7527	-5808
7435	-5807
7343	-5806
7251	-5805
7159	-5804
7067	-5804
6975	-5804
6883	-5803
6791	-5803
6699	-5803
6607	-5802
6515	-5801
6423	-5800
6331	-5798
6239	-5798
6147	-5798
6055	-5797
5963	-5796
5871	-5795
5779	-5793
5687	-5791
5595	-5790
5503	-5789
5411	-5789
5319	-5789
5227	-5789
5135	-5789
5043	-5789
4951	-5790
4859	-5790
4768	-5790
4676	-5791
4584	-5791
4493	-5791
4401	-5790

4309	-5790
4218	-5789
4126	-5790
4034	-5791
3942	-5793
3851	-5794
3759	-5795
3667	-5798
3576	-5800
3484	-5802
3392	-5802
3301	-5801
3209	-5798
3117	-5794
3026	-5789
2934	-5788
2842	-5788
2751	-5786
2659	-5783
2567	-5779
2475	-5777
2384	-5777
2292	-5774
2200	-5768
2109	-5755
2017	-5736
1925	-5717
1834	-5701
1742	-5683
1650	-5659
1559	-5637
1467	-5619
1375	-5601
1284	-5589
1192	-5582
1100	-5586
1009	-5598
917	-5616
825	-5634
733	-5653

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 70PC Site 68		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/14/2013, 11:10:35 PM	File Name: RR0705_70_68_0g.sli	

642	-5676
550	-5697
458	-5707
367	-5717
275	-5727
183	-5729
92	-5727
0	-5724
0	-8000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	Core RR0705 72PC Site 64	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/14/2013	File Name: RR0705_72_64_0g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_72_64_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: Core RR0705 72PC Site 64
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/14/2013
Comments:

http://earthjay.com
http://activetectonics.oregonstate.edu

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364854814
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 50
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: Core RR0705 72PC Site 64		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/14/2013	File Name: RR0705_72_64_0g.sli	

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Global Minimums

Method: spencer

FS: 1.871590
Center: 898.475, -3204.956
Radius: 334.731
Left Slip Surface Endpoint: 686.531, -3464.041
Right Slip Surface Endpoint: 922.905, -3538.795
Left Slope Intercept: 686.531 -0.000
Right Slope Intercept: 922.905 -0.000
Resisting Moment=4.20356e+006 kN-m
Driving Moment=2.24599e+006 kN-m
Resisting Horizontal Force=11813.6 kN
Driving Horizontal Force=6312.09 kN
Total Slice Area=831599 m2

Method: gle/morgenstern-price

FS: 1.871320
Center: 898.253, -3205.424
Radius: 334.178
Left Slip Surface Endpoint: 686.644, -3464.069
Right Slip Surface Endpoint: 922.606, -3538.714
Left Slope Intercept: 686.644 -0.000
Right Slope Intercept: 922.606 -0.000
Resisting Moment=4.18292e+006 kN-m
Driving Moment=2.23528e+006 kN-m
Resisting Horizontal Force=11776.3 kN

Driving Horizontal Force=6293.08 kN
Total Slice Area=830136 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 38559
Number of Invalid Surfaces: 10873

Error Codes:

Error Code -108 reported for 10873 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 49430
Number of Invalid Surfaces: 2

Error Codes:

Error Code -108 reported for 2 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.87159

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	9.45496	337848	basement	5.551	27.1	3.79666	7.10579	35721.1	35718	3.07986
2	9.45496	338807	basement	5.551	27.1	10.2592	19.2011	35818.7	35792.1	26.6458
3	9.45496	339689	basement	5.551	27.1	16.2011	30.3219	35909.3	35860.9	48.3563
4	9.45496	340477	basement	5.551	27.1	21.4087	40.0683	35992.3	35924.8	67.4765
5	9.45496	341174	basement	5.551	27.1	25.2032	47.1701	36065.5	35984.2	81.2665
6	9.45496	341809	basement	5.551	27.1	28.4941	53.3292	36132.6	36039.2	93.4261
7	9.45496	342385	basement	5.551	27.1	31.2975	58.576	36193.9	36090.2	103.65

8	9.45496	342904	basement	5.551	27.1	33.6241	62.9306	36249.5	36137.4	112.083
9	9.45496	343370	basement	5.551	27.1	35.4834	66.4103	36299.7	36180.8	118.914
10	9.45496	343783	basement	5.551	27.1	36.8828	69.0295	36344.7	36220.7	124.039
11	9.45496	344147	basement	5.551	27.1	37.8288	70.8	36384.7	36257.2	127.466
12	9.45496	344463	basement	5.551	27.1	38.3264	71.7313	36419.7	36290.4	129.276
13	9.45496	344732	basement	5.551	27.1	38.3792	71.8301	36449.9	36320.4	129.547
14	9.45496	344957	basement	5.551	27.1	38.0298	71.1762	36475.5	36347.3	128.25
15	9.45496	345139	basement	5.551	27.1	37.2513	69.7192	36496.5	36371.1	125.422
16	9.45496	345276	basement	5.551	27.1	36.0332	67.4394	36512.9	36392	120.933
17	9.45496	345372	basement	5.551	27.1	34.3747	64.3353	36524.8	36409.9	114.931
18	9.45496	345425	basement	5.551	27.1	32.2737	60.4031	36532.2	36425	107.175
19	9.45496	345437	basement	5.551	27.1	29.727	55.6368	36535.2	36437.3	97.8869
20	9.45496	345408	basement	5.551	27.1	26.7302	50.028	36533.6	36446.7	86.9395
21	9.45496	345338	basement	5.551	27.1	23.2777	43.5664	36527.7	36453.4	74.3152
22	9.45496	345228	basement	5.551	27.1	19.3485	36.2125	36517.2	36457.3	59.88
23	9.45496	345096	basement	5.551	27.1	15.217	28.48	36503.2	36458.4	44.789
24	9.45496	344937	basement	5.551	27.1	11.2807	21.1128	36487.2	36456.8	30.4339
25	9.45496	344739	basement	5.551	27.1	6.86648	12.8512	36466.7	36452.5	14.1994

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.87132

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	9.43848	337261	basement	5.551	27.1	5.36497	10.0396	35727	35718.2	8.80897
2	9.43848	338217	basement	5.551	27.1	11.0926	20.7578	35821.9	35792.2	29.6847
3	9.43848	339096	basement	5.551	27.1	16.4089	30.7063	35910.1	35860.9	49.1572
4	9.43848	339881	basement	5.551	27.1	20.9813	39.2627	35990.6	35924.7	65.8953
5	9.43848	340576	basement	5.551	27.1	24.4782	45.8066	36062.6	35984	78.6056
6	9.43848	341209	basement	5.551	27.1	27.585	51.6203	36128.9	36038.9	90.043
7	9.43848	341783	basement	5.551	27.1	30.3082	56.7164	36189.8	36089.9	99.9069
8	9.43848	342300	basement	5.551	27.1	32.6491	61.097	36245.5	36136.9	108.559
9	9.43848	342764	basement	5.551	27.1	34.6045	64.756	36296	36180.3	115.698
10	9.43848	343176	basement	5.551	27.1	36.167	67.6801	36341.5	36220.1	121.423
11	9.43848	343539	basement	5.551	27.1	37.3264	69.8497	36382.2	36256.6	125.64
12	9.43848	343854	basement	5.551	27.1	38.0694	71.2401	36418.1	36289.7	128.429
13	9.43848	344122	basement	5.551	27.1	38.3778	71.8172	36449.2	36319.7	129.458
14	9.43848	344347	basement	5.551	27.1	38.2783	71.6309	36475.6	36346.5	129.093
15	9.43848	344528	basement	5.551	27.1	37.7272	70.5996	36497.5	36370.3	127.169
16	9.43848	344665	basement	5.551	27.1	36.6935	68.6653	36514.5	36391.2	123.337
17	9.43848	344760	basement	5.551	27.1	35.1595	65.7946	36526.8	36409.1	117.737
18	9.43848	344813	basement	5.551	27.1	33.1083	61.9562	36534.4	36424.2	110.226

19	9.43848	344825	basement	5.551	27.1	30.5243	57.1207	36537.2	36436.4	100.807
20	9.43848	344796	basement	5.551	27.1	27.3936	51.2622	36535.2	36445.8	89.3567
21	9.43848	344727	basement	5.551	27.1	23.7043	44.3584	36528.4	36452.5	75.851
22	9.43848	344618	basement	5.551	27.1	19.4433	36.3847	36516.7	36456.4	60.2609
23	9.43848	344485	basement	5.551	27.1	15.015	28.0978	36501.6	36457.6	43.9633
24	9.43848	344327	basement	5.551	27.1	10.6218	19.8768	36483.9	36456	27.9204
25	9.43848	344130	basement	5.551	27.1	5.66375	10.5987	36461.4	36451.6	9.83523

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.87159

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	686.531	-3464.04	6.17978e+007	0	0
2	695.986	-3471.5	183767	79.1389	0.0246743
3	705.441	-3478.42	349177	150.372	0.0246742
4	714.896	-3484.86	497496	214.245	0.0246742
5	724.351	-3490.83	598796	257.87	0.0246743
6	733.806	-3496.38	684576	294.81	0.0246742
7	743.261	-3501.53	755959	325.552	0.0246743
8	752.716	-3506.29	813620	350.383	0.0246743
9	762.171	-3510.68	858142	369.556	0.0246742
10	771.626	-3514.72	890031	383.289	0.0246742
11	781.081	-3518.43	909732	391.773	0.0246742
12	790.536	-3521.81	917631	395.175	0.0246743
13	799.991	-3524.87	914067	393.64	0.0246742
14	809.446	-3527.63	900072	387.613	0.0246742
15	818.901	-3530.09	875712	377.123	0.0246743
16	828.356	-3532.26	840670	362.032	0.0246743
17	837.811	-3534.14	795140	342.425	0.0246743
18	847.266	-3535.75	739288	318.372	0.0246742
19	856.721	-3537.07	673253	289.934	0.0246742
20	866.175	-3538.13	597152	257.161	0.0246742
21	875.63	-3538.91	511078	220.094	0.0246742
22	885.085	-3539.42	415104	178.763	0.0246742
23	894.54	-3539.66	310533	133.73	0.0246742
24	903.995	-3539.64	216805	93.3664	0.0246742
25	913.45	-3539.35	113297	48.7911	0.0246743
26	922.905	-3538.79	6.44938e+007	0	0

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	Core RR0705 72PC Site 64	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/14/2013	File Name: RR0705_72_64_0g.sli

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.87132

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	686.644	-3464.07	6.17988e+007	0	0
2	696.083	-3471.51	183509	12.9997	0.00405881
3	705.521	-3478.43	348676	49.0106	0.00805361
4	714.96	-3484.85	496770	103.362	0.0119214
5	724.398	-3490.82	597708	162.751	0.0156012
6	733.837	-3496.36	683360	227.027	0.0190349
7	743.275	-3501.49	754639	291.98	0.0221685
8	752.714	-3506.25	812219	353.723	0.0249524
9	762.152	-3510.63	856685	408.83	0.0273429
10	771.59	-3514.67	888542	454.416	0.0293021
11	781.029	-3518.37	908234	488.218	0.0307991
12	790.467	-3521.74	916146	508.643	0.0318105
13	799.906	-3524.8	912617	514.803	0.0323203
14	809.344	-3527.56	898663	506.932	0.0323203
15	818.783	-3530.02	874376	485.452	0.0318105
16	828.221	-3532.18	839425	451.23	0.0307991
17	837.66	-3534.06	794003	406.067	0.0293021
18	847.098	-3535.66	738277	352.323	0.0273429
19	856.537	-3536.99	672387	292.826	0.0249524
20	865.975	-3538.04	596448	230.773	0.0221684
21	875.414	-3538.82	510555	169.618	0.019035
22	884.852	-3539.33	414781	112.942	0.0156012
23	894.291	-3539.58	309852	64.4703	0.0119214
24	903.729	-3539.56	216327	30.4074	0.00805362
25	913.168	-3539.27	113046	8.00811	0.0040588
26	922.606	-3538.71	6.44909e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.883852
Factor of Safety, standard deviation: 0.304258
Factor of Safety, minimum: 0.904698
Factor of Safety, maximum: 3.017090
Probability of Failure: 0.030% (= 3 failed surfaces / 9998 valid surfaces), 2 invalid surfaces
Reliability index: 2.90494 (assuming normal distribution)

Reliability index: 3.86642 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 1.883567
Factor of Safety, standard deviation: 0.304176
Factor of Safety, minimum: 0.904454
Factor of Safety, maximum: 3.016740
Probability of Failure: 0.030% (= 3 failed surfaces / 10000 valid surfaces)
Reliability index: 2.90479 (assuming normal distribution)
Reliability index: 3.86595 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
4377	-6000
4377	0
0	0

External Boundary

X	Y
4377	-6000
4377	-4086
4294	-4083
4212	-4080
4129	-4078
4046	-4078
3963	-4078
3883	-4079
3802	-4080
3722	-4081
3641	-4080
3561	-4078
3475	-4077
3389	-4075
3303	-4074

3217	-4070
3131	-4058
3045	-4040
2955	-4023
2866	-4001
2776	-3974
2686	-3947
2596	-3929
2507	-3914
2417	-3901
2327	-3887
2237	-3867
2148	-3841
2058	-3818
1968	-3795
1878	-3767
1789	-3741
1699	-3723
1609	-3706
1519	-3684
1430	-3659
1340	-3636
1251	-3614
1162	-3593
1072	-3575
983	-3555
894	-3531
804	-3501
715	-3471
625	-3449
536	-3435
447	-3423
357	-3404
268	-3387
179	-3376
89	-3367
0	-3355
0	-6000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	Core RR0705 72PC Site 64	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/14/2013	File Name: RR0705_72_64_1g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_72_64_1g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: Core RR0705 72PC Site 64
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/14/2013
Comments:

http://earthjay.com
http://activetectonics.oregonstate.edu

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	Core RR0705 72PC Site 64	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/14/2013	File Name: RR0705_72_64_1g.sli

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364854642
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 50
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.026311
Center: 1240.808, -1859.704
Radius: 1716.312
Left Slip Surface Endpoint: 573.203, -3440.852
Right Slip Surface Endpoint: 1002.605, -3559.406
Left Slope Intercept: 573.203 -0.000
Right Slope Intercept: 1002.605 -0.000
Resisting Moment=5.42259e+006 kN-m
Driving Moment=2.06094e+008 kN-m
Resisting Horizontal Force=3077.97 kN

Driving Horizontal Force=116983 kN
Total Slice Area=1.50727e+006 m2

Method: gle/morgenstern-price

FS: 0.031422
Center: 2982.002, 2355.786
Radius: 6264.578
Left Slip Surface Endpoint: 628.239, -3449.792
Right Slip Surface Endpoint: 2221.424, -3862.450
Left Slope Intercept: 628.239 -0.000
Right Slope Intercept: 2221.424 -0.000
Resisting Moment=2.29399e+008 kN-m
Driving Moment=7.30057e+009 kN-m
Resisting Horizontal Force=35871 kN
Driving Horizontal Force=1.14158e+006 kN
Total Slice Area=5.88439e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 24288
Number of Invalid Surfaces: 154

Error Codes:

Error Code -108 reported for 133 surfaces
Error Code -112 reported for 21 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 24419
Number of Invalid Surfaces: 23

Error Codes:

Error Code -108 reported for 13 surfaces
Error Code -112 reported for 10 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This

screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.0263113

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	17.1761	609580	basement	5.551	27.1	85.5868	2.2519	35506.4	35512.9	-6.48103
2	17.1761	611241	basement	5.551	27.1	144.171	3.79333	35650.8	35654.2	-3.40648
3	17.1761	612843	basement	5.551	27.1	203.036	5.34213	35789.5	35789.9	-0.378465
4	17.1761	614318	basement	5.551	27.1	240.482	6.3274	35910	35908.5	1.5284
5	17.1761	615661	basement	5.551	27.1	277.394	7.2986	36012.7	36009.3	3.41078
6	17.1761	616947	basement	5.551	27.1	313.48	8.24807	36109.9	36104.7	5.24385
7	17.1761	618177	basement	5.551	27.1	348.473	9.16879	36201.7	36194.7	7.03562
8	17.1761	619352	basement	5.551	27.1	382.279	10.0583	36288.2	36279.4	8.80145
9	17.1761	620429	basement	5.551	27.1	396.836	10.4413	36361.3	36351.8	9.50168
10	17.1761	621347	basement	5.551	27.1	397.642	10.4625	36411.1	36401.5	9.60711
11	17.1761	622205	basement	5.551	27.1	397.997	10.4718	36454.9	36445.3	9.56554
12	17.1761	623011	basement	5.551	27.1	394.767	10.3868	36493.4	36483.9	9.45985
13	17.1761	623764	basement	5.551	27.1	387.626	10.1989	36526.6	36517.5	9.09374
14	17.1761	624465	basement	5.551	27.1	376.795	9.91397	36554.7	36546.2	8.53731
15	17.1761	625119	basement	5.551	27.1	362.181	9.52946	36578.5	36570.7	7.76828
16	17.1761	625722	basement	5.551	27.1	342.319	9.00686	36597.1	36590.4	6.71031
17	17.1761	626274	basement	5.551	27.1	316.869	8.33724	36610.6	36605.2	5.40202
18	17.1761	626776	basement	5.551	27.1	285.23	7.50476	36618.9	36615.1	3.77945
19	17.1761	627232	basement	5.551	27.1	252.661	6.64783	36623.2	36621	2.18716
20	17.1761	627714	basement	5.551	27.1	237.13	6.2392	36636	36634.7	1.33029
21	17.1761	628171	basement	5.551	27.1	211.383	5.56176	36647.6	36647.6	0.0334162
22	17.1761	628578	basement	5.551	27.1	178.527	4.69728	36654.1	36655.8	-1.69939
23	17.1761	628936	basement	5.551	27.1	137.616	3.62085	36655.4	36659.2	-3.78958
24	17.1761	629246	basement	5.551	27.1	89.5463	2.35608	36651.8	36658	-6.17225
25	17.1761	629553	basement	5.551	27.1	50.7516	1.33534	36651.6	36659.9	-8.2734

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.0314221

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	63.7274	2.27452e+006	basement	5.551	27.1	124.981	3.92718	35738.9	35742.2	-3.26744
2	63.7274	2.2939e+006	basement	5.551	27.1	279.296	8.77607	36137.4	36131.1	6.30136

3	63.7274	2.31092e+006	basement	5.551	27.1	338.874	10.6481	36440.5	36430.7	9.84503
4	63.7274	2.32707e+006	basement	5.551	27.1	387.239	12.1679	36718.9	36706	12.9325
5	63.7274	2.34295e+006	basement	5.551	27.1	498.203	15.6546	37003.9	36984.2	19.669
6	63.7274	2.35907e+006	basement	5.551	27.1	639.391	20.091	37316.3	37287.8	28.488
7	63.7274	2.37521e+006	basement	5.551	27.1	810.49	25.4673	37645.3	37606.4	38.9297
8	63.7274	2.39104e+006	basement	5.551	27.1	995.51	31.281	37976.2	37926	50.2128
9	63.7274	2.40622e+006	basement	5.551	27.1	1083.9	34.0585	38286.1	38230.5	55.6314
10	63.7274	2.42005e+006	basement	5.551	27.1	1123.25	35.2949	38546.7	38488.6	58.1131
11	63.7274	2.4329e+006	basement	5.551	27.1	1139.13	35.7939	38776.3	38717.2	59.0603
12	63.7274	2.44488e+006	basement	5.551	27.1	1127.55	35.43	38978.9	38920.5	58.4244
13	63.7274	2.45595e+006	basement	5.551	27.1	1071.93	33.6823	39152.2	39097.3	54.9354
14	63.7274	2.46587e+006	basement	5.551	27.1	968.016	30.4171	39284.7	39236.2	48.5227
15	63.7274	2.47541e+006	basement	5.551	27.1	1001.92	31.4825	39422.1	39371.5	50.6095
16	63.7274	2.48487e+006	basement	5.551	27.1	1053.06	33.0894	39570.3	39516.5	53.8063
17	63.7274	2.49455e+006	basement	5.551	27.1	1103.96	34.6887	39741.4	39684.5	56.9078
18	63.7274	2.50345e+006	basement	5.551	27.1	1063.41	33.4147	39885.8	39831.3	54.4638
19	63.7274	2.51093e+006	basement	5.551	27.1	826.323	25.9648	39967.5	39927.6	39.8785
20	63.7274	2.51629e+006	basement	5.551	27.1	633.166	19.8954	39970.2	39942.1	28.0618
21	63.7274	2.52059e+006	basement	5.551	27.1	465.248	14.6191	39940.2	39922.5	17.657
22	63.7274	2.52472e+006	basement	5.551	27.1	444.744	13.9748	39924.8	39908.4	16.3912
23	63.7274	2.52884e+006	basement	5.551	27.1	356.211	11.1929	39917.1	39906.1	10.9722
24	63.7274	2.53226e+006	basement	5.551	27.1	259.262	8.14655	39890.8	39885.8	5.03144
25	63.7274	2.53449e+006	basement	5.551	27.1	118.49	3.72319	39821.1	39824.8	-3.65164

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.0263113

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	573.203	-3440.85	6.09732e+007	0	0
2	590.379	-3447.99	157080	-235.785	-0.0860038
3	607.555	-3454.92	307643	-461.787	-0.0860037
4	624.731	-3461.63	451625	-677.912	-0.0860038
5	641.907	-3468.13	536638	-805.52	-0.0860037
6	659.083	-3474.42	613801	-921.345	-0.0860037
7	676.259	-3480.51	683915	-1026.59	-0.0860037
8	693.435	-3486.39	746952	-1121.21	-0.0860036
9	710.612	-3492.07	802888	-1205.18	-0.0860041
10	727.788	-3497.55	809425	-1214.99	-0.0860039

11	744.964	-3502.83	794049	-1191.91	-0.086004
12	762.14	-3507.92	771245	-1157.68	-0.086004
13	779.316	-3512.81	741041	-1112.34	-0.0860038
14	796.492	-3517.51	703468	-1055.94	-0.0860037
15	813.668	-3522.01	659866	-990.492	-0.0860038
16	830.844	-3526.33	609997	-915.635	-0.0860037
17	848.02	-3530.47	552903	-829.934	-0.0860037
18	865.196	-3534.41	488645	-733.48	-0.0860037
19	882.373	-3538.17	417294	-626.379	-0.0860037
20	899.549	-3541.75	351712	-527.937	-0.0860037
21	916.725	-3545.14	306027	-459.361	-0.0860036
22	933.901	-3548.35	253550	-380.591	-0.0860037
23	951.077	-3551.38	194363	-291.749	-0.0860039
24	968.253	-3554.24	128562	-192.978	-0.0860038
25	985.429	-3556.91	60231.2	-90.41	-0.0860037
26	1002.61	-3559.41	6.52472e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.0314221

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	628.239	-3449.79	6.12905e+007	0	0
2	691.966	-3475.22	351956	-893.297	-0.145422
3	755.694	-3499.85	546777	-2753.66	-0.288549
4	819.421	-3523.68	641104	-4779.3	-0.42712
5	883.148	-3546.73	714500	-6970.57	-0.558953
6	946.876	-3569.01	880625	-10482.2	-0.681967
7	1010.6	-3590.52	1.08957e+006	-15104.3	-0.794219
8	1074.33	-3611.27	1.333e+006	-20799.4	-0.893939
9	1138.06	-3631.27	1.6052e+006	-27446.1	-0.979562
10	1201.79	-3650.52	1.80187e+006	-33016.4	-1.04974
11	1265.51	-3669.05	1.93678e+006	-37301.7	-1.10336
12	1329.24	-3686.84	2.02636e+006	-40308.5	-1.13958
13	1392.97	-3703.91	2.07435e+006	-41924.3	-1.15784
14	1456.7	-3720.26	2.0691e+006	-41818.1	-1.15783
15	1520.42	-3735.91	2.00579e+006	-39899.3	-1.13958
16	1584.15	-3750.85	1.99678e+006	-38457.2	-1.10336
17	1647.88	-3765.08	2.03916e+006	-37364.4	-1.04974
18	1711.61	-3778.63	2.10078e+006	-35919.7	-0.979563
19	1775.33	-3791.48	2.11643e+006	-33023.6	-0.893939
20	1839.06	-3803.65	1.93724e+006	-26855.2	-0.794218

21	1902.79	-3815.13	1.66473e+006	-19815.4	-0.681964
22	1966.51	-3825.94	1.3332e+006	-13006.6	-0.558956
23	2030.24	-3836.07	1.09973e+006	-8198.24	-0.427119
24	2093.97	-3845.53	838359	-4222.11	-0.288548
25	2157.7	-3854.32	531584	-1349.21	-0.145422
26	2221.42	-3862.45	7.68304e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.094178
Factor of Safety, standard deviation: 0.116846
Factor of Safety, minimum: 0.001343
Factor of Safety, maximum: 2.129030
Probability of Failure: 99.810% (= 9972 failed surfaces / 9991 valid surfaces), 9 invalid surfaces
Reliability index: -7.75229 (assuming normal distribution)
Reliability index: -2.93005 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 0.073733
Factor of Safety, standard deviation: 0.118981
Factor of Safety, minimum: 0.002055
Factor of Safety, maximum: 2.096240
Probability of Failure: 99.770% (= 9977 failed surfaces / 10000 valid surfaces)
Reliability index: -7.78502 (assuming normal distribution)
Reliability index: -2.86887 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
4377	-6000
4377	0
0	0

External Boundary

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: Core RR0705 72PC Site 64		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/14/2013	File Name: RR0705_72_64_1g.sli	

X	Y
4377	-6000
4377	-4086
4294	-4083
4212	-4080
4129	-4078
4046	-4078
3963	-4078
3883	-4079
3802	-4080
3722	-4081
3641	-4080
3561	-4078
3475	-4077
3389	-4075
3303	-4074
3217	-4070
3131	-4058
3045	-4040
2955	-4023
2866	-4001
2776	-3974
2686	-3947
2596	-3929
2507	-3914
2417	-3901
2327	-3887
2237	-3867
2148	-3841
2058	-3818
1968	-3795
1878	-3767
1789	-3741
1699	-3723
1609	-3706
1519	-3684
1430	-3659
1340	-3636
1251	-3614
1162	-3593

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: Core RR0705 72PC Site 64		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/14/2013	File Name: RR0705_72_64_1g.sli	

1072	-3575
983	-3555
894	-3531
804	-3501
715	-3471
625	-3449
536	-3435
447	-3423
357	-3404
268	-3387
179	-3376
89	-3367
0	-3355
0	-6000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 76PC Site 63		
	Drawn By	Jason R. Patton	Company	Oregon State University
	Date	3/25/2013	File Name	RR0705_76_63_0g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_76_63_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 76PC Site 63
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/25/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364855263
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 76PC Site 63		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/25/2013	File Name: RR0705_76_63_0g.sli	

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Global Minimums

Method: spencer

FS: 1.613400
Center: 1211.708, -2523.575
Radius: 466.507
Left Slip Surface Endpoint: 906.471, -2876.363
Right Slip Surface Endpoint: 1221.863, -2989.972
Left Slope Intercept: 906.471 -0.000
Right Slope Intercept: 1221.863 -0.000
Resisting Moment=9.93713e+006 kN-m
Driving Moment=6.15913e+006 kN-m
Resisting Horizontal Force=19835.4 kN
Driving Horizontal Force=12294.2 kN
Total Slice Area=932095 m2

Method: gle/morgenstern-price

FS: 1.610260
Center: 1210.257, -2531.093
Radius: 458.369
Left Slip Surface Endpoint: 910.155, -2877.562
Right Slip Surface Endpoint: 1219.769, -2989.363
Left Slope Intercept: 910.155 -0.000
Right Slope Intercept: 1219.769 -0.000
Resisting Moment=9.41105e+006 kN-m
Driving Moment=5.84444e+006 kN-m
Resisting Horizontal Force=19145.8 kN

Driving Horizontal Force=11889.9 kN
Total Slice Area=914984 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1895
Number of Invalid Surfaces: 1145

Error Codes:

Error Code -108 reported for 1145 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 3040
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.6134

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	12.6157	374670	basement	5.551	27.1	4.46731	7.20756	29684	29680.8	3.20808
2	12.6157	376420	basement	5.551	27.1	13.4721	21.7359	29817.2	29785.5	31.6569
3	12.6157	378022	basement	5.551	27.1	21.6387	34.9119	29940.5	29883.1	57.4057
4	12.6157	379483	basement	5.551	27.1	28.684	46.2787	30053.7	29974.1	79.585
5	12.6157	380823	basement	5.551	27.1	34.962	56.4077	30158.3	30058.9	99.3795
6	12.6157	382050	basement	5.551	27.1	40.5071	65.3542	30254.7	30137.8	116.887
7	12.6157	383170	basement	5.551	27.1	45.3359	73.145	30343.4	30211.3	132.138
8	12.6157	384189	basement	5.551	27.1	49.4627	79.8032	30424.8	30279.6	145.154
9	12.6157	385112	basement	5.551	27.1	52.9147	85.3725	30499	30343	155.969
10	12.6157	385924	basement	5.551	27.1	55.4725	89.4993	30565.6	30401.6	164.002
11	12.6157	386635	basement	5.551	27.1	56.8649	91.7459	30624.1	30455.6	168.466

12	12.6157	387260	basement	5.551	27.1	57.5807	92.9007	30676	30505.3	170.674
13	12.6157	387802	basement	5.551	27.1	57.6251	92.9724	30721.5	30550.7	170.823
14	12.6157	388264	basement	5.551	27.1	57.0022	91.9673	30760.9	30592	168.867
15	12.6157	388649	basement	5.551	27.1	55.714	89.8889	30794.1	30629.3	164.806
16	12.6157	388957	basement	5.551	27.1	53.7609	86.7379	30821.3	30662.6	158.66
17	12.6157	389190	basement	5.551	27.1	51.1421	82.5127	30842.5	30692.2	150.345
18	12.6157	389350	basement	5.551	27.1	47.8548	77.2089	30858	30718	140.022
19	12.6157	389438	basement	5.551	27.1	43.8947	70.8197	30867.6	30740.1	127.523
20	12.6157	389455	basement	5.551	27.1	39.2557	63.3351	30871.4	30758.5	112.908
21	12.6157	389403	basement	5.551	27.1	33.9301	54.7428	30869.5	30773.4	96.1053
22	12.6157	389280	basement	5.551	27.1	27.9083	45.0273	30861.7	30784.6	77.1334
23	12.6157	389097	basement	5.551	27.1	21.0927	34.031	30848	30792.4	55.6049
24	12.6157	388907	basement	5.551	27.1	15.0308	24.2507	30833.1	30796.6	36.4913
25	12.6157	388661	basement	5.551	27.1	8.94245	14.4278	30814.6	30797.2	17.3854

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.61026

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	12.3846	367944	basement	5.551	27.1	6.74958	10.8686	29702.6	29692.2	10.3652
2	12.3846	369632	basement	5.551	27.1	14.6151	23.5341	29830.3	29795.2	35.0957
3	12.3846	371174	basement	5.551	27.1	21.6482	34.8592	29948.4	29891.1	57.2817
4	12.3846	372583	basement	5.551	27.1	27.9201	44.9587	30057.5	29980.5	76.981
5	12.3846	373877	basement	5.551	27.1	33.6176	54.1331	30158.8	30063.8	94.9953
6	12.3846	375062	basement	5.551	27.1	38.757	62.4088	30252.6	30141.5	111.079
7	12.3846	376143	basement	5.551	27.1	43.3475	69.8008	30339.3	30213.7	125.595
8	12.3846	377127	basement	5.551	27.1	47.3916	76.3128	30419.2	30280.9	138.275
9	12.3846	378018	basement	5.551	27.1	50.9185	81.9921	30492.5	30343.1	149.403
10	12.3846	378799	basement	5.551	27.1	53.5838	86.2838	30558.5	30400.8	157.715
11	12.3846	379486	basement	5.551	27.1	55.2735	89.0047	30617	30453.9	163.111
12	12.3846	380091	basement	5.551	27.1	56.3443	90.729	30669.2	30502.8	166.421
13	12.3846	380615	basement	5.551	27.1	56.7734	91.42	30715.3	30547.5	167.806
14	12.3846	381063	basement	5.551	27.1	56.536	91.0376	30755.2	30588.1	167.052
15	12.3846	381435	basement	5.551	27.1	55.6057	89.5396	30789	30624.8	164.181
16	12.3846	381734	basement	5.551	27.1	53.9559	86.8831	30816.6	30657.7	158.924
17	12.3846	381961	basement	5.551	27.1	51.5609	83.0265	30838.2	30686.8	151.394
18	12.3846	382117	basement	5.551	27.1	48.396	77.9301	30853.7	30712.3	141.427
19	12.3846	382205	basement	5.551	27.1	44.4387	71.5578	30863.1	30734	129.053
20	12.3846	382223	basement	5.551	27.1	39.6691	63.8776	30866.2	30752.3	113.915
21	12.3846	382174	basement	5.551	27.1	34.071	54.8631	30863.3	30767	96.3283
22	12.3846	382059	basement	5.551	27.1	27.6311	44.4932	30854.3	30778.1	76.1817

23	12.3846	381881	basement	5.551	27.1	20.3829	32.8218	30839.1	30785.9	53.2423
24	12.3846	381694	basement	5.551	27.1	13.8026	22.2257	30822.7	30790.1	32.5904
25	12.3846	381460	basement	5.551	27.1	7.06613	11.3783	30802.3	30790.9	11.4161

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.6134

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	906.471	-2876.36	4.26083e+007	0	0
2	919.086	-2886.9	190814	139.064	0.0417568
3	931.702	-2896.7	361182	263.227	0.0417568
4	944.318	-2905.85	504666	367.798	0.0417569
5	956.933	-2914.37	629348	458.665	0.0417568
6	969.549	-2922.31	737125	537.212	0.0417568
7	982.165	-2929.7	828856	604.066	0.0417569
8	994.78	-2936.58	905284	659.765	0.0417568
9	1007.4	-2942.96	967051	704.781	0.0417568
10	1020.01	-2948.88	1.01366e+006	738.75	0.0417569
11	1032.63	-2954.34	1.03449e+006	753.929	0.0417568
12	1045.24	-2959.37	1.0421e+006	759.476	0.0417568
13	1057.86	-2963.98	1.03688e+006	755.672	0.0417568
14	1070.47	-2968.19	1.01917e+006	742.763	0.0417567
15	1083.09	-2972	989261	720.967	0.0417568
16	1095.71	-2975.43	947424	690.477	0.0417568
17	1108.32	-2978.48	893889	651.461	0.0417568
18	1120.94	-2981.17	828859	604.068	0.0417568
19	1133.55	-2983.49	752514	548.428	0.0417568
20	1146.17	-2985.46	665007	484.653	0.0417568
21	1158.78	-2987.07	566470	412.84	0.0417568
22	1171.4	-2988.34	457016	333.07	0.0417567
23	1184.02	-2989.26	336737	245.412	0.0417568
24	1196.63	-2989.84	221801	161.647	0.0417568
25	1209.25	-2990.08	116191	84.6793	0.0417568
26	1221.86	-2989.97	4.60406e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.61026

Slice	X coordinate	Y coordinate - Bottom	Interslice Normal Force	Interslice Shear Force	Interslice Force Angle

	[m]	[m]	[kN]	[kN]	[degrees]
1	910.155	-2877.56	4.26439e+007	0	0
2	922.54	-2887.91	187780	20.5597	0.00627321
3	934.925	-2897.55	354101	76.9284	0.0124475
4	947.309	-2906.54	494429	159.001	0.0184255
5	959.694	-2914.92	617149	259.727	0.0241129
6	972.078	-2922.72	723253	371.373	0.02942
7	984.463	-2929.99	813591	486.531	0.0342631
8	996.847	-2936.75	888897	598.319	0.0385659
9	1009.23	-2943.03	949808	700.565	0.0422606
10	1021.62	-2948.84	994138	785.803	0.0452887
11	1034	-2954.22	1.01486e+006	843.164	0.0476024
12	1046.39	-2959.17	1.0226e+006	877.501	0.0491659
13	1058.77	-2963.71	1.01776e+006	887.34	0.0499536
14	1071.15	-2967.85	1.00066e+006	872.431	0.0499536
15	1083.54	-2971.6	971598	833.732	0.0491657
16	1095.92	-2974.97	930828	773.352	0.0476026
17	1108.31	-2977.98	878583	694.464	0.0452887
18	1120.69	-2980.63	815061	601.178	0.0422606
19	1133.08	-2982.92	740440	498.392	0.0385659
20	1145.46	-2984.86	654872	391.617	0.0342632
21	1157.85	-2986.46	558488	286.77	0.02942
22	1170.23	-2987.71	451401	189.972	0.0241129
23	1182.62	-2988.63	333704	107.314	0.0184254
24	1195	-2989.21	216904	47.1224	0.0124475
25	1207.38	-2989.45	113634	12.4416	0.00627322
26	1219.77	-2989.36	4.60219e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.623947
Factor of Safety, standard deviation: 0.265974
Factor of Safety, minimum: 0.811253
Factor of Safety, maximum: 2.604280
Probability of Failure: 0.520% (= 52 failed surfaces / 10000 valid surfaces)
Reliability index: 2.34589 (assuming normal distribution)
Reliability index: 2.89873 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price

Factor of Safety, mean: 1.621156
Factor of Safety, standard deviation: 0.265484
Factor of Safety, minimum: 0.813129
Factor of Safety, maximum: 2.604760
Probability of Failure: 0.500% (= 50 failed surfaces / 10000 valid surfaces)
Reliability index: 2.33971 (assuming normal distribution)
Reliability index: 2.88854 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-5000
3285	-5000
3285	0
0	0

External Boundary

X	Y
3285	-5000
3285	-3225
3194	-3224
3103	-3222
3012	-3221
2920	-3225
2829	-3230
2738	-3232
2647	-3230
2555	-3223
2464	-3218
2373	-3216
2290	-3213
2206	-3208
2123	-3201
2040	-3194
1957	-3184
1874	-3168

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 76PC Site 63		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/25/2013	File Name: RR0705_76_63_0g.sli	

1791	-3140
1707	-3114
1621	-3096
1535	-3074
1449	-3046
1363	-3024
1277	-3006
1191	-2981
1105	-2948
1019	-2915
933	-2885
847	-2857
763	-2840
678	-2828
593	-2806
508	-2792
424	-2782
339	-2769
254	-2756
169	-2745
85	-2734
0	-2718
0	-5000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 76PC Site 63		
	Drawn By	Jason R. Patton	Company	Oregon State University
	Date	3/25/2013	File Name	RR0705_76_63_0g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_76_63_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 76PC Site 63
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/25/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 76PC Site 63		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/25/2013	File Name: RR0705_76_63_0g.sli	

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364855085
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.006723
Center: 1179.949, -2675.920
Radius: 301.133
Left Slip Surface Endpoint: 980.568, -2901.593
Right Slip Surface Endpoint: 1180.711, -2977.052
Left Slope Intercept: 980.568 -0.000
Right Slope Intercept: 1180.711 -0.000
Resisting Moment=127765 kN-m
Driving Moment=1.90042e+007 kN-m
Resisting Horizontal Force=426.7 kN

Driving Horizontal Force=63469 kN
Total Slice Area=591100 m2

Method: gle/morgenstern-price

FS: 0.004105
Center: 1153.017, -2686.140
Radius: 280.922
Left Slip Surface Endpoint: 967.396, -2896.998
Right Slip Surface Endpoint: 1154.662, -2967.056
Left Slope Intercept: 967.396 -0.000
Right Slope Intercept: 1154.662 -0.000
Resisting Moment=64261.9 kN-m
Driving Moment=1.56547e+007 kN-m
Resisting Horizontal Force=228.778 kN
Driving Horizontal Force=55732.1 kN
Total Slice Area=551533 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1036
Number of Invalid Surfaces: 16

Error Codes:

Error Code -108 reported for 10 surfaces
Error Code -112 reported for 6 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1036
Number of Invalid Surfaces: 16

Error Codes:

Error Code -112 reported for 16 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with

many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.00672297

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	8.00574	239635	basement	5.551	27.1	432.989	2.91097	29948.5	29953.7	-5.18275
2	8.00574	240349	basement	5.551	27.1	456.136	3.06659	30077.3	30082.1	-4.84407
3	8.00574	241007	basement	5.551	27.1	478.458	3.21666	30194.3	30198.8	-4.54411
4	8.00574	241612	basement	5.551	27.1	499.672	3.35928	30300.5	30304.8	-4.31958
5	8.00574	242169	basement	5.551	27.1	512.277	3.44402	30396.5	30400.6	-4.05908
6	8.00574	242671	basement	5.551	27.1	496.63	3.33883	30479.8	30484.1	-4.30896
7	8.00574	243126	basement	5.551	27.1	505.699	3.3998	30553.1	30557.3	-4.21192
8	8.00574	243540	basement	5.551	27.1	511.508	3.43885	30617.9	30622	-4.14502
9	8.00574	243915	basement	5.551	27.1	513.472	3.45206	30674.7	30678.8	-4.11727
10	8.00574	244253	basement	5.551	27.1	510.892	3.43471	30723.7	30727.8	-4.08184
11	8.00574	244556	basement	5.551	27.1	502.904	3.38101	30765.3	30769.6	-4.32532
12	8.00574	244824	basement	5.551	27.1	488.433	3.28372	30799.8	30804.2	-4.44888
13	8.00574	245058	basement	5.551	27.1	466.102	3.13359	30827.3	30832	-4.72558
14	8.00574	245261	basement	5.551	27.1	434.119	2.91857	30848	30853.2	-5.18924
15	8.00574	245432	basement	5.551	27.1	390.104	2.62266	30862.1	30867.9	-5.78188
16	8.00574	245572	basement	5.551	27.1	330.806	2.224	30869.8	30876.3	-6.49744
17	8.00574	245683	basement	5.551	27.1	251.666	1.69194	30871.1	30878.6	-7.47817
18	8.00574	245764	basement	5.551	27.1	146.066	0.982	30865.9	30874.9	-9.00498
19	8.00574	245817	basement	5.551	27.1	0	0	30854.3	30865.2	-10.8575
20	8.00574	245841	basement	5.551	27.1	0	0	30814.4	30849.7	-35.3235
21	8.00574	245838	basement	5.551	27.1	0	0	30767.5	30828.5	-61.0318
22	8.00574	245806	basement	5.551	27.1	0	0	30713.9	30801.5	-87.6184
23	8.00574	245748	basement	5.551	27.1	0	0	30653.5	30768.9	-115.403
24	8.00574	245662	basement	5.551	27.1	0	0	30586.3	30730.7	-144.385
25	8.00574	245548	basement	5.551	27.1	0	0	30470.6	30686.9	-216.273

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00410497

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	7.49065	223838	basement	5.551	27.1	86.0274	0.35314	29891.6	29901.7	-10.1423
2	7.49065	224461	basement	5.551	27.1	220.357	0.90456	30012.2	30021.2	-9.02604
3	7.49065	225034	basement	5.551	27.1	346.716	1.42326	30121.8	30129.9	-8.08022

4	7.49065	225562	basement	5.551	27.1	461.358	1.89386	30221.3	30228.5	-7.15519
5	7.49065	226046	basement	5.551	27.1	560.869	2.30235	30311.3	30317.7	-6.39853
6	7.49065	226491	basement	5.551	27.1	642.253	2.63643	30392.3	30398	-5.65743
7	7.49065	226898	basement	5.551	27.1	699.559	2.87167	30464.9	30470.1	-5.24183
8	7.49065	227262	basement	5.551	27.1	701.917	2.88135	30526.5	30531.8	-5.28049
9	7.49065	227588	basement	5.551	27.1	703.274	2.88692	30579.1	30584.3	-5.18162
10	7.49065	227882	basement	5.551	27.1	680.297	2.7926	30624.2	30629.7	-5.45139
11	7.49065	228144	basement	5.551	27.1	633.206	2.59929	30662.5	30668.2	-5.73803
12	7.49065	228376	basement	5.551	27.1	562.825	2.31038	30693.7	30700	-6.2944
13	7.49065	228579	basement	5.551	27.1	470.561	1.93164	30718.4	30725.5	-7.09312
14	7.49065	228754	basement	5.551	27.1	358.346	1.471	30736.8	30744.8	-7.97714
15	7.49065	228901	basement	5.551	27.1	228.577	0.9383	30749	30758	-9.02756
16	7.49065	229021	basement	5.551	27.1	84.0761	0.34513	30755.2	30765.3	-10.0996
17	7.49065	229116	basement	5.551	27.1	0	0	30743.7	30766.9	-23.1644
18	7.49065	229185	basement	5.551	27.1	0	0	30717.1	30762.9	-45.8095
19	7.49065	229228	basement	5.551	27.1	0	0	30691	30753.2	-62.2328
20	7.49065	229247	basement	5.551	27.1	0	0	30666	30738.2	-72.211
21	7.49065	229241	basement	5.551	27.1	0	0	30642.9	30717.7	-74.8475
22	7.49065	229211	basement	5.551	27.1	0	0	30621.4	30691.9	-70.4878
23	7.49065	229156	basement	5.551	27.1	0	0	30601.6	30660.8	-59.1861
24	7.49065	229078	basement	5.551	27.1	0	0	30583	30624.4	-41.4261
25	7.49065	228976	basement	5.551	27.1	0	0	30564.7	30582.8	-18.0801

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.00672297

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	980.568	-2901.59	4.33591e+007	0	0
2	988.574	-2908.42	118844	-1905.17	-0.918421
3	996.579	-2914.79	224916	-3605.6	-0.918423
4	1004.59	-2920.72	319067	-5114.93	-0.918424
5	1012.59	-2926.26	402012	-6444.6	-0.918422
6	1020.6	-2931.44	472722	-7578.15	-0.918423
7	1028.6	-2936.26	526775	-8444.66	-0.918422
8	1036.61	-2940.75	571165	-9156.28	-0.918423
9	1044.61	-2944.93	606293	-9719.39	-0.918421
10	1052.62	-2948.81	632508	-10139.7	-0.918427
11	1060.63	-2952.4	650125	-10422.1	-0.918425

12	1068.63	-2955.72	659424	-10571.1	-0.918419
13	1076.64	-2958.78	660659	-10590.9	-0.918419
14	1084.64	-2961.57	654067	-10485.3	-0.918426
15	1092.65	-2964.12	639866	-10257.6	-0.918422
16	1100.65	-2966.43	618270	-9911.41	-0.918423
17	1108.66	-2968.49	589489	-9450.02	-0.918422
18	1116.67	-2970.33	553741	-8876.95	-0.918423
19	1124.67	-2971.94	511266	-8196.03	-0.918422
20	1132.68	-2973.32	462364	-7412.1	-0.918423
21	1140.68	-2974.48	406272	-6512.89	-0.918422
22	1148.69	-2975.43	343051	-5499.4	-0.918422
23	1156.69	-2976.15	272751	-4372.44	-0.918423
24	1164.7	-2976.67	195415	-3132.67	-0.918422
25	1172.71	-2976.97	111071	-1780.56	-0.91842
26	1180.71	-2977.05	4.56436e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00410497

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	967.396	-2897	4.32219e+007	0	0
2	974.886	-2903.36	112051	-207.373	-0.106037
3	982.377	-2909.3	211574	-776.942	-0.210401
4	989.868	-2914.83	299406	-1627.51	-0.311445
5	997.358	-2919.99	376278	-2676.71	-0.407575
6	1004.85	-2924.81	442829	-3843.47	-0.497278
7	1012.34	-2929.3	499635	-5050.39	-0.579135
8	1019.83	-2933.48	546358	-6216.22	-0.651858
9	1027.32	-2937.37	577486	-7199.81	-0.714298
10	1034.81	-2940.98	600287	-8020.34	-0.765474
11	1042.3	-2944.32	615154	-8638.91	-0.80458
12	1049.79	-2947.41	622445	-9028.35	-0.830997
13	1057.28	-2950.25	622484	-9173.58	-0.84431
14	1064.77	-2952.84	615559	-9071.53	-0.84431
15	1072.26	-2955.2	601930	-8730.78	-0.830997
16	1079.76	-2957.34	581820	-8170.79	-0.80458
17	1087.25	-2959.25	555425	-7420.95	-0.765475
18	1094.74	-2960.95	522527	-6514.61	-0.714299
19	1102.23	-2962.43	482791	-5492.98	-0.651858
20	1109.72	-2963.7	436308	-4410.27	-0.579135
21	1117.21	-2964.77	383153	-3325.52	-0.497278

22	1124.7	-2965.63	323387	-2300.47	-0.407577
23	1132.19	-2966.29	257054	-1397.3	-0.311447
24	1139.68	-2966.74	184183	-676.359	-0.210401
25	1147.17	-2967	104788	-193.932	-0.106038
26	1154.66	-2967.06	4.53376e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.106816
Factor of Safety, standard deviation: 0.094977
Factor of Safety, minimum: 0.001247
Factor of Safety, maximum: 1.390070
Probability of Failure: 99.950% (= 9994 failed surfaces / 9999 valid surfaces), 1 invalid surfaces
Reliability index: -9.40425 (assuming normal distribution)
Reliability index: -3.31204 (assuming lognormal distribution)
* best fit = Beta

Method: gle/morgenstern-price
Factor of Safety, mean: 0.116335
Factor of Safety, standard deviation: 0.094451
Factor of Safety, minimum: 0.000664
Factor of Safety, maximum: 1.410160
Probability of Failure: 99.950% (= 9994 failed surfaces / 9999 valid surfaces), 1 invalid surfaces
Reliability index: -9.35585 (assuming normal distribution)
Reliability index: -3.37913 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-5000
3285	-5000
3285	0
0	0

External Boundary

X	Y

3285	-5000
3285	-3225
3194	-3224
3103	-3222
3012	-3221
2920	-3225
2829	-3230
2738	-3232
2647	-3230
2555	-3223
2464	-3218
2373	-3216
2290	-3213
2206	-3208
2123	-3201
2040	-3194
1957	-3184
1874	-3168
1791	-3140
1707	-3114
1621	-3096
1535	-3074
1449	-3046
1363	-3024
1277	-3006
1191	-2981
1105	-2948
1019	-2915
933	-2885
847	-2857
763	-2840
678	-2828
593	-2806
508	-2792
424	-2782
339	-2769
254	-2756
169	-2745
85	-2734
0	-2718

rocscience SLIDEINTERPRET 6.020	*Project* Sumatra Submarine Slide		
	Analysis Description RR0705 76PC Site 63		
	Drawn By Jason R. Patton	*Company*	Oregon State University
	Date 3/25/2013	*File Name*	RR0705_76_63_0g.sli

0 -5000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 76PC Site 63	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/25/2013	File Name: RR0705_77_58_0g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_77_58_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 76PC Site 63
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/25/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364855701
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 76PC Site 63		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/25/2013	File Name: RR0705_77_58_0g.sli	

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Global Minimums

Method: spencer

FS: 1.181530
Center: 3511.388, 129.242
Radius: 3750.062
Left Slip Surface Endpoint: 1364.045, -2945.150
Right Slip Surface Endpoint: 2621.764, -3513.770
Left Slope Intercept: 1364.045 -0.000
Right Slope Intercept: 2621.764 -0.000
Resisting Moment=5.93258e+008 kN-m
Driving Moment=5.02108e+008 kN-m
Resisting Horizontal Force=143537 kN
Driving Horizontal Force=121484 kN
Total Slice Area=4.1207e+006 m2

Method: gle/morgenstern-price

FS: 1.181790
Center: 3529.763, 181.518
Radius: 3803.470
Left Slip Surface Endpoint: 1364.045, -2945.150
Right Slip Surface Endpoint: 2607.846, -3508.530
Left Slope Intercept: 1364.045 -0.000
Right Slope Intercept: 2607.846 -0.000
Resisting Moment=5.8093e+008 kN-m
Driving Moment=4.91566e+008 kN-m
Resisting Horizontal Force=138549 kN

Driving Horizontal Force=117236 kN
Total Slice Area=4.06978e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2648
Number of Invalid Surfaces: 136

Error Codes:

Error Code -108 reported for 136 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2783
Number of Invalid Surfaces: 1

Error Codes:

Error Code -108 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.18153

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	50.3088	1.53689e+006	basement	5.551	27.1	10.9181	12.9001	30527.2	30512.9	14.3466
2	50.3088	1.55815e+006	basement	5.551	27.1	35.6931	42.1725	30934.1	30862.5	71.5966
3	50.3088	1.57837e+006	basement	5.551	27.1	58.6952	69.3501	31324.7	31200.1	124.644
4	50.3088	1.59724e+006	basement	5.551	27.1	76.5888	90.492	31692	31526	166.008
5	50.3088	1.61526e+006	basement	5.551	27.1	92.332	109.093	32042.9	31840.6	202.331
6	50.3088	1.63253e+006	basement	5.551	27.1	107.041	126.472	32380.7	32144.3	236.389
7	50.3088	1.6488e+006	basement	5.551	27.1	119.27	140.921	32701.8	32437.3	264.483

8	50.3088	1.66413e+006	basement	5.551	27.1	128.202	151.475	33005	32719.9	285.131
9	50.3088	1.67866e+006	basement	5.551	27.1	135.285	159.843	33293.8	32992.3	301.503
10	50.3088	1.69244e+006	basement	5.551	27.1	140.502	166.007	33568.4	33254.8	313.565
11	50.3088	1.7057e+006	basement	5.551	27.1	145.353	171.739	33832.4	33507.6	324.791
12	50.3088	1.71825e+006	basement	5.551	27.1	149.084	176.147	34084.4	33751	333.411
13	50.3088	1.72991e+006	basement	5.551	27.1	149.774	176.962	34320	33985.1	334.897
14	50.3088	1.74074e+006	basement	5.551	27.1	148.01	174.878	34541	34210.1	330.897
15	50.3088	1.75061e+006	basement	5.551	27.1	142.215	168.031	34743.6	34426.1	317.501
16	50.3088	1.75979e+006	basement	5.551	27.1	134.295	158.674	34932.6	34633.4	299.206
17	50.3088	1.7683e+006	basement	5.551	27.1	124.495	147.094	35108.6	34832.1	276.539
18	50.3088	1.77628e+006	basement	5.551	27.1	113.6	134.222	35273.6	35022.3	251.346
19	50.3088	1.78365e+006	basement	5.551	27.1	101.338	119.734	35427.4	35204.2	223.154
20	50.3088	1.79038e+006	basement	5.551	27.1	87.2249	103.059	35568.3	35377.8	190.54
21	50.3088	1.79667e+006	basement	5.551	27.1	71.9796	85.046	35698.8	35543.4	155.359
22	50.3088	1.80264e+006	basement	5.551	27.1	57.7299	68.2096	35823.5	35700.9	122.567
23	50.3088	1.80822e+006	basement	5.551	27.1	43.0307	50.8421	35939.2	35850.6	88.5645
24	50.3088	1.81337e+006	basement	5.551	27.1	27.8555	32.9121	36045.9	35992.5	53.4487
25	50.3088	1.81837e+006	basement	5.551	27.1	14.2576	16.8458	36148.7	36126.7	22.0298

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.18179

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	49.752	1.51966e+006	basement	5.551	27.1	14.5939	17.2469	30532.4	30509.5	22.9255
2	49.752	1.54025e+006	basement	5.551	27.1	37.0796	43.8203	30927.5	30852.7	74.7968
3	49.752	1.55986e+006	basement	5.551	27.1	57.6455	68.1249	31306.6	31184.3	122.254
4	49.752	1.57819e+006	basement	5.551	27.1	73.7675	87.1777	31664.3	31504.8	159.547
5	49.752	1.59569e+006	basement	5.551	27.1	88.2087	104.244	32007.3	31814.4	192.945
6	49.752	1.61247e+006	basement	5.551	27.1	101.868	120.386	32337.9	32113.5	224.399
7	49.752	1.62834e+006	basement	5.551	27.1	113.527	134.165	32653.7	32402.3	251.378
8	49.752	1.64327e+006	basement	5.551	27.1	122.215	144.433	32952.4	32681.1	271.34
9	49.752	1.65746e+006	basement	5.551	27.1	129.322	152.832	33237.9	32950.1	287.84
10	49.752	1.67092e+006	basement	5.551	27.1	134.771	159.271	33509.9	33209.6	300.306
11	49.752	1.68386e+006	basement	5.551	27.1	139.787	165.199	33771.7	33459.7	311.973
12	49.752	1.69618e+006	basement	5.551	27.1	144.224	170.442	34022.8	33700.7	322.13
13	49.752	1.70764e+006	basement	5.551	27.1	145.895	172.417	34258.7	33932.7	326.017
14	49.752	1.71833e+006	basement	5.551	27.1	145.246	171.65	34480.5	34156	324.463
15	49.752	1.72807e+006	basement	5.551	27.1	140.596	166.155	34684.4	34370.6	313.787
16	49.752	1.73714e+006	basement	5.551	27.1	133.441	157.699	34874	34576.8	297.219
17	49.752	1.74556e+006	basement	5.551	27.1	124.267	146.857	35050.7	34774.6	276.111
18	49.752	1.75346e+006	basement	5.551	27.1	113.588	134.237	35215.7	34964.2	251.455

19	49.752	1.76079e+006	basement	5.551	27.1	101.595	120.064	35369.5	35145.8	223.694
20	49.752	1.76752e+006	basement	5.551	27.1	87.5144	103.424	35510.8	35319.4	191.379
21	49.752	1.77375e+006	basement	5.551	27.1	71.7876	84.8379	35640.1	35485.2	154.941
22	49.752	1.77974e+006	basement	5.551	27.1	57.0048	67.3677	35764	35643.3	120.692
23	49.752	1.7853e+006	basement	5.551	27.1	41.5059	49.0513	35878.8	35793.7	85.0959
24	49.752	1.79049e+006	basement	5.551	27.1	25.7718	30.4569	35985.2	35936.6	48.6211
25	49.752	1.79548e+006	basement	5.551	27.1	11.1916	13.2261	36087.1	36072	15.0539

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.18153

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	1364.05	-2945.15	4.46706e+007	0	0
2	1414.35	-2979.68	404501	722.903	0.102396
3	1464.66	-3013.03	797165	1424.65	0.102396
4	1514.97	-3045.23	1.11554e+006	1993.63	0.102396
5	1565.28	-3076.32	1.38228e+006	2470.34	0.102396
6	1615.59	-3106.33	1.63365e+006	2919.57	0.102396
7	1665.9	-3135.28	1.8572e+006	3319.1	0.102396
8	1716.21	-3163.22	2.01649e+006	3603.77	0.102396
9	1766.52	-3190.15	2.14519e+006	3833.77	0.102396
10	1816.82	-3216.12	2.24321e+006	4008.94	0.102396
11	1867.13	-3241.13	2.32336e+006	4152.18	0.102396
12	1917.44	-3265.21	2.39591e+006	4281.85	0.102396
13	1967.75	-3288.38	2.42407e+006	4332.17	0.102396
14	2018.06	-3310.66	2.40919e+006	4305.58	0.102396
15	2068.37	-3332.07	2.33076e+006	4165.41	0.102396
16	2118.68	-3352.61	2.20843e+006	3946.8	0.102396
17	2168.99	-3372.32	2.05472e+006	3672.08	0.102396
18	2219.29	-3391.19	1.87575e+006	3352.23	0.102396
19	2269.6	-3409.25	1.67963e+006	3001.75	0.102396
20	2319.91	-3426.51	1.45251e+006	2595.86	0.102396
21	2370.22	-3442.97	1.19446e+006	2134.67	0.102396
22	2420.53	-3458.65	960428	1716.43	0.102396
23	2470.84	-3473.57	710765	1270.24	0.102396
24	2521.15	-3487.72	465737	832.341	0.102396
25	2571.46	-3501.12	226882	405.471	0.102396
26	2621.76	-3513.77	6.35849e+007	0	0

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 76PC Site 63		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/25/2013	File Name: RR0705_77_58_0g.sli	

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.18179

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	1364.05	-2945.15	4.46706e+007	0	0
2	1413.8	-2979.03	391642	112.408	0.0164449
3	1463.55	-3011.78	772574	439.988	0.0326305
4	1513.3	-3043.43	1.0826e+006	912.655	0.0483016
5	1563.05	-3074.01	1.34069e+006	1479.09	0.0632104
6	1612.81	-3103.55	1.58361e+006	2131.62	0.077123
7	1662.56	-3132.08	1.80127e+006	2823.75	0.0898193
8	1712.31	-3159.63	1.95733e+006	3453.72	0.101099
9	1762.06	-3186.21	2.08229e+006	4026.21	0.110784
10	1811.81	-3211.86	2.17776e+006	4512.51	0.118722
11	1861.57	-3236.6	2.25257e+006	4905.99	0.124787
12	1911.32	-3260.43	2.32444e+006	5228.78	0.128885
13	1961.07	-3283.39	2.35659e+006	5386.04	0.130951
14	2010.82	-3305.49	2.34365e+006	5356.47	0.130951
15	2060.57	-3326.74	2.27535e+006	5118.35	0.128885
16	2110.33	-3347.16	2.15782e+006	4699.65	0.124788
17	2160.08	-3366.77	2.01002e+006	4164.94	0.118722
18	2209.83	-3385.58	1.83429e+006	3546.67	0.110783
19	2259.58	-3403.59	1.64601e+006	2904.4	0.101099
20	2309.33	-3420.83	1.42783e+006	2238.32	0.0898189
21	2359.09	-3437.31	1.17978e+006	1588.04	0.0771228
22	2408.84	-3453.03	942351	1039.63	0.0632104
23	2458.59	-3468	696644	587.285	0.0483015
24	2508.34	-3482.24	460532	262.278	0.0326306
25	2558.09	-3495.74	214155	61.4662	0.0164449
26	2607.85	-3508.53	6.33954e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.189948
Factor of Safety, standard deviation: 0.199046
Factor of Safety, minimum: 0.625441
Factor of Safety, maximum: 1.877130
Probability of Failure: 16.880% (= 1688 failed surfaces / 10000 valid surfaces)
Reliability index: 0.95429 (assuming normal distribution)

Reliability index: 0.96383 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 1.189104
Factor of Safety, standard deviation: 0.198738
Factor of Safety, minimum: 0.624303
Factor of Safety, maximum: 1.874340
Probability of Failure: 16.900% (= 1690 failed surfaces / 10000 valid surfaces)
Reliability index: 0.95153 (assuming normal distribution)
Reliability index: 0.96049 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
6581	-6000
6581	0
0	0

External Boundary

X	Y
6581	-6000
6581	-3774
6492	-3772
6403	-3785
6313	-3788
6224	-3785
6135	-3784
6046	-3784
5957	-3786
5868	-3786
5779	-3785
5689	-3784
5600	-3786
5511	-3788
5422	-3787

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 76PC Site 63		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/25/2013	File Name: RR0705_77_58_0g.sli	

5333	-3764
5244	-3746
5154	-3725
5068	-3714
4982	-3712
4896	-3707
4809	-3702
4723	-3697
4637	-3695
4550	-3696
4464	-3696
4378	-3693
4291	-3686
4205	-3677
4116	-3666
4027	-3657
3938	-3647
3849	-3642
3760	-3636
3672	-3630
3583	-3625
3494	-3622
3405	-3618
3316	-3611
3231	-3605
3146	-3600
3061	-3593
2975	-3584
2890	-3574
2805	-3561
2719	-3543
2633	-3518
2548	-3486
2462	-3450
2376	-3412
2290	-3371
2204	-3330
2118	-3288
2032	-3246
1941	-3204

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 76PC Site 63		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/25/2013	File Name: RR0705_77_58_0g.sli	

1849	-3163
1757	-3120
1665	-3077
1573	-3036
1481	-2994
1389	-2956
1297	-2916
1206	-2880
1114	-2838
1022	-2804
930	-2781
837	-2771
744	-2765
651	-2767
558	-2770
465	-2776
372	-2783
279	-2792
186	-2803
93	-2816
0	-2829
0	-6000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 76PC Site 63	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/25/2013	File Name: RR0705_77_58_0g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_77_58_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 76PC Site 63
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/25/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364855522
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.002564
Center: 3675.407, 731.965
Radius: 4358.065
Left Slip Surface Endpoint: 1282.029, -2910.077
Right Slip Surface Endpoint: 2490.473, -3461.919
Left Slope Intercept: 1282.029 -0.000
Right Slope Intercept: 2490.473 -0.000
Resisting Moment=1.29788e+007 kN-m
Driving Moment=5.06287e+009 kN-m
Resisting Horizontal Force=2964.84 kN

Driving Horizontal Force=1.15655e+006 kN
Total Slice Area=3.89518e+006 m2

Method: gle/morgenstern-price

FS: 0.002488
Center: 3700.019, 908.979
Radius: 4536.554
Left Slip Surface Endpoint: 1203.497, -2878.857
Right Slip Surface Endpoint: 2500.517, -3466.124
Left Slope Intercept: 1203.497 -0.000
Right Slope Intercept: 2500.517 -0.000
Resisting Moment=1.59237e+007 kN-m
Driving Moment=6.40103e+009 kN-m
Resisting Horizontal Force=3473.43 kN
Driving Horizontal Force=1.39626e+006 kN
Total Slice Area=4.16811e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1060
Number of Invalid Surfaces: 18

Error Codes:

Error Code -108 reported for 10 surfaces
Error Code -112 reported for 8 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1061
Number of Invalid Surfaces: 17

Error Codes:

Error Code -108 reported for 7 surfaces
Error Code -112 reported for 10 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This

screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.00256352

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	48.3378	1.45819e+006	basement	5.551	27.1	113.882	0.29194	30214.5	30224.8	-10.2527
2	48.3378	1.47624e+006	basement	5.551	27.1	274.1	0.70266	30691.2	30700.6	-9.4488
3	48.3378	1.49368e+006	basement	5.551	27.1	432.729	1.10931	31148.3	31157.1	-8.75825
4	48.3378	1.51065e+006	basement	5.551	27.1	597.893	1.53271	31594.1	31602	-7.86881
5	48.3378	1.52675e+006	basement	5.551	27.1	744.796	1.9093	32005.1	32012.2	-7.12683
6	48.3378	1.54188e+006	basement	5.551	27.1	862.622	2.21135	32374.2	32380.7	-6.49956
7	48.3378	1.55644e+006	basement	5.551	27.1	976.466	2.50319	32725.9	32731.8	-5.94308
8	48.3378	1.57048e+006	basement	5.551	27.1	1087.03	2.78662	33061.1	33066.5	-5.37341
9	48.3378	1.58376e+006	basement	5.551	27.1	1177.39	3.01826	33366.4	33371.4	-5.00223
10	48.3378	1.59633e+006	basement	5.551	27.1	1248.33	3.20013	33644.6	33649.3	-4.70019
11	48.3378	1.60833e+006	basement	5.551	27.1	1307.7	3.35231	33903.2	33907.6	-4.35792
12	48.3378	1.61978e+006	basement	5.551	27.1	1355.31	3.47436	34143.3	34147.4	-4.11803
13	48.3378	1.63087e+006	basement	5.551	27.1	1405.4	3.60276	34376.1	34380	-3.91269
14	48.3378	1.64149e+006	basement	5.551	27.1	1447.52	3.71074	34594.1	34597.6	-3.47246
15	48.3378	1.65141e+006	basement	5.551	27.1	1462.34	3.74875	34784.6	34788.1	-3.53591
16	48.3378	1.66073e+006	basement	5.551	27.1	1453.52	3.72614	34952.3	34955.8	-3.48233
17	48.3378	1.66926e+006	basement	5.551	27.1	1402.19	3.59454	35086.4	35090.4	-3.95241
18	48.3378	1.67724e+006	basement	5.551	27.1	1324.58	3.39559	35200.6	35204.7	-4.11874
19	48.3378	1.68471e+006	basement	5.551	27.1	1223.11	3.13547	35297.2	35301.9	-4.7457
20	48.3378	1.69174e+006	basement	5.551	27.1	1102.02	2.82506	35380.6	35385.9	-5.29514
21	48.3378	1.69838e+006	basement	5.551	27.1	962.197	2.46661	35452.3	35458.2	-5.88328
22	48.3378	1.70453e+006	basement	5.551	27.1	792.176	2.03076	35507.2	35514.1	-6.89165
23	48.3378	1.71022e+006	basement	5.551	27.1	591.995	1.51759	35547.4	35555.3	-7.87433
24	48.3378	1.71578e+006	basement	5.551	27.1	394.863	1.01224	35591.2	35600.1	-8.90413
25	48.3378	1.72102e+006	basement	5.551	27.1	186.267	0.4775	35627.4	35637.3	-9.91544

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00248767

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	51.8808	1.54925e+006	basement	5.551	27.1	264.123	0.65705	29918.4	29928	-9.5891
2	51.8808	1.57066e+006	basement	5.551	27.1	731.194	1.81897	30463.3	30470.6	-7.28763

3	51.8808	1.59087e+006	basement	5.551	27.1	1108.27	2.75702	30960.9	30966.4	-5.5256
4	51.8808	1.61013e+006	basement	5.551	27.1	1482.25	3.68736	31424.6	31428.2	-3.6126
5	51.8808	1.62886e+006	basement	5.551	27.1	1856.85	4.61924	31877.1	31879	-1.85865
6	51.8808	1.64676e+006	basement	5.551	27.1	2060.65	5.12622	32300.4	32301.3	-0.907856
7	51.8808	1.66344e+006	basement	5.551	27.1	2179.15	5.421	32673.8	32674.1	-0.283781
8	51.8808	1.67943e+006	basement	5.551	27.1	2323.87	5.78102	33025.9	33025.4	0.462969
9	51.8808	1.69481e+006	basement	5.551	27.1	2372.61	5.90226	33360.2	33359.6	0.615407
10	51.8808	1.70931e+006	basement	5.551	27.1	2237.68	5.5666	33661.3	33661.2	0.104239
11	51.8808	1.723e+006	basement	5.551	27.1	2120.95	5.27622	33933.7	33934.2	-0.478962
12	51.8808	1.73602e+006	basement	5.551	27.1	1947.26	4.84413	34184.7	34186	-1.34478
13	51.8808	1.74844e+006	basement	5.551	27.1	1806.73	4.49454	34417.8	34419.8	-2.00743
14	51.8808	1.76046e+006	basement	5.551	27.1	1634.38	4.0658	34643.8	34646.7	-2.88106
15	51.8808	1.77181e+006	basement	5.551	27.1	1278.09	3.17947	34846.4	34851.1	-4.66784
16	51.8808	1.78238e+006	basement	5.551	27.1	942.939	2.34572	35020.8	35027.1	-6.30302
17	51.8808	1.79211e+006	basement	5.551	27.1	442.925	1.10185	35162.7	35171.5	-8.78
18	51.8808	1.80105e+006	basement	5.551	27.1	122.878	0.30568	35276.1	35286.3	-10.2233
19	51.8808	1.80939e+006	basement	5.551	27.1	0	0	35339.1	35382.2	-43.1132
20	51.8808	1.81719e+006	basement	5.551	27.1	0	0	35383.3	35462	-78.6541
21	51.8808	1.82453e+006	basement	5.551	27.1	0	0	35424.2	35530	-105.81
22	51.8808	1.83131e+006	basement	5.551	27.1	0	0	35457.6	35580.2	-122.641
23	51.8808	1.83756e+006	basement	5.551	27.1	0	0	35495.9	35614.7	-118.792
24	51.8808	1.84364e+006	basement	5.551	27.1	0	0	35550.6	35652.8	-102.232
25	51.8808	1.84936e+006	basement	5.551	27.1	0	0	35599	35683.7	-84.6504

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.00256352

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	1282.03	-2910.08	4.3613e+007	0	0
2	1330.37	-2941.39	332777	40.1399	0.00691108
3	1378.7	-2971.8	634196	76.4973	0.00691107
4	1427.04	-3001.34	945950	114.101	0.00691105
5	1475.38	-3030.03	1.24919e+006	150.679	0.00691109
6	1523.72	-3057.89	1.47761e+006	178.231	0.00691108
7	1572.06	-3084.92	1.67835e+006	202.444	0.00691107
8	1620.39	-3111.17	1.87432e+006	226.083	0.00691109
9	1668.73	-3136.62	2.04655e+006	246.857	0.00691108
10	1717.07	-3161.32	2.16501e+006	261.146	0.00691108

11	1765.41	-3185.26	2.2592e+006	272.507	0.00691108
12	1813.74	-3208.46	2.32844e+006	280.859	0.00691108
13	1862.08	-3230.94	2.38145e+006	287.253	0.00691108
14	1910.42	-3252.7	2.43413e+006	293.607	0.00691107
15	1958.76	-3273.76	2.45189e+006	295.749	0.00691106
16	2007.1	-3294.13	2.42706e+006	292.754	0.00691106
17	2055.43	-3313.82	2.35402e+006	283.944	0.00691107
18	2103.77	-3332.85	2.23035e+006	269.027	0.00691107
19	2152.11	-3351.21	2.07816e+006	250.67	0.00691108
20	2200.45	-3368.92	1.89744e+006	228.872	0.0069111
21	2248.78	-3385.98	1.70633e+006	205.82	0.0069111
22	2297.12	-3402.41	1.48878e+006	179.578	0.00691107
23	2345.46	-3418.21	1.24361e+006	150.006	0.0069111
24	2393.8	-3433.39	993077	119.786	0.00691108
25	2442.14	-3447.96	753997	90.9479	0.00691108
26	2490.47	-3461.92	6.17221e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00248767

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	1203.5	-2878.86	4.26823e+007	0	0
2	1255.38	-2912.55	390617	-2352.17	-0.345013
3	1307.26	-2945.24	754951	-9020.44	-0.684559
4	1359.14	-2976.97	1.04975e+006	-18566.6	-1.01327
5	1411.02	-3007.76	1.3359e+006	-30920.7	-1.32593
6	1462.9	-3037.62	1.61837e+006	-45703.3	-1.61762
7	1514.78	-3066.58	1.83469e+006	-60341.4	-1.88373
8	1566.66	-3094.66	2.00385e+006	-74181.6	-2.1201
9	1618.54	-3121.88	2.16365e+006	-87770.4	-2.32298
10	1670.42	-3148.25	2.2989e+006	-99939.5	-2.48924
11	1722.31	-3173.79	2.38184e+006	-108835	-2.61623
12	1774.19	-3198.51	2.44202e+006	-115249	-2.70202
13	1826.07	-3222.44	2.47987e+006	-118911	-2.74526
14	1877.95	-3245.58	2.51424e+006	-120559	-2.74526
15	1929.83	-3267.95	2.54213e+006	-119974	-2.70203
16	1981.71	-3289.56	2.5298e+006	-115596	-2.61624
17	2033.59	-3310.42	2.48887e+006	-108198	-2.48924
18	2085.47	-3330.54	2.38394e+006	-96707	-2.32299
19	2137.35	-3349.94	2.25328e+006	-83415.3	-2.12009
20	2189.23	-3368.62	2.09008e+006	-68741.1	-1.88373

21	2241.11	-3386.59	1.90527e+006	-53805.5	-1.61762
22	2292.99	-3403.86	1.69013e+006	-39119.8	-1.32593
23	2344.87	-3420.44	1.43834e+006	-25439.5	-1.01327
24	2396.76	-3436.34	1.17528e+006	-14042.7	-0.68456
25	2448.64	-3451.57	915336	-5511.85	-0.345012
26	2500.52	-3466.12	6.18722e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.032376
Factor of Safety, standard deviation: 0.071854
Factor of Safety, minimum: 0.000153
Factor of Safety, maximum: 1.384660
Probability of Failure: 99.950% (= 9912 failed surfaces / 9917 valid surfaces), 83 invalid surfaces
Reliability index: -13.46644 (assuming normal distribution)
Reliability index: -3.23861 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 0.030722
Factor of Safety, standard deviation: 0.072470
Factor of Safety, minimum: 0.000168
Factor of Safety, maximum: 1.385050
Probability of Failure: 99.950% (= 9980 failed surfaces / 9985 valid surfaces), 15 invalid surfaces
Reliability index: -13.37491 (assuming normal distribution)
Reliability index: -3.22482 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
6581	-6000
6581	0
0	0

External Boundary

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 76PC Site 63		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/25/2013	File Name: RR0705_77_58_0g.sli	

X	Y
6581	-6000
6581	-3774
6492	-3772
6403	-3785
6313	-3788
6224	-3785
6135	-3784
6046	-3784
5957	-3786
5868	-3786
5779	-3785
5689	-3784
5600	-3786
5511	-3788
5422	-3787
5333	-3764
5244	-3746
5154	-3725
5068	-3714
4982	-3712
4896	-3707
4809	-3702
4723	-3697
4637	-3695
4550	-3696
4464	-3696
4378	-3693
4291	-3686
4205	-3677
4116	-3666
4027	-3657
3938	-3647
3849	-3642
3760	-3636
3672	-3630
3583	-3625
3494	-3622
3405	-3618
3316	-3611

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 76PC Site 63		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/25/2013	File Name: RR0705_77_58_0g.sli	

3231	-3605
3146	-3600
3061	-3593
2975	-3584
2890	-3574
2805	-3561
2719	-3543
2633	-3518
2548	-3486
2462	-3450
2376	-3412
2290	-3371
2204	-3330
2118	-3288
2032	-3246
1941	-3204
1849	-3163
1757	-3120
1665	-3077
1573	-3036
1481	-2994
1389	-2956
1297	-2916
1206	-2880
1114	-2838
1022	-2804
930	-2781
837	-2771
744	-2765
651	-2767
558	-2770
465	-2776
372	-2783
279	-2792
186	-2803
93	-2816
0	-2829
0	-6000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 77PC Site 61	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/25/2013	File Name: RR0705_77_61_0g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_77_61_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 77PC Site 61
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/25/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364856030
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.2
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	Automatically Calculated
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 77PC Site 61		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/25/2013	File Name: RR0705_77_61_0g.sli	

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.2	5.7	8.7	0.5

Global Minimums

Method: spencer

FS: 1.599530
Center: 890.587, -3401.193
Radius: 336.328
Left Slip Surface Endpoint: 668.747, -3653.985
Right Slip Surface Endpoint: 893.527, -3737.508
Left Slope Intercept: 668.747 -0.000
Right Slope Intercept: 893.527 -0.000
Resisting Moment=3.80068e+006 kN-m
Driving Moment=2.37613e+006 kN-m
Resisting Horizontal Force=10464.7 kN
Driving Horizontal Force=6542.35 kN
Total Slice Area=834278 m2

Method: gle/morgenstern-price

FS: 1.599390
Center: 890.358, -3401.476
Radius: 335.965
Left Slip Surface Endpoint: 668.747, -3653.985
Right Slip Surface Endpoint: 893.267, -3737.428
Left Slope Intercept: 668.747 -0.000
Right Slope Intercept: 893.267 -0.000
Resisting Moment=3.78981e+006 kN-m
Driving Moment=2.36953e+006 kN-m
Resisting Horizontal Force=10446.6 kN

Driving Horizontal Force=6531.6 kN
Total Slice Area=833302 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 988
Number of Invalid Surfaces: 399

Error Codes:

Error Code -108 reported for 399 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1387
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.59953

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	8.99117	338872	basement	5.551	27.1	3.93583	6.29547	37676.7	37675.3	1.38971
2	8.99117	339795	basement	5.551	27.1	11.1008	17.7561	37774.9	37751	23.9019
3	8.99117	340647	basement	5.551	27.1	17.7183	28.341	37866.2	37821.7	44.5189
4	8.99117	341433	basement	5.551	27.1	23.8434	38.1383	37951.3	37887.6	63.6867
5	8.99117	342123	basement	5.551	27.1	28.9426	46.2946	38028.6	37949	79.6281
6	8.99117	342731	basement	5.551	27.1	32.247	51.58	38096.3	38006.3	90.0186
7	8.99117	343285	basement	5.551	27.1	35.0182	56.0127	38158.4	38059.7	98.666
8	8.99117	343787	basement	5.551	27.1	37.268	59.6113	38215	38109.4	105.611
9	8.99117	344240	basement	5.551	27.1	39.0061	62.3915	38266.6	38155.5	111.097
10	8.99117	344646	basement	5.551	27.1	40.2412	64.367	38313.2	38198.3	114.871
11	8.99117	345007	basement	5.551	27.1	40.9802	65.549	38355	38237.8	117.218

12	8.99117	345325	basement	5.551	27.1	41.2285	65.9463	38392.2	38274.2	118.032
13	8.99117	345601	basement	5.551	27.1	40.9909	65.5661	38424.9	38307.5	117.352
14	8.99117	345837	basement	5.551	27.1	40.2397	64.3646	38452.9	38338	114.87
15	8.99117	346047	basement	5.551	27.1	39.3939	63.0118	38477.8	38365.6	112.222
16	8.99117	346222	basement	5.551	27.1	38.2927	61.2504	38499.2	38390.4	108.85
17	8.99117	346358	basement	5.551	27.1	36.721	58.7364	38516.3	38412.4	103.915
18	8.99117	346458	basement	5.551	27.1	34.6772	55.4673	38529.4	38431.9	97.4652
19	8.99117	346522	basement	5.551	27.1	32.1588	51.4389	38538.4	38448.6	89.7693
20	8.99117	346549	basement	5.551	27.1	29.1618	46.6451	38543.2	38462.9	80.2558
21	8.99117	346541	basement	5.551	27.1	25.6812	41.0779	38544	38474.5	69.4903
22	8.99117	346498	basement	5.551	27.1	21.7109	34.7273	38540.7	38483.7	57.0164
23	8.99117	346421	basement	5.551	27.1	17.2434	27.5813	38533.3	38490.3	43.0207
24	8.99117	346314	basement	5.551	27.1	12.2503	19.5948	38521.9	38494.5	27.447
25	8.99117	346195	basement	5.551	27.1	7.58747	12.1364	38509	38496.1	12.9185

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.59939

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	8.9808	338481	basement	5.551	27.1	5.90266	9.44065	37682.9	37675.2	7.65269
2	8.9808	339402	basement	5.551	27.1	12.1478	19.4291	37778	37750.9	27.1193
3	8.9808	340252	basement	5.551	27.1	17.9801	28.7572	37866.9	37821.5	45.3641
4	8.9808	341036	basement	5.551	27.1	23.447	37.5009	37949.7	37887.3	62.4183
5	8.9808	341725	basement	5.551	27.1	27.9595	44.7181	38025.2	37948.7	76.518
6	8.9808	342332	basement	5.551	27.1	31.0727	49.6973	38092.2	38005.9	86.326
7	8.9808	342884	basement	5.551	27.1	33.7788	54.0255	38154	38059.3	94.7386
8	8.9808	343385	basement	5.551	27.1	36.0766	57.7005	38210.8	38108.9	101.914
9	8.9808	343837	basement	5.551	27.1	37.9595	60.712	38262.8	38155	107.804
10	8.9808	344243	basement	5.551	27.1	39.4167	63.0427	38310.1	38197.7	112.36
11	8.9808	344603	basement	5.551	27.1	40.4339	64.6695	38352.7	38237.2	115.463
12	8.9808	344920	basement	5.551	27.1	40.9933	65.5642	38390.8	38273.5	117.307
13	8.9808	345195	basement	5.551	27.1	41.0754	65.6956	38424.4	38306.8	117.624
14	8.9808	345431	basement	5.551	27.1	40.6059	64.9447	38453.3	38337.2	116.088
15	8.9808	345641	basement	5.551	27.1	39.9919	63.9626	38478.9	38364.8	114.128
16	8.9808	345815	basement	5.551	27.1	39.1183	62.5654	38501	38389.6	111.383
17	8.9808	345951	basement	5.551	27.1	37.7039	60.3032	38518.6	38411.6	107.01
18	8.9808	346051	basement	5.551	27.1	35.7287	57.1441	38531.8	38431	100.825
19	8.9808	346114	basement	5.551	27.1	33.1748	53.0594	38540.7	38447.8	92.897
20	8.9808	346142	basement	5.551	27.1	30.0264	48.024	38545	38462	83.0495
21	8.9808	346134	basement	5.551	27.1	26.271	42.0175	38544.9	38473.7	71.2235
22	8.9808	346091	basement	5.551	27.1	21.8985	35.0242	38540.4	38482.8	57.5808

23	8.9808	346014	basement	5.551	27.1	16.9026	27.0338	38531.4	38489.5	41.9077
24	8.9808	345907	basement	5.551	27.1	11.4246	18.2724	38518.5	38493.6	24.8838
25	8.9808	345788	basement	5.551	27.1	6.19649	9.91061	38503.8	38495.3	8.51569

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.59953

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	668.747	-3653.98	6.87608e+007	0	0
2	677.738	-3661.6	190730	84.3644	0.0253433
3	686.73	-3668.7	362489	160.338	0.0253434
4	695.721	-3675.32	516660	228.531	0.0253433
5	704.712	-3681.49	650923	287.919	0.0253433
6	713.703	-3687.25	729178	322.533	0.0253433
7	722.694	-3692.62	792757	350.655	0.0253433
8	731.685	-3697.62	842394	372.611	0.0253433
9	740.677	-3702.26	878727	388.682	0.0253433
10	749.668	-3706.58	902312	399.115	0.0253433
11	758.659	-3710.57	913638	404.124	0.0253433
12	767.65	-3714.25	913131	403.9	0.0253433
13	776.641	-3717.63	901169	398.609	0.0253433
14	785.632	-3720.73	878084	388.398	0.0253433
15	794.624	-3723.54	849528	375.767	0.0253433
16	803.615	-3726.08	818356	361.979	0.0253433
17	812.606	-3728.36	776862	343.625	0.0253433
18	821.597	-3730.37	725243	320.793	0.0253433
19	830.588	-3732.13	663672	293.558	0.0253433
20	839.579	-3733.63	592296	261.987	0.0253433
21	848.571	-3734.89	511242	226.135	0.0253433
22	857.562	-3735.9	420616	186.049	0.0253434
23	866.553	-3736.66	320504	141.767	0.0253434
24	875.544	-3737.18	210974	93.3188	0.0253433
25	884.535	-3737.47	105845	46.8176	0.0253432
26	893.527	-3737.51	7.19402e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.59939

Slice	X coordinate	Y coordinate - Bottom	Interslice Normal Force	Interslice Shear Force	Interslice Force Angle

	[m]	[m]	[kN]	[kN]	[degrees]
1	668.747	-3653.98	6.87608e+007	0	0
2	677.728	-3661.59	190564	13.9733	0.00420127
3	686.709	-3668.68	362163	52.693	0.00833626
4	695.69	-3675.29	516183	111.17	0.0123398
5	704.67	-3681.46	650509	183.345	0.0161487
6	713.651	-3687.22	728687	250.582	0.019703
7	722.632	-3692.58	792205	317.272	0.0229465
8	731.613	-3697.57	841799	379.471	0.0258281
9	740.594	-3702.21	878105	433.759	0.0283025
10	749.574	-3706.52	901681	477.319	0.0303304
11	758.555	-3710.51	913013	508.011	0.03188
12	767.536	-3714.18	912527	524.415	0.032927
13	776.517	-3717.57	900602	525.854	0.0334545
14	785.498	-3720.66	877566	512.404	0.0334546
15	794.478	-3723.47	848858	487.825	0.032927
16	803.459	-3726.01	817745	455.003	0.03188
17	812.44	-3728.28	776321	410.958	0.0303304
18	821.421	-3730.29	724784	358.022	0.0283024
19	830.402	-3732.05	663305	299.009	0.0258282
20	839.382	-3733.55	592033	237.105	0.0229466
21	848.363	-3734.81	511095	175.756	0.0197029
22	857.344	-3735.81	420597	118.545	0.0161488
23	866.325	-3736.58	320627	69.0535	0.0123398
24	875.306	-3737.1	211255	30.7366	0.00833626
25	884.286	-3737.39	105680	7.74909	0.00420127
26	893.267	-3737.43	7.19371e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.610185
Factor of Safety, standard deviation: 0.261171
Factor of Safety, minimum: 0.842265
Factor of Safety, maximum: 2.605140
Probability of Failure: 0.590% (= 59 failed surfaces / 9999 valid surfaces), 1 invalid surfaces
Reliability index: 2.33634 (assuming normal distribution)
Reliability index: 2.87541 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price

Factor of Safety, mean: 1.610037
Factor of Safety, standard deviation: 0.261138
Factor of Safety, minimum: 0.837444
Factor of Safety, maximum: 2.604880
Probability of Failure: 0.590% (= 59 failed surfaces / 10000 valid surfaces)
Reliability index: 2.33607 (assuming normal distribution)
Reliability index: 2.87494 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-5000
2322	-5000
2322	0
0	0

External Boundary

X	Y
2322	-5000
2322	-3774
2230	-3782
2138	-3784
2046	-3783
1955	-3781
1863	-3780
1771	-3779
1679	-3779
1587	-3779
1496	-3779
1404	-3777
1316	-3776
1229	-3777
1141	-3775
1054	-3773
966	-3760
879	-3733

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 77PC Site 61		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/25/2013	File Name: RR0705_77_61_0g.sli	

791	-3700
704	-3664
616	-3639
528	-3630
440	-3625
352	-3614
264	-3611
176	-3610
88	-3605
0	-3607
0	-5000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 77PC Site 61	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/25/2013	File Name: RR0705_77_61_1g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_77_61_1g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 77PC Site 61
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/25/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 77PC Site 61		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/25/2013	File Name: RR0705_77_61_1g.sli	

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364855911
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.2
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	Automatically Calculated
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.2	5.7	8.7	0.5

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.011172
Center: 1237.339, -2365.846
Radius: 1420.254
Left Slip Surface Endpoint: 605.785, -3637.955
Right Slip Surface Endpoint: 965.479, -3759.838
Left Slope Intercept: 605.785 -0.000
Right Slope Intercept: 965.479 -0.000
Resisting Moment=1.34049e+006 kN-m
Driving Moment=1.19991e+008 kN-m
Resisting Horizontal Force=915.072 kN

Driving Horizontal Force=81910.5 kN
Total Slice Area=1.3337e+006 m2

Method: gle/morgenstern-price

FS: 0.011070
Center: 1237.339, -2365.846
Radius: 1420.254
Left Slip Surface Endpoint: 605.785, -3637.955
Right Slip Surface Endpoint: 965.479, -3759.838
Left Slope Intercept: 605.785 -0.000
Right Slope Intercept: 965.479 -0.000
Resisting Moment=1.32833e+006 kN-m
Driving Moment=1.19991e+008 kN-m
Resisting Horizontal Force=906.773 kN
Driving Horizontal Force=81910.9 kN
Total Slice Area=1.3337e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 847
Number of Invalid Surfaces: 37

Error Codes:

Error Code -108 reported for 34 surfaces
Error Code -112 reported for 3 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 883
Number of Invalid Surfaces: 1

Error Codes:

Error Code -112 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with

many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.0111716

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	14.3878	539860	basement	5.551	27.1	118.618	1.32515	37541.5	37549.7	-8.22665
2	14.3878	541172	basement	5.551	27.1	144.855	1.61826	37669.5	37677.1	-7.64552
3	14.3878	542386	basement	5.551	27.1	183.848	2.05388	37782	37788.8	-6.82554
4	14.3878	543555	basement	5.551	27.1	222.179	2.4821	37889.4	37895.4	-5.97516
5	14.3878	544680	basement	5.551	27.1	259.786	2.90223	37991.8	37997	-5.17486
6	14.3878	545762	basement	5.551	27.1	296.605	3.31355	38089.3	38093.7	-4.38577
7	14.3878	546799	basement	5.551	27.1	327.511	3.65882	38181.3	38185	-3.74672
8	14.3878	547697	basement	5.551	27.1	319.833	3.57305	38248.4	38252.3	-3.85791
9	14.3878	548502	basement	5.551	27.1	321.146	3.58772	38301	38304.8	-3.80204
10	14.3878	549266	basement	5.551	27.1	319.354	3.56769	38348.8	38352.6	-3.83841
11	14.3878	549990	basement	5.551	27.1	314.204	3.51016	38391.8	38395.8	-4.00948
12	14.3878	550674	basement	5.551	27.1	305.421	3.41204	38430.2	38434.4	-4.19783
13	14.3878	551318	basement	5.551	27.1	294.004	3.28449	38464	38468.5	-4.4564
14	14.3878	551951	basement	5.551	27.1	292.515	3.26786	38499.1	38503.6	-4.49043
15	14.3878	552562	basement	5.551	27.1	282.728	3.15852	38532.9	38537.6	-4.69238
16	14.3878	553135	basement	5.551	27.1	268.659	3.00135	38562.2	38567.2	-5.02963
17	14.3878	553670	basement	5.551	27.1	249.896	2.79174	38587.1	38592.5	-5.44565
18	14.3878	554168	basement	5.551	27.1	225.969	2.52444	38607.5	38613.4	-5.88741
19	14.3878	554628	basement	5.551	27.1	196.556	2.19585	38623.6	38630.1	-6.53954
20	14.3878	555089	basement	5.551	27.1	192.818	2.15409	38643.5	38650.1	-6.60674
21	14.3878	555551	basement	5.551	27.1	174.752	1.95226	38666.2	38673.2	-7.03166
22	14.3878	555976	basement	5.551	27.1	150.935	1.68619	38684.5	38692.1	-7.56738
23	14.3878	556365	basement	5.551	27.1	120.668	1.34806	38698.6	38706.8	-8.15011
24	14.3878	556718	basement	5.551	27.1	83.1322	0.92872	38708.4	38717.5	-9.05452
25	14.3878	557035	basement	5.551	27.1	27.0776	0.3025	38713.8	38724.1	-10.2588

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.0110702

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	14.3878	539860	basement	5.551	27.1	74.4792	0.8245	37540.5	37549.7	-9.16305
2	14.3878	541172	basement	5.551	27.1	139.72	1.54673	37669.3	37677.1	-7.77105
3	14.3878	542386	basement	5.551	27.1	194.172	2.14952	37782.2	37788.8	-6.63625

4	14.3878	543555	basement	5.551	27.1	246.088	2.72424	37889.9	37895.4	-5.46782
5	14.3878	544680	basement	5.551	27.1	294.955	3.26521	37992.6	37997	-4.41012
6	14.3878	545762	basement	5.551	27.1	340.327	3.76749	38090.1	38093.7	-3.55338
7	14.3878	546799	basement	5.551	27.1	375.082	4.15223	38182.2	38185	-2.78188
8	14.3878	547697	basement	5.551	27.1	356.94	3.9514	38249.2	38252.3	-3.08263
9	14.3878	548502	basement	5.551	27.1	350.499	3.88009	38301.6	38304.8	-3.2181
10	14.3878	549266	basement	5.551	27.1	339.427	3.75753	38349.2	38352.6	-3.44752
11	14.3878	549990	basement	5.551	27.1	323.959	3.58629	38392	38395.8	-3.81327
12	14.3878	550674	basement	5.551	27.1	304.388	3.36964	38430.1	38434.4	-4.26348
13	14.3878	551318	basement	5.551	27.1	283.312	3.13632	38463.8	38468.5	-4.71998
14	14.3878	551951	basement	5.551	27.1	278.641	3.08461	38498.7	38503.6	-4.88719
15	14.3878	552562	basement	5.551	27.1	260.012	2.87839	38532.4	38537.6	-5.22318
16	14.3878	553135	basement	5.551	27.1	238.623	2.6416	38561.5	38567.2	-5.69529
17	14.3878	553670	basement	5.551	27.1	214.805	2.37793	38586.3	38592.5	-6.24693
18	14.3878	554168	basement	5.551	27.1	188.844	2.09054	38606.6	38613.4	-6.75806
19	14.3878	554628	basement	5.551	27.1	161.201	1.78453	38622.8	38630.1	-7.34551
20	14.3878	555089	basement	5.551	27.1	164.578	1.82191	38642.8	38650.1	-7.28021
21	14.3878	555551	basement	5.551	27.1	149.832	1.65867	38665.6	38673.2	-7.63937
22	14.3878	555976	basement	5.551	27.1	133.344	1.47615	38684.1	38692.1	-7.97353
23	14.3878	556365	basement	5.551	27.1	114.949	1.27251	38698.4	38706.8	-8.35366
24	14.3878	556718	basement	5.551	27.1	94.2702	1.04359	38708.6	38717.5	-8.85051
25	14.3878	557035	basement	5.551	27.1	70.6681	0.78231	38714.7	38724.1	-9.37288

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.0111716

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	605.785	-3637.96	6.81588e+007	0	0
2	620.173	-3645	179993	-348.246	-0.110854
3	634.561	-3651.84	284119	-549.708	-0.110855
4	648.949	-3658.49	381574	-738.261	-0.110854
5	663.336	-3664.94	472358	-913.907	-0.110854
6	677.724	-3671.2	556470	-1076.64	-0.110854
7	692.112	-3677.28	633911	-1226.48	-0.110855
8	706.5	-3683.17	692495	-1339.82	-0.110854
9	720.887	-3688.87	686199	-1327.64	-0.110854
10	735.275	-3694.4	672838	-1301.79	-0.110854
11	749.663	-3699.75	652451	-1262.35	-0.110855

12	764.051	-3704.92	625076	-1209.38	-0.110854
13	778.438	-3709.92	590756	-1142.98	-0.110854
14	792.826	-3714.75	552223	-1068.43	-0.110855
15	807.214	-3719.4	525375	-1016.48	-0.110854
16	821.602	-3723.89	491823	-951.568	-0.110854
17	835.989	-3728.21	451613	-873.77	-0.110854
18	850.377	-3732.37	404794	-783.186	-0.110854
19	864.765	-3736.36	351422	-679.924	-0.110855
20	879.153	-3740.19	291936	-564.832	-0.110855
21	893.54	-3743.86	261224	-505.409	-0.110854
22	907.928	-3747.37	224231	-433.837	-0.110854
23	922.316	-3750.72	181015	-350.223	-0.110854
24	936.704	-3753.92	131641	-254.695	-0.110854
25	951.092	-3756.96	76182.1	-147.395	-0.110854
26	965.479	-3759.84	7.28024e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.0110702

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	605.785	-3637.96	6.81588e+007	0	0
2	620.173	-3645	180514	-77.0233	-0.0244475
3	634.561	-3651.84	284715	-241.054	-0.0485095
4	648.949	-3658.49	382070	-478.833	-0.0718065
5	663.336	-3664.94	472601	-775.114	-0.0939709
6	677.724	-3671.2	556335	-1113.27	-0.114653
7	692.112	-3677.28	633303	-1475.91	-0.133527
8	706.5	-3683.17	691373	-1813.59	-0.150296
9	720.887	-3688.87	684682	-1968.09	-0.164694
10	735.275	-3694.4	671016	-2067.02	-0.176495
11	749.663	-3699.75	650430	-2105.97	-0.185512
12	764.051	-3704.92	622976	-2083.32	-0.191604
13	778.438	-3709.92	588700	-2000.24	-0.194674
14	792.826	-3714.75	550322	-1869.84	-0.194674
15	807.214	-3719.4	523666	-1751.21	-0.191604
16	821.602	-3723.89	490406	-1587.85	-0.185513
17	835.989	-3728.21	450572	-1387.96	-0.176496
18	850.377	-3732.37	404187	-1161.82	-0.164694
19	864.765	-3736.36	351269	-921.438	-0.150296
20	879.153	-3740.19	292214	-681.005	-0.133528
21	893.54	-3743.86	261849	-523.981	-0.114653

22	907.928	-3747.37	225164	-369.292	-0.0939709
23	922.316	-3750.72	182168	-228.304	-0.0718065
24	936.704	-3753.92	132873	-112.497	-0.0485095
25	951.092	-3756.96	77294	-32.9806	-0.0244476
26	965.479	-3759.84	7.28024e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.073105
Factor of Safety, standard deviation: 0.099711
Factor of Safety, minimum: 0.000636
Factor of Safety, maximum: 1.350580
Probability of Failure: 99.890% (= 9984 failed surfaces / 9995 valid surfaces), 5 invalid surfaces
Reliability index: -9.29581 (assuming normal distribution)
Reliability index: -3.06425 (assuming lognormal distribution)
* best fit = Beta

Method: gle/morgenstern-price
Factor of Safety, mean: 0.077652
Factor of Safety, standard deviation: 0.099727
Factor of Safety, minimum: 0.000600
Factor of Safety, maximum: 1.351060
Probability of Failure: 99.890% (= 9989 failed surfaces / 10000 valid surfaces)
Reliability index: -9.24869 (assuming normal distribution)
Reliability index: -3.08250 (assuming lognormal distribution)
* best fit = Beta

List Of Coordinates

Water Table

X	Y
0	0
0	-5000
2322	-5000
2322	0
0	0

External Boundary

X	Y

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 77PC Site 61		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/25/2013	File Name: RR0705_77_61_1g.sli	

2322	-5000
2322	-3774
2230	-3782
2138	-3784
2046	-3783
1955	-3781
1863	-3780
1771	-3779
1679	-3779
1587	-3779
1496	-3779
1404	-3777
1316	-3776
1229	-3777
1141	-3775
1054	-3773
966	-3760
879	-3733
791	-3700
704	-3664
616	-3639
528	-3630
440	-3625
352	-3614
264	-3611
176	-3610
88	-3605
0	-3607
0	-5000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 78PC Site 57	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/26/2013	File Name: RR0705_78_57_0g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_78_57_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 78PC Site 57
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/26/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 100
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1367175040
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.2
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	Automatically Calculated
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 78PC Site 57		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_78_57_0g.sli	

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.2	5.7	8.7	0.5

Global Minimums

Method: spencer

FS: 1.112280
Center: 2404.726, -3827.311
Radius: 698.165
Left Slip Surface Endpoint: 1902.309, -4312.090
Right Slip Surface Endpoint: 2303.586, -4518.111
Left Slope Intercept: 1902.309 0.000
Right Slope Intercept: 2303.586 0.000
Resisting Moment=2.24639e+007 kN-m
Driving Moment=2.01962e+007 kN-m
Resisting Horizontal Force=28558.4 kN
Driving Horizontal Force=25675.5 kN
Total Slice Area=1.783e+006 m2

Method: gle/morgenstern-price

FS: 1.111680
Center: 2428.386, -3780.245
Radius: 753.986
Left Slip Surface Endpoint: 1886.838, -4304.859
Right Slip Surface Endpoint: 2321.908, -4526.674
Left Slope Intercept: 1886.838 0.000
Right Slope Intercept: 2321.908 0.000
Resisting Moment=2.82541e+007 kN-m
Driving Moment=2.54157e+007 kN-m
Resisting Horizontal Force=33301.4 kN

Driving Horizontal Force=29955.9 kN
Total Slice Area=1.93447e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2446
Number of Invalid Surfaces: 635

Error Codes:

Error Code -108 reported for 621 surfaces
Error Code -112 reported for 14 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 3081
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.11228

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	4.01277	178336	basement	5.551	27.1	0.366796	0.40798	44425.8	44435.8	-10.0338
2	4.01277	178555	basement	5.551	27.1	4.40644	4.90119	44476.6	44477.9	-1.25543
3	4.01277	178769	basement	5.551	27.1	8.36721	9.30668	44526.8	44519.4	7.38241
4	4.01277	178980	basement	5.551	27.1	12.2494	13.6248	44576	44560.1	15.8959
5	4.01277	179186	basement	5.551	27.1	16.0534	17.8559	44624.4	44600.3	24.1189
6	4.01277	179389	basement	5.551	27.1	19.7795	22.0003	44672	44639.8	32.1758
7	4.01277	179588	basement	5.551	27.1	23.428	26.0585	44718.7	44678.7	40.0406

8	4.01277	179782	basement	5.551	27.1	26.9992	30.0307	44764.8	44716.9	47.8618
9	4.01277	179974	basement	5.551	27.1	30.4937	33.9175	44810.1	44754.6	55.4628
10	4.01277	180161	basement	5.551	27.1	33.9115	37.7191	44854.6	44791.7	62.9437
11	4.01277	180345	basement	5.551	27.1	37.2532	41.436	44898.3	44828.2	70.0946
12	4.01277	180526	basement	5.551	27.1	40.519	45.0685	44941.3	44864.2	77.145
13	4.01277	180703	basement	5.551	27.1	43.7093	48.617	44983.7	44899.6	84.1338
14	4.01277	180877	basement	5.551	27.1	46.8245	52.0819	45025.4	44934.5	90.8802
15	4.01277	181048	basement	5.551	27.1	49.8648	55.4636	45066.4	44968.8	97.5763
16	4.01277	181215	basement	5.551	27.1	52.8306	58.7624	45106.6	45002.7	103.907
17	4.01277	181380	basement	5.551	27.1	55.7222	61.9787	45146.3	45036	110.33
18	4.01277	181541	basement	5.551	27.1	58.54	65.1129	45185.2	45068.8	116.405
19	4.01277	181698	basement	5.551	27.1	61.5114	68.4179	45224.1	45101.2	122.855
20	4.01277	181848	basement	5.551	27.1	64.1686	71.3734	45261.7	45133	128.727
21	4.01277	181994	basement	5.551	27.1	66.2227	73.6582	45297.4	45164.4	133.031
22	4.01277	182137	basement	5.551	27.1	68.2	75.8575	45332.7	45195.3	137.45
23	4.01277	182277	basement	5.551	27.1	70.1009	77.9718	45367.3	45225.8	141.478
24	4.01277	182415	basement	5.551	27.1	71.9257	80.0015	45401.2	45255.8	145.399
25	4.01277	182549	basement	5.551	27.1	73.6747	81.9469	45434.7	45285.3	149.392
26	4.01277	182681	basement	5.551	27.1	75.3482	83.8083	45467.3	45314.4	152.917
27	4.01277	182810	basement	5.551	27.1	76.9465	85.5861	45499.4	45343.1	156.338
28	4.01277	182937	basement	5.551	27.1	78.47	87.2806	45531	45371.4	159.607
29	4.01277	183060	basement	5.551	27.1	79.919	88.8923	45562.2	45399.2	162.976
30	4.01277	183182	basement	5.551	27.1	81.2936	90.4212	45592.5	45426.7	165.764
31	4.01277	183301	basement	5.551	27.1	82.5942	91.8679	45622.4	45453.7	168.725
32	4.01277	183417	basement	5.551	27.1	83.8211	93.2325	45651.6	45480.3	171.264
33	4.01277	183531	basement	5.551	27.1	84.9745	94.5154	45680.4	45506.5	173.927
34	4.01277	183642	basement	5.551	27.1	86.0546	95.7168	45708.5	45532.4	176.103
35	4.01277	183751	basement	5.551	27.1	87.0617	96.837	45736.1	45557.8	178.321
36	4.01277	183858	basement	5.551	27.1	87.996	97.8762	45763.2	45582.9	180.281
37	4.01277	183962	basement	5.551	27.1	88.8578	98.8347	45789.8	45607.5	182.291
38	4.01277	184064	basement	5.551	27.1	89.647	99.7126	45815.8	45631.9	183.941
39	4.01277	184164	basement	5.551	27.1	90.3643	100.51	45841.4	45655.8	185.632
40	4.01277	184262	basement	5.551	27.1	91.0095	101.228	45866.4	45679.4	187.044
41	4.01277	184357	basement	5.551	27.1	91.5829	101.866	45890.8	45702.6	188.153
42	4.01277	184450	basement	5.551	27.1	92.0525	102.388	45914.7	45725.4	189.265
43	4.01277	184541	basement	5.551	27.1	92.5109	102.898	45938.3	45748	190.268
44	4.01277	184631	basement	5.551	27.1	92.9184	103.351	45961.2	45770.1	191.107
45	4.01277	184718	basement	5.551	27.1	93.255	103.726	45983.8	45791.9	191.882
46	4.01277	184803	basement	5.551	27.1	93.521	104.022	46005.9	45813.4	192.452
47	4.01277	184886	basement	5.551	27.1	93.7163	104.239	46027.5	45834.5	192.99

48	4.01277	184966	basement	5.551	27.1	93.8412	104.378	46048.5	45855.3	193.247
49	4.01277	185045	basement	5.551	27.1	93.8957	104.438	46069.1	45875.8	193.293
50	4.01277	185122	basement	5.551	27.1	93.8799	104.421	46089.2	45895.9	193.293
51	4.01277	185197	basement	5.551	27.1	93.7939	104.325	46108.7	45915.7	192.99
52	4.01277	185269	basement	5.551	27.1	93.6378	104.152	46127.9	45935.2	192.671
53	4.01277	185340	basement	5.551	27.1	93.4118	103.9	46146.6	45954.4	192.171
54	4.01277	185409	basement	5.551	27.1	93.1158	103.571	46164.8	45973.3	191.549
55	4.01277	185476	basement	5.551	27.1	92.7499	103.164	46182.5	45991.8	190.736
56	4.01277	185541	basement	5.551	27.1	92.3142	102.679	46199.9	46010	189.914
57	4.01277	185603	basement	5.551	27.1	91.8086	102.117	46216.6	46027.9	188.679
58	4.01277	185665	basement	5.551	27.1	91.2333	101.477	46233	46045.6	187.44
59	4.01277	185724	basement	5.551	27.1	90.5883	100.76	46248.9	46062.9	185.988
60	4.01277	185781	basement	5.551	27.1	89.8737	99.9647	46264.4	46079.9	184.502
61	4.01277	185837	basement	5.551	27.1	89.0893	99.0922	46279.4	46096.6	182.798
62	4.01277	185890	basement	5.551	27.1	88.2352	98.1422	46293.9	46113	180.92
63	4.01277	185942	basement	5.551	27.1	87.3114	97.1147	46308	46129.1	178.912
64	4.01277	185992	basement	5.551	27.1	86.3179	96.0097	46321.7	46144.9	176.817
65	4.01277	186040	basement	5.551	27.1	85.2547	94.8271	46334.8	46160.5	174.342
66	4.01277	186087	basement	5.551	27.1	84.1217	93.5669	46347.7	46175.7	171.961
67	4.01277	186131	basement	5.551	27.1	82.919	92.2292	46360	46190.7	169.278
68	4.01277	186174	basement	5.551	27.1	81.6464	90.8137	46372.1	46205.3	166.765
69	4.01277	186215	basement	5.551	27.1	80.304	89.3205	46383.5	46219.7	163.789
70	4.01277	186255	basement	5.551	27.1	78.8916	87.7495	46394.5	46233.8	160.719
71	4.01277	186292	basement	5.551	27.1	77.4091	86.1006	46405	46247.7	157.252
72	4.01277	186328	basement	5.551	27.1	75.8565	84.3737	46415.3	46261.2	154.095
73	4.01277	186362	basement	5.551	27.1	74.2338	82.5688	46425.1	46274.5	150.607
74	4.01277	186395	basement	5.551	27.1	72.5408	80.6857	46434.4	46287.5	146.917
75	4.01277	186426	basement	5.551	27.1	70.7775	78.7244	46443.3	46300.2	143.055
76	4.01277	186455	basement	5.551	27.1	68.9436	76.6846	46451.6	46312.7	138.949
77	4.01277	186482	basement	5.551	27.1	67.0391	74.5663	46459.6	46324.9	134.728
78	4.01277	186508	basement	5.551	27.1	65.0639	72.3693	46467.5	46336.8	130.659
79	4.01277	186532	basement	5.551	27.1	63.0179	70.0935	46474.4	46348.4	126.048
80	4.01277	186555	basement	5.551	27.1	60.9008	67.7387	46481.3	46359.8	121.541
81	4.01277	186576	basement	5.551	27.1	58.7125	65.3047	46487.7	46370.9	116.782
82	4.01277	186595	basement	5.551	27.1	56.4529	62.7914	46493.7	46381.8	111.935
83	4.01277	186612	basement	5.551	27.1	54.1218	60.1986	46499.3	46392.4	106.883
84	4.01277	186628	basement	5.551	27.1	51.719	57.526	46504.3	46402.7	101.647
85	4.01277	186643	basement	5.551	27.1	49.2443	54.7735	46508.9	46412.8	96.149
86	4.01277	186656	basement	5.551	27.1	46.6976	51.9408	46513.4	46422.6	90.7518
87	4.01277	186667	basement	5.551	27.1	44.0786	49.0277	46517.1	46432.2	84.8909

88	4.01277	186678	basement	5.551	27.1	40.9191	45.5135	46519.5	46441.5	77.9547
89	4.01277	186692	basement	5.551	27.1	38.6429	42.9817	46523.6	46450.5	73.1254
90	4.01277	186705	basement	5.551	27.1	36.42	40.5092	46527.7	46459.3	68.3783
91	4.01277	186715	basement	5.551	27.1	34.1271	37.9589	46531.1	46467.9	63.2437
92	4.01277	186725	basement	5.551	27.1	31.7639	35.3304	46534.3	46476.1	58.1822
93	4.01277	186732	basement	5.551	27.1	29.3302	32.6234	46537.1	46484.2	52.9104
94	4.01277	186738	basement	5.551	27.1	26.8256	29.8376	46539.4	46492	47.3993
95	4.01277	186743	basement	5.551	27.1	24.25	26.9728	46541.4	46499.5	41.909
96	4.01277	186746	basement	5.551	27.1	21.603	24.0286	46542.9	46506.8	36.1087
97	4.01277	186747	basement	5.551	27.1	18.8844	21.0047	46543.9	46513.8	30.1123
98	4.01277	186747	basement	5.551	27.1	16.0937	17.9007	46544.7	46520.6	24.079
99	4.01277	186746	basement	5.551	27.1	13.2308	14.7164	46545	46527.2	17.7761
100	4.01277	186742	basement	5.551	27.1	10.2968	11.453	46545.1	46533.5	11.5622

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.11168

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	4.3507	193039	basement	5.551	27.1	5.29405	5.88529	44363.7	44363	0.698556
2	4.3507	193295	basement	5.551	27.1	9.09119	10.1065	44417.5	44408.5	8.96877
3	4.3507	193547	basement	5.551	27.1	12.8195	14.2512	44470.3	44453.3	16.9744
4	4.3507	193793	basement	5.551	27.1	16.4798	18.3203	44522.3	44497.3	25.0045
5	4.3507	194034	basement	5.551	27.1	20.0731	22.3149	44573.4	44540.6	32.7875
6	4.3507	194271	basement	5.551	27.1	23.6002	26.2359	44623.6	44583.3	40.3482
7	4.3507	194504	basement	5.551	27.1	27.062	30.0843	44673.2	44625.3	47.8853
8	4.3507	194732	basement	5.551	27.1	30.4591	33.8608	44721.9	44666.6	55.3033
9	4.3507	194955	basement	5.551	27.1	33.7924	37.5663	44769.8	44707.3	62.5485
10	4.3507	195175	basement	5.551	27.1	37.0626	41.2017	44817	44747.3	69.7449
11	4.3507	195390	basement	5.551	27.1	40.2703	44.7677	44863.3	44786.7	76.6216
12	4.3507	195601	basement	5.551	27.1	43.4162	48.2649	44909	44825.6	83.4054
13	4.3507	195808	basement	5.551	27.1	46.5009	51.6941	44953.9	44863.8	90.086
14	4.3507	196012	basement	5.551	27.1	49.5249	55.0558	44998.3	44901.4	96.8593
15	4.3507	196211	basement	5.551	27.1	52.4888	58.3507	45041.7	44938.5	103.201
16	4.3507	196407	basement	5.551	27.1	55.3928	61.5791	45084.5	44975	109.476
17	4.3507	196599	basement	5.551	27.1	58.2376	64.7416	45126.7	45011	115.66
18	4.3507	196787	basement	5.551	27.1	61.0235	67.8386	45168.1	45046.4	121.737
19	4.3507	196972	basement	5.551	27.1	63.7507	70.8704	45209	45081.3	127.656
20	4.3507	197153	basement	5.551	27.1	66.4196	73.8373	45249.2	45115.7	133.456
21	4.3507	197331	basement	5.551	27.1	69.1752	76.9007	45288.9	45149.6	139.348
22	4.3507	197500	basement	5.551	27.1	71.7614	79.7757	45328	45182.9	145.083
23	4.3507	197663	basement	5.551	27.1	73.7081	81.9398	45365	45215.8	149.166

24	4.3507	197824	basement	5.551	27.1	75.5909	84.0329	45401.6	45248.1	153.452
25	4.3507	197981	basement	5.551	27.1	77.4099	86.055	45437.4	45280	157.358
26	4.3507	198135	basement	5.551	27.1	79.1648	88.0059	45472.6	45311.4	161.15
27	4.3507	198285	basement	5.551	27.1	80.8556	89.8856	45507.1	45342.4	164.702
28	4.3507	198433	basement	5.551	27.1	82.4823	91.6939	45541.2	45372.9	168.267
29	4.3507	198578	basement	5.551	27.1	84.0443	93.4304	45574.7	45402.9	171.803
30	4.3507	198719	basement	5.551	27.1	85.5415	95.0948	45607.5	45432.5	174.97
31	4.3507	198858	basement	5.551	27.1	86.9737	96.6869	45639.8	45461.6	178.195
32	4.3507	198994	basement	5.551	27.1	88.3403	98.2062	45671.4	45490.3	181.123
33	4.3507	199126	basement	5.551	27.1	89.6411	99.6522	45702.5	45518.6	183.879
34	4.3507	199256	basement	5.551	27.1	90.8755	101.025	45733.1	45546.4	186.682
35	4.3507	199384	basement	5.551	27.1	92.0432	102.323	45763	45573.9	189.059
36	4.3507	199508	basement	5.551	27.1	93.1436	103.546	45792.4	45600.9	191.515
37	4.3507	199630	basement	5.551	27.1	94.1761	104.694	45821.2	45627.5	193.665
38	4.3507	199748	basement	5.551	27.1	95.1407	105.766	45849.5	45653.7	195.808
39	4.3507	199865	basement	5.551	27.1	96.0357	106.761	45877.3	45679.5	197.847
40	4.3507	199978	basement	5.551	27.1	96.8606	107.678	45904.6	45704.9	199.677
41	4.3507	200089	basement	5.551	27.1	97.6162	108.518	45931.1	45729.9	201.188
42	4.3507	200198	basement	5.551	27.1	98.2729	109.248	45957.2	45754.6	202.57
43	4.3507	200304	basement	5.551	27.1	98.8711	109.913	45982.7	45778.8	203.907
44	4.3507	200408	basement	5.551	27.1	99.463	110.571	46008	45802.7	205.285
45	4.3507	200509	basement	5.551	27.1	99.982	111.148	46032.5	45826.2	206.274
46	4.3507	200608	basement	5.551	27.1	100.427	111.643	46056.7	45849.3	207.357
47	4.3507	200704	basement	5.551	27.1	100.799	112.056	46080.2	45872.1	208.102
48	4.3507	200798	basement	5.551	27.1	101.096	112.386	46103.2	45894.5	208.677
49	4.3507	200890	basement	5.551	27.1	101.316	112.631	46125.7	45916.5	209.153
50	4.3507	200979	basement	5.551	27.1	101.46	112.791	46147.7	45938.2	209.494
51	4.3507	201066	basement	5.551	27.1	101.527	112.866	46169.2	45959.5	209.66
52	4.3507	201150	basement	5.551	27.1	101.516	112.853	46190.1	45980.5	209.611
53	4.3507	201232	basement	5.551	27.1	101.425	112.752	46210.6	46001.1	209.509
54	4.3507	201312	basement	5.551	27.1	101.255	112.563	46230.5	46021.4	209.101
55	4.3507	201390	basement	5.551	27.1	101.004	112.284	46249.8	46041.3	208.543
56	4.3507	201465	basement	5.551	27.1	100.671	111.914	46268.9	46061	207.9
57	4.3507	201538	basement	5.551	27.1	100.256	111.453	46287.1	46080.2	206.892
58	4.3507	201609	basement	5.551	27.1	99.758	110.899	46305.1	46099.2	205.903
59	4.3507	201677	basement	5.551	27.1	99.1751	110.251	46322.3	46117.8	204.547
60	4.3507	201743	basement	5.551	27.1	98.5077	109.509	46339.3	46136.1	203.196
61	4.3507	201808	basement	5.551	27.1	97.7547	108.672	46355.6	46154	201.569
62	4.3507	201870	basement	5.551	27.1	96.9146	107.738	46371.4	46171.7	199.726
63	4.3507	201930	basement	5.551	27.1	95.9881	106.708	46386.7	46189	197.693

64	4.3507	201987	basement	5.551	27.1	94.9725	105.579	46401.4	46206	195.414
65	4.3507	202043	basement	5.551	27.1	93.8688	104.352	46415.8	46222.7	193.143
66	4.3507	202096	basement	5.551	27.1	92.6753	103.025	46429.6	46239	190.588
67	4.3507	202148	basement	5.551	27.1	91.3915	101.598	46442.9	46255.1	187.803
68	4.3507	202197	basement	5.551	27.1	90.0166	100.07	46455.6	46270.9	184.708
69	4.3507	202244	basement	5.551	27.1	88.55	98.4393	46467.7	46286.3	181.438
70	4.3507	202290	basement	5.551	27.1	86.9911	96.7063	46479.5	46301.5	178.044
71	4.3507	202333	basement	5.551	27.1	85.3393	94.87	46490.8	46316.3	174.542
72	4.3507	202374	basement	5.551	27.1	83.5939	92.9297	46501.7	46330.8	170.865
73	4.3507	202413	basement	5.551	27.1	81.7544	90.8847	46511.8	46345.1	166.725
74	4.3507	202450	basement	5.551	27.1	79.8202	88.7345	46521.6	46359	162.57
75	4.3507	202486	basement	5.551	27.1	77.7908	86.4785	46530.7	46372.6	158.111
76	4.3507	202519	basement	5.551	27.1	75.6657	84.1161	46539.5	46386	153.495
77	4.3507	202550	basement	5.551	27.1	73.4445	81.6468	46547.7	46399	148.73
78	4.3507	202579	basement	5.551	27.1	71.1268	79.0702	46555.4	46411.8	143.642
79	4.3507	202607	basement	5.551	27.1	68.7121	76.3859	46562.7	46424.3	138.357
80	4.3507	202632	basement	5.551	27.1	66.2003	73.5935	46569.4	46436.5	132.9
81	4.3507	202655	basement	5.551	27.1	63.5908	70.6926	46575.7	46448.4	127.294
82	4.3507	202677	basement	5.551	27.1	60.8834	67.6829	46581.3	46460	121.342
83	4.3507	202697	basement	5.551	27.1	58.078	64.5641	46586.6	46471.3	115.287
84	4.3507	202714	basement	5.551	27.1	55.1384	61.2963	46591.2	46482.4	108.829
85	4.3507	202734	basement	5.551	27.1	52.0316	57.8425	46595.3	46493.1	102.189
86	4.3507	202755	basement	5.551	27.1	49.6556	55.2011	46600.6	46503.6	96.9774
87	4.3507	202774	basement	5.551	27.1	47.1862	52.456	46605.6	46513.8	91.7524
88	4.3507	202791	basement	5.551	27.1	44.6233	49.6068	46609.8	46523.7	86.0842
89	4.3507	202806	basement	5.551	27.1	41.9667	46.6535	46613.7	46533.4	80.3399
90	4.3507	202820	basement	5.551	27.1	39.2161	43.5958	46617	46542.8	74.1876
91	4.3507	202831	basement	5.551	27.1	36.3719	40.4339	46620	46551.8	68.1946
92	4.3507	202841	basement	5.551	27.1	33.4336	37.1675	46622.6	46560.7	61.8525
93	4.3507	202849	basement	5.551	27.1	30.4016	33.7968	46624.5	46569.2	55.2516
94	4.3507	202855	basement	5.551	27.1	27.2756	30.3217	46625.9	46577.5	48.4327
95	4.3507	202859	basement	5.551	27.1	24.0558	26.7424	46627	46585.5	41.5109
96	4.3507	202861	basement	5.551	27.1	20.7425	23.059	46627.5	46593.2	34.2741
97	4.3507	202862	basement	5.551	27.1	17.3356	19.2716	46627.6	46600.7	26.8626
98	4.3507	202861	basement	5.551	27.1	13.8352	15.3804	46627.1	46607.9	19.1628
99	4.3507	202858	basement	5.551	27.1	10.2418	11.3856	46626.2	46614.8	11.4145
100	4.3507	202853	basement	5.551	27.1	6.55542	7.28753	46624.8	46621.5	3.30274

Interslice Data

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 78PC Site 57		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_78_57_0g.sli	

Global Minimum Query (spencer) - Safety Factor: 1.11228

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	1902.31	-4312.09	9.57597e+007	0	0
2	1906.32	-4316.21	99918.4	64.0869	0.0367491
3	1910.33	-4320.27	197007	126.359	0.0367491
4	1914.35	-4324.26	291329	186.856	0.036749
5	1918.36	-4328.19	382944	245.617	0.036749
6	1922.37	-4332.06	471911	302.68	0.0367491
7	1926.39	-4335.86	558284	358.079	0.0367491
8	1930.4	-4339.61	642115	411.847	0.036749
9	1934.41	-4343.29	723454	464.018	0.0367491
10	1938.42	-4346.92	802350	514.621	0.0367491
11	1942.44	-4350.5	878847	563.686	0.0367491
12	1946.45	-4354.01	952991	611.241	0.0367491
13	1950.46	-4357.48	1.02482e+006	657.313	0.0367491
14	1954.48	-4360.89	1.09438e+006	701.928	0.0367491
15	1958.49	-4364.25	1.16171e+006	745.111	0.036749
16	1962.5	-4367.56	1.22684e+006	786.885	0.036749
17	1966.51	-4370.82	1.28981e+006	827.274	0.0367491
18	1970.53	-4374.03	1.35065e+006	866.299	0.0367492
19	1974.54	-4377.2	1.40941e+006	903.982	0.036749
20	1978.55	-4380.31	1.46116e+006	937.176	0.036749
21	1982.56	-4383.38	1.50304e+006	964.038	0.0367491
22	1986.58	-4386.4	1.54291e+006	989.609	0.036749
23	1990.59	-4389.38	1.58079e+006	1013.91	0.0367492
24	1994.6	-4392.32	1.61671e+006	1036.95	0.0367492
25	1998.62	-4395.21	1.65071e+006	1058.75	0.036749
26	2002.63	-4398.06	1.68279e+006	1079.33	0.0367491
27	2006.64	-4400.86	1.713e+006	1098.7	0.0367489
28	2010.65	-4403.63	1.74135e+006	1116.89	0.0367491
29	2014.67	-4406.35	1.76786e+006	1133.89	0.036749
30	2018.68	-4409.03	1.79256e+006	1149.74	0.0367493
31	2022.69	-4411.68	1.81548e+006	1164.43	0.0367489
32	2026.71	-4414.28	1.83662e+006	1177.99	0.0367489
33	2030.72	-4416.85	1.85602e+006	1190.43	0.0367489
34	2034.73	-4419.37	1.87368e+006	1201.77	0.0367493
35	2038.74	-4421.86	1.88964e+006	1212	0.0367491
36	2042.76	-4424.31	1.90391e+006	1221.15	0.036749
37	2046.77	-4426.73	1.9165e+006	1229.23	0.0367491

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 78PC Site 57		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_78_57_0g.sli	

38	2050.78	-4429.11	1.92743e+006	1236.24	0.0367491
39	2054.79	-4431.45	1.93673e+006	1242.2	0.036749
40	2058.81	-4433.75	1.9444e+006	1247.12	0.036749
41	2062.82	-4436.03	1.95047e+006	1251.01	0.0367489
42	2066.83	-4438.26	1.95494e+006	1253.88	0.036749
43	2070.85	-4440.46	1.95859e+006	1256.23	0.0367492
44	2074.86	-4442.63	1.96099e+006	1257.77	0.0367492
45	2078.87	-4444.77	1.96184e+006	1258.31	0.0367491
46	2082.88	-4446.87	1.96116e+006	1257.87	0.036749
47	2086.9	-4448.94	1.95896e+006	1256.46	0.036749
48	2090.91	-4450.97	1.95525e+006	1254.08	0.036749
49	2094.92	-4452.97	1.95005e+006	1250.75	0.0367492
50	2098.93	-4454.95	1.94336e+006	1246.46	0.0367492
51	2102.95	-4456.89	1.93521e+006	1241.23	0.0367491
52	2106.96	-4458.79	1.92559e+006	1235.06	0.0367491
53	2110.97	-4460.67	1.91453e+006	1227.96	0.0367489
54	2114.99	-4462.52	1.90203e+006	1219.95	0.0367491
55	2119	-4464.33	1.88811e+006	1211.02	0.0367491
56	2123.01	-4466.12	1.87276e+006	1201.18	0.0367493
57	2127.02	-4467.87	1.85602e+006	1190.44	0.0367492
58	2131.04	-4469.59	1.83788e+006	1178.8	0.036749
59	2135.05	-4471.29	1.81835e+006	1166.27	0.0367489
60	2139.06	-4472.96	1.79744e+006	1152.86	0.0367489
61	2143.08	-4474.59	1.77517e+006	1138.58	0.0367491
62	2147.09	-4476.2	1.75154e+006	1123.42	0.0367489
63	2151.1	-4477.78	1.72656e+006	1107.4	0.036749
64	2155.11	-4479.33	1.70023e+006	1090.52	0.0367493
65	2159.13	-4480.85	1.67257e+006	1072.78	0.0367493
66	2163.14	-4482.35	1.64359e+006	1054.19	0.0367492
67	2167.15	-4483.81	1.61329e+006	1034.75	0.036749
68	2171.16	-4485.25	1.58168e+006	1014.48	0.0367492
69	2175.18	-4486.66	1.54877e+006	993.368	0.036749
70	2179.19	-4488.04	1.51456e+006	971.426	0.036749
71	2183.2	-4489.4	1.47906e+006	948.659	0.0367491
72	2187.22	-4490.73	1.44228e+006	925.069	0.0367491
73	2191.23	-4492.03	1.40423e+006	900.661	0.036749
74	2195.24	-4493.31	1.36491e+006	875.44	0.036749
75	2199.25	-4494.56	1.32432e+006	849.41	0.0367491
76	2203.27	-4495.78	1.28248e+006	822.573	0.0367491
77	2207.28	-4496.97	1.23939e+006	794.935	0.0367491

78	2211.29	-4498.14	1.19506e+006	766.5	0.036749
79	2215.31	-4499.29	1.14948e+006	737.27	0.0367492
80	2219.32	-4500.41	1.10268e+006	707.249	0.036749
81	2223.33	-4501.5	1.05464e+006	676.441	0.0367492
82	2227.34	-4502.57	1.00539e+006	644.849	0.036749
83	2231.36	-4503.61	954918	612.477	0.0367491
84	2235.37	-4504.62	903235	579.327	0.036749
85	2239.38	-4505.61	850344	545.404	0.0367491
86	2243.39	-4506.58	796251	510.709	0.036749
87	2247.41	-4507.52	740961	475.246	0.036749
88	2251.42	-4508.44	684478	439.019	0.0367491
89	2255.43	-4509.33	637174	408.679	0.0367491
90	2259.45	-4510.19	590446	378.708	0.0367491
91	2263.46	-4511.03	542548	347.986	0.0367491
92	2267.47	-4511.85	493483	316.516	0.036749
93	2271.48	-4512.64	443255	284.3	0.036749
94	2275.5	-4513.41	391868	251.341	0.036749
95	2279.51	-4514.15	339325	217.641	0.0367492
96	2283.52	-4514.87	285631	183.201	0.036749
97	2287.54	-4515.57	230788	148.026	0.0367492
98	2291.55	-4516.24	174801	112.116	0.0367491
99	2295.56	-4516.89	117671	75.4733	0.0367491
100	2299.57	-4517.51	59403	38.1006	0.036749
101	2303.59	-4518.11	1.05129e+008	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.11168

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	1886.84	-4304.86	9.54388e+007	0	0
2	1891.19	-4309.31	107395	3.0654	0.00163541
3	1895.54	-4313.69	211742	12.0817	0.00326922
4	1899.89	-4318.01	313110	26.7763	0.00489978
5	1904.24	-4322.25	411562	46.8735	0.00652551
6	1908.59	-4326.42	507160	72.0947	0.00814481
7	1912.94	-4330.53	599963	102.159	0.00975607
8	1917.29	-4334.57	690026	136.783	0.0113577
9	1921.64	-4338.55	777404	175.683	0.0129481
10	1925.99	-4342.47	862146	218.573	0.0145257
11	1930.34	-4346.33	944303	265.167	0.0160891
12	1934.7	-4350.13	1.02392e+006	315.178	0.0176365

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 78PC Site 57		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_78_57_0g.sli	

13	1939.05	-4353.87	1.10104e+006	368.319	0.0191665
14	1943.4	-4357.55	1.17572e+006	424.307	0.0206775
15	1947.75	-4361.18	1.24798e+006	482.855	0.0221683
16	1952.1	-4364.75	1.31787e+006	543.682	0.0236371
17	1956.45	-4368.27	1.38543e+006	606.506	0.0250826
18	1960.8	-4371.73	1.4507e+006	671.05	0.0265033
19	1965.15	-4375.15	1.5137e+006	737.039	0.027898
20	1969.5	-4378.51	1.57448e+006	804.2	0.0292651
21	1973.85	-4381.82	1.63307e+006	872.265	0.0306032
22	1978.2	-4385.08	1.68567e+006	938.84	0.0319111
23	1982.55	-4388.3	1.72611e+006	999.819	0.0331876
24	1986.9	-4391.46	1.76443e+006	1060.32	0.0344314
25	1991.25	-4394.58	1.80066e+006	1120.11	0.0356411
26	1995.61	-4397.65	1.83483e+006	1178.98	0.0368157
27	1999.96	-4400.68	1.86697e+006	1236.72	0.0379539
28	2004.31	-4403.66	1.89709e+006	1293.12	0.0390547
29	2008.66	-4406.6	1.92523e+006	1348	0.0401171
30	2013.01	-4409.49	1.95142e+006	1401.16	0.0411395
31	2017.36	-4412.35	1.97566e+006	1452.43	0.0421217
32	2021.71	-4415.15	1.99799e+006	1501.64	0.0430621
33	2026.06	-4417.92	2.01842e+006	1548.63	0.0439601
34	2030.41	-4420.64	2.03698e+006	1593.25	0.0448146
35	2034.76	-4423.33	2.05369e+006	1635.37	0.0456251
36	2039.11	-4425.97	2.06856e+006	1674.85	0.0463906
37	2043.46	-4428.57	2.08162e+006	1711.56	0.04711
38	2047.81	-4431.14	2.09289e+006	1745.41	0.047783
39	2052.16	-4433.66	2.10238e+006	1776.29	0.0484089
40	2056.52	-4436.15	2.11011e+006	1804.12	0.0489872
41	2060.87	-4438.59	2.11609e+006	1828.8	0.049517
42	2065.22	-4441	2.12035e+006	1850.28	0.049998
43	2069.57	-4443.38	2.12331e+006	1868.86	0.0504296
44	2073.92	-4445.71	2.12532e+006	1884.79	0.0508114
45	2078.27	-4448.01	2.12565e+006	1897.38	0.0511429
46	2082.62	-4450.27	2.12431e+006	1906.62	0.0514243
47	2086.97	-4452.5	2.12132e+006	1912.47	0.0516548
48	2091.32	-4454.69	2.1167e+006	1914.93	0.0518342
49	2095.67	-4456.85	2.11045e+006	1914	0.0519624
50	2100.02	-4458.97	2.10259e+006	1909.7	0.0520395
51	2104.37	-4461.06	2.09314e+006	1902.06	0.0520653
52	2108.72	-4463.11	2.0821e+006	1891.09	0.0520395

SLIDEINTERPRET 6.020

Project	Sumatra Submarine Slide
Analysis Description	RR0705 78PC Site 57
Drawn By	Jason R. Patton
Company	Oregon State University
Date	3/26/2013
File Name	RR0705_78_57_0g.sli

53	2113.07	-4465.13	2.06948e+006	1876.85	0.0519626
54	2117.42	-4467.12	2.05531e+006	1859.39	0.0518341
55	2121.78	-4469.07	2.03958e+006	1838.78	0.0516549
56	2126.13	-4470.99	2.02232e+006	1815.08	0.0514243
57	2130.48	-4472.88	2.00353e+006	1788.38	0.051143
58	2134.83	-4474.74	1.98322e+006	1758.77	0.0508113
59	2139.18	-4476.56	1.9614e+006	1726.35	0.0504296
60	2143.53	-4478.35	1.93808e+006	1691.23	0.0499981
61	2147.88	-4480.11	1.91328e+006	1653.52	0.0495169
62	2152.23	-4481.84	1.887e+006	1613.36	0.0489871
63	2156.58	-4483.53	1.85924e+006	1570.87	0.0484091
64	2160.93	-4485.2	1.83003e+006	1526.2	0.0477833
65	2165.28	-4486.84	1.79937e+006	1479.49	0.0471101
66	2169.63	-4488.44	1.76726e+006	1430.9	0.0463907
67	2173.98	-4490.02	1.73372e+006	1380.58	0.0456252
68	2178.33	-4491.56	1.69876e+006	1328.71	0.0448147
69	2182.69	-4493.07	1.66237e+006	1275.45	0.0439601
70	2187.04	-4494.56	1.62457e+006	1220.99	0.0430622
71	2191.39	-4496.01	1.58537e+006	1165.51	0.0421219
72	2195.74	-4497.44	1.54478e+006	1109.19	0.0411398
73	2200.09	-4498.84	1.50279e+006	1052.22	0.0401172
74	2204.44	-4500.2	1.45943e+006	994.795	0.0390547
75	2208.79	-4501.54	1.41469e+006	937.118	0.0379538
76	2213.14	-4502.85	1.36857e+006	879.385	0.0368158
77	2217.49	-4504.14	1.3211e+006	821.799	0.0356412
78	2221.84	-4505.39	1.27228e+006	764.562	0.0344312
79	2226.19	-4506.61	1.2221e+006	707.881	0.0331876
80	2230.54	-4507.81	1.17058e+006	651.959	0.0319111
81	2234.89	-4508.98	1.11772e+006	597.004	0.0306032
82	2239.24	-4510.12	1.06353e+006	543.221	0.0292651
83	2243.59	-4511.24	1.00801e+006	490.814	0.0278981
84	2247.95	-4512.32	951178	439.988	0.0265034
85	2252.3	-4513.38	893921	391.336	0.0250826
86	2256.65	-4514.41	847601	349.674	0.0236371
87	2261	-4515.42	799986	309.523	0.0221683
88	2265.35	-4516.39	751082	271.06	0.0206776
89	2269.7	-4517.34	700894	234.462	0.0191665
90	2274.05	-4518.27	649426	199.903	0.0176365
91	2278.4	-4519.16	596682	167.553	0.0160891
92	2282.75	-4520.03	542668	137.578	0.0145257

93	2287.1	-4520.88	487386	110.143	0.0129481
94	2291.45	-4521.69	430842	85.4054	0.0113577
95	2295.8	-4522.48	373039	63.5193	0.00975605
96	2300.15	-4523.25	313981	44.6336	0.00814481
97	2304.5	-4523.98	253672	28.8912	0.00652553
98	2308.86	-4524.7	192116	16.4293	0.0048998
99	2313.21	-4525.38	129316	7.37859	0.00326922
100	2317.56	-4526.04	65276.2	1.8632	0.00163541
101	2321.91	-4526.67	1.05528e+008	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.122238
Factor of Safety, standard deviation: 0.186116
Factor of Safety, minimum: 0.562349
Factor of Safety, maximum: 1.763860
Probability of Failure: 26.130% (= 2613 failed surfaces / 10000 valid surfaces)
Reliability index: 0.65679 (assuming normal distribution)
Reliability index: 0.61777 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 1.121453
Factor of Safety, standard deviation: 0.186454
Factor of Safety, minimum: 0.563591
Factor of Safety, maximum: 1.760780
Probability of Failure: 26.400% (= 2640 failed surfaces / 10000 valid surfaces)
Reliability index: 0.65138 (assuming normal distribution)
Reliability index: 0.61159 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-8000
7502	-8000
7502	0
0	0

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 78PC Site 57		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_78_57_0g.sli	

External Boundary

X	Y
7502	-8000
7502	-5364
7413	-5363
7325	-5362
7237	-5363
7148	-5363
7060	-5364
6972	-5364
6883	-5363
6795	-5359
6707	-5355
6618	-5352
6530	-5351
6442	-5347
6353	-5341
6265	-5331
6177	-5319
6088	-5310
6000	-5297
5911	-5283
5819	-5267
5727	-5250
5635	-5241
5543	-5231
5451	-5221
5359	-5213
5267	-5207
5174	-5204
5082	-5202
4990	-5198
4898	-5191
4806	-5188
4714	-5181
4622	-5167
4537	-5157
4451	-5150
4366	-5150

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 78PC Site 57		
	Drawn By: Jason R. Patton	Company: Oregon State University	
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4281	-5140
4196	-5132
4111	-5112
4026	-5093
3941	-5073
3852	-5051
3764	-5021
3676	-4999
3587	-4975
3499	-4949
3411	-4916
3323	-4887
3234	-4864
3146	-4834
3058	-4798
2969	-4762
2881	-4726
2793	-4695
2704	-4666
2616	-4639
2528	-4610
2436	-4577
2344	-4537
2252	-4494
2160	-4445
2068	-4396
1977	-4347
1885	-4304
1793	-4266
1701	-4228
1611	-4193
1522	-4156
1432	-4118
1343	-4078
1253	-4040
1164	-3993
1074	-3955
985	-3921
895	-3891
806	-3863

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 78PC Site 57		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_78_57_0g.sli	

716	-3840
627	-3815
537	-3797
448	-3783
358	-3772
269	-3762
179	-3756
90	-3753
0	-3755
0	-8000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 78PC Site 57	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/26/2013	File Name: RR0705_78_57_1g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_78_57_1g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 78PC Site 57
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/26/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 100
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 78PC Site 57	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/26/2013	File Name: RR0705_78_57_1g.sli

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1367174839
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.2
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	Automatically Calculated
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.2	5.7	8.7	0.5

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.001664
Center: 2577.300, -3411.219
Radius: 1139.200
Left Slip Surface Endpoint: 1853.645, -4291.049
Right Slip Surface Endpoint: 2298.701, -4515.827
Left Slope Intercept: 1853.645 0.000
Right Slope Intercept: 2298.701 0.000
Resisting Moment=457331 kN-m
Driving Moment=2.74906e+008 kN-m
Resisting Horizontal Force=405.9 kN

Driving Horizontal Force=243991 kN
Total Slice Area=1.96898e+006 m2

Method: gle/morgenstern-price

FS: 0.001535
Center: 2579.414, -3510.827
Radius: 1046.731
Left Slip Surface Endpoint: 1910.452, -4315.896
Right Slip Surface Endpoint: 2315.800, -4523.820
Left Slope Intercept: 1910.452 0.000
Right Slope Intercept: 2315.800 0.000
Resisting Moment=290183 kN-m
Driving Moment=1.89074e+008 kN-m
Resisting Horizontal Force=280.332 kN
Driving Horizontal Force=182656 kN
Total Slice Area=1.79922e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1085
Number of Invalid Surfaces: 1

Error Codes:

Error Code -112 reported for 1 surface

Method: gle/morgenstern-price

Number of Valid Surfaces: 1084
Number of Invalid Surfaces: 2

Error Codes:

Error Code -108 reported for 1 surface
Error Code -111 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This

screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.00166359

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	4.45056	196811	basement	5.551	27.1	267.512	0.44503	44221	44230.9	-9.93531
2	4.45056	197021	basement	5.551	27.1	291.737	0.48533	44286.7	44296.6	-9.8512
3	4.45056	197229	basement	5.551	27.1	315.913	0.52555	44351.5	44361.3	-9.81166
4	4.45056	197435	basement	5.551	27.1	340.042	0.56569	44415.4	44425.1	-9.68288
5	4.45056	197637	basement	5.551	27.1	364.116	0.60574	44478.2	44487.9	-9.65965
6	4.45056	197838	basement	5.551	27.1	388.136	0.6457	44540.2	44549.8	-9.61131
7	4.45056	198035	basement	5.551	27.1	412.097	0.68556	44601.3	44610.7	-9.38367
8	4.45056	198228	basement	5.551	27.1	402.93	0.67031	44659.5	44669	-9.46863
9	4.45056	198415	basement	5.551	27.1	421.125	0.70058	44714.9	44724.3	-9.43819
10	4.45056	198599	basement	5.551	27.1	440.661	0.73308	44769.3	44778.7	-9.38419
11	4.45056	198781	basement	5.551	27.1	460.035	0.76531	44822.9	44832.2	-9.25827
12	4.45056	198961	basement	5.551	27.1	479.253	0.79728	44875.6	44884.9	-9.29443
13	4.45056	199138	basement	5.551	27.1	498.308	0.82898	44927.4	44936.6	-9.24817
14	4.45056	199313	basement	5.551	27.1	517.195	0.8604	44978.4	44987.6	-9.19325
15	4.45056	199486	basement	5.551	27.1	535.907	0.89153	45028.4	45037.6	-9.15159
16	4.45056	199656	basement	5.551	27.1	554.439	0.92236	45077.9	45086.8	-8.9154
17	4.45056	199825	basement	5.551	27.1	572.785	0.95288	45126.2	45135.2	-8.99528
18	4.45056	199991	basement	5.551	27.1	590.951	0.9831	45173.8	45182.8	-8.98442
19	4.45056	200154	basement	5.551	27.1	608.912	1.01298	45220.8	45229.6	-8.84333
20	4.45056	200316	basement	5.551	27.1	626.681	1.04254	45266.7	45275.5	-8.80586
21	4.45056	200475	basement	5.551	27.1	644.245	1.07176	45311.8	45320.7	-8.85069
22	4.45056	200633	basement	5.551	27.1	661.599	1.10063	45356.3	45365	-8.74228
23	4.45056	200788	basement	5.551	27.1	678.737	1.12914	45400	45408.6	-8.64575
24	4.45056	200941	basement	5.551	27.1	695.652	1.15728	45442.8	45451.4	-8.61551
25	4.45056	201092	basement	5.551	27.1	712.339	1.18504	45485	45493.4	-8.43053
26	4.45056	201241	basement	5.551	27.1	728.797	1.21242	45526.2	45534.7	-8.53732
27	4.45056	201388	basement	5.551	27.1	745.015	1.2394	45566.8	45575.2	-8.42629
28	4.45056	201532	basement	5.551	27.1	745.725	1.24058	45606.3	45614.7	-8.4382
29	4.45056	201669	basement	5.551	27.1	718.368	1.19507	45641.6	45650	-8.40898
30	4.45056	201802	basement	5.551	27.1	727.108	1.20961	45674.9	45683.3	-8.4274
31	4.45056	201933	basement	5.551	27.1	735.458	1.2235	45707.3	45715.8	-8.52107

32	4.45056	202062	basement	5.551	27.1	743.404	1.23672	45739.2	45747.6	-8.3772
33	4.45056	202189	basement	5.551	27.1	750.936	1.24925	45770.2	45778.6	-8.44683
34	4.45056	202315	basement	5.551	27.1	758.047	1.26108	45800.7	45809	-8.3236
35	4.45056	202438	basement	5.551	27.1	764.732	1.2722	45830.2	45838.7	-8.46263
36	4.45056	202559	basement	5.551	27.1	770.971	1.28258	45859.2	45867.6	-8.35045
37	4.45056	202679	basement	5.551	27.1	776.76	1.29221	45887.5	45895.9	-8.35659
38	4.45056	202796	basement	5.551	27.1	782.086	1.30107	45915.1	45923.4	-8.25699
39	4.45056	202912	basement	5.551	27.1	786.937	1.30914	45942.1	45950.3	-8.22802
40	4.45056	203026	basement	5.551	27.1	791.307	1.31641	45968.2	45976.5	-8.34345
41	4.45056	203138	basement	5.551	27.1	795.178	1.32285	45993.8	46002	-8.18694
42	4.45056	203249	basement	5.551	27.1	798.55	1.32846	46018.7	46026.9	-8.23053
43	4.45056	203357	basement	5.551	27.1	801.393	1.33319	46042.7	46051	-8.2536
44	4.45056	203464	basement	5.551	27.1	803.714	1.33705	46066.3	46074.6	-8.33697
45	4.45056	203569	basement	5.551	27.1	805.487	1.34	46089.2	46097.4	-8.15933
46	4.45056	203672	basement	5.551	27.1	806.701	1.34202	46111.5	46119.6	-8.09952
47	4.45056	203773	basement	5.551	27.1	807.35	1.3431	46133.1	46141.2	-8.13831
48	4.45056	203873	basement	5.551	27.1	807.41	1.3432	46153.9	46162.1	-8.15677
49	4.45056	203971	basement	5.551	27.1	811.684	1.35031	46174.4	46182.5	-8.13517
50	4.45056	204068	basement	5.551	27.1	812.105	1.35101	46194.3	46202.6	-8.2539
51	4.45056	204163	basement	5.551	27.1	811.023	1.34921	46213.9	46222	-8.09371
52	4.45056	204257	basement	5.551	27.1	809.31	1.34636	46232.7	46240.8	-8.1405
53	4.45056	204349	basement	5.551	27.1	806.948	1.34243	46250.8	46259	-8.17535
54	4.45056	204439	basement	5.551	27.1	803.918	1.33739	46268.4	46276.6	-8.18116
55	4.45056	204527	basement	5.551	27.1	800.215	1.33123	46285.3	46293.5	-8.24483
56	4.45056	204614	basement	5.551	27.1	795.809	1.3239	46301.6	46309.8	-8.24698
57	4.45056	204699	basement	5.551	27.1	790.688	1.31538	46317.3	46325.6	-8.27134
58	4.45056	204783	basement	5.551	27.1	784.833	1.30564	46332.4	46340.7	-8.30682
59	4.45056	204865	basement	5.551	27.1	778.221	1.29464	46347	46355.2	-8.23359
60	4.45056	204945	basement	5.551	27.1	770.833	1.28235	46360.9	46369.1	-8.24185
61	4.45056	205024	basement	5.551	27.1	762.646	1.26873	46374.1	46382.4	-8.31752
62	4.45056	205101	basement	5.551	27.1	753.647	1.25376	46386.9	46395.2	-8.34033
63	4.45056	205176	basement	5.551	27.1	743.801	1.23738	46399	46407.3	-8.30235
64	4.45056	205250	basement	5.551	27.1	733.089	1.21956	46410.5	46418.9	-8.39017
65	4.45056	205323	basement	5.551	27.1	721.488	1.20026	46421.4	46429.9	-8.49063
66	4.45056	205393	basement	5.551	27.1	708.973	1.17944	46431.7	46440.3	-8.59075
67	4.45056	205463	basement	5.551	27.1	695.514	1.15705	46441.4	46450.1	-8.67777
68	4.45056	205530	basement	5.551	27.1	681.087	1.13305	46450.8	46459.4	-8.63054
69	4.45056	205597	basement	5.551	27.1	665.663	1.10739	46459.3	46468.1	-8.75355
70	4.45056	205661	basement	5.551	27.1	649.204	1.08001	46467.4	46476.2	-8.82641
71	4.45056	205724	basement	5.551	27.1	631.694	1.05088	46474.9	46483.7	-8.83713

72	4.45056	205786	basement	5.551	27.1	613.09	1.01993	46481.8	46490.7	-8.87396
73	4.45056	205846	basement	5.551	27.1	593.361	0.98711	46488.3	46497.2	-8.9253
74	4.45056	205905	basement	5.551	27.1	572.473	0.95236	46494	46503.1	-9.0904
75	4.45056	205962	basement	5.551	27.1	550.382	0.91561	46499.3	46508.4	-9.14805
76	4.45056	206018	basement	5.551	27.1	527.065	0.87682	46504	46513.2	-9.18719
77	4.45056	206072	basement	5.551	27.1	502.468	0.8359	46508.1	46517.4	-9.30856
78	4.45056	206124	basement	5.551	27.1	476.548	0.79278	46511.7	46521.1	-9.39048
79	4.45056	206176	basement	5.551	27.1	449.275	0.74741	46514.9	46524.2	-9.32241
80	4.45056	206225	basement	5.551	27.1	420.59	0.69969	46517.4	46526.8	-9.40653
81	4.45056	206274	basement	5.551	27.1	390.457	0.64956	46519.3	46528.9	-9.63351
82	4.45056	206320	basement	5.551	27.1	358.814	0.59692	46520.7	46530.4	-9.68109
83	4.45056	206366	basement	5.551	27.1	325.621	0.5417	46521.5	46531.4	-9.85278
84	4.45056	206410	basement	5.551	27.1	290.811	0.48379	46522	46531.9	-9.92603
85	4.45056	206452	basement	5.551	27.1	254.329	0.4231	46521.8	46531.8	-10.0052
86	4.45056	206493	basement	5.551	27.1	216.123	0.35954	46521	46531.2	-10.1818
87	4.45056	206533	basement	5.551	27.1	176.125	0.293	46519.9	46530.1	-10.2327
88	4.45056	206571	basement	5.551	27.1	134.258	0.22335	46518.1	46528.5	-10.3636
89	4.45056	206608	basement	5.551	27.1	90.467	0.1505	46515.8	46526.3	-10.4664
90	4.45056	206645	basement	5.551	27.1	97.1994	0.1617	46513.6	46524.2	-10.5869
91	4.45056	206685	basement	5.551	27.1	113.363	0.18859	46514.5	46525	-10.4967
92	4.45056	206725	basement	5.551	27.1	76.5994	0.12743	46515.3	46525.9	-10.6125
93	4.45056	206763	basement	5.551	27.1	37.9721	0.06317	46515.5	46526.3	-10.7577
94	4.45056	206801	basement	5.551	27.1	0	0	46514.8	46526.2	-11.3577
95	4.45056	206836	basement	5.551	27.1	0	0	46508.4	46525.5	-17.0716
96	4.45056	206871	basement	5.551	27.1	0	0	46501.5	46524.4	-22.9058
97	4.45056	206904	basement	5.551	27.1	0	0	46493.8	46522.7	-28.8701
98	4.45056	206935	basement	5.551	27.1	0	0	46485.7	46520.6	-34.9406
99	4.45056	206966	basement	5.551	27.1	0	0	46476.8	46517.9	-41.1279
100	4.45056	206995	basement	5.551	27.1	0	0	46331.3	46514.7	-183.406

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00153475

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	4.05348	180279	basement	5.551	27.1	52.2561	0.0802	44471.9	44482.6	-10.732
2	4.05348	180451	basement	5.551	27.1	98.1789	0.15068	44529.3	44539.8	-10.5404
3	4.05348	180621	basement	5.551	27.1	143.711	0.22056	44585.7	44596.1	-10.4283
4	4.05348	180788	basement	5.551	27.1	188.793	0.28975	44641.4	44651.6	-10.242
5	4.05348	180953	basement	5.551	27.1	233.367	0.35816	44696	44706.2	-10.2056
6	4.05348	181117	basement	5.551	27.1	277.374	0.4257	44749.8	44759.9	-10.0686
7	4.05348	181278	basement	5.551	27.1	320.762	0.49229	44802.9	44812.8	-9.87329

8	4.05348	181437	basement	5.551	27.1	363.473	0.55784	44855.1	44864.9	-9.75884
9	4.05348	181594	basement	5.551	27.1	405.454	0.62227	44906.5	44916.1	-9.5722
10	4.05348	181749	basement	5.551	27.1	446.646	0.68549	44956.9	44966.5	-9.55837
11	4.05348	181902	basement	5.551	27.1	486.998	0.74742	45006.8	45016.1	-9.27332
12	4.05348	182054	basement	5.551	27.1	526.47	0.808	45055.6	45064.9	-9.2601
13	4.05348	182203	basement	5.551	27.1	564.998	0.86713	45103.8	45113	-9.17598
14	4.05348	182350	basement	5.551	27.1	602.541	0.92475	45151.2	45160.2	-8.97277
15	4.05348	182496	basement	5.551	27.1	639.055	0.98079	45197.7	45206.6	-8.90603
16	4.05348	182639	basement	5.551	27.1	674.488	1.03517	45243.5	45252.3	-8.83267
17	4.05348	182780	basement	5.551	27.1	681.896	1.04654	45287.8	45296.5	-8.71671
18	4.05348	182913	basement	5.551	27.1	687.337	1.05489	45327.6	45336.5	-8.86095
19	4.05348	183045	basement	5.551	27.1	708.689	1.08766	45366.7	45375.3	-8.60509
20	4.05348	183174	basement	5.551	27.1	728.738	1.11843	45404.8	45413.5	-8.71371
21	4.05348	183302	basement	5.551	27.1	747.457	1.14716	45442.2	45450.9	-8.74587
22	4.05348	183428	basement	5.551	27.1	764.822	1.17381	45479	45487.5	-8.45874
23	4.05348	183552	basement	5.551	27.1	780.818	1.19836	45514.9	45523.5	-8.63051
24	4.05348	183675	basement	5.551	27.1	795.426	1.22078	45550.3	45558.7	-8.40963
25	4.05348	183796	basement	5.551	27.1	808.64	1.24106	45584.9	45593.3	-8.37246
26	4.05348	183915	basement	5.551	27.1	820.44	1.25917	45618.6	45627.1	-8.49346
27	4.05348	184032	basement	5.551	27.1	830.819	1.2751	45652	45660.2	-8.21732
28	4.05348	184148	basement	5.551	27.1	839.778	1.28885	45684.5	45692.7	-8.23486
29	4.05348	184262	basement	5.551	27.1	847.304	1.3004	45716.3	45724.5	-8.20715
30	4.05348	184374	basement	5.551	27.1	853.409	1.30977	45747.3	45755.6	-8.31338
31	4.05348	184485	basement	5.551	27.1	858.081	1.31694	45777.9	45786.1	-8.20393
32	4.05348	184594	basement	5.551	27.1	861.332	1.32193	45807.5	45815.9	-8.38082
33	4.05348	184702	basement	5.551	27.1	863.17	1.32475	45836.8	45845	-8.18316
34	4.05348	184807	basement	5.551	27.1	863.6	1.32541	45865.2	45873.5	-8.31748
35	4.05348	184912	basement	5.551	27.1	862.649	1.32395	45893.1	45901.3	-8.23329
36	4.05348	185014	basement	5.551	27.1	860.316	1.32037	45920.3	45928.5	-8.21635
37	4.05348	185116	basement	5.551	27.1	856.622	1.3147	45946.9	45955.1	-8.24112
38	4.05348	185215	basement	5.551	27.1	851.598	1.30699	45972.6	45981	-8.39705
39	4.05348	185313	basement	5.551	27.1	846.405	1.29902	45998	46006.3	-8.331
40	4.05348	185410	basement	5.551	27.1	846.77	1.29958	46023	46031.2	-8.21715
41	4.05348	185506	basement	5.551	27.1	838.71	1.28721	46047.2	46055.7	-8.46234
42	4.05348	185600	basement	5.551	27.1	829.425	1.27296	46071.2	46079.5	-8.3115
43	4.05348	185692	basement	5.551	27.1	818.928	1.25685	46094.4	46102.7	-8.27442
44	4.05348	185784	basement	5.551	27.1	807.272	1.23896	46117	46125.3	-8.33007
45	4.05348	185873	basement	5.551	27.1	794.481	1.21933	46138.8	46147.4	-8.55778
46	4.05348	185961	basement	5.551	27.1	780.603	1.19803	46160.3	46168.8	-8.51854
47	4.05348	186048	basement	5.551	27.1	765.675	1.17512	46181.1	46189.6	-8.51006

48	4.05348	186133	basement	5.551	27.1	749.751	1.15068	46201.3	46209.9	-8.6127
49	4.05348	186217	basement	5.551	27.1	732.869	1.12477	46220.9	46229.6	-8.70717
50	4.05348	186299	basement	5.551	27.1	715.081	1.09747	46239.9	46248.7	-8.77449
51	4.05348	186380	basement	5.551	27.1	696.433	1.06885	46258.4	46267.2	-8.796
52	4.05348	186460	basement	5.551	27.1	676.99	1.03901	46276.3	46285.1	-8.75333
53	4.05348	186538	basement	5.551	27.1	656.798	1.00802	46293.5	46302.5	-8.95049
54	4.05348	186615	basement	5.551	27.1	635.908	0.97596	46310.5	46319.3	-8.82612
55	4.05348	186690	basement	5.551	27.1	614.387	0.94293	46326.5	46335.6	-9.13024
56	4.05348	186764	basement	5.551	27.1	592.292	0.90902	46342.2	46351.3	-9.07818
57	4.05348	186837	basement	5.551	27.1	569.682	0.87432	46357.3	46366.4	-9.0994
58	4.05348	186908	basement	5.551	27.1	546.623	0.83893	46371.7	46381	-9.27861
59	4.05348	186978	basement	5.551	27.1	523.173	0.80294	46385.7	46395	-9.27603
60	4.05348	187047	basement	5.551	27.1	499.397	0.76645	46399.1	46408.5	-9.40073
61	4.05348	187114	basement	5.551	27.1	475.361	0.72956	46412.1	46421.5	-9.41257
62	4.05348	187180	basement	5.551	27.1	451.129	0.69237	46424.5	46433.9	-9.42197
63	4.05348	187245	basement	5.551	27.1	426.773	0.65499	46436.3	46445.8	-9.51486
64	4.05348	187308	basement	5.551	27.1	402.346	0.6175	46447.5	46457.1	-9.57739
65	4.05348	187370	basement	5.551	27.1	377.931	0.58003	46458.2	46468	-9.79592
66	4.05348	187431	basement	5.551	27.1	353.582	0.54266	46468.6	46478.3	-9.72941
67	4.05348	187491	basement	5.551	27.1	329.376	0.50551	46478.2	46488	-9.81954
68	4.05348	187549	basement	5.551	27.1	305.366	0.46866	46487.3	46497.3	-10.0261
69	4.05348	187606	basement	5.551	27.1	281.629	0.43223	46496.1	46506	-9.90746
70	4.05348	187662	basement	5.551	27.1	258.231	0.39632	46504.2	46514.3	-10.1083
71	4.05348	187716	basement	5.551	27.1	235.23	0.36102	46511.8	46522	-10.1879
72	4.05348	187769	basement	5.551	27.1	212.693	0.32643	46519	46529.2	-10.234
73	4.05348	187821	basement	5.551	27.1	190.676	0.29264	46525.7	46535.9	-10.2346
74	4.05348	187872	basement	5.551	27.1	169.252	0.25976	46531.7	46542	-10.3087
75	4.05348	187921	basement	5.551	27.1	148.474	0.22787	46537.3	46547.7	-10.4147
76	4.05348	187969	basement	5.551	27.1	128.399	0.19706	46542.5	46552.9	-10.4411
77	4.05348	188016	basement	5.551	27.1	109.08	0.16741	46547	46557.6	-10.6085
78	4.05348	188062	basement	5.551	27.1	90.5685	0.139	46551.1	46561.8	-10.6748
79	4.05348	188106	basement	5.551	27.1	72.9304	0.11193	46554.9	46565.5	-10.629
80	4.05348	188150	basement	5.551	27.1	56.1916	0.08624	46558	46568.7	-10.6932
81	4.05348	188192	basement	5.551	27.1	40.417	0.06203	46560.5	46571.4	-10.858
82	4.05348	188233	basement	5.551	27.1	25.6394	0.03935	46562.7	46573.6	-10.8804
83	4.05348	188272	basement	5.551	27.1	11.8912	0.01825	46564.5	46575.3	-10.7502
84	4.05348	188311	basement	5.551	27.1	0	0	46565.6	46576.6	-11.0256
85	4.05348	188350	basement	5.551	27.1	49.6498	0.0762	46567.9	46578.5	-10.5889
86	4.05348	188392	basement	5.551	27.1	62.2772	0.09558	46572.3	46582.9	-10.6198
87	4.05348	188433	basement	5.551	27.1	54.0479	0.08295	46576.1	46586.9	-10.7847

88	4.05348	188473	basement	5.551	27.1	46.7698	0.07178	46579.7	46590.4	-10.74
89	4.05348	188511	basement	5.551	27.1	40.4756	0.06212	46582.7	46593.5	-10.8122
90	4.05348	188549	basement	5.551	27.1	35.1784	0.05399	46585.4	46596.1	-10.6574
91	4.05348	188585	basement	5.551	27.1	30.8975	0.04742	46587.5	46598.2	-10.7392
92	4.05348	188620	basement	5.551	27.1	27.6397	0.04242	46589.2	46599.9	-10.6778
93	4.05348	188654	basement	5.551	27.1	25.4178	0.03901	46590.3	46601.1	-10.8381
94	4.05348	188687	basement	5.551	27.1	24.2254	0.03718	46591.1	46601.8	-10.7395
95	4.05348	188719	basement	5.551	27.1	24.0626	0.03693	46591.4	46602.1	-10.7109
96	4.05348	188750	basement	5.551	27.1	24.9161	0.03824	46591	46601.9	-10.8827
97	4.05348	188779	basement	5.551	27.1	26.7666	0.04108	46590.4	46601.2	-10.7728
98	4.05348	188807	basement	5.551	27.1	29.5944	0.04542	46589.4	46600.1	-10.7116
99	4.05348	188835	basement	5.551	27.1	33.354	0.05119	46587.7	46598.5	-10.8304
100	4.05348	188861	basement	5.551	27.1	38.0192	0.05835	46585.8	46596.5	-10.7459

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.00166359

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	1853.64	-4291.05	9.48275e+007	0	0
2	1858.1	-4294.69	79268.1	-399.414	-0.288698
3	1862.55	-4298.3	157164	-791.916	-0.288699
4	1867	-4301.86	233698	-1177.55	-0.288698
5	1871.45	-4305.39	308878	-1556.37	-0.288699
6	1875.9	-4308.89	382713	-1928.4	-0.288697
7	1880.35	-4312.35	455212	-2293.71	-0.288698
8	1884.8	-4315.77	526382	-2652.32	-0.288698
9	1889.25	-4319.16	586046	-2952.95	-0.288698
10	1893.7	-4322.52	643885	-3244.39	-0.288698
11	1898.15	-4325.84	700389	-3529.1	-0.288698
12	1902.6	-4329.13	755566	-3807.13	-0.288698
13	1907.05	-4332.38	809423	-4078.5	-0.288698
14	1911.5	-4335.61	861968	-4343.26	-0.288698
15	1915.95	-4338.79	913207	-4601.45	-0.288698
16	1920.4	-4341.95	963149	-4853.09	-0.288698
17	1924.85	-4345.08	1.0118e+006	-5098.24	-0.288699
18	1929.3	-4348.17	1.05917e+006	-5336.91	-0.288698
19	1933.75	-4351.23	1.10526e+006	-5569.14	-0.288697
20	1938.21	-4354.26	1.15008e+006	-5794.98	-0.288697

21	1942.66	-4357.27	1.19363e+006	-6014.44	-0.288698
22	1947.11	-4360.24	1.23593e+006	-6227.56	-0.288697
23	1951.56	-4363.18	1.27697e+006	-6434.38	-0.288699
24	1956.01	-4366.09	1.31677e+006	-6634.92	-0.288699
25	1960.46	-4368.97	1.35533e+006	-6829.2	-0.288698
26	1964.91	-4371.82	1.39265e+006	-7017.27	-0.288699
27	1969.36	-4374.64	1.42875e+006	-7199.15	-0.288698
28	1973.81	-4377.44	1.46362e+006	-7374.87	-0.288699
29	1978.26	-4380.2	1.4933e+006	-7524.39	-0.288698
30	1982.71	-4382.94	1.51166e+006	-7616.92	-0.288698
31	1987.16	-4385.65	1.52878e+006	-7703.2	-0.288699
32	1991.61	-4388.33	1.54467e+006	-7783.23	-0.288698
33	1996.06	-4390.98	1.55932e+006	-7857.06	-0.288698
34	2000.51	-4393.61	1.57275e+006	-7924.71	-0.288697
35	2004.96	-4396.21	1.58495e+006	-7986.2	-0.288698
36	2009.41	-4398.78	1.59594e+006	-8041.57	-0.288698
37	2013.86	-4401.33	1.60572e+006	-8090.84	-0.288697
38	2018.32	-4403.85	1.61429e+006	-8134.04	-0.288698
39	2022.77	-4406.34	1.62166e+006	-8171.19	-0.288698
40	2027.22	-4408.81	1.62784e+006	-8202.32	-0.288698
41	2031.67	-4411.25	1.63283e+006	-8227.46	-0.288698
42	2036.12	-4413.67	1.63663e+006	-8246.62	-0.288698
43	2040.57	-4416.06	1.63925e+006	-8259.83	-0.288699
44	2045.02	-4418.42	1.6407e+006	-8267.13	-0.288699
45	2049.47	-4420.76	1.64098e+006	-8268.52	-0.288698
46	2053.92	-4423.07	1.64009e+006	-8264.04	-0.288698
47	2058.37	-4425.36	1.63804e+006	-8253.71	-0.288698
48	2062.82	-4427.63	1.63483e+006	-8237.55	-0.288698
49	2067.27	-4429.87	1.63047e+006	-8215.59	-0.288699
50	2071.72	-4432.09	1.62595e+006	-8192.77	-0.288697
51	2076.17	-4434.28	1.62047e+006	-8165.17	-0.288698
52	2080.62	-4436.45	1.61385e+006	-8131.85	-0.288699
53	2085.07	-4438.59	1.60611e+006	-8092.82	-0.288698
54	2089.52	-4440.71	1.59724e+006	-8048.11	-0.288697
55	2093.97	-4442.81	1.58724e+006	-7997.75	-0.288698
56	2098.43	-4444.88	1.57613e+006	-7941.75	-0.288698
57	2102.88	-4446.93	1.5639e+006	-7880.14	-0.288698
58	2107.33	-4448.96	1.55056e+006	-7812.94	-0.288699
59	2111.78	-4450.96	1.53612e+006	-7740.16	-0.288698
60	2116.23	-4452.94	1.52058e+006	-7661.84	-0.288697

61	2120.68	-4454.9	1.50393e+006	-7577.98	-0.288699
62	2125.13	-4456.84	1.4862e+006	-7488.62	-0.288698
63	2129.58	-4458.75	1.46738e+006	-7393.78	-0.288697
64	2134.03	-4460.64	1.44747e+006	-7293.47	-0.288698
65	2138.48	-4462.51	1.42648e+006	-7187.72	-0.288698
66	2142.93	-4464.36	1.40442e+006	-7076.55	-0.288698
67	2147.38	-4466.18	1.38128e+006	-6959.98	-0.288699
68	2151.83	-4467.99	1.35708e+006	-6838.03	-0.288698
69	2156.28	-4469.77	1.33182e+006	-6710.72	-0.288697
70	2160.73	-4471.53	1.30549e+006	-6578.08	-0.288699
71	2165.18	-4473.26	1.27811e+006	-6440.13	-0.288699
72	2169.63	-4474.98	1.24968e+006	-6296.88	-0.288699
73	2174.08	-4476.67	1.22021e+006	-6148.36	-0.288698
74	2178.54	-4478.35	1.18969e+006	-5994.6	-0.288699
75	2182.99	-4480	1.15814e+006	-5835.61	-0.288698
76	2187.44	-4481.63	1.12556e+006	-5671.42	-0.288697
77	2191.89	-4483.24	1.09194e+006	-5502.05	-0.288699
78	2196.34	-4484.83	1.05731e+006	-5327.52	-0.288697
79	2200.79	-4486.4	1.02165e+006	-5147.86	-0.288698
80	2205.24	-4487.95	984980	-4963.09	-0.288698
81	2209.69	-4489.48	947301	-4773.24	-0.288698
82	2214.14	-4490.98	908617	-4578.32	-0.288698
83	2218.59	-4492.47	868934	-4378.36	-0.288698
84	2223.04	-4493.94	828255	-4173.39	-0.288698
85	2227.49	-4495.38	786587	-3963.44	-0.288698
86	2231.94	-4496.81	743935	-3748.52	-0.288698
87	2236.39	-4498.21	700303	-3528.67	-0.288698
88	2240.84	-4499.6	655697	-3303.91	-0.288698
89	2245.29	-4500.97	610122	-3074.27	-0.288698
90	2249.74	-4502.31	563585	-2839.78	-0.288698
91	2254.19	-4503.64	522609	-2633.31	-0.288698
92	2258.65	-4504.95	487388	-2455.84	-0.288698
93	2263.1	-4506.23	451234	-2273.67	-0.288699
94	2267.55	-4507.5	414150	-2086.81	-0.288698
95	2272	-4508.75	376137	-1895.27	-0.288698
96	2276.45	-4509.98	337107	-1698.6	-0.288697
97	2280.9	-4511.18	297061	-1496.83	-0.288699
98	2285.35	-4512.37	256002	-1289.94	-0.288699
99	2289.8	-4513.54	213930	-1077.94	-0.288697
100	2294.25	-4514.7	170845	-860.85	-0.288698

101	2298.7	-4515.83	1.05022e+008	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00153475

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	1910.45	-4315.9	9.59288e+007	0	0
2	1914.51	-4319.25	64740.2	-17.6198	-0.0155937
3	1918.56	-4322.56	128129	-69.7092	-0.031172
4	1922.61	-4325.85	190176	-155.072	-0.0467197
5	1926.67	-4329.1	250892	-272.46	-0.0622212
6	1930.72	-4332.31	310286	-420.576	-0.0776613
7	1934.77	-4335.5	368369	-598.079	-0.0930246
8	1938.83	-4338.65	425150	-803.587	-0.108296
9	1942.88	-4341.77	480638	-1035.68	-0.123461
10	1946.93	-4344.86	534843	-1292.9	-0.138503
11	1950.99	-4347.92	587775	-1573.78	-0.15341
12	1955.04	-4350.95	639442	-1876.79	-0.168165
13	1959.09	-4353.95	689854	-2200.4	-0.182753
14	1963.15	-4356.91	739019	-2543.06	-0.197161
15	1967.2	-4359.85	786946	-2903.21	-0.211375
16	1971.25	-4362.76	833644	-3279.27	-0.225381
17	1975.31	-4365.64	879123	-3669.65	-0.239164
18	1979.36	-4368.49	915916	-4039.79	-0.25271
19	1983.41	-4371.31	946131	-4392.64	-0.266007
20	1987.47	-4374.1	975127	-4749.1	-0.279042
21	1991.52	-4376.87	1.00291e+006	-5107.77	-0.291802
22	1995.58	-4379.61	1.0295e+006	-5467.25	-0.304271
23	1999.63	-4382.32	1.05489e+006	-5826.18	-0.316443
24	2003.68	-4385	1.07909e+006	-6183.22	-0.328303
25	2007.74	-4387.66	1.10212e+006	-6537.05	-0.339837
26	2011.79	-4390.29	1.12398e+006	-6886.42	-0.351036
27	2015.84	-4392.89	1.14468e+006	-7230.07	-0.361889
28	2019.9	-4395.47	1.16423e+006	-7566.81	-0.372384
29	2023.95	-4398.02	1.18263e+006	-7895.47	-0.382512
30	2028	-4400.54	1.19989e+006	-8214.95	-0.392265
31	2032.06	-4403.04	1.21603e+006	-8524.15	-0.401626
32	2036.11	-4405.52	1.23104e+006	-8822.07	-0.410595
33	2040.16	-4407.96	1.24494e+006	-9107.72	-0.419156
34	2044.22	-4410.39	1.25773e+006	-9380.17	-0.427305
35	2048.27	-4412.79	1.26942e+006	-9638.56	-0.435032

36	2052.32	-4415.16	1.28002e+006	-9882.06	-0.442328
37	2056.38	-4417.51	1.28953e+006	-10109.9	-0.449189
38	2060.43	-4419.84	1.29796e+006	-10321.4	-0.455607
39	2064.48	-4422.14	1.30532e+006	-10515.9	-0.461575
40	2068.54	-4424.42	1.31175e+006	-10693.9	-0.467087
41	2072.59	-4426.67	1.31804e+006	-10861.4	-0.472139
42	2076.64	-4428.91	1.32328e+006	-11010.5	-0.476725
43	2080.7	-4431.11	1.32748e+006	-11140.7	-0.480836
44	2084.75	-4433.3	1.33063e+006	-11251.7	-0.484477
45	2088.81	-4435.46	1.33275e+006	-11343.2	-0.48764
46	2092.86	-4437.6	1.33384e+006	-11414.9	-0.490321
47	2096.91	-4439.72	1.3339e+006	-11466.6	-0.492519
48	2100.97	-4441.81	1.33295e+006	-11498.3	-0.494233
49	2105.02	-4443.88	1.33099e+006	-11509.7	-0.495451
50	2109.07	-4445.93	1.32801e+006	-11501.1	-0.496192
51	2113.13	-4447.96	1.32404e+006	-11472.3	-0.496434
52	2117.18	-4449.97	1.31907e+006	-11423.6	-0.496189
53	2121.23	-4451.95	1.3131e+006	-11355.1	-0.495456
54	2125.29	-4453.91	1.30614e+006	-11267	-0.494232
55	2129.34	-4455.86	1.2982e+006	-11159.7	-0.492519
56	2133.39	-4457.78	1.28928e+006	-11033.6	-0.490323
57	2137.45	-4459.67	1.27938e+006	-10889	-0.487641
58	2141.5	-4461.55	1.26851e+006	-10726.5	-0.484481
59	2145.55	-4463.41	1.25667e+006	-10546.5	-0.480839
60	2149.61	-4465.24	1.24386e+006	-10349.7	-0.476726
61	2153.66	-4467.06	1.23009e+006	-10136.6	-0.472137
62	2157.71	-4468.85	1.21536e+006	-9908.08	-0.467087
63	2161.77	-4470.63	1.19967e+006	-9664.76	-0.461575
64	2165.82	-4472.38	1.18303e+006	-9407.46	-0.455607
65	2169.87	-4474.12	1.16544e+006	-9137.01	-0.449188
66	2173.93	-4475.83	1.14689e+006	-8854.3	-0.44233
67	2177.98	-4477.52	1.1274e+006	-8560.23	-0.435032
68	2182.04	-4479.2	1.10697e+006	-8255.78	-0.427304
69	2186.09	-4480.85	1.08559e+006	-7941.95	-0.419156
70	2190.14	-4482.48	1.06327e+006	-7619.77	-0.410595
71	2194.2	-4484.1	1.04001e+006	-7290.31	-0.401628
72	2198.25	-4485.69	1.01581e+006	-6954.67	-0.392265
73	2202.3	-4487.27	990680	-6613.98	-0.382513
74	2206.36	-4488.82	964609	-6269.41	-0.372385
75	2210.41	-4490.36	937603	-5922.12	-0.361889

76	2214.46	-4491.88	909663	-5573.33	-0.351036
77	2218.52	-4493.37	880789	-5224.26	-0.339837
78	2222.57	-4494.85	850982	-4876.14	-0.328302
79	2226.62	-4496.31	820243	-4530.23	-0.316443
80	2230.68	-4497.76	788571	-4187.79	-0.304272
81	2234.73	-4499.18	755968	-3850.1	-0.291801
82	2238.78	-4500.58	722432	-3518.42	-0.279042
83	2242.84	-4501.97	687963	-3194.03	-0.266007
84	2246.89	-4503.34	652563	-2878.23	-0.25271
85	2250.94	-4504.69	616228	-2572.27	-0.239164
86	2255	-4506.02	587911	-2312.64	-0.225381
87	2259.05	-4507.33	561837	-2072.74	-0.211376
88	2263.11	-4508.62	534861	-1840.53	-0.197162
89	2267.16	-4509.9	506982	-1617.1	-0.182753
90	2271.21	-4511.16	478200	-1403.54	-0.168165
91	2275.27	-4512.4	448515	-1200.9	-0.153409
92	2279.32	-4513.62	417925	-1010.27	-0.138504
93	2283.37	-4514.82	386430	-832.681	-0.123461
94	2287.43	-4516.01	354030	-669.163	-0.108296
95	2291.48	-4517.18	320724	-520.724	-0.0930247
96	2295.53	-4518.33	286511	-388.35	-0.0776612
97	2299.59	-4519.46	251391	-273.002	-0.0622212
98	2303.64	-4520.58	215363	-175.61	-0.0467198
99	2307.69	-4521.68	178426	-97.0738	-0.0311721
100	2311.75	-4522.76	140580	-38.2606	-0.0155938
101	2315.8	-4523.82	1.05394e+008	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.023671
Factor of Safety, standard deviation: 0.062192
Factor of Safety, minimum: 0.000130
Factor of Safety, maximum: 1.055590
Probability of Failure: 99.990% (= 9918 failed surfaces / 9919 valid surfaces), 81 invalid surfaces
Reliability index: -15.69853 (assuming normal distribution)
Reliability index: -3.32254 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 0.023558
Factor of Safety, standard deviation: 0.062458

Factor of Safety, minimum: 0.000152
Factor of Safety, maximum: 1.066160
Probability of Failure: 99.990% (= 9996 failed surfaces / 9997 valid surfaces), 3 invalid surfaces
Reliability index: -15.63352 (assuming normal distribution)
Reliability index: -3.31869 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-8000
7502	-8000
7502	0
0	0

External Boundary

X	Y
7502	-8000
7502	-5364
7413	-5363
7325	-5362
7237	-5363
7148	-5363
7060	-5364
6972	-5364
6883	-5363
6795	-5359
6707	-5355
6618	-5352
6530	-5351
6442	-5347
6353	-5341
6265	-5331
6177	-5319
6088	-5310
6000	-5297
5911	-5283

5819	-5267
5727	-5250
5635	-5241
5543	-5231
5451	-5221
5359	-5213
5267	-5207
5174	-5204
5082	-5202
4990	-5198
4898	-5191
4806	-5188
4714	-5181
4622	-5167
4537	-5157
4451	-5150
4366	-5150
4281	-5140
4196	-5132
4111	-5112
4026	-5093
3941	-5073
3852	-5051
3764	-5021
3676	-4999
3587	-4975
3499	-4949
3411	-4916
3323	-4887
3234	-4864
3146	-4834
3058	-4798
2969	-4762
2881	-4726
2793	-4695
2704	-4666
2616	-4639
2528	-4610
2436	-4577
2344	-4537

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 78PC Site 57		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_78_57_1g.sli	

2252	-4494
2160	-4445
2068	-4396
1977	-4347
1885	-4304
1793	-4266
1701	-4228
1611	-4193
1522	-4156
1432	-4118
1343	-4078
1253	-4040
1164	-3993
1074	-3955
985	-3921
895	-3891
806	-3863
716	-3840
627	-3815
537	-3797
448	-3783
358	-3772
269	-3762
179	-3756
90	-3753
0	-3755
0	-8000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 79PC Site 54	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/24/2013	File Name: RR0705_79_54_0g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_79_54_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 79PC Site 54
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/24/2013
Comments:

http://earthjay.com/
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364856404
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 79PC Site 54		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/24/2013	File Name: RR0705_79_54_0g.sli	

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Global Minimums

Method: spencer

FS: 1.163760
Center: 891.462, -3287.565
Radius: 375.796
Left Slip Surface Endpoint: 621.081, -3548.557
Right Slip Surface Endpoint: 837.159, -3659.416
Left Slope Intercept: 621.081 0.000
Right Slope Intercept: 837.159 0.000
Resisting Moment=3.99041e+006 kN-m
Driving Moment=3.42889e+006 kN-m
Resisting Horizontal Force=9370.84 kN
Driving Horizontal Force=8052.2 kN
Total Slice Area=782017 m2

Method: gle/morgenstern-price

FS: 1.159690
Center: 888.164, -3294.134
Radius: 367.902
Left Slip Surface Endpoint: 622.931, -3549.091
Right Slip Surface Endpoint: 833.592, -3657.966
Left Slope Intercept: 622.931 0.000
Right Slope Intercept: 833.592 0.000
Resisting Moment=3.72205e+006 kN-m
Driving Moment=3.20953e+006 kN-m
Resisting Horizontal Force=8943.16 kN

Driving Horizontal Force=7711.69 kN
Total Slice Area=762239 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1472
Number of Invalid Surfaces: 582

Error Codes:

Error Code -108 reported for 582 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2053
Number of Invalid Surfaces: 1

Error Codes:

Error Code -108 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.16376

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	8.64311	316442	basement	5.551	27.1	4.42989	5.15532	36594	36594.8	-0.820513
2	8.64311	317458	basement	5.551	27.1	15.3193	17.828	36705.2	36681.3	23.9447
3	8.64311	318336	basement	5.551	27.1	22.895	26.6443	36803.7	36762.4	41.2701
4	8.64311	319142	basement	5.551	27.1	29.0804	33.8426	36894	36838.8	55.2292
5	8.64311	319889	basement	5.551	27.1	34.6111	40.279	36978.5	36910.5	67.9558
6	8.64311	320579	basement	5.551	27.1	39.5011	45.9698	37057.2	36978.1	79.053
7	8.64311	321217	basement	5.551	27.1	43.7633	50.93	37130.5	37041.8	88.6572

8	8.64311	321806	basement	5.551	27.1	47.4092	55.1729	37198.7	37101.8	96.9204
9	8.64311	322348	basement	5.551	27.1	50.4489	58.7104	37262.1	37158.3	103.798
10	8.64311	322846	basement	5.551	27.1	52.8914	61.5529	37320.9	37211.4	109.492
11	8.64311	323301	basement	5.551	27.1	54.7445	63.7095	37375	37261.4	113.624
12	8.64311	323717	basement	5.551	27.1	56.0556	65.2353	37425	37308.4	116.647
13	8.64311	324075	basement	5.551	27.1	56.4619	65.7081	37470.1	37352.5	117.561
14	8.64311	324384	basement	5.551	27.1	55.2946	64.3496	37508.6	37393.7	114.897
15	8.64311	324657	basement	5.551	27.1	53.5286	62.2944	37543.2	37432.3	110.891
16	8.64311	324896	basement	5.551	27.1	51.1664	59.5454	37573.8	37468.3	105.479
17	8.64311	325100	basement	5.551	27.1	48.2093	56.104	37600.5	37501.7	98.7573
18	8.64311	325271	basement	5.551	27.1	44.6573	51.9704	37623.4	37532.7	90.7352
19	8.64311	325411	basement	5.551	27.1	40.5095	47.1433	37642.5	37561.3	81.2335
20	8.64311	325519	basement	5.551	27.1	35.7635	41.6201	37658	37587.5	70.4878
21	8.64311	325597	basement	5.551	27.1	30.4161	35.397	37669.7	37611.4	58.3109
22	8.64311	325644	basement	5.551	27.1	24.4625	28.4685	37677.9	37633.1	44.7733
23	8.64311	325679	basement	5.551	27.1	17.7493	20.6559	37682	37652.5	29.5253
24	8.64311	325735	basement	5.551	27.1	13.3234	15.5053	37689.3	37669.8	19.4975
25	8.64311	325767	basement	5.551	27.1	8.94158	10.4059	37694.5	37685	9.45532

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.15969

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	8.42645	308545	basement	5.551	27.1	7.91712	9.1814	36606.4	36599.3	7.12227
2	8.42645	309504	basement	5.551	27.1	16.3632	18.9762	36710.3	36684	26.2576
3	8.42645	310339	basement	5.551	27.1	22.3568	25.927	36803.4	36763.5	39.8768
4	8.42645	311110	basement	5.551	27.1	27.7729	32.208	36890.4	36838.3	52.1059
5	8.42645	311824	basement	5.551	27.1	32.7231	37.9487	36971.9	36908.6	63.2819
6	8.42645	312485	basement	5.551	27.1	37.218	43.1613	37048.3	36974.8	73.5484
7	8.42645	313095	basement	5.551	27.1	41.2619	47.851	37119.9	37037.2	82.677
8	8.42645	313659	basement	5.551	27.1	44.8531	52.0157	37186.9	37096	90.8647
9	8.42645	314178	basement	5.551	27.1	47.9842	55.6468	37249.3	37151.4	97.9361
10	8.42645	314656	basement	5.551	27.1	50.6429	58.7301	37307.5	37203.6	103.879
11	8.42645	315093	basement	5.551	27.1	52.8122	61.2458	37361.4	37252.6	108.818
12	8.42645	315492	basement	5.551	27.1	54.4751	63.1742	37411.3	37298.7	112.617
13	8.42645	315839	basement	5.551	27.1	55.5258	64.3927	37457	37342	115.021
14	8.42645	316137	basement	5.551	27.1	54.823	63.5777	37495.9	37382.5	113.395
15	8.42645	316400	basement	5.551	27.1	53.4821	62.0227	37530.8	37420.5	110.282
16	8.42645	316631	basement	5.551	27.1	51.4779	59.6984	37561.7	37455.9	105.768
17	8.42645	316829	basement	5.551	27.1	48.7867	56.5775	37588.5	37488.8	99.6858
18	8.42645	316996	basement	5.551	27.1	45.3876	52.6356	37611.3	37519.3	91.9889

19	8.42645	317133	basement	5.551	27.1	41.2626	47.8518	37630.1	37547.5	82.5741
20	8.42645	317240	basement	5.551	27.1	36.3973	42.2096	37644.9	37573.3	71.6333
21	8.42645	317318	basement	5.551	27.1	30.7823	35.6979	37655.9	37597	58.8597
22	8.42645	317368	basement	5.551	27.1	24.4121	28.3105	37662.9	37618.5	44.3864
23	8.42645	317392	basement	5.551	27.1	17.3395	20.1085	37666.2	37637.8	28.4266
24	8.42645	317439	basement	5.551	27.1	12.0014	13.9179	37671.3	37654.9	16.4136
25	8.42645	317473	basement	5.551	27.1	7.11642	8.25284	37675.3	37670	5.33113

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.16376

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	621.081	-3548.56	6.48501e+007	0	0
2	629.725	-3557.22	225827	117.607	0.0298387
3	638.368	-3565.35	390121	203.169	0.0298388
4	647.011	-3572.99	510870	266.053	0.0298387
5	655.654	-3580.17	615301	320.439	0.0298387
6	664.297	-3586.93	704507	366.896	0.0298387
7	672.94	-3593.29	779423	405.911	0.0298387
8	681.583	-3599.29	840854	437.903	0.0298387
9	690.226	-3604.94	889504	463.239	0.0298387
10	698.869	-3610.26	925985	482.238	0.0298387
11	707.513	-3615.26	950837	495.18	0.0298387
12	716.156	-3619.97	964538	502.316	0.0298387
13	724.799	-3624.38	965371	502.75	0.0298387
14	733.442	-3628.52	934806	486.831	0.0298387
15	742.085	-3632.4	894166	465.667	0.0298387
16	750.728	-3636.01	843757	439.415	0.0298387
17	759.371	-3639.38	783849	408.216	0.0298387
18	768.014	-3642.51	714689	372.198	0.0298387
19	776.657	-3645.39	636496	331.477	0.0298387
20	785.301	-3648.05	549467	286.154	0.0298388
21	793.944	-3650.49	453782	236.322	0.0298387
22	802.587	-3652.7	349599	182.065	0.0298386
23	811.23	-3654.7	237061	123.458	0.0298388
24	819.873	-3656.48	154125	80.266	0.0298388
25	828.516	-3658.05	81013.6	42.1906	0.0298387
26	837.159	-3659.42	6.89653e+007	0	0

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Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.15969

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	622.931	-3549.09	6.48696e+007	0	0
2	631.357	-3557.58	221544	15.8086	0.00408843
3	639.784	-3565.54	370710	52.488	0.00811238
4	648.21	-3573.01	489651	102.624	0.0120084
5	656.637	-3580.05	592645	162.55	0.015715
6	665.063	-3586.67	680769	227.817	0.0191738
7	673.49	-3592.91	754939	294.227	0.0223302
8	681.916	-3598.79	815949	357.941	0.0251345
9	690.343	-3604.33	864489	415.564	0.0275424
10	698.769	-3609.54	901159	464.232	0.0295159
11	707.196	-3614.45	926491	501.667	0.0310239
12	715.622	-3619.07	940952	526.228	0.0320427
13	724.048	-3623.4	944828	536.862	0.0325561
14	732.475	-3627.47	916147	520.565	0.0325561
15	740.901	-3631.28	877654	490.828	0.0320427
16	749.328	-3634.83	829645	449.227	0.0310239
17	757.754	-3638.15	772387	397.895	0.0295159
18	766.181	-3641.22	706122	339.437	0.0275424
19	774.607	-3644.07	631064	276.835	0.0251345
20	783.034	-3646.7	547410	213.346	0.0223303
21	791.46	-3649.1	455334	152.376	0.0191738
22	799.887	-3651.29	354994	97.3675	0.015715
23	808.313	-3653.27	246532	51.6698	0.0120084
24	816.739	-3655.04	147713	20.9144	0.0081124
25	825.166	-3656.6	77695.3	5.54407	0.00408843
26	833.592	-3657.97	6.89107e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.171465
Factor of Safety, standard deviation: 0.188943
Factor of Safety, minimum: 0.626706
Factor of Safety, maximum: 1.834720
Probability of Failure: 18.600% (= 1860 failed surfaces / 10000 valid surfaces)
Reliability index: 0.90750 (assuming normal distribution) * best fit = Normal

Reliability index: 0.90741 (assuming lognormal distribution)

Method: gle/morgenstern-price
Factor of Safety, mean: 1.169408
Factor of Safety, standard deviation: 0.189453
Factor of Safety, minimum: 0.621666
Factor of Safety, maximum: 1.835540
Probability of Failure: 19.200% (= 1920 failed surfaces / 10000 valid surfaces)
Reliability index: 0.89419 (assuming normal distribution) * best fit = Normal
Reliability index: 0.89180 (assuming lognormal distribution)

List Of Coordinates

Water Table

X	Y
0	0
0	-5000
2503	-5000
2503	0
0	0

External Boundary

X	Y
2503	-5000
2503	-3829
2414	-3822
2325	-3813
2236	-3809
2146	-3810
2057	-3811
1968	-3810
1878	-3809
1789	-3808
1701	-3808
1613	-3807
1525	-3803
1436	-3798
1348	-3791
1260	-3779
1172	-3760

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1084	-3737
995	-3714
905	-3687
814	-3650
724	-3598
633	-3552
543	-3526
452	-3510
362	-3496
271	-3482
181	-3468
90	-3454
0	-3445
0	-5000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 79PC Site 54	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/24/2013	File Name: RR0705_79_54_1g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_79_54_1g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 79PC Site 54
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/24/2013
Comments:

http://earthjay.com/
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
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	Date: 3/24/2013	File Name: RR0705_79_54_1g.sli	

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364856279
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.002215
Center: 955.795, -3154.812
Radius: 515.878
Left Slip Surface Endpoint: 623.216, -3549.173
Right Slip Surface Endpoint: 820.423, -3652.611
Left Slope Intercept: 623.216 0.000
Right Slope Intercept: 820.423 0.000
Resisting Moment=61148.6 kN-m
Driving Moment=2.76092e+007 kN-m
Resisting Horizontal Force=119.424 kN

Driving Horizontal Force=53921.2 kN
Total Slice Area=711928 m2

Method: gle/morgenstern-price

FS: 0.001957
Center: 962.631, -3123.867
Radius: 548.305
Left Slip Surface Endpoint: 612.972, -3546.214
Right Slip Surface Endpoint: 825.979, -3654.870
Left Slope Intercept: 612.972 0.000
Right Slope Intercept: 825.979 0.000
Resisting Moment=69293.6 kN-m
Driving Moment=3.54022e+007 kN-m
Resisting Horizontal Force=127.428 kN
Driving Horizontal Force=65103.2 kN
Total Slice Area=769045 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1221
Number of Invalid Surfaces: 65

Error Codes:

Error Code -108 reported for 50 surfaces
Error Code -111 reported for 3 surfaces
Error Code -112 reported for 12 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1268
Number of Invalid Surfaces: 18

Error Codes:

Error Code -108 reported for 8 surfaces
Error Code -111 reported for 1 surface
Error Code -112 reported for 9 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving

force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.00221479

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	7.88828	288726	basement	5.551	27.1	75.9169	0.16814	36613.3	36623.8	-10.5249
2	7.88828	289405	basement	5.551	27.1	117.727	0.26074	36736.9	36747.2	-10.3397
3	7.88828	290002	basement	5.551	27.1	148.782	0.32952	36835.2	36845.4	-10.2249
4	7.88828	290565	basement	5.551	27.1	180.676	0.40016	36926.5	36936.6	-10.0588
5	7.88828	291100	basement	5.551	27.1	211.496	0.46842	37011.7	37021.7	-9.97387
6	7.88828	291608	basement	5.551	27.1	241.115	0.53402	37091.3	37101.1	-9.81893
7	7.88828	292088	basement	5.551	27.1	269.407	0.59668	37165.2	37174.8	-9.64734
8	7.88828	292543	basement	5.551	27.1	296.236	0.6561	37233.7	37243.3	-9.64163
9	7.88828	292973	basement	5.551	27.1	321.457	0.71196	37297	37306.5	-9.49638
10	7.88828	293379	basement	5.551	27.1	344.9	0.76388	37355.3	37364.7	-9.39299
11	7.88828	293762	basement	5.551	27.1	366.4	0.8115	37408.8	37418.1	-9.25536
12	7.88828	294122	basement	5.551	27.1	385.761	0.85438	37457.5	37466.7	-9.17896
13	7.88828	294460	basement	5.551	27.1	401.284	0.88876	37501.4	37510.5	-9.06388
14	7.88828	294759	basement	5.551	27.1	402.77	0.89205	37534.6	37543.7	-9.0554
15	7.88828	295030	basement	5.551	27.1	400.936	0.88799	37560.8	37569.9	-9.12259
16	7.88828	295280	basement	5.551	27.1	394.76	0.87431	37582.7	37591.8	-9.11348
17	7.88828	295511	basement	5.551	27.1	383.77	0.84997	37600.4	37609.6	-9.17252
18	7.88828	295722	basement	5.551	27.1	367.434	0.81379	37614	37623.3	-9.32261
19	7.88828	295914	basement	5.551	27.1	345.116	0.76436	37623.6	37633	-9.40466
20	7.88828	296087	basement	5.551	27.1	316.089	0.70007	37629.4	37638.8	-9.43675
21	7.88828	296242	basement	5.551	27.1	279.494	0.61902	37631.2	37640.8	-9.61362
22	7.88828	296379	basement	5.551	27.1	234.311	0.51895	37629.2	37639	-9.84513
23	7.88828	296499	basement	5.551	27.1	179.322	0.39716	37623.4	37633.5	-10.0668
24	7.88828	296601	basement	5.551	27.1	113.063	0.25041	37614	37624.4	-10.3766
25	7.88828	296705	basement	5.551	27.1	57.3914	0.12711	37608.2	37618.8	-10.5896

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00195732

Slice	Width	Weight	Base	Base Cohesion	Base Friction Angle	Shear Stress	Shear Strength	Base Normal Stress	Pore Pressure	Effective Normal Stress

				[kPa]	[degrees]	[kPa]	[kPa]	[kPa]	[kPa]	[kPa]
1	8.52027	311621	basement	5.551	27.1	102.078	0.1998	36586.5	36597	-10.4653
2	8.52027	312421	basement	5.551	27.1	250.93	0.49115	36725.4	36735.3	-9.91853
3	8.52027	313166	basement	5.551	27.1	355.905	0.69662	36850.8	36860.4	-9.55321
4	8.52027	313812	basement	5.551	27.1	417.224	0.81664	36948.1	36957.3	-9.20941
5	8.52027	314419	basement	5.551	27.1	478.603	0.93678	37036.9	37046	-9.05179
6	8.52027	314994	basement	5.551	27.1	528.12	1.0337	37119.6	37128.5	-8.86188
7	8.52027	315538	basement	5.551	27.1	564.905	1.1057	37196.2	37204.9	-8.69021
8	8.52027	316052	basement	5.551	27.1	588.473	1.15183	37267	37275.6	-8.64873
9	8.52027	316537	basement	5.551	27.1	598.717	1.17188	37332.1	37340.7	-8.56338
10	8.52027	316994	basement	5.551	27.1	595.932	1.16643	37391.9	37400.4	-8.54899
11	8.52027	317425	basement	5.551	27.1	580.825	1.13686	37446.2	37454.8	-8.58619
12	8.52027	317828	basement	5.551	27.1	554.478	1.08529	37495.5	37504.2	-8.69277
13	8.52027	318207	basement	5.551	27.1	518.372	1.01462	37539.8	37548.6	-8.81799
14	8.52027	318546	basement	5.551	27.1	393.977	0.77114	37574.3	37583.6	-9.29801
15	8.52027	318846	basement	5.551	27.1	326.293	0.63866	37599.1	37608.7	-9.60212
16	8.52027	319122	basement	5.551	27.1	259.993	0.50889	37619.4	37629.2	-9.80223
17	8.52027	319375	basement	5.551	27.1	195.425	0.38251	37635.2	37645.3	-10.1103
18	8.52027	319605	basement	5.551	27.1	135.282	0.26479	37646.6	37656.9	-10.2987
19	8.52027	319812	basement	5.551	27.1	82.1838	0.16086	37653.7	37664.2	-10.5073
20	8.52027	319998	basement	5.551	27.1	38.5118	0.07538	37656.7	37667.3	-10.6168
21	8.52027	320163	basement	5.551	27.1	6.33519	0.0124	37655.5	37666.3	-10.7835
22	8.52027	320306	basement	5.551	27.1	0	0	37648.4	37661.2	-12.7948
23	8.52027	320429	basement	5.551	27.1	0	0	37638.6	37652.1	-13.4521
24	8.52027	320537	basement	5.551	27.1	11.9756	0.02344	37630.1	37640.9	-10.7695
25	8.52027	320676	basement	5.551	27.1	56.4496	0.11049	37632.4	37643	-10.5637

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.00221479

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	623.216	-3549.17	6.48727e+007	0	0
2	631.104	-3555.69	155324	-84.6339	-0.0312197
3	638.992	-3561.96	254715	-138.791	-0.0312197
4	646.88	-3567.97	330641	-180.162	-0.0312197
5	654.769	-3573.75	398385	-217.075	-0.0312198
6	662.657	-3579.31	458204	-249.67	-0.0312198
7	670.545	-3584.65	510328	-278.072	-0.0312198

8	678.434	-3589.78	554971	-302.397	-0.0312198
9	686.322	-3594.71	592326	-322.751	-0.0312197
10	694.21	-3599.45	622574	-339.233	-0.0312198
11	702.098	-3604	645881	-351.932	-0.0312197
12	709.987	-3608.36	662399	-360.933	-0.0312198
13	717.875	-3612.55	672272	-366.312	-0.0312197
14	725.763	-3616.56	670911	-365.571	-0.0312197
15	733.651	-3620.41	646700	-352.379	-0.0312198
16	741.54	-3624.09	616121	-335.716	-0.0312197
17	749.428	-3627.61	579290	-315.648	-0.0312198
18	757.316	-3630.98	536323	-292.235	-0.0312197
19	765.205	-3634.19	487325	-265.537	-0.0312197
20	773.093	-3637.25	432404	-235.611	-0.0312197
21	780.981	-3640.17	371659	-202.512	-0.0312197
22	788.869	-3642.94	305192	-166.296	-0.0312199
23	796.758	-3645.56	233103	-127.015	-0.0312198
24	804.646	-3648.05	155490	-84.7246	-0.0312198
25	812.534	-3650.4	72456.5	-39.4806	-0.0312197
26	820.423	-3652.61	6.87091e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00195732

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	612.972	-3546.21	6.47645e+007	0	0
2	621.492	-3553.13	162828	-129.245	-0.0454786
3	630.012	-3559.76	316417	-498.352	-0.0902399
4	638.533	-3566.13	417273	-972.822	-0.133578
5	647.053	-3572.25	485603	-1481.58	-0.174809
6	655.573	-3578.13	545304	-2029.9	-0.213283
7	664.093	-3583.77	596658	-2586.7	-0.248394
8	672.614	-3589.19	639927	-3122.69	-0.279587
9	681.134	-3594.4	675359	-3611.3	-0.306371
10	689.654	-3599.39	703182	-4029.5	-0.328323
11	698.175	-3604.18	723611	-4358.43	-0.345098
12	706.695	-3608.77	736844	-4583.87	-0.35643
13	715.215	-3613.18	743064	-4696.63	-0.36214
14	723.735	-3617.39	742434	-4692.65	-0.362141
15	732.256	-3621.43	713217	-4436.89	-0.35643
16	740.776	-3625.28	676612	-4075.34	-0.345097
17	749.296	-3628.97	633426	-3629.77	-0.328323

18	757.816	-3632.48	583747	-3121.43	-0.306371
19	766.337	-3635.83	527647	-2574.79	-0.279587
20	774.857	-3639.02	465181	-2016.71	-0.248394
21	783.377	-3642.04	396386	-1475.56	-0.213284
22	791.898	-3644.91	321290	-980.259	-0.174809
23	800.418	-3647.63	239852	-559.185	-0.133578
24	808.938	-3650.19	152110	-239.57	-0.0902396
25	817.458	-3652.6	80369.1	-63.793	-0.0454785
26	825.979	-3654.87	6.87941e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.028123
Factor of Safety, standard deviation: 0.066311
Factor of Safety, minimum: 0.000189
Factor of Safety, maximum: 0.981155
Probability of Failure: 100.000% (= 9903 failed surfaces / 9903 valid surfaces), 97 invalid surfaces
Reliability index: -14.65632 (assuming normal distribution)
Reliability index: -3.28962 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 0.024941
Factor of Safety, standard deviation: 0.065007
Factor of Safety, minimum: 0.000166
Factor of Safety, maximum: 0.979122
Probability of Failure: 100.000% (= 9995 failed surfaces / 9995 valid surfaces), 5 invalid surfaces
Reliability index: -14.99933 (assuming normal distribution)
Reliability index: -3.29248 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-5000
2503	-5000
2503	0
0	0

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 79PC Site 54	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/24/2013	File Name: RR0705_79_54_1g.sli

External Boundary

X	Y
2503	-5000
2503	-3829
2414	-3822
2325	-3813
2236	-3809
2146	-3810
2057	-3811
1968	-3810
1878	-3809
1789	-3808
1701	-3808
1613	-3807
1525	-3803
1436	-3798
1348	-3791
1260	-3779
1172	-3760
1084	-3737
995	-3714
905	-3687
814	-3650
724	-3598
633	-3552
543	-3526
452	-3510
362	-3496
271	-3482
181	-3468
90	-3454
0	-3445
0	-5000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 83PC Site 47		
	Drawn By	Jason R. Patton	Company	Oregon State University
	Date	3/26/2013	File Name	RR0705_83_47_02g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_83_47_02g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 83PC Site 47
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/26/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 83PC Site 47		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_83_47_02g.sli	

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364950088
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.2
Seismic Load Coefficient (Vertical): 0.2

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	Automatically Calculated
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	0.2	0	0.4	0.1
Vertical Seismic Coefficient		Normal	0.2	0	0.4	0.1

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.359159
Center: 2025.895, -571.555
Radius: 2493.165
Left Slip Surface Endpoint: 837.710, -2763.378
Right Slip Surface Endpoint: 1505.519, -3009.809
Left Slope Intercept: 837.710 0.000
Right Slope Intercept: 1505.519 0.000
Resisting Moment=8.49044e+007 kN-m
Driving Moment=2.36398e+008 kN-m
Resisting Horizontal Force=31995.1 kN

Driving Horizontal Force=89083.4 kN
Total Slice Area=1.9398e+006 m2

Method: gle/morgenstern-price

FS: 0.359155
Center: 2025.895, -571.555
Radius: 2493.165
Left Slip Surface Endpoint: 837.710, -2763.378
Right Slip Surface Endpoint: 1505.519, -3009.809
Left Slope Intercept: 837.710 0.000
Right Slope Intercept: 1505.519 0.000
Resisting Moment=8.49035e+007 kN-m
Driving Moment=2.36398e+008 kN-m
Resisting Horizontal Force=31994.9 kN
Driving Horizontal Force=89083.7 kN
Total Slice Area=1.9398e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2121
Number of Invalid Surfaces: 67

Error Codes:

Error Code -108 reported for 66 surfaces
Error Code -112 reported for 1 surface

Method: gle/morgenstern-price

Number of Valid Surfaces: 2183
Number of Invalid Surfaces: 5

Error Codes:

Error Code -112 reported for 5 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with

many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.359159

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	26.7124	762854	basement	5.551	27.1	14.137	5.07745	28547.8	28548.7	-0.939306
2	26.7124	767655	basement	5.551	27.1	46.6016	16.7374	28735.2	28713.3	21.9021
3	26.7124	772154	basement	5.551	27.1	70.777	25.4202	28908.6	28869.8	38.7967
4	26.7124	776482	basement	5.551	27.1	93.6635	33.6401	29075.7	29020.8	54.8513
5	26.7124	780648	basement	5.551	27.1	115.263	41.3976	29236.6	29166.5	70.1109
6	26.7124	784655	basement	5.551	27.1	135.851	48.792	29391.8	29307.3	84.4542
7	26.7124	788501	basement	5.551	27.1	155.081	55.6989	29540.8	29442.8	98.0136
8	26.7124	792172	basement	5.551	27.1	173.278	62.2345	29683.8	29573	110.751
9	26.7124	795557	basement	5.551	27.1	186.094	66.8374	29815.2	29695.5	119.705
10	26.7124	798760	basement	5.551	27.1	195.185	70.1024	29938.6	29812.4	126.157
11	26.7124	801810	basement	5.551	27.1	202.628	72.7756	30055.9	29924.5	131.394
12	26.7124	804575	basement	5.551	27.1	207.388	74.4853	30163.7	30029	134.7
13	26.7124	807025	basement	5.551	27.1	201.128	72.2369	30255.5	30125.2	130.349
14	26.7124	809329	basement	5.551	27.1	192.619	69.1807	30341.2	30216.8	124.352
15	26.7124	811502	basement	5.551	27.1	181.728	65.2692	30420.8	30304.1	116.675
16	26.7124	813628	basement	5.551	27.1	172.079	61.8036	30498.8	30388.9	109.878
17	26.7124	815631	basement	5.551	27.1	161.965	58.1712	30572.4	30469.5	102.866
18	26.7124	817494	basement	5.551	27.1	149.742	53.7811	30640	30545.8	94.2247
19	26.7124	819329	basement	5.551	27.1	136.289	48.9493	30704.8	30620	84.7834
20	26.7124	821146	basement	5.551	27.1	128.385	46.1108	30771.6	30692.3	79.319
21	26.7124	822827	basement	5.551	27.1	118.48	42.5532	30832.7	30760.4	72.3209
22	26.7124	824354	basement	5.551	27.1	106.976	38.4214	30888	30823.8	64.1804
23	26.7124	825607	basement	5.551	27.1	87.9858	31.6009	30930.8	30879.9	50.91
24	26.7124	826700	basement	5.551	27.1	64.0123	22.9906	30965.3	30931.3	34.05
25	26.7124	827662	basement	5.551	27.1	37.5785	13.4967	30994	30978.5	15.4938

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.359155

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	26.7124	762854	basement	5.551	27.1	24.3759	8.75472	28554.9	28548.7	6.22578
2	26.7124	767655	basement	5.551	27.1	50.4462	18.118	28737.9	28713.3	24.5938
3	26.7124	772154	basement	5.551	27.1	71.7367	25.7646	28909.3	28869.8	39.4654

4	26.7124	776482	basement	5.551	27.1	92.1619	33.1004	29074.6	29020.8	53.8087
5	26.7124	780648	basement	5.551	27.1	111.816	40.1592	29234.2	29166.5	67.6754
6	26.7124	784655	basement	5.551	27.1	130.93	47.024	29388.3	29307.3	81.0187
7	26.7124	788501	basement	5.551	27.1	149.241	53.6007	29536.7	29442.8	93.9101
8	26.7124	792172	basement	5.551	27.1	167.165	60.038	29679.5	29573	106.455
9	26.7124	795557	basement	5.551	27.1	180.523	64.8357	29811.3	29695.5	115.802
10	26.7124	798760	basement	5.551	27.1	190.569	68.4437	29935.3	29812.4	122.895
11	26.7124	801810	basement	5.551	27.1	199.306	71.5818	30053.6	29924.5	129.058
12	26.7124	804575	basement	5.551	27.1	206.68	74.23	30163.2	30029	134.21
13	26.7124	807025	basement	5.551	27.1	202.213	72.6258	30256.3	30125.2	131.123
14	26.7124	809329	basement	5.551	27.1	195.252	70.1256	30343	30216.8	126.188
15	26.7124	811502	basement	5.551	27.1	185.418	66.5938	30423.4	30304.1	119.263
16	26.7124	813628	basement	5.551	27.1	176.527	63.4006	30501.9	30388.9	113.01
17	26.7124	815631	basement	5.551	27.1	167.01	59.9823	30575.9	30469.5	106.402
18	26.7124	817494	basement	5.551	27.1	154.876	55.6244	30643.6	30545.8	97.8085
19	26.7124	819329	basement	5.551	27.1	141.3	50.7485	30708.3	30620	88.3071
20	26.7124	821146	basement	5.551	27.1	133.101	47.8039	30774.9	30692.3	82.6014
21	26.7124	822827	basement	5.551	27.1	122.363	43.9473	30835.4	30760.4	75.0344
22	26.7124	824354	basement	5.551	27.1	108.765	39.0636	30889.3	30823.8	65.4503
23	26.7124	825607	basement	5.551	27.1	86.3045	30.9967	30929.6	30879.9	49.7458
24	26.7124	826700	basement	5.551	27.1	58.7557	21.1024	30961.7	30931.3	30.3657
25	26.7124	827662	basement	5.551	27.1	28.0924	10.0895	30987.3	30978.5	8.83847

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.359159

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	837.71	-2763.38	3.93267e+007	0	0
2	864.423	-2777.65	215411	404.731	0.107652
3	891.135	-2791.51	364707	685.24	0.107652
4	917.847	-2804.96	503678	946.349	0.107652
5	944.56	-2818.02	632313	1188.04	0.107652
6	971.272	-2830.68	752712	1414.25	0.107651
7	997.984	-2842.96	862989	1621.45	0.107652
8	1024.7	-2854.86	962928	1809.23	0.107652
9	1051.41	-2866.39	1.0382e+006	1950.65	0.107652
10	1078.12	-2877.55	1.08374e+006	2036.21	0.107651
11	1104.83	-2888.35	1.1187e+006	2101.9	0.107652

12	1131.55	-2898.79	1.1431e+006	2147.75	0.107652
13	1158.26	-2908.88	1.10064e+006	2067.97	0.107652
14	1184.97	-2918.62	1.04396e+006	1961.47	0.107651
15	1211.68	-2928.02	976313	1834.37	0.107651
16	1238.4	-2937.08	909734	1709.28	0.107652
17	1265.11	-2945.81	846266	1590.03	0.107652
18	1291.82	-2954.2	772153	1450.78	0.107652
19	1318.53	-2962.27	687434	1291.6	0.107651
20	1345.25	-2970.01	638095	1198.9	0.107651
21	1371.96	-2977.43	579349	1088.53	0.107652
22	1398.67	-2984.53	510416	959.01	0.107652
23	1425.38	-2991.32	413542	776.995	0.107652
24	1452.09	-2997.79	285804	536.992	0.107652
25	1478.81	-3003.95	147788	277.675	0.107651
26	1505.52	-3009.81	4.66536e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.359155

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	837.71	-2763.38	3.93267e+007	0	0
2	864.423	-2777.65	215239	65.5451	0.0174478
3	891.135	-2791.51	364469	220.228	0.0346206
4	917.847	-2804.96	503423	450.279	0.0512473
5	944.56	-2818.02	632084	739.867	0.0670658
6	971.272	-2830.68	752545	1074.74	0.0818264
7	997.984	-2842.96	862912	1435.24	0.0952972
8	1024.7	-2854.86	962960	1802.78	0.107265
9	1051.41	-2866.39	1.03835e+006	2130.14	0.11754
10	1078.12	-2877.55	1.08399e+006	2383.12	0.125963
11	1104.83	-2888.35	1.11904e+006	2585.87	0.132398
12	1131.55	-2898.79	1.14351e+006	2729.17	0.136745
13	1158.26	-2908.88	1.10106e+006	2669.98	0.138937
14	1184.97	-2918.62	1.04436e+006	2532.47	0.138936
15	1211.68	-2928.02	976658	2330.96	0.136746
16	1238.4	-2937.08	910003	2102.82	0.132398
17	1265.11	-2945.81	846444	1860.88	0.125963
18	1291.82	-2954.2	772225	1584.2	0.117541
19	1318.53	-2962.27	687397	1286.89	0.107264
20	1345.25	-2970.01	637951	1061.07	0.0952969
21	1371.96	-2977.43	579103	827.043	0.0818266

22	1398.67	-2984.53	510085	597.065	0.0670659
23	1425.38	-2991.32	413171	369.555	0.0512474
24	1452.09	-2997.79	285471	172.494	0.0346206
25	1478.81	-3003.95	147573	44.9394	0.0174479
26	1505.52	-3009.81	4.66536e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.408047
Factor of Safety, standard deviation: 0.201388
Factor of Safety, minimum: 0.086365
Factor of Safety, maximum: 2.176010
Probability of Failure: 98.170% (= 9817 failed surfaces / 10000 valid surfaces)
Reliability index: -2.93936 (assuming normal distribution)
Reliability index: -2.15328 (assuming lognormal distribution) * best fit = Lognormal

Method: gle/morgenstern-price
Factor of Safety, mean: 0.407645
Factor of Safety, standard deviation: 0.201531
Factor of Safety, minimum: 0.089694
Factor of Safety, maximum: 2.175820
Probability of Failure: 98.160% (= 9816 failed surfaces / 10000 valid surfaces)
Reliability index: -2.93928 (assuming normal distribution)
Reliability index: -2.15283 (assuming lognormal distribution) * best fit = Lognormal

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
3281	-6000
3281	0
0	0

External Boundary

X	Y
3281	-6000
3281	-3036

3193	-3036
3105	-3036
3017	-3038
2929	-3041
2841	-3042
2753	-3042
2665	-3043
2577	-3043
2489	-3044
2401	-3046
2313	-3051
2225	-3051
2137	-3051
2049	-3051
1961	-3048
1873	-3048
1785	-3044
1692	-3038
1599	-3029
1506	-3010
1413	-2973
1319	-2940
1226	-2902
1133	-2861
1040	-2827
947	-2797
861	-2769
774	-2748
688	-2731
602	-2714
516	-2701
430	-2692
344	-2682
258	-2669
172	-2655
86	-2651
0	-2649
0	-6000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 83PC Site 47	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/26/2013	File Name: RR0705_83_47_0g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_83_47_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 83PC Site 47
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/26/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364856648
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	Automatically Calculated
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 83PC Site 47		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_83_47_0g.sli	

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Global Minimums

Method: spencer

FS: 1.452720
Center: 1651.340, -1852.935
Radius: 1165.502
Left Slip Surface Endpoint: 985.235, -2809.334
Right Slip Surface Endpoint: 1503.564, -3009.031
Left Slope Intercept: 985.235 0.000
Right Slope Intercept: 1503.564 0.000
Resisting Moment=4.46855e+007 kN-m
Driving Moment=3.07598e+007 kN-m
Resisting Horizontal Force=35639 kN
Driving Horizontal Force=24532.5 kN
Total Slice Area=1.52036e+006 m2

Method: gle/morgenstern-price

FS: 1.453910
Center: 1357.791, -2497.304
Radius: 452.427
Left Slip Surface Endpoint: 1053.173, -2831.816
Right Slip Surface Endpoint: 1346.302, -2949.585
Left Slope Intercept: 1053.173 0.000
Right Slope Intercept: 1346.302 0.000
Resisting Moment=8.28399e+006 kN-m
Driving Moment=5.69774e+006 kN-m
Resisting Horizontal Force=16849.2 kN

Driving Horizontal Force=11588.9 kN
Total Slice Area=853371 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2069
Number of Invalid Surfaces: 516

Error Codes:

Error Code -108 reported for 516 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2585
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.45272

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	20.7332	601876	basement	5.551	27.1	6.60252	9.59161	29016.7	29008.8	7.91735
2	20.7332	605646	basement	5.551	27.1	18.2521	26.5152	29191.8	29150.9	40.9467
3	20.7332	609203	basement	5.551	27.1	29.092	42.2626	29358.2	29286.5	71.7113
4	20.7332	612486	basement	5.551	27.1	38.1415	55.4089	29513.3	29415.9	97.4109
5	20.7332	615557	basement	5.551	27.1	45.8789	66.6492	29658.7	29539.3	119.441
6	20.7332	618443	basement	5.551	27.1	52.7966	76.6987	29796.1	29657	139.065
7	20.7332	621152	basement	5.551	27.1	58.9021	85.5682	29925.5	29769.2	156.34
8	20.7332	623619	basement	5.551	27.1	63.672	92.4976	30045.8	29875.9	169.908
9	20.7332	625808	basement	5.551	27.1	65.6153	95.3206	30152.8	29977.4	175.43
10	20.7332	627833	basement	5.551	27.1	66.6362	96.8038	30252.1	30073.8	178.317
11	20.7332	629699	basement	5.551	27.1	66.8295	97.0845	30344.2	30165.3	178.859

12	20.7332	631416	basement	5.551	27.1	66.1924	96.159	30429	30251.9	177.07
13	20.7332	633039	basement	5.551	27.1	65.5387	95.2094	30509	30333.8	175.212
14	20.7332	634529	basement	5.551	27.1	64.4469	93.6233	30583.2	30411.1	172.095
15	20.7332	635875	basement	5.551	27.1	62.5536	90.8728	30650.6	30483.9	166.703
16	20.7332	637078	basement	5.551	27.1	59.8591	86.9585	30711.3	30552.2	159.099
17	20.7332	638198	basement	5.551	27.1	56.8251	82.5509	30766.6	30616.2	150.439
18	20.7332	639262	basement	5.551	27.1	54.6216	79.3499	30820.1	30675.8	144.254
19	20.7332	640192	basement	5.551	27.1	51.6952	75.0986	30867.2	30731.3	135.884
20	20.7332	640989	basement	5.551	27.1	47.9884	69.7137	30908	30782.6	125.36
21	20.7332	641647	basement	5.551	27.1	43.5168	63.2177	30942.5	30829.8	112.663
22	20.7332	642092	basement	5.551	27.1	37.0462	53.8177	30967.2	30872.9	94.341
23	20.7332	642386	basement	5.551	27.1	29.1645	42.3679	30984	30912	71.994
24	20.7332	642553	basement	5.551	27.1	20.4605	29.7234	30994.4	30947.2	47.2217
25	20.7332	642594	basement	5.551	27.1	10.927	15.8738	30998.5	30978.4	20.1477

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.45391

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	11.7252	342816	basement	5.551	27.1	6.97284	10.1379	29229.8	29220.8	8.98549
2	11.7252	344393	basement	5.551	27.1	14.9237	21.6977	29355.1	29323.5	31.5572
3	11.7252	345847	basement	5.551	27.1	22.2672	32.3745	29471.8	29419.4	52.4043
4	11.7252	347188	basement	5.551	27.1	29.0352	42.2145	29580.7	29509	71.6566
5	11.7252	348423	basement	5.551	27.1	35.2521	51.2534	29682.1	29592.8	89.2678
6	11.7252	349558	basement	5.551	27.1	40.9344	59.515	29776.5	29671	105.518
7	11.7252	350599	basement	5.551	27.1	46.1547	67.1048	29864.5	29744.2	120.305
8	11.7252	351515	basement	5.551	27.1	50.245	73.0517	29944.3	29812.5	131.845
9	11.7252	352327	basement	5.551	27.1	52.9423	76.9733	30015.7	29876.1	139.568
10	11.7252	353059	basement	5.551	27.1	55.0403	80.0236	30080.9	29935.3	145.557
11	11.7252	353715	basement	5.551	27.1	56.5194	82.1741	30140	29990.3	149.727
12	11.7252	354297	basement	5.551	27.1	57.3558	83.3901	30193.3	30041.2	152.099
13	11.7252	354808	basement	5.551	27.1	57.5223	83.6323	30240.8	30088.1	152.652
14	11.7252	355249	basement	5.551	27.1	56.9901	82.8585	30282.4	30131.3	151.05
15	11.7252	355625	basement	5.551	27.1	55.6805	80.9545	30318.1	30170.8	147.289
16	11.7252	355953	basement	5.551	27.1	53.9647	78.4598	30349.1	30206.6	142.524
17	11.7252	356224	basement	5.551	27.1	51.8807	75.4298	30375.5	30239	136.547
18	11.7252	356432	basement	5.551	27.1	49.008	71.2532	30396.3	30267.9	128.393
19	11.7252	356580	basement	5.551	27.1	45.322	65.8941	30411.3	30293.4	117.918
20	11.7252	356668	basement	5.551	27.1	40.8014	59.3215	30420.7	30315.6	105.132
21	11.7252	356696	basement	5.551	27.1	35.4287	51.5101	30424.4	30334.6	89.7992
22	11.7252	356666	basement	5.551	27.1	29.1909	42.441	30422.4	30350.3	72.077

23	11.7252	356581	basement	5.551	27.1	22.1036	32.1366	30414.8	30362.8	51.96
24	11.7252	356470	basement	5.551	27.1	15.1209	21.9845	30404.3	30372.2	32.1312
25	11.7252	356312	basement	5.551	27.1	7.72199	11.2271	30389.5	30378.4	11.1126

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.45272

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	985.235	-2809.33	4.06456e+007	0	0
2	1005.97	-2823.45	215567	174.054	0.046262
3	1026.7	-2836.92	414248	334.475	0.0462621
4	1047.43	-2849.78	587167	474.094	0.0462621
5	1068.17	-2862.05	727268	587.216	0.0462622
6	1088.9	-2873.75	851544	687.559	0.0462621
7	1109.63	-2884.9	960330	775.397	0.0462622
8	1130.37	-2895.52	1.05394e+006	850.978	0.0462621
9	1151.1	-2905.62	1.0924e+006	882.033	0.0462621
10	1171.83	-2915.23	1.11011e+006	896.329	0.046262
11	1192.57	-2924.35	1.11315e+006	898.784	0.046262
12	1213.3	-2932.99	1.10175e+006	889.583	0.0462622
13	1234.03	-2941.17	1.08389e+006	875.163	0.0462622
14	1254.77	-2948.89	1.06436e+006	859.391	0.046262
15	1275.5	-2956.18	1.03111e+006	832.548	0.0462623
16	1296.23	-2963.02	984327	794.772	0.0462621
17	1316.97	-2969.44	924163	746.194	0.0462621
18	1337.7	-2975.44	883427	713.303	0.0462622
19	1358.43	-2981.03	833330	672.853	0.0462621
20	1379.16	-2986.21	770455	622.087	0.0462622
21	1399.9	-2990.99	694922	561.099	0.0462622
22	1420.63	-2995.37	595897	481.144	0.0462622
23	1441.36	-2999.37	465547	375.895	0.0462621
24	1462.1	-3002.97	322717	260.57	0.0462621
25	1482.83	-3006.19	167504	135.248	0.0462624
26	1503.56	-3009.03	4.66295e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.45391

Slice	X coordinate	Y coordinate - Bottom	Interslice Normal Force	Interslice Shear Force	Interslice Force Angle

	[m]	[m]	[kN]	[kN]	[degrees]
1	1053.17	-2831.82	4.12988e+007	0	0
2	1064.9	-2842.13	176234	20.831	0.00677241
3	1076.62	-2851.75	333304	78.1721	0.013438
4	1088.35	-2860.75	472577	164.067	0.0198917
5	1100.07	-2869.15	595203	270.423	0.0260316
6	1111.8	-2877.01	702161	389.232	0.031761
7	1123.52	-2884.36	794289	512.785	0.0369896
8	1135.25	-2891.21	867317	630.248	0.0416348
9	1146.97	-2897.61	905787	721.258	0.0456233
10	1158.7	-2903.57	931231	794.651	0.0488924
11	1170.42	-2909.11	944135	846.826	0.0513905
12	1182.15	-2914.25	944924	875.364	0.053078
13	1193.88	-2918.99	933975	879.085	0.0539285
14	1205.6	-2923.37	911621	858.044	0.0539284
15	1217.33	-2927.37	878158	813.513	0.053078
16	1229.05	-2931.03	836793	750.547	0.0513904
17	1240.78	-2934.34	793209	676.872	0.0488924
18	1252.5	-2937.31	739257	588.654	0.0456234
19	1264.23	-2939.95	675120	490.586	0.0416348
20	1275.95	-2942.27	600961	387.974	0.0369895
21	1287.68	-2944.26	516921	286.547	0.031761
22	1299.4	-2945.95	423125	192.241	0.0260315
23	1311.13	-2947.32	319680	110.985	0.0198917
24	1322.85	-2948.38	213392	50.0484	0.013438
25	1334.58	-2949.13	111382	13.1654	0.00677239
26	1346.3	-2949.58	4.48053e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.462063
Factor of Safety, standard deviation: 0.239609
Factor of Safety, minimum: 0.758508
Factor of Safety, maximum: 2.287490
Probability of Failure: 2.170% (= 217 failed surfaces / 10000 valid surfaces)
Reliability index: 1.92840 (assuming normal distribution)
Reliability index: 2.25183 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price

Factor of Safety, mean: 1.463131
Factor of Safety, standard deviation: 0.237771
Factor of Safety, minimum: 0.754003
Factor of Safety, maximum: 2.292150
Probability of Failure: 2.100% (= 210 failed surfaces / 10000 valid surfaces)
Reliability index: 1.94780 (assuming normal distribution)
Reliability index: 2.27652 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
3281	-6000
3281	0
0	0

External Boundary

X	Y
3281	-6000
3281	-3036
3193	-3036
3105	-3036
3017	-3038
2929	-3041
2841	-3042
2753	-3042
2665	-3043
2577	-3043
2489	-3044
2401	-3046
2313	-3051
2225	-3051
2137	-3051
2049	-3051
1961	-3048
1873	-3048

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 83PC Site 47		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_83_47_0g.sli	

1785	-3044
1692	-3038
1599	-3029
1506	-3010
1413	-2973
1319	-2940
1226	-2902
1133	-2861
1040	-2827
947	-2797
861	-2769
774	-2748
688	-2731
602	-2714
516	-2701
430	-2692
344	-2682
258	-2669
172	-2655
86	-2651
0	-2649
0	-6000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 83PC Site 47	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/26/2013	File Name: RR0705_83_47_1g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_83_47_1g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 83PC Site 47
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/26/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 83PC Site 47	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/26/2013	File Name: RR0705_83_47_1g.sli

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364856554
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	Automatically Calculated
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.005766
Center: 1896.786, -1383.668
Radius: 1671.943
Left Slip Surface Endpoint: 1075.421, -2839.950
Right Slip Surface Endpoint: 1501.519, -3008.217
Left Slope Intercept: 1075.421 0.000
Right Slope Intercept: 1501.519 0.000
Resisting Moment=949604 kN-m
Driving Moment=1.64694e+008 kN-m
Resisting Horizontal Force=550.539 kN

Driving Horizontal Force=95482.4 kN
Total Slice Area=1.25076e+006 m2

Method: gle/morgenstern-price

FS: 0.005683
Center: 1896.786, -1383.668
Radius: 1671.943
Left Slip Surface Endpoint: 1075.421, -2839.950
Right Slip Surface Endpoint: 1501.519, -3008.217
Left Slope Intercept: 1075.421 0.000
Right Slope Intercept: 1501.519 0.000
Resisting Moment=935974 kN-m
Driving Moment=1.64694e+008 kN-m
Resisting Horizontal Force=542.708 kN
Driving Horizontal Force=95494.8 kN
Total Slice Area=1.25076e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 958
Number of Invalid Surfaces: 5

Error Codes:

Error Code -108 reported for 4 surfaces
Error Code -112 reported for 1 surface

Method: gle/morgenstern-price

Number of Valid Surfaces: 955
Number of Invalid Surfaces: 8

Error Codes:

Error Code -108 reported for 5 surfaces
Error Code -112 reported for 3 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This

screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.00576587

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	17.0439	499548	basement	5.551	27.1	92.8481	0.53535	29316.4	29326.2	-9.82952
2	17.0439	501488	basement	5.551	27.1	134.486	0.77543	29462.8	29472.1	-9.28006
3	17.0439	503359	basement	5.551	27.1	174.785	1.00779	29602.5	29611.4	-8.85726
4	17.0439	505138	basement	5.551	27.1	197.774	1.14034	29731.6	29740.2	-8.58719
5	17.0439	506760	basement	5.551	27.1	209.236	1.20643	29839.1	29847.6	-8.52718
6	17.0439	508308	basement	5.551	27.1	224.079	1.29201	29938.8	29947.1	-8.34104
7	17.0439	509792	basement	5.551	27.1	235.968	1.36056	30032.2	30040.4	-8.21988
8	17.0439	511212	basement	5.551	27.1	244.693	1.41087	30119.4	30127.5	-8.06888
9	17.0439	512570	basement	5.551	27.1	251.787	1.45177	30200.7	30208.7	-7.98957
10	17.0439	513900	basement	5.551	27.1	268.175	1.54626	30281.8	30289.6	-7.83155
11	17.0439	515188	basement	5.551	27.1	276.163	1.59232	30359.9	30367.6	-7.70013
12	17.0439	516416	basement	5.551	27.1	280.556	1.61765	30432.2	30439.9	-7.72377
13	17.0439	517584	basement	5.551	27.1	281.071	1.62062	30498.7	30506.4	-7.67435
14	17.0439	518695	basement	5.551	27.1	277.396	1.59943	30559.6	30567.3	-7.73508
15	17.0439	519771	basement	5.551	27.1	289.308	1.66811	30619	30626.5	-7.54958
16	17.0439	520857	basement	5.551	27.1	302.641	1.74499	30683.9	30691.3	-7.44306
17	17.0439	521891	basement	5.551	27.1	306.601	1.76782	30743.9	30751.3	-7.37814
18	17.0439	522869	basement	5.551	27.1	306.249	1.76579	30798.5	30806	-7.46123
19	17.0439	523792	basement	5.551	27.1	301.179	1.73656	30847.8	30855.3	-7.48327
20	17.0439	524659	basement	5.551	27.1	286.533	1.65211	30891.5	30899.1	-7.62878
21	17.0439	525423	basement	5.551	27.1	239.745	1.38234	30921.2	30929.4	-8.18072
22	17.0439	526108	basement	5.551	27.1	195.925	1.12968	30941.8	30950.4	-8.62708
23	17.0439	526741	basement	5.551	27.1	143.477	0.82727	30957.1	30966.3	-9.24461
24	17.0439	527321	basement	5.551	27.1	81.4534	0.46965	30967.2	30977.2	-9.96911
25	17.0439	527849	basement	5.551	27.1	0	0	30969	30983	-13.9525

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00568311

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	17.0439	499548	basement	5.551	27.1	58.4029	0.33191	29316	29326.2	-10.2397
2	17.0439	501488	basement	5.551	27.1	123.23	0.70033	29462.7	29472.1	-9.43486

3	17.0439	503359	basement	5.551	27.1	184.737	1.04988	29602.6	29611.4	-8.75342
4	17.0439	505138	basement	5.551	27.1	227.372	1.29218	29731.9	29740.2	-8.32605
5	17.0439	506760	basement	5.551	27.1	247.959	1.40918	29839.4	29847.6	-8.15946
6	17.0439	508308	basement	5.551	27.1	266.245	1.5131	29939.2	29947.1	-7.91844
7	17.0439	509792	basement	5.551	27.1	278.186	1.58096	30032.6	30040.4	-7.795
8	17.0439	511212	basement	5.551	27.1	283.704	1.61232	30119.8	30127.5	-7.69517
9	17.0439	512570	basement	5.551	27.1	285.754	1.62397	30201.1	30208.7	-7.61398
10	17.0439	513900	basement	5.551	27.1	300.566	1.70815	30282.1	30289.6	-7.50806
11	17.0439	515188	basement	5.551	27.1	299.575	1.70252	30360.1	30367.6	-7.48346
12	17.0439	516416	basement	5.551	27.1	292.954	1.66489	30432.3	30439.9	-7.61495
13	17.0439	517584	basement	5.551	27.1	281.165	1.59789	30498.7	30506.4	-7.729
14	17.0439	518695	basement	5.551	27.1	264.765	1.50469	30559.4	30567.3	-7.89972
15	17.0439	519771	basement	5.551	27.1	276.558	1.57171	30618.8	30626.5	-7.71489
16	17.0439	520857	basement	5.551	27.1	281.904	1.60209	30683.6	30691.3	-7.71965
17	17.0439	521891	basement	5.551	27.1	273.206	1.55266	30743.5	30751.3	-7.76682
18	17.0439	522869	basement	5.551	27.1	261.825	1.48798	30798	30806	-7.96277
19	17.0439	523792	basement	5.551	27.1	248.429	1.41185	30847.2	30855.3	-8.09839
20	17.0439	524659	basement	5.551	27.1	228.803	1.30031	30890.8	30899.1	-8.30205
21	17.0439	525423	basement	5.551	27.1	185.418	1.05375	30920.6	30929.4	-8.79986
22	17.0439	526108	basement	5.551	27.1	157.173	0.89323	30941.3	30950.4	-9.07875
23	17.0439	526741	basement	5.551	27.1	128.481	0.73017	30956.9	30966.3	-9.41448
24	17.0439	527321	basement	5.551	27.1	98.893	0.56202	30967.4	30977.2	-9.79876
25	17.0439	527849	basement	5.551	27.1	67.5634	0.38397	30972.9	30983	-10.1379

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.00576587

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	1075.42	-2839.95	4.15364e+007	0	0
2	1092.46	-2849.43	94783.9	-330.888	-0.200017
3	1109.51	-2858.66	183277	-639.815	-0.200017
4	1126.55	-2867.63	265433	-926.619	-0.200017
5	1143.6	-2876.35	317769	-1109.32	-0.200017
6	1160.64	-2884.83	349061	-1218.57	-0.200018
7	1177.68	-2893.07	373471	-1303.78	-0.200018
8	1194.73	-2901.07	390990	-1364.94	-0.200018
9	1211.77	-2908.84	401616	-1402.03	-0.200017
10	1228.82	-2916.38	408045	-1424.48	-0.200018

11	1245.86	-2923.7	421312	-1470.79	-0.200017
12	1262.9	-2930.79	427865	-1493.67	-0.200018
13	1279.95	-2937.67	427707	-1493.12	-0.200018
14	1296.99	-2944.32	420846	-1469.16	-0.200017
15	1314.04	-2950.77	407297	-1421.87	-0.200018
16	1331.08	-2957	407997	-1424.31	-0.200018
17	1348.12	-2963.02	410837	-1434.22	-0.200017
18	1365.17	-2968.84	407265	-1421.75	-0.200017
19	1382.21	-2974.46	397295	-1386.95	-0.200018
20	1399.26	-2979.87	380947	-1329.88	-0.200018
21	1416.3	-2985.08	353570	-1234.3	-0.200017
22	1433.34	-2990.1	300314	-1048.39	-0.200018
23	1450.39	-2994.92	240677	-840.199	-0.200018
24	1467.43	-2999.54	174738	-610.007	-0.200018
25	1484.48	-3003.98	102588	-358.133	-0.200018
26	1501.52	-3008.22	4.66043e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00568311

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	1075.42	-2839.95	4.15364e+007	0	0
2	1092.46	-2849.43	95227.6	-77.0729	-0.0463726
3	1109.51	-2858.66	183884	-295.308	-0.0920139
4	1126.55	-2867.63	265948	-632.215	-0.136204
5	1143.6	-2876.35	317953	-989.146	-0.178246
6	1160.64	-2884.83	348803	-1323.95	-0.217476
7	1177.68	-2893.07	372730	-1647.67	-0.253277
8	1194.73	-2901.07	389768	-1939.36	-0.285083
9	1211.77	-2908.84	399953	-2180.68	-0.312393
10	1228.82	-2916.38	406006	-2372.31	-0.334778
11	1245.86	-2923.7	418920	-2572.82	-0.351881
12	1262.9	-2930.79	425232	-2697.35	-0.363436
13	1279.95	-2937.67	424970	-2738.88	-0.369259
14	1296.99	-2944.32	418159	-2694.98	-0.369259
15	1314.04	-2950.77	404817	-2567.85	-0.363436
16	1331.08	-2957	405728	-2491.8	-0.351881
17	1348.12	-2963.02	408880	-2389.1	-0.334777
18	1365.17	-2968.84	405780	-2212.45	-0.312393
19	1382.21	-2974.46	396418	-1972.45	-0.285083
20	1399.26	-2979.87	380781	-1683.26	-0.253277

21	1416.3	-2985.08	354173	-1344.33	-0.217476
22	1433.34	-2990.1	301637	-938.388	-0.178246
23	1450.39	-2994.92	242518	-576.517	-0.136204
24	1467.43	-2999.54	176792	-283.918	-0.0920137
25	1484.48	-3003.98	104440	-84.5286	-0.0463724
26	1501.52	-3008.22	4.66043e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.056211
Factor of Safety, standard deviation: 0.091023
Factor of Safety, minimum: 0.000514
Factor of Safety, maximum: 1.288490
Probability of Failure: 99.950% (= 9991 failed surfaces / 9996 valid surfaces), 4 invalid surfaces
Reliability index: -10.36870 (assuming normal distribution)
Reliability index: -3.10463 (assuming lognormal distribution)
* best fit = Beta

Method: gle/morgenstern-price
Factor of Safety, mean: 0.062186
Factor of Safety, standard deviation: 0.092339
Factor of Safety, minimum: 0.000585
Factor of Safety, maximum: 1.289850
Probability of Failure: 99.950% (= 9988 failed surfaces / 9993 valid surfaces), 7 invalid surfaces
Reliability index: -10.15621 (assuming normal distribution)
Reliability index: -3.11338 (assuming lognormal distribution)
* best fit = Beta

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
3281	-6000
3281	0
0	0

External Boundary

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 83PC Site 47		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_83_47_1g.sli	

X	Y
3281	-6000
3281	-3036
3193	-3036
3105	-3036
3017	-3038
2929	-3041
2841	-3042
2753	-3042
2665	-3043
2577	-3043
2489	-3044
2401	-3046
2313	-3051
2225	-3051
2137	-3051
2049	-3051
1961	-3048
1873	-3048
1785	-3044
1692	-3038
1599	-3029
1506	-3010
1413	-2973
1319	-2940
1226	-2902
1133	-2861
1040	-2827
947	-2797
861	-2769
774	-2748
688	-2731
602	-2714
516	-2701
430	-2692
344	-2682
258	-2669
172	-2655
86	-2651
0	-2649

SLIDEINTERPRET 6.020	*Project* Sumatra Submarine Slide		
	Analysis Description RR0705 83PC Site 47		
	Drawn By Jason R. Patton	*Company*	Oregon State University
	Date 3/26/2013	*File Name*	RR0705_83_47_1g.sli

0 -6000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 84PC Site 49		
	Drawn By	Jason R. Patton	Company	Oregon State University
	Date	3/24/2013	File Name	RR0705_84_49_0g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_84_49_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 84PC Site 49
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/24/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364857131
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	Basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 84PC Site 49		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/24/2013	File Name: RR0705_84_49_0g.sli	

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
Basement	Cohesion	Normal	5.551	0.551	10.551	2.6
Basement	Phi	Normal	27.1	14.8	39.4	4.1
Basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Global Minimums

Method: spencer

FS: 1.096090
Center: 1212.650, -3490.129
Radius: 429.863
Left Slip Surface Endpoint: 898.767, -3783.829
Right Slip Surface Endpoint: 1138.287, -3913.511
Left Slope Intercept: 898.767 -0.000
Right Slope Intercept: 1138.287 -0.000
Resisting Moment=5.42816e+006 kN-m
Driving Moment=4.95231e+006 kN-m
Resisting Horizontal Force=11027 kN
Driving Horizontal Force=10060.4 kN
Total Slice Area=925869 m2

Method: gle/morgenstern-price

FS: 1.093000
Center: 1209.267, -3499.366
Radius: 419.393
Left Slip Surface Endpoint: 902.513, -3785.360
Right Slip Surface Endpoint: 1135.332, -3912.191
Left Slope Intercept: 902.513 -0.000
Right Slope Intercept: 1135.332 -0.000
Resisting Moment=4.99503e+006 kN-m
Driving Moment=4.57003e+006 kN-m
Resisting Horizontal Force=10409.5 kN

Driving Horizontal Force=9523.84 kN
Total Slice Area=899882 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2402
Number of Invalid Surfaces: 639

Error Codes:

Error Code -108 reported for 638 surfaces
Error Code -112 reported for 1 surface

Method: gle/morgenstern-price

Number of Valid Surfaces: 2996
Number of Invalid Surfaces: 45

Error Codes:

Error Code -108 reported for 45 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.09609

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	9.58081	374047	Basement	5.551	27.1	4.32554	4.74118	39022.9	39024.5	-1.55775
2	9.58081	375301	Basement	5.551	27.1	15.0955	16.546	39145	39123.5	21.5074
3	9.58081	376467	Basement	5.551	27.1	25.1653	27.5834	39259.6	39216.5	43.1029
4	9.58081	377535	Basement	5.551	27.1	34.7235	38.0601	39367.6	39304.1	63.4932

5	9.58081	378468	Basement	5.551	27.1	41.1387	45.0917	39463.8	39386.6	77.2408
6	9.58081	379325	Basement	5.551	27.1	46.167	50.6032	39552.4	39464.3	88.078
7	9.58081	380117	Basement	5.551	27.1	50.4502	55.298	39634.9	39537.7	97.2155
8	9.58081	380848	Basement	5.551	27.1	54.002	59.1911	39711.8	39607	104.752
9	9.58081	381522	Basement	5.551	27.1	56.8347	62.2959	39783.2	39672.3	110.896
10	9.58081	382141	Basement	5.551	27.1	58.9588	64.6241	39849.3	39733.9	115.441
11	9.58081	382707	Basement	5.551	27.1	60.3835	66.1858	39910.5	39792.1	118.424
12	9.58081	383224	Basement	5.551	27.1	61.1169	66.9896	39966.8	39846.8	120.05
13	9.58081	383693	Basement	5.551	27.1	61.1651	67.0425	40018.5	39898.3	120.24
14	9.58081	384114	Basement	5.551	27.1	60.5247	66.3405	40065.6	39946.8	118.815
15	9.58081	384488	Basement	5.551	27.1	59.0016	64.6711	40107.7	39992.2	115.515
16	9.58081	384819	Basement	5.551	27.1	56.7929	62.2501	40145.6	40034.8	110.815
17	9.58081	385108	Basement	5.551	27.1	53.9072	59.0871	40179.1	40074.5	104.626
18	9.58081	385358	Basement	5.551	27.1	50.3447	55.1823	40208.6	40111.6	96.9783
19	9.58081	385568	Basement	5.551	27.1	46.1043	50.5345	40233.9	40146	87.9098
20	9.58081	385740	Basement	5.551	27.1	41.1838	45.1412	40255.2	40177.8	77.3867
21	9.58081	385874	Basement	5.551	27.1	35.5797	38.9985	40272.4	40207.1	65.3448
22	9.58081	385973	Basement	5.551	27.1	29.287	32.1012	40285.7	40233.9	51.8183
23	9.58081	386036	Basement	5.551	27.1	22.0884	24.2109	40294.8	40258.3	36.4587
24	9.58081	386111	Basement	5.551	27.1	15.5102	17.0006	40302.6	40280.3	22.3235
25	9.58081	386172	Basement	5.551	27.1	10.1996	11.1797	40310.9	40299.9	11.0481

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.093

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	9.31276	363714	Basement	5.551	27.1	7.96191	8.70237	39045.2	39039	6.19901
2	9.31276	364904	Basement	5.551	27.1	17.0123	18.5944	39161.1	39135.6	25.5173
3	9.31276	366011	Basement	5.551	27.1	25.5831	27.9623	39270.2	39226.4	43.7849
4	9.31276	367006	Basement	5.551	27.1	33.0816	36.1582	39371.6	39311.8	59.8412
5	9.31276	367887	Basement	5.551	27.1	38.2463	41.8032	39463.2	39392.3	70.8551
6	9.31276	368701	Basement	5.551	27.1	42.8472	46.832	39548.9	39468.3	80.641
7	9.31276	369455	Basement	5.551	27.1	46.9207	51.2843	39629.3	39539.9	89.4063
8	9.31276	370150	Basement	5.551	27.1	50.4615	55.1544	39704.4	39607.5	96.9407
9	9.31276	370791	Basement	5.551	27.1	53.4574	58.4289	39774.7	39671.4	103.263
10	9.31276	371380	Basement	5.551	27.1	55.89	61.0878	39840.1	39731.6	108.499
11	9.31276	371920	Basement	5.551	27.1	57.736	63.1054	39900.9	39788.4	112.475
12	9.31276	372412	Basement	5.551	27.1	58.9678	64.4518	39957	39841.9	115.077
13	9.31276	372860	Basement	5.551	27.1	59.5549	65.0935	40008.6	39892.3	116.321
14	9.31276	373262	Basement	5.551	27.1	59.467	64.9974	40055.8	39939.7	116.133
15	9.31276	373620	Basement	5.551	27.1	58.4496	63.8854	40098.2	39984.2	113.957

16	9.31276	373937	Basement	5.551	27.1	56.6758	61.9466	40136	40025.8	110.221
17	9.31276	374215	Basement	5.551	27.1	54.1205	59.1537	40169.6	40064.8	104.755
18	9.31276	374455	Basement	5.551	27.1	50.7566	55.477	40198.6	40101.1	97.5396
19	9.31276	374658	Basement	5.551	27.1	46.5612	50.8914	40223.5	40134.9	88.5535
20	9.31276	374825	Basement	5.551	27.1	41.5159	45.3769	40243.9	40166.1	77.8163
21	9.31276	374956	Basement	5.551	27.1	35.608	38.9195	40260	40194.9	65.1214
22	9.31276	375054	Basement	5.551	27.1	28.8304	31.5116	40272	40221.2	50.7739
23	9.31276	375117	Basement	5.551	27.1	21.1826	23.1526	40279.7	40245.3	34.3984
24	9.31276	375178	Basement	5.551	27.1	13.8822	15.1732	40285.8	40267	18.7919
25	9.31276	375240	Basement	5.551	27.1	7.89221	8.62619	40292.4	40286.4	6.03902

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.09609

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	898.767	-3783.83	7.37344e+007	0	0
2	908.348	-3793.75	234241	133.247	0.0325925
3	917.929	-3803.05	445674	253.52	0.0325925
4	927.509	-3811.81	636159	361.877	0.0325925
5	937.09	-3820.05	768813	437.336	0.0325925
6	946.671	-3827.82	861225	489.905	0.0325925
7	956.252	-3835.15	936535	532.745	0.0325925
8	965.833	-3842.07	995722	566.413	0.0325925
9	975.413	-3848.6	1.03964e+006	591.395	0.0325925
10	984.994	-3854.76	1.06903e+006	608.114	0.0325925
11	994.575	-3860.57	1.08455e+006	616.944	0.0325926
12	1004.16	-3866.04	1.08679e+006	618.215	0.0325924
13	1013.74	-3871.2	1.07625e+006	612.221	0.0325925
14	1023.32	-3876.05	1.0534e+006	599.223	0.0325925
15	1032.9	-3880.61	1.01485e+006	577.294	0.0325925
16	1042.48	-3884.87	964469	548.635	0.0325925
17	1052.06	-3888.87	902878	513.599	0.0325925
18	1061.64	-3892.59	830377	472.357	0.0325925
19	1071.22	-3896.06	747237	425.063	0.0325925
20	1080.8	-3899.27	653702	371.856	0.0325925
21	1090.38	-3902.24	549993	312.861	0.0325924
22	1099.96	-3904.96	436308	248.192	0.0325925
23	1109.54	-3907.44	312827	177.95	0.0325924

24	1119.13	-3909.69	191154	108.737	0.0325924
25	1128.71	-3911.72	100201	56.9987	0.0325923
26	1138.29	-3913.51	7.88752e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.093

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	902.513	-3785.36	7.37941e+007	0	0
2	911.825	-3795.03	229194	18.6451	0.00466105
3	921.138	-3804.12	436129	70.3992	0.00924859
4	930.451	-3812.66	622634	148.772	0.0136902
5	939.764	-3820.7	734890	229.796	0.0179161
6	949.076	-3828.29	825921	315.102	0.0218593
7	958.389	-3835.45	900303	400.024	0.0254577
8	967.702	-3842.2	958995	479.613	0.0286548
9	977.015	-3848.58	1.00283e+006	549.583	0.0313999
10	986.327	-3854.6	1.03254e+006	606.412	0.0336499
11	995.64	-3860.27	1.04877e+006	647.412	0.035369
12	1004.95	-3865.63	1.05208e+006	670.782	0.0365305
13	1014.27	-3870.67	1.04298e+006	675.635	0.0371158
14	1023.58	-3875.41	1.02192e+006	661.99	0.0371157
15	1032.89	-3879.87	985496	628.33	0.0365305
16	1042.2	-3884.05	937687	578.84	0.035369
17	1051.52	-3887.96	878993	516.232	0.0336498
18	1060.83	-3891.61	809707	443.745	0.0313999
19	1070.14	-3895.01	730095	365.135	0.0286548
20	1079.46	-3898.16	640395	284.541	0.0254577
21	1088.77	-3901.08	540824	206.333	0.0218593
22	1098.08	-3903.75	431578	134.952	0.0179161
23	1107.39	-3906.2	312834	74.7486	0.0136903
24	1116.71	-3908.42	184752	29.8224	0.0092486
25	1126.02	-3910.41	96065.3	7.81497	0.00466105
26	1135.33	-3912.19	7.8822e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.103470
Factor of Safety, standard deviation: 0.178751
Factor of Safety, minimum: 0.558296

Factor of Safety, maximum: 1.725490
Probability of Failure: 28.880% (= 2888 failed surfaces / 10000 valid surfaces)
Reliability index: 0.57885 (assuming normal distribution)
Reliability index: 0.53130 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 1.100997
Factor of Safety, standard deviation: 0.178695
Factor of Safety, minimum: 0.560878
Factor of Safety, maximum: 1.726430
Probability of Failure: 29.500% (= 2950 failed surfaces / 10000 valid surfaces)
Reliability index: 0.56519 (assuming normal distribution)
Reliability index: 0.51607 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-8000
20725	-8000
20725	0
0	0

External Boundary

X	Y
20725	-8000
20725	-5300
20633	-5302
20541	-5303
20449	-5302
20357	-5300
20265	-5300
20173	-5299
20081	-5299
19990	-5300
19898	-5300
19806	-5302
19714	-5302

19622	-5301
19530	-5301
19438	-5300
19346	-5299
19254	-5299
19163	-5300
19071	-5301
18979	-5301
18887	-5301
18795	-5298
18703	-5298
18611	-5298
18519	-5300
18427	-5300
18336	-5301
18244	-5302
18152	-5303
18060	-5303
17968	-5302
17876	-5302
17784	-5302
17692	-5301
17600	-5301
17509	-5301
17417	-5299
17325	-5300
17233	-5300
17141	-5301
17049	-5301
16957	-5301
16865	-5300
16773	-5300
16682	-5298
16590	-5298
16496	-5298
16403	-5298
16310	-5297
16217	-5297
16124	-5298
16031	-5300

15937	-5301
15844	-5300
15751	-5298
15658	-5296
15565	-5295
15471	-5296
15378	-5297
15285	-5297
15192	-5298
15099	-5299
15005	-5299
14912	-5299
14819	-5298
14726	-5298
14633	-5298
14539	-5297
14446	-5297
14353	-5296
14260	-5295
14167	-5293
14073	-5291
13980	-5287
13887	-5285
13794	-5284
13701	-5284
13608	-5286
13514	-5287
13421	-5287
13328	-5286
13235	-5286
13142	-5287
13048	-5290
12955	-5291
12862	-5291
12769	-5290
12676	-5290
12582	-5289
12490	-5287
12397	-5283
12304	-5275

12212	-5267
12119	-5259
12026	-5249
11934	-5238
11841	-5228
11748	-5217
11656	-5206
11563	-5196
11470	-5187
11378	-5181
11285	-5173
11192	-5162
11100	-5148
11007	-5134
10914	-5119
10822	-5101
10729	-5082
10636	-5063
10544	-5045
10451	-5028
10359	-5012
10266	-4995
10173	-4976
10081	-4954
9988	-4929
9895	-4906
9803	-4888
9710	-4876
9617	-4866
9525	-4865
9432	-4873
9339	-4891
9247	-4909
9154	-4925
9061	-4936
8969	-4943
8876	-4949
8783	-4951
8691	-4950
8598	-4949

8505	-4949
8413	-4952
8320	-4954
8227	-4954
8135	-4953
8042	-4953
7949	-4954
7857	-4955
7764	-4955
7671	-4960
7584	-4967
7497	-4972
7409	-4972
7322	-4968
7235	-4961
7148	-4955
7060	-4950
6973	-4948
6886	-4946
6799	-4941
6711	-4937
6624	-4936
6537	-4932
6449	-4931
6362	-4928
6279	-4921
6196	-4920
6113	-4907
6030	-4879
5946	-4868
5863	-4872
5780	-4875
5697	-4865
5614	-4845
5523	-4818
5432	-4806
5340	-4819
5249	-4822
5158	-4808
5067	-4795

4976	-4791
4895	-4780
4814	-4777
4734	-4778
4653	-4777
4572	-4773
4492	-4759
4411	-4743
4322	-4732
4232	-4724
4143	-4712
4054	-4702
3964	-4698
3875	-4691
3786	-4678
3699	-4658
3613	-4645
3526	-4626
3440	-4606
3353	-4595
3267	-4589
3181	-4582
3095	-4545
3009	-4509
2923	-4503
2837	-4498
2751	-4482
2665	-4458
2579	-4429
2493	-4399
2407	-4368
2321	-4335
2235	-4294
2142	-4263
2049	-4235
1956	-4197
1862	-4165
1769	-4140
1676	-4123
1583	-4099

1490	-4060
1397	-4009
1304	-3975
1211	-3946
1117	-3904
1024	-3850
931	-3797
838	-3759
745	-3725
652	-3697
559	-3679
466	-3662
372	-3659
279	-3666
186	-3679
93	-3694
0	-3705
0	-8000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 84PC Site 49		
	Drawn By	Jason R. Patton	Company	Oregon State University
	Date	3/24/2013	File Name	RR0705_84_49_1g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_84_49_1g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 84PC Site 49
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/24/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364857007
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	Basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
Basement	Cohesion	Normal	5.551	0.551	10.551	2.6
Basement	Phi	Normal	27.1	14.8	39.4	4.1
Basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.001389
Center: 1285.411, -3340.620
Radius: 588.059
Left Slip Surface Endpoint: 899.048, -3783.944
Right Slip Surface Endpoint: 1117.322, -3904.144
Left Slope Intercept: 899.048 -0.000
Right Slope Intercept: 1117.322 -0.000
Resisting Moment=54077.7 kN-m
Driving Moment=3.89309e+007 kN-m
Resisting Horizontal Force=92.6917 kN

Driving Horizontal Force=66729.4 kN
Total Slice Area=841275 m2

Method: gle/morgenstern-price

FS: 0.001337
Center: 1283.790, -3344.142
Radius: 584.044
Left Slip Surface Endpoint: 899.891, -3784.289
Right Slip Surface Endpoint: 1116.518, -3903.720
Left Slope Intercept: 899.891 -0.000
Right Slope Intercept: 1116.518 -0.000
Resisting Moment=50885.9 kN-m
Driving Moment=3.80522e+007 kN-m
Resisting Horizontal Force=87.7484 kN
Driving Horizontal Force=65617.9 kN
Total Slice Area=834902 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1141
Number of Invalid Surfaces: 37

Error Codes:

Error Code -111 reported for 1 surface
Error Code -112 reported for 36 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1168
Number of Invalid Surfaces: 10

Error Codes:

Error Code -108 reported for 1 surface
Error Code -111 reported for 2 surfaces
Error Code -112 reported for 7 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.00138907

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	8.73097	340717	Basement	5.551	27.1	388.908	0.54022	39034.2	39044	-9.79109
2	8.73097	341558	Basement	5.551	27.1	436.724	0.60664	39169.3	39179	-9.67866
3	8.73097	342360	Basement	5.551	27.1	484.101	0.67245	39297	39306.6	-9.60125
4	8.73097	343121	Basement	5.551	27.1	483.374	0.67144	39416.3	39425.8	-9.4962
5	8.73097	343797	Basement	5.551	27.1	415.616	0.57732	39512.4	39522.1	-9.71513
6	8.73097	344423	Basement	5.551	27.1	429.453	0.59654	39597.4	39607.1	-9.67946
7	8.73097	345016	Basement	5.551	27.1	440.208	0.61148	39676.3	39685.9	-9.63636
8	8.73097	345578	Basement	5.551	27.1	447.609	0.62176	39749	39758.7	-9.67769
9	8.73097	346109	Basement	5.551	27.1	451.381	0.627	39816	39825.7	-9.66151
10	8.73097	346610	Basement	5.551	27.1	451.201	0.62675	39877.4	39887.1	-9.65431
11	8.73097	347083	Basement	5.551	27.1	446.738	0.62055	39933.5	39943.1	-9.61573
12	8.73097	347528	Basement	5.551	27.1	437.609	0.60787	39984.2	39993.9	-9.66817
13	8.73097	347946	Basement	5.551	27.1	423.391	0.58812	40029.9	40039.6	-9.68031
14	8.73097	348337	Basement	5.551	27.1	403.623	0.56066	40070.6	40080.3	-9.74913
15	8.73097	348702	Basement	5.551	27.1	367.498	0.51048	40106	40115.8	-9.79144
16	8.73097	349039	Basement	5.551	27.1	327.6	0.45506	40135.7	40145.6	-9.94862
17	8.73097	349352	Basement	5.551	27.1	284.392	0.39504	40160.7	40170.7	-9.99335
18	8.73097	349640	Basement	5.551	27.1	232.803	0.32338	40181.1	40191.4	-10.3073
19	8.73097	349905	Basement	5.551	27.1	171.921	0.23881	40197.2	40207.6	-10.4226
20	8.73097	350148	Basement	5.551	27.1	100.715	0.1399	40208.9	40219.5	-10.5507
21	8.73097	350368	Basement	5.551	27.1	17.9617	0.02495	40216.4	40227.2	-10.7599
22	8.73097	350566	Basement	5.551	27.1	0	0	40206.9	40230.7	-23.7953
23	8.73097	350742	Basement	5.551	27.1	0	0	40189.5	40230.2	-40.7145
24	8.73097	350897	Basement	5.551	27.1	0	0	40167.3	40225.7	-58.4169
25	8.73097	351032	Basement	5.551	27.1	0	0	40112.1	40217.2	-105.094

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00133726

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]

1	8.66509	338174	Basement	5.551	27.1	117.098	0.15659	39036.6	39047.1	-10.5439
2	8.66509	339003	Basement	5.551	27.1	293.436	0.3924	39171.1	39181.2	-10.1165
3	8.66509	339794	Basement	5.551	27.1	461.092	0.6166	39298.4	39308	-9.61961
4	8.66509	340543	Basement	5.551	27.1	575.707	0.76987	39416.6	39425.9	-9.32788
5	8.66509	341206	Basement	5.551	27.1	604.565	0.80846	39511.4	39520.7	-9.30564
6	8.66509	341823	Basement	5.551	27.1	651.556	0.8713	39596	39605.2	-9.15839
7	8.66509	342408	Basement	5.551	27.1	677.602	0.90613	39674.5	39683.5	-9.03291
8	8.66509	342962	Basement	5.551	27.1	682.38	0.91252	39746.9	39755.9	-9.03884
9	8.66509	343486	Basement	5.551	27.1	666.25	0.89095	39813.5	39822.5	-9.0404
10	8.66509	343981	Basement	5.551	27.1	630.289	0.84286	39874.4	39883.6	-9.21641
11	8.66509	344447	Basement	5.551	27.1	576.275	0.77063	39930.1	39939.4	-9.33744
12	8.66509	344886	Basement	5.551	27.1	506.663	0.67754	39980.4	39989.9	-9.53263
13	8.66509	345298	Basement	5.551	27.1	424.532	0.56771	40025.6	40035.4	-9.77817
14	8.66509	345685	Basement	5.551	27.1	333.503	0.44598	40065.9	40075.9	-9.97589
15	8.66509	346045	Basement	5.551	27.1	224.122	0.29971	40101.2	40111.4	-10.2478
16	8.66509	346378	Basement	5.551	27.1	120.096	0.1606	40130.6	40141.1	-10.5487
17	8.66509	346686	Basement	5.551	27.1	27.519	0.0368	40155.4	40166.1	-10.7483
18	8.66509	346971	Basement	5.551	27.1	0	0	40165.3	40186.8	-21.5001
19	8.66509	347233	Basement	5.551	27.1	0	0	40169.4	40203	-33.5992
20	8.66509	347473	Basement	5.551	27.1	0	0	40173.7	40215	-41.2635
21	8.66509	347690	Basement	5.551	27.1	0	0	40178.5	40222.8	-44.2602
22	8.66509	347886	Basement	5.551	27.1	0	0	40184	40226.4	-42.4188
23	8.66509	348060	Basement	5.551	27.1	0	0	40189.7	40226	-36.2645
24	8.66509	348214	Basement	5.551	27.1	0	0	40195.5	40221.7	-26.1765
25	8.66509	348347	Basement	5.551	27.1	0	0	40200.7	40213.4	-12.7227

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.00138907

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	899.048	-3783.94	7.37389e+007	0	0
2	907.779	-3791.4	150818	-1138.77	-0.432611
3	916.51	-3798.58	291566	-2201.5	-0.43261
4	925.241	-3805.48	422601	-3190.9	-0.43261
5	933.972	-3812.11	525662	-3969.08	-0.432611
6	942.703	-3818.49	583391	-4404.96	-0.43261
7	951.434	-3824.64	631962	-4771.7	-0.43261
8	960.165	-3830.55	671639	-5071.29	-0.43261

9	968.896	-3836.23	702662	-5305.53	-0.43261
10	977.627	-3841.7	725256	-5476.13	-0.43261
11	986.358	-3846.96	739629	-5584.65	-0.43261
12	995.088	-3852.02	745973	-5632.56	-0.432611
13	1003.82	-3856.87	744470	-5621.21	-0.43261
14	1012.55	-3861.54	735291	-5551.9	-0.43261
15	1021.28	-3866.02	718596	-5425.84	-0.43261
16	1030.01	-3870.32	692008	-5225.09	-0.43261
17	1038.74	-3874.44	657046	-4961.1	-0.43261
18	1047.47	-3878.39	614991	-4643.56	-0.43261
19	1056.21	-3882.17	565979	-4273.49	-0.43261
20	1064.94	-3885.78	510144	-3851.9	-0.43261
21	1073.67	-3889.23	447615	-3379.77	-0.43261
22	1082.4	-3892.52	378521	-2858.07	-0.432611
23	1091.13	-3895.66	302639	-2285.11	-0.43261
24	1099.86	-3898.64	219962	-1660.85	-0.432611
25	1108.59	-3901.47	130559	-985.801	-0.43261
26	1117.32	-3904.14	7.8498e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00133726

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	899.891	-3784.29	7.37523e+007	0	0
2	908.556	-3791.7	151014	-196.626	-0.0746013
3	917.221	-3798.82	291541	-753.209	-0.148026
4	925.886	-3805.67	421968	-1613.74	-0.219116
5	934.551	-3812.27	520380	-2604.38	-0.28675
6	943.216	-3818.61	577193	-3524.51	-0.349861
7	951.881	-3824.71	624792	-4443.22	-0.407453
8	960.546	-3830.58	663505	-5311.08	-0.458619
9	969.211	-3836.23	693641	-6084.21	-0.502552
10	977.876	-3841.66	715486	-6725.51	-0.53856
11	986.541	-3846.89	729308	-7205.69	-0.566074
12	995.207	-3851.91	735351	-7503.98	-0.584662
13	1003.87	-3856.74	733837	-7608.52	-0.594029
14	1012.54	-3861.37	724964	-7516.52	-0.594029
15	1021.2	-3865.83	708902	-7234.07	-0.584661
16	1029.87	-3870.1	683341	-6751.53	-0.566074
17	1038.53	-3874.19	649669	-6106.84	-0.53856
18	1047.2	-3878.12	609144	-5343.05	-0.502552

19	1055.86	-3881.87	561580	-4495.21	-0.458619
20	1064.53	-3885.47	506966	-3605.29	-0.407452
21	1073.19	-3888.9	445411	-2719.8	-0.349859
22	1081.86	-3892.17	377013	-1886.86	-0.286749
23	1090.52	-3895.28	301866	-1154.43	-0.219116
24	1099.19	-3898.24	220052	-568.514	-0.148026
25	1107.85	-3901.06	131647	-171.41	-0.0746015
26	1116.52	-3903.72	7.8481e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.024272
Factor of Safety, standard deviation: 0.062288
Factor of Safety, minimum: 0.000107
Factor of Safety, maximum: 0.952076
Probability of Failure: 100.000% (= 9711 failed surfaces / 9711 valid surfaces), 289 invalid surfaces
Reliability index: -15.66486 (assuming normal distribution)
Reliability index: -3.32397 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 0.020856
Factor of Safety, standard deviation: 0.060175
Factor of Safety, minimum: 0.000076
Factor of Safety, maximum: 0.956916
Probability of Failure: 100.000% (= 9988 failed surfaces / 9988 valid surfaces), 12 invalid surfaces
Reliability index: -16.27172 (assuming normal distribution)
Reliability index: -3.33718 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-8000
20725	-8000
20725	0
0	0

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 84PC Site 49		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/24/2013	File Name: RR0705_84_49_1g.sli	

External Boundary

X	Y
20725	-8000
20725	-5300
20633	-5302
20541	-5303
20449	-5302
20357	-5300
20265	-5300
20173	-5299
20081	-5299
19990	-5300
19898	-5300
19806	-5302
19714	-5302
19622	-5301
19530	-5301
19438	-5300
19346	-5299
19254	-5299
19163	-5300
19071	-5301
18979	-5301
18887	-5301
18795	-5298
18703	-5298
18611	-5298
18519	-5300
18427	-5300
18336	-5301
18244	-5302
18152	-5303
18060	-5303
17968	-5302
17876	-5302
17784	-5302
17692	-5301
17600	-5301
17509	-5301
17417	-5299

17325	-5300
17233	-5300
17141	-5301
17049	-5301
16957	-5301
16865	-5300
16773	-5300
16682	-5298
16590	-5298
16496	-5298
16403	-5298
16310	-5297
16217	-5297
16124	-5298
16031	-5300
15937	-5301
15844	-5300
15751	-5298
15658	-5296
15565	-5295
15471	-5296
15378	-5297
15285	-5297
15192	-5298
15099	-5299
15005	-5299
14912	-5299
14819	-5298
14726	-5298
14633	-5298
14539	-5297
14446	-5297
14353	-5296
14260	-5295
14167	-5293
14073	-5291
13980	-5287
13887	-5285
13794	-5284
13701	-5284

13608	-5286
13514	-5287
13421	-5287
13328	-5286
13235	-5286
13142	-5287
13048	-5290
12955	-5291
12862	-5291
12769	-5290
12676	-5290
12582	-5289
12490	-5287
12397	-5283
12304	-5275
12212	-5267
12119	-5259
12026	-5249
11934	-5238
11841	-5228
11748	-5217
11656	-5206
11563	-5196
11470	-5187
11378	-5181
11285	-5173
11192	-5162
11100	-5148
11007	-5134
10914	-5119
10822	-5101
10729	-5082
10636	-5063
10544	-5045
10451	-5028
10359	-5012
10266	-4995
10173	-4976
10081	-4954
9988	-4929

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 84PC Site 49		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/24/2013	File Name: RR0705_84_49_1g.sli	

9895	-4906
9803	-4888
9710	-4876
9617	-4866
9525	-4865
9432	-4873
9339	-4891
9247	-4909
9154	-4925
9061	-4936
8969	-4943
8876	-4949
8783	-4951
8691	-4950
8598	-4949
8505	-4949
8413	-4952
8320	-4954
8227	-4954
8135	-4953
8042	-4953
7949	-4954
7857	-4955
7764	-4955
7671	-4960
7584	-4967
7497	-4972
7409	-4972
7322	-4968
7235	-4961
7148	-4955
7060	-4950
6973	-4948
6886	-4946
6799	-4941
6711	-4937
6624	-4936
6537	-4932
6449	-4931
6362	-4928

6279	-4921
6196	-4920
6113	-4907
6030	-4879
5946	-4868
5863	-4872
5780	-4875
5697	-4865
5614	-4845
5523	-4818
5432	-4806
5340	-4819
5249	-4822
5158	-4808
5067	-4795
4976	-4791
4895	-4780
4814	-4777
4734	-4778
4653	-4777
4572	-4773
4492	-4759
4411	-4743
4322	-4732
4232	-4724
4143	-4712
4054	-4702
3964	-4698
3875	-4691
3786	-4678
3699	-4658
3613	-4645
3526	-4626
3440	-4606
3353	-4595
3267	-4589
3181	-4582
3095	-4545
3009	-4509
2923	-4503

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 84PC Site 49		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/24/2013	File Name: RR0705_84_49_1g.sli	

2837	-4498
2751	-4482
2665	-4458
2579	-4429
2493	-4399
2407	-4368
2321	-4335
2235	-4294
2142	-4263
2049	-4235
1956	-4197
1862	-4165
1769	-4140
1676	-4123
1583	-4099
1490	-4060
1397	-4009
1304	-3975
1211	-3946
1117	-3904
1024	-3850
931	-3797
838	-3759
745	-3725
652	-3697
559	-3679
466	-3662
372	-3659
279	-3666
186	-3679
93	-3694
0	-3705
0	-8000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 85PC Site 43		
	Drawn By	Jason R. Patton	Company	Oregon State University
	Date	3/26/2013	File Name	RR0705_85_43_0g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_85_43_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 85PC Site 43
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/26/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364857438
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	Automatically Calculated
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 85PC Site 43		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_85_43_0g.sli	

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Global Minimums

Method: spencer

FS: 1.319790
Center: 1243.139, -2739.410
Radius: 389.138
Left Slip Surface Endpoint: 972.955, -3019.462
Right Slip Surface Endpoint: 1212.469, -3127.337
Left Slope Intercept: 972.955 -0.000
Right Slope Intercept: 1212.469 -0.000
Resisting Moment=4.92188e+006 kN-m
Driving Moment=3.72928e+006 kN-m
Resisting Horizontal Force=11430.2 kN
Driving Horizontal Force=8660.58 kN
Total Slice Area=740139 m2

Method: gle/morgenstern-price

FS: 1.316790
Center: 1241.008, -2745.473
Radius: 382.298
Left Slip Surface Endpoint: 975.282, -3020.321
Right Slip Surface Endpoint: 1210.127, -3126.522
Left Slope Intercept: 975.282 -0.000
Right Slope Intercept: 1210.127 -0.000
Resisting Moment=4.66125e+006 kN-m
Driving Moment=3.53987e+006 kN-m
Resisting Horizontal Force=11032.9 kN

Driving Horizontal Force=8378.68 kN
Total Slice Area=725640 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1916
Number of Invalid Surfaces: 715

Error Codes:

Error Code -108 reported for 715 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2631
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.31979

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	9.58057	298546	basement	5.551	27.1	4.21431	5.56201	31146.5	31146.5	0.00532804
2	9.58057	299673	basement	5.551	27.1	12.9056	17.0327	31258	31235.6	22.3653
3	9.58057	300716	basement	5.551	27.1	20.9362	27.6314	31362.1	31318.9	43.1549
4	9.58057	301682	basement	5.551	27.1	28.3216	37.3786	31459.2	31397.1	62.1331
5	9.58057	302564	basement	5.551	27.1	35.1503	46.391	31550.1	31470.3	79.8017
6	9.58057	303337	basement	5.551	27.1	39.8194	52.5532	31630.9	31539.1	91.8076
7	9.58057	304041	basement	5.551	27.1	43.4263	57.3136	31704.6	31603.5	101.143
8	9.58057	304686	basement	5.551	27.1	46.3919	61.2275	31772.7	31663.9	108.803
9	9.58057	305274	basement	5.551	27.1	48.7277	64.3103	31835.3	31720.5	114.837
10	9.58057	305809	basement	5.551	27.1	50.4436	66.5749	31892.8	31773.5	119.252
11	9.58057	306292	basement	5.551	27.1	51.5479	68.0324	31945	31823	122.041

12	9.58057	306726	basement	5.551	27.1	52.0476	68.6919	31992.5	31869.1	123.432
13	9.58057	307112	basement	5.551	27.1	51.9482	68.5607	32035.2	31912.1	123.062
14	9.58057	307453	basement	5.551	27.1	51.2538	67.6443	32073.2	31951.9	121.341
15	9.58057	307752	basement	5.551	27.1	49.9881	65.9738	32106.9	31988.8	118.066
16	9.58057	308014	basement	5.551	27.1	48.4029	63.8817	32136.7	32022.7	113.969
17	9.58057	308233	basement	5.551	27.1	46.2459	61.0349	32162.2	32053.8	108.396
18	9.58057	308412	basement	5.551	27.1	43.504	57.4162	32183.4	32082.1	101.316
19	9.58057	308551	basement	5.551	27.1	40.1751	53.0227	32200.5	32107.7	92.7717
20	9.58057	308650	basement	5.551	27.1	36.2558	47.85	32213.3	32130.7	82.6058
21	9.58057	308711	basement	5.551	27.1	31.7414	41.892	32222	32151	70.9898
22	9.58057	308733	basement	5.551	27.1	26.6261	35.1409	32226.6	32168.8	57.8432
23	9.58057	308719	basement	5.551	27.1	20.9026	27.587	32227.1	32184	43.1411
24	9.58057	308670	basement	5.551	27.1	14.3965	19.0004	32223.1	32196.8	26.3231
25	9.58057	308628	basement	5.551	27.1	8.60257	11.3536	32218.4	32207.1	11.2684

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.31679

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	9.39381	292800	basement	5.551	27.1	6.85406	9.02536	31161.4	31154.5	6.85632
2	9.39381	293886	basement	5.551	27.1	14.2831	18.8079	31268	31242.1	25.8712
3	9.39381	294892	basement	5.551	27.1	21.2277	27.9524	31367.8	31324	43.8232
4	9.39381	295823	basement	5.551	27.1	27.715	36.4948	31461.3	31400.8	60.4808
5	9.39381	296668	basement	5.551	27.1	33.5953	44.2379	31548.5	31472.8	75.6566
6	9.39381	297410	basement	5.551	27.1	37.6767	49.6123	31626.5	31540.4	86.1145
7	9.39381	298089	basement	5.551	27.1	41.1369	54.1687	31698.8	31603.7	95.0904
8	9.39381	298712	basement	5.551	27.1	44.1111	58.085	31765.8	31663.2	102.635
9	9.39381	299280	basement	5.551	27.1	46.5906	61.3501	31827.8	31718.8	109.022
10	9.39381	299796	basement	5.551	27.1	48.5619	63.9458	31885.1	31770.9	114.177
11	9.39381	300263	basement	5.551	27.1	50.0065	65.848	31937.4	31819.6	117.845
12	9.39381	300683	basement	5.551	27.1	50.9026	67.028	31985.2	31865	120.201
13	9.39381	301057	basement	5.551	27.1	51.2256	67.4534	32028.3	31907.3	121.026
14	9.39381	301387	basement	5.551	27.1	50.9495	67.0898	32066.8	31946.5	120.293
15	9.39381	301677	basement	5.551	27.1	50.0476	65.9022	32100.8	31982.8	117.951
16	9.39381	301931	basement	5.551	27.1	48.7836	64.2377	32130.9	32016.3	114.606
17	9.39381	302144	basement	5.551	27.1	46.873	61.7219	32156.7	32046.9	109.759
18	9.39381	302319	basement	5.551	27.1	44.2728	58.298	32177.9	32074.9	103.048
19	9.39381	302454	basement	5.551	27.1	40.9623	53.9388	32194.7	32100.2	94.4819
20	9.39381	302552	basement	5.551	27.1	36.9238	48.6209	32207	32122.8	84.1854
21	9.39381	302613	basement	5.551	27.1	32.1438	42.3267	32214.8	32143	71.8067
22	9.39381	302638	basement	5.551	27.1	26.6132	35.044	32218.3	32160.6	57.6507

23	9.39381	302626	basement	5.551	27.1	20.3272	26.7666	32217.2	32175.7	41.4768
24	9.39381	302579	basement	5.551	27.1	13.2823	17.49	32211.7	32188.4	23.3372
25	9.39381	302531	basement	5.551	27.1	6.8677	9.04332	32205.5	32198.7	6.76605

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.31979

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	972.955	-3019.46	4.69533e+007	0	0
2	982.536	-3028.4	168120	106.878	0.0364243
3	992.116	-3036.76	318998	202.794	0.0364242
4	1001.7	-3044.59	453940	288.579	0.0364241
5	1011.28	-3051.93	574043	364.931	0.0364241
6	1020.86	-3058.81	659289	419.124	0.0364241
7	1030.44	-3065.27	718029	456.466	0.0364241
8	1040.02	-3071.33	764245	485.847	0.0364242
9	1049.6	-3077.01	798540	507.649	0.0364242
10	1059.18	-3082.32	821440	522.207	0.0364241
11	1068.76	-3087.29	833409	529.816	0.0364242
12	1078.34	-3091.93	834855	530.735	0.0364241
13	1087.92	-3096.25	826140	525.195	0.0364242
14	1097.5	-3100.27	807587	513.4	0.0364241
15	1107.08	-3103.99	779482	495.533	0.0364241
16	1116.66	-3107.42	746616	474.64	0.0364242
17	1126.24	-3110.58	705177	448.296	0.0364241
18	1135.82	-3113.46	654887	416.326	0.0364242
19	1145.41	-3116.07	595929	378.845	0.0364242
20	1154.99	-3118.43	528464	335.956	0.0364242
21	1164.57	-3120.53	452636	287.75	0.0364241
22	1174.15	-3122.38	368571	234.308	0.0364241
23	1183.73	-3123.99	276381	175.701	0.0364241
24	1193.31	-3125.34	176164	111.991	0.0364241
25	1202.89	-3126.46	79118.7	50.2974	0.0364241
26	1212.47	-3127.34	5.03682e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.31679

Slice	X coordinate	Y coordinate - Bottom	Interslice Normal Force	Interslice Shear Force	Interslice Force Angle

	[m]	[m]	[kN]	[kN]	[degrees]
1	975.282	-3020.32	4.69801e+007	0	0
2	984.675	-3029.1	165509	15.6871	0.00543055
3	994.069	-3037.32	314061	59.0648	0.0107755
4	1003.46	-3045.01	446951	124.426	0.0159505
5	1012.86	-3052.23	565261	205.935	0.0208739
6	1022.25	-3059	643978	286.25	0.0254681
7	1031.64	-3065.35	702071	363.447	0.0296608
8	1041.04	-3071.3	747878	435.78	0.0333856
9	1050.43	-3076.88	781994	499.31	0.0365839
10	1059.83	-3082.11	804936	550.786	0.0392052
11	1069.22	-3087	817161	587.72	0.0412084
12	1078.61	-3091.57	819072	608.439	0.0425616
13	1088.01	-3095.82	811026	612.115	0.0432435
14	1097.4	-3099.77	793337	598.764	0.0432435
15	1106.8	-3103.44	766289	569.229	0.0425615
16	1116.19	-3106.82	734419	528.21	0.0412084
17	1125.58	-3109.93	694309	475.089	0.0392053
18	1134.98	-3112.77	645530	412.177	0.0365839
19	1144.37	-3115.36	588260	342.772	0.0333856
20	1153.76	-3117.68	522659	270.569	0.0296608
21	1163.16	-3119.76	448869	199.524	0.0254682
22	1172.55	-3121.59	367017	133.711	0.0208739
23	1181.95	-3123.18	277213	77.1729	0.0159505
24	1191.34	-3124.53	179556	33.7687	0.0107755
25	1200.73	-3125.64	76950.6	7.29347	0.00543056
26	1210.13	-3126.52	5.0342e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.328289
Factor of Safety, standard deviation: 0.214848
Factor of Safety, minimum: 0.680794
Factor of Safety, maximum: 2.067240
Probability of Failure: 5.840% (= 584 failed surfaces / 10000 valid surfaces)
Reliability index: 1.52801 (assuming normal distribution)
Reliability index: 1.68620 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price

Factor of Safety, mean: 1.325699
Factor of Safety, standard deviation: 0.214640
Factor of Safety, minimum: 0.678645
Factor of Safety, maximum: 2.065400
Probability of Failure: 5.940% (= 594 failed surfaces / 10000 valid surfaces)
Reliability index: 1.51743 (assuming normal distribution)
Reliability index: 1.67227 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
3935	-6000
3935	0
0	0

External Boundary

X	Y
3935	-6000
3935	-3341
3846	-3343
3757	-3343
3668	-3342
3579	-3339
3490	-3336
3401	-3335
3312	-3333
3223	-3333
3134	-3333
3045	-3332
2956	-3330
2867	-3325
2778	-3314
2689	-3299
2596	-3284
2503	-3270

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 85PC Site 43		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_85_43_0g.sli	

2410	-3247
2317	-3218
2224	-3182
2131	-3155
2037	-3153
1944	-3156
1851	-3163
1758	-3169
1665	-3173
1572	-3176
1479	-3178
1386	-3173
1292	-3155
1200	-3123
1108	-3080
1015	-3035
923	-3001
831	-2971
739	-2938
646	-2908
554	-2888
462	-2873
369	-2848
277	-2822
185	-2812
92	-2819
0	-2827
0	-6000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 85PC Site 43	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/26/2013	File Name: RR0705_85_43_1g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_85_43_1g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 85PC Site 43
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/26/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 85PC Site 43		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_85_43_1g.sli	

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364857324
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	Automatically Calculated
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.003340
Center: 1385.941, -2397.382
Radius: 756.713
Left Slip Surface Endpoint: 936.024, -3005.813
Right Slip Surface Endpoint: 1258.148, -3143.225
Left Slope Intercept: 936.024 -0.000
Right Slope Intercept: 1258.148 -0.000
Resisting Moment=276318 kN-m
Driving Moment=8.27393e+007 kN-m
Resisting Horizontal Force=362.514 kN

Driving Horizontal Force=108549 kN
Total Slice Area=995175 m2

Method: gle/morgenstern-price

FS: 0.001281
Center: 1285.838, -2683.120
Radius: 460.938
Left Slip Surface Endpoint: 969.175, -3018.065
Right Slip Surface Endpoint: 1258.148, -3143.225
Left Slope Intercept: 969.175 -0.000
Right Slope Intercept: 1258.148 -0.000
Resisting Moment=73465.2 kN-m
Driving Moment=5.73418e+007 kN-m
Resisting Horizontal Force=161.513 kN
Driving Horizontal Force=126065 kN
Total Slice Area=896070 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1196
Number of Invalid Surfaces: 29

Error Codes:

Error Code -108 reported for 16 surfaces
Error Code -111 reported for 2 surfaces
Error Code -112 reported for 11 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1207
Number of Invalid Surfaces: 18

Error Codes:

Error Code -108 reported for 8 surfaces
Error Code -112 reported for 10 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.00333963

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	12.8849	399699	basement	5.551	27.1	240.554	0.80336	31034.8	31044.1	-9.29236
2	12.8849	401223	basement	5.551	27.1	295.626	0.98728	31198.4	31207.3	-8.93308
3	12.8849	402667	basement	5.551	27.1	349.859	1.1684	31351.6	31360.2	-8.62578
4	12.8849	404033	basement	5.551	27.1	403.09	1.34617	31494.9	31503.1	-8.23305
5	12.8849	405324	basement	5.551	27.1	455.14	1.52	31628.6	31636.5	-7.93385
6	12.8849	406544	basement	5.551	27.1	505.834	1.6893	31753.1	31760.6	-7.48904
7	12.8849	407654	basement	5.551	27.1	476.852	1.59251	31859.4	31867.1	-7.71346
8	12.8849	408632	basement	5.551	27.1	483.323	1.61412	31942.9	31950.6	-7.66408
9	12.8849	409543	basement	5.551	27.1	495.013	1.65316	32018	32025.6	-7.59649
10	12.8849	410392	basement	5.551	27.1	501.451	1.67466	32084.9	32092.5	-7.55486
11	12.8849	411179	basement	5.551	27.1	502.035	1.67661	32144.1	32151.6	-7.52095
12	12.8849	411907	basement	5.551	27.1	496.073	1.6567	32195.5	32203.1	-7.61527
13	12.8849	412576	basement	5.551	27.1	482.76	1.61224	32239.4	32247	-7.63577
14	12.8849	413192	basement	5.551	27.1	472.753	1.57882	32276.7	32284.5	-7.79146
15	12.8849	413763	basement	5.551	27.1	453.362	1.51406	32309.3	32317.2	-7.8657
16	12.8849	414280	basement	5.551	27.1	418.645	1.39812	32335.1	32343.2	-8.11906
17	12.8849	414744	basement	5.551	27.1	372.389	1.24364	32353.9	32362.3	-8.42135
18	12.8849	415155	basement	5.551	27.1	312.78	1.04457	32365.9	32374.7	-8.80208
19	12.8849	415515	basement	5.551	27.1	237.598	0.79349	32371.3	32380.6	-9.33588
20	12.8849	415824	basement	5.551	27.1	144.085	0.48119	32370	32379.9	-9.9141
21	12.8849	416097	basement	5.551	27.1	128.652	0.42965	32366	32376	-9.98076
22	12.8849	416405	basement	5.551	27.1	142.327	0.47532	32374.3	32384.2	-9.89282
23	12.8849	416676	basement	5.551	27.1	54.2934	0.18132	32378.6	32389.1	-10.5171
24	12.8849	416900	basement	5.551	27.1	0	0	32369.7	32387.8	-18.1403
25	12.8849	417076	basement	5.551	27.1	0	0	32325.4	32380.4	-55.0334

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00128118

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]

1	11.5589	360153	basement	5.551	27.1	127.265	0.16305	31179.9	31190.5	-10.5634
2	11.5589	361755	basement	5.551	27.1	337.447	0.43233	31380.3	31390.2	-9.94076
3	11.5589	363235	basement	5.551	27.1	538.995	0.69055	31563.2	31572.7	-9.48582
4	11.5589	364602	basement	5.551	27.1	724.371	0.92805	31730.1	31739.2	-9.06749
5	11.5589	365820	basement	5.551	27.1	800.012	1.02496	31870.7	31879.6	-8.86186
6	11.5589	366901	basement	5.551	27.1	887.572	1.13714	31987.7	31996.3	-8.59889
7	11.5589	367891	basement	5.551	27.1	946.3	1.21238	32091.6	32100.1	-8.47107
8	11.5589	368794	basement	5.551	27.1	974.516	1.24853	32183.1	32191.5	-8.41052
9	11.5589	369615	basement	5.551	27.1	971.425	1.24457	32262.8	32271.2	-8.36555
10	11.5589	370358	basement	5.551	27.1	937.144	1.20065	32331.4	32339.9	-8.53136
11	11.5589	371026	basement	5.551	27.1	872.672	1.11805	32389.1	32397.8	-8.67722
12	11.5589	371623	basement	5.551	27.1	779.898	0.99919	32436.7	32445.5	-8.82199
13	11.5589	372156	basement	5.551	27.1	698.973	0.89551	32475.8	32484.9	-9.12481
14	11.5589	372629	basement	5.551	27.1	566.595	0.72591	32506.9	32516.3	-9.42791
15	11.5589	373038	basement	5.551	27.1	415.359	0.53215	32528.7	32538.4	-9.74812
16	11.5589	373383	basement	5.551	27.1	250.441	0.32086	32541.4	32551.6	-10.2082
17	11.5589	373667	basement	5.551	27.1	77.374	0.09913	32545.4	32556.1	-10.6742
18	11.5589	373891	basement	5.551	27.1	0	0	32527.4	32552	-24.5582
19	11.5589	374057	basement	5.551	27.1	0	0	32495.6	32539.5	-43.9102
20	11.5589	374165	basement	5.551	27.1	0	0	32463.2	32518.9	-55.7377
21	11.5589	374263	basement	5.551	27.1	0	0	32469.7	32501.8	-32.0753
22	11.5589	374348	basement	5.551	27.1	0	0	32451.1	32487.1	-36.0008
23	11.5589	374378	basement	5.551	27.1	0	0	32430	32464.5	-34.5185
24	11.5589	374354	basement	5.551	27.1	0	0	32406.2	32434.2	-28.0011
25	11.5589	374275	basement	5.551	27.1	0	0	32379.3	32396.2	-16.9255

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.00333963

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	936.024	-3005.81	4.65298e+007	0	0
2	948.909	-3015.13	140359	-1019.39	-0.416117
3	961.794	-3024.05	269900	-1960.21	-0.416116
4	974.679	-3032.58	388861	-2824.19	-0.416116
5	987.564	-3040.74	497456	-3612.89	-0.416117
6	1000.45	-3048.54	595881	-4327.72	-0.416116
7	1013.33	-3056	684313	-4969.98	-0.416116
8	1026.22	-3063.12	723170	-5252.19	-0.416117

9	1039.1	-3069.93	746080	-5418.58	-0.416117
10	1051.99	-3076.42	759089	-5513.06	-0.416117
11	1064.87	-3082.6	762360	-5536.82	-0.416117
12	1077.76	-3088.5	756053	-5491.01	-0.416117
13	1090.64	-3094.1	740319	-5376.74	-0.416117
14	1103.53	-3099.42	715309	-5195.1	-0.416117
15	1116.41	-3104.47	685502	-4978.62	-0.416117
16	1129.3	-3109.24	649049	-4713.87	-0.416117
17	1142.18	-3113.76	603803	-4385.26	-0.416117
18	1155.07	-3118.01	549915	-3993.89	-0.416117
19	1167.95	-3122.02	487544	-3540.9	-0.416116
20	1180.84	-3125.77	416859	-3027.54	-0.416117
21	1193.72	-3129.27	338048	-2455.15	-0.416116
22	1206.61	-3132.54	276055	-2004.91	-0.416116
23	1219.49	-3135.56	229842	-1669.28	-0.416116
24	1232.38	-3138.35	176123	-1279.13	-0.416115
25	1245.26	-3140.9	114646	-832.643	-0.416116
26	1258.15	-3143.23	5.08813e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00128118

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	969.175	-3018.06	4.69099e+007	0	0
2	980.734	-3028.63	196273	-352.888	-0.103015
3	992.293	-3038.5	372714	-1329.67	-0.204404
4	1003.85	-3047.74	530583	-2801.93	-0.302568
5	1015.41	-3056.39	669517	-4626.96	-0.395959
6	1026.97	-3064.5	752346	-6343.73	-0.483103
7	1038.53	-3072.09	819323	-8045.77	-0.562628
8	1050.09	-3079.21	871259	-9630.22	-0.633277
9	1061.65	-3085.86	908886	-11008.5	-0.693937
10	1073.21	-3092.08	932867	-12108.6	-0.743657
11	1084.76	-3097.89	943805	-12876.5	-0.781648
12	1096.32	-3103.3	942244	-13277.3	-0.80731
13	1107.88	-3108.32	928672	-13295.8	-0.820248
14	1119.44	-3112.98	909321	-13018.7	-0.820245
15	1131	-3117.27	878856	-12384.1	-0.807311
16	1142.56	-3121.22	837543	-11426.7	-0.781645
17	1154.12	-3124.84	785655	-10197.8	-0.743657
18	1165.68	-3128.12	723410	-8762.02	-0.693939

19	1177.24	-3131.08	650356	-7188.53	-0.633277
20	1188.79	-3133.73	566166	-5559.75	-0.562626
21	1200.35	-3136.06	472338	-3982.72	-0.483102
22	1211.91	-3138.09	411016	-2840.48	-0.395958
23	1223.47	-3139.82	339312	-1791.86	-0.302568
24	1235.03	-3141.25	257291	-917.893	-0.204403
25	1246.59	-3142.38	164998	-296.656	-0.103014
26	1258.15	-3143.23	5.08813e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.042400
Factor of Safety, standard deviation: 0.078243
Factor of Safety, minimum: 0.000293
Factor of Safety, maximum: 1.389890
Probability of Failure: 99.990% (= 9996 failed surfaces / 9997 valid surfaces), 3 invalid surfaces
Reliability index: -12.23887 (assuming normal distribution)
Reliability index: -3.20440 (assuming lognormal distribution)
* best fit = Beta

Method: gle/morgenstern-price
Factor of Safety, mean: 0.064394
Factor of Safety, standard deviation: 0.084039
Factor of Safety, minimum: 0.000255
Factor of Safety, maximum: 1.360930
Probability of Failure: 99.990% (= 9979 failed surfaces / 9980 valid surfaces), 20 invalid surfaces
Reliability index: -11.13306 (assuming normal distribution)
Reliability index: -3.24901 (assuming lognormal distribution)
* best fit = Beta

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
3935	-6000
3935	0
0	0

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 85PC Site 43		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_85_43_1g.sli	

External Boundary

X	Y
3935	-6000
3935	-3341
3846	-3343
3757	-3343
3668	-3342
3579	-3339
3490	-3336
3401	-3335
3312	-3333
3223	-3333
3134	-3333
3045	-3332
2956	-3330
2867	-3325
2778	-3314
2689	-3299
2596	-3284
2503	-3270
2410	-3247
2317	-3218
2224	-3182
2131	-3155
2037	-3153
1944	-3156
1851	-3163
1758	-3169
1665	-3173
1572	-3176
1479	-3178
1386	-3173
1292	-3155
1200	-3123
1108	-3080
1015	-3035
923	-3001
831	-2971
739	-2938
646	-2908

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 85PC Site 43		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_85_43_1g.sli	

554	-2888
462	-2873
369	-2848
277	-2822
185	-2812
92	-2819
0	-2827
0	-6000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 875PC Site 87		
	Drawn By	Jason R. Patton	Company	Oregon State University
	Date	3/26/2013	File Name	RR0705_87_87_0g.slim

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_87_87_0g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 875PC Site 87
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/26/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364881384
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.2
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	Automatically Calculated
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 875PC Site 87		
	Drawn By	Jason R. Patton	Company	Oregon State University
	Date	3/26/2013	File Name	RR0705_87_87_0g.slim

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.2	5.7	8.7	0.5

Global Minimums

Method: spencer

FS: 1.100520
Center: 1029.700, -3500.080
Radius: 649.725
Left Slip Surface Endpoint: 559.877, -3948.866
Right Slip Surface Endpoint: 929.575, -4142.044
Left Slope Intercept: 559.877 0.000
Right Slope Intercept: 929.575 0.000
Resisting Moment=1.7889e+007 kN-m
Driving Moment=1.62551e+007 kN-m
Resisting Horizontal Force=24352 kN
Driving Horizontal Force=22127.8 kN
Total Slice Area=1.50519e+006 m2

Method: gle/morgenstern-price

FS: 1.100730
Center: 1055.492, -3448.239
Radius: 711.014
Left Slip Surface Endpoint: 543.358, -3941.453
Right Slip Surface Endpoint: 951.245, -4151.569
Left Slope Intercept: 543.358 0.000
Right Slope Intercept: 951.245 0.000
Resisting Moment=2.33843e+007 kN-m
Driving Moment=2.12444e+007 kN-m
Resisting Horizontal Force=29137.5 kN

Driving Horizontal Force=26471.1 kN
Total Slice Area=1.6622e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2376
Number of Invalid Surfaces: 568

Error Codes:

Error Code -108 reported for 568 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2929
Number of Invalid Surfaces: 15

Error Codes:

Error Code -108 reported for 15 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.10052

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	14.7879	602952	basement	5.551	27.1	5.67851	6.24932	40751.9	40750.5	1.35453
2	14.7879	605802	basement	5.551	27.1	20.2414	22.2761	40932.8	40900.1	32.6948
3	14.7879	608443	basement	5.551	27.1	33.6672	37.0514	41102.1	41040.6	61.5325
4	14.7879	610893	basement	5.551	27.1	45.9755	50.597	41260.7	41172.6	88.0816
5	14.7879	613166	basement	5.551	27.1	57.1861	62.9344	41409.1	41297	112.099
6	14.7879	615221	basement	5.551	27.1	67.0845	73.8278	41547.5	41414.1	133.413
7	14.7879	617029	basement	5.551	27.1	72.8662	80.1907	41670.3	41524.5	145.84

8	14.7879	618690	basement	5.551	27.1	77.2876	85.0566	41783.9	41628.5	155.358
9	14.7879	620215	basement	5.551	27.1	80.5813	88.6813	41889	41726.5	162.496
10	14.7879	621610	basement	5.551	27.1	82.7631	91.0824	41986	41818.9	167.131
11	14.7879	622881	basement	5.551	27.1	83.8465	92.2747	42075.3	41905.8	169.489
12	14.7879	624054	basement	5.551	27.1	83.8398	92.2674	42157	41987.6	169.431
13	14.7879	625170	basement	5.551	27.1	84.512	93.0071	42235.3	42064.3	170.969
14	14.7879	626181	basement	5.551	27.1	84.4708	92.9618	42307.1	42136.3	170.83
15	14.7879	627087	basement	5.551	27.1	83.4117	91.7962	42372.3	42203.7	168.552
16	14.7879	627891	basement	5.551	27.1	81.3367	89.5127	42430.7	42266.6	164.108
17	14.7879	628596	basement	5.551	27.1	78.2463	86.1116	42482.7	42325.2	157.469
18	14.7879	629201	basement	5.551	27.1	74.1718	81.6276	42528.3	42379.6	148.676
19	14.7879	629693	basement	5.551	27.1	68.5034	75.3894	42566.4	42429.9	136.499
20	14.7879	630090	basement	5.551	27.1	61.6006	67.7927	42597.8	42476.2	121.616
21	14.7879	630398	basement	5.551	27.1	53.6496	59.0425	42623.1	42518.6	104.498
22	14.7879	630618	basement	5.551	27.1	44.6414	49.1288	42642.2	42557.1	85.1276
23	14.7879	630752	basement	5.551	27.1	34.565	38.0395	42655.3	42591.9	63.4382
24	14.7879	630810	basement	5.551	27.1	23.1826	25.5129	42661.9	42622.9	38.9692
25	14.7879	630874	basement	5.551	27.1	13.0278	14.3373	42667.4	42650.3	17.1401

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.10073

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	16.3155	664161	basement	5.551	27.1	10.7521	11.8352	40693.7	40681.4	12.2885
2	16.3155	667596	basement	5.551	27.1	24.5352	27.0066	40887	40845.1	41.9157
3	16.3155	670777	basement	5.551	27.1	37.3509	41.1133	41068.2	40998.7	69.5109
4	16.3155	673726	basement	5.551	27.1	49.2639	54.2262	41238.2	41143.1	95.1115
5	16.3155	676461	basement	5.551	27.1	60.3087	66.3836	41397.9	41279	118.891
6	16.3155	678986	basement	5.551	27.1	70.6922	77.813	41548.2	41407	141.169
7	16.3155	681195	basement	5.551	27.1	78.0927	85.959	41684.6	41527.5	157.109
8	16.3155	683187	basement	5.551	27.1	82.9242	91.2771	41808.6	41641	167.556
9	16.3155	685012	basement	5.551	27.1	86.7324	95.469	41923.7	41748	175.702
10	16.3155	686680	basement	5.551	27.1	89.4857	98.4996	42030.3	41848.7	181.622
11	16.3155	688197	basement	5.551	27.1	91.1436	100.325	42128.6	41943.4	185.2
12	16.3155	689598	basement	5.551	27.1	91.5134	100.732	42218.4	42032.4	186.011
13	16.3155	690928	basement	5.551	27.1	92.7744	102.12	42304.6	42115.9	188.717
14	16.3155	692129	basement	5.551	27.1	93.226	102.617	42383.9	42194.2	189.676
15	16.3155	693202	basement	5.551	27.1	92.4791	101.795	42455.4	42267.3	188.085
16	16.3155	694150	basement	5.551	27.1	90.479	99.593	42519.3	42335.6	183.709
17	16.3155	694978	basement	5.551	27.1	87.2147	95.9998	42575.8	42399	176.761
18	16.3155	695668	basement	5.551	27.1	82.2608	90.5469	42623.9	42457.8	166.129

19	16.3155	696232	basement	5.551	27.1	75.3205	82.9075	42663.3	42512.1	151.159
20	16.3155	696685	basement	5.551	27.1	66.9154	73.6558	42695	42561.9	133.147
21	16.3155	697029	basement	5.551	27.1	57.0193	62.7629	42719.3	42607.5	111.77
22	16.3155	697265	basement	5.551	27.1	45.6154	50.2102	42736	42648.7	87.3062
23	16.3155	697422	basement	5.551	27.1	33.0973	36.4312	42746.2	42685.8	60.3741
24	16.3155	697585	basement	5.551	27.1	22.3841	24.6389	42756.1	42718.8	37.2979
25	16.3155	697658	basement	5.551	27.1	10.8706	11.9656	42760.3	42747.7	12.5557

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.10052

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	559.877	-3948.87	8.03068e+007	0	0
2	574.665	-3963.85	332829	232.668	0.0400533
3	589.453	-3977.91	629736	440.224	0.0400532
4	604.241	-3991.13	893524	624.628	0.0400533
5	619.029	-4003.56	1.12654e+006	787.522	0.0400533
6	633.817	-4015.27	1.33078e+006	930.296	0.0400532
7	648.605	-4026.3	1.44531e+006	1010.36	0.0400532
8	663.393	-4036.7	1.52311e+006	1064.75	0.0400534
9	678.18	-4046.5	1.57627e+006	1101.91	0.0400533
10	692.968	-4055.74	1.60594e+006	1122.65	0.0400532
11	707.756	-4064.43	1.61311e+006	1127.66	0.0400532
12	722.544	-4072.62	1.59865e+006	1117.56	0.0400535
13	737.332	-4080.31	1.59172e+006	1112.71	0.0400533
14	752.12	-4087.53	1.57703e+006	1102.44	0.0400532
15	766.908	-4094.29	1.54298e+006	1078.64	0.0400533
16	781.696	-4100.61	1.49013e+006	1041.69	0.0400532
17	796.484	-4106.51	1.41899e+006	991.964	0.0400534
18	811.271	-4111.99	1.33002e+006	929.764	0.0400532
19	826.059	-4117.07	1.21615e+006	850.166	0.0400534
20	840.847	-4121.75	1.07896e+006	754.261	0.0400534
21	855.635	-4126.05	924998	646.631	0.0400533
22	870.423	-4129.98	754563	527.486	0.0400533
23	885.211	-4133.54	567929	397.018	0.0400533
24	899.999	-4136.73	365344	255.398	0.0400533
25	914.787	-4139.56	171410	119.826	0.0400532
26	929.575	-4142.04	8.83561e+007	0	0

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 875PC Site 87		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_87_87_0g.slim	

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.10073

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	543.358	-3941.45	8.00055e+007	0	0
2	559.673	-3957.85	369723	46.7267	0.00724121
3	575.989	-3973.23	691625	173.441	0.0143682
4	592.304	-3987.68	977279	362.774	0.0212687
5	608.62	-4001.27	1.22922e+006	597.141	0.0278336
6	624.935	-4014.07	1.4496e+006	859.19	0.0339597
7	641.251	-4026.12	1.6142e+006	1114.25	0.0395501
8	657.566	-4037.47	1.69549e+006	1317.34	0.0445169
9	673.882	-4048.17	1.74967e+006	1489.67	0.0487816
10	690.197	-4058.24	1.77794e+006	1622.2	0.0522769
11	706.513	-4067.72	1.78138e+006	1708.38	0.0549478
12	722.828	-4076.63	1.76093e+006	1744.23	0.0567524
13	739.144	-4085	1.7508e+006	1761.98	0.0576616
14	755.459	-4092.85	1.73e+006	1741.05	0.0576617
15	771.775	-4100.19	1.68779e+006	1671.78	0.0567523
16	788.09	-4107.05	1.62475e+006	1558.17	0.0549479
17	804.406	-4113.44	1.54145e+006	1406.42	0.0522767
18	820.721	-4119.38	1.43583e+006	1222.47	0.0487818
19	837.037	-4124.86	1.29827e+006	1008.71	0.0445168
20	853.352	-4129.91	1.1417e+006	788.091	0.03955
21	869.668	-4134.54	966486	572.844	0.0339597
22	885.983	-4138.75	772967	375.499	0.0278337
23	902.299	-4142.55	561439	208.41	0.0212686
24	918.614	-4145.95	372694	93.4614	0.0143682
25	934.93	-4148.96	194875	24.6289	0.00724122
26	951.245	-4151.57	8.8763e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.110514
Factor of Safety, standard deviation: 0.183539
Factor of Safety, minimum: 0.543619
Factor of Safety, maximum: 1.748460
Probability of Failure: 28.470% (= 2847 failed surfaces / 10000 valid surfaces)
Reliability index: 0.60213 (assuming normal distribution)

Reliability index: 0.55645 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 1.110405
Factor of Safety, standard deviation: 0.184138
Factor of Safety, minimum: 0.546216
Factor of Safety, maximum: 1.748450
Probability of Failure: 28.650% (= 2865 failed surfaces / 10000 valid surfaces)
Reliability index: 0.59958 (assuming normal distribution)
Reliability index: 0.55347 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-8000
8154	-8000
8154	0
0	0

External Boundary

X	Y
8154	-8000
8154	-5135
8062	-5134
7970	-5131
7879	-5129
7787	-5128
7695	-5127
7603	-5127
7512	-5128
7420	-5130
7328	-5128
7236	-5127
7144	-5126
7053	-5124
6961	-5123

6869	-5122
6777	-5121
6685	-5121
6594	-5120
6502	-5119
6410	-5117
6318	-5115
6226	-5114
6135	-5113
6043	-5112
5951	-5111
5859	-5111
5768	-5111
5676	-5111
5584	-5110
5492	-5108
5400	-5104
5309	-5099
5217	-5093
5125	-5086
5033	-5079
4941	-5071
4848	-5064
4756	-5056
4664	-5047
4572	-5036
4479	-5022
4387	-5004
4295	-4977
4203	-4945
4111	-4912
4018	-4880
3926	-4849
3834	-4812
3742	-4775
3649	-4735
3557	-4692
3465	-4652
3373	-4614
3281	-4590

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 875PC Site 87		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_87_87_0g.slim	

3188	-4567
3096	-4539
3004	-4512
2912	-4492
2819	-4475
2727	-4460
2636	-4448
2545	-4434
2455	-4421
2364	-4406
2273	-4394
2182	-4383
2091	-4379
2000	-4377
1909	-4374
1818	-4370
1727	-4364
1636	-4354
1545	-4339
1455	-4319
1364	-4293
1273	-4264
1182	-4239
1091	-4210
1000	-4173
909	-4133
818	-4084
727	-4037
636	-3984
545	-3942
455	-3912
364	-3895
273	-3889
182	-3888
91	-3887
0	-3891
0	-8000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 875PC Site 87	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/26/2013	File Name: RR0705_87_87_1g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_87_87_1g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 875PC Site 87
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/26/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 875PC Site 87		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_87_87_1g.sli	

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364881284
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.2
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	Automatically Calculated
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.2	5.7	8.7	0.5

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.001511
Center: 1175.226, -3212.142
Radius: 960.918
Left Slip Surface Endpoint: 556.368, -3947.247
Right Slip Surface Endpoint: 924.268, -4139.711
Left Slope Intercept: 556.368 0.000
Right Slope Intercept: 924.268 0.000
Resisting Moment=228213 kN-m
Driving Moment=1.51039e+008 kN-m
Resisting Horizontal Force=239.803 kN

Driving Horizontal Force=158709 kN
Total Slice Area=1.49388e+006 m2

Method: gle/morgenstern-price

FS: 0.001404
Center: 1146.333, -3243.179
Radius: 919.590
Left Slip Surface Endpoint: 552.859, -3945.627
Right Slip Surface Endpoint: 903.834, -4130.218
Left Slope Intercept: 552.859 0.000
Right Slope Intercept: 903.834 0.000
Resisting Moment=193676 kN-m
Driving Moment=1.37905e+008 kN-m
Resisting Horizontal Force=213.467 kN
Driving Horizontal Force=151997 kN
Total Slice Area=1.42293e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1283
Number of Invalid Surfaces: 31

Error Codes:

Error Code -108 reported for 13 surfaces
Error Code -111 reported for 2 surfaces
Error Code -112 reported for 16 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1304
Number of Invalid Surfaces: 10

Error Codes:

Error Code -108 reported for 4 surfaces
Error Code -111 reported for 1 surface
Error Code -112 reported for 5 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving

force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.00151096

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	14.716	599443	basement	5.551	27.1	355.595	0.53729	40751.9	40761.7	-9.82612
2	14.716	601668	basement	5.551	27.1	423.241	0.6395	40955.9	40965.5	-9.5518
3	14.716	603783	basement	5.551	27.1	489.033	0.73891	41147.7	41157.1	-9.4189
4	14.716	605794	basement	5.551	27.1	552.735	0.83516	41327.7	41336.9	-9.23945
5	14.716	607704	basement	5.551	27.1	614.073	0.92784	41496.4	41505.5	-9.07266
6	14.716	609493	basement	5.551	27.1	597.825	0.90329	41649.3	41658.4	-9.10227
7	14.716	611079	basement	5.551	27.1	569.347	0.86026	41770.7	41779.9	-9.21964
8	14.716	612565	basement	5.551	27.1	580.452	0.87704	41879.8	41889	-9.17525
9	14.716	613963	basement	5.551	27.1	584.926	0.8838	41979.3	41988.4	-9.14047
10	14.716	615278	basement	5.551	27.1	582.186	0.87966	42069.4	42078.5	-9.13955
11	14.716	616513	basement	5.551	27.1	571.577	0.86363	42150.3	42159.5	-9.16294
12	14.716	617675	basement	5.551	27.1	587.765	0.88809	42223.9	42233	-9.1315
13	14.716	618820	basement	5.551	27.1	631.268	0.95382	42300.3	42309.3	-8.96062
14	14.716	619904	basement	5.551	27.1	621.3	0.93876	42371	42380	-8.95214
15	14.716	620917	basement	5.551	27.1	602.372	0.91016	42433.6	42442.7	-9.12075
16	14.716	621858	basement	5.551	27.1	573.516	0.86656	42488.2	42497.4	-9.20527
17	14.716	622730	basement	5.551	27.1	533.667	0.80635	42535	42544.3	-9.28697
18	14.716	623534	basement	5.551	27.1	473.295	0.71513	42574.1	42583.5	-9.42275
19	14.716	624254	basement	5.551	27.1	370.414	0.55968	42602.1	42611.9	-9.77156
20	14.716	624900	basement	5.551	27.1	276.4	0.41763	42621.4	42631.4	-10.0251
21	14.716	625483	basement	5.551	27.1	163.777	0.24746	42633.4	42643.8	-10.3506
22	14.716	626003	basement	5.551	27.1	30.0273	0.04537	42638.4	42649.2	-10.777
23	14.716	626461	basement	5.551	27.1	0	0	42617.6	42647.6	-30.0174
24	14.716	626859	basement	5.551	27.1	0	0	42585.2	42639.3	-54.0722
25	14.716	627261	basement	5.551	27.1	0	0	42550.1	42636.6	-86.5079

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00140441

Slice	Width	Weight	Base	Base Cohesion	Base Friction Angle	Shear Stress	Shear Strength	Base Normal Stress	Pore Pressure	Effective Normal Stress

				[kPa]	[degrees]	[kPa]	[kPa]	[kPa]	[kPa]	[kPa]
1	14.039	571587	basement	5.551	27.1	115.543	0.16227	40730.2	40740.7	-10.5077
2	14.039	573621	basement	5.551	27.1	285.729	0.40128	40926.2	40936.3	-10.0785
3	14.039	575556	basement	5.551	27.1	446.657	0.62729	41110.4	41120.1	-9.65212
4	14.039	577395	basement	5.551	27.1	595.033	0.83567	41283.5	41292.7	-9.24687
5	14.039	579142	basement	5.551	27.1	727.886	1.02225	41445.7	41454.6	-8.87829
6	14.039	580802	basement	5.551	27.1	834.742	1.17232	41597.5	41606.1	-8.57871
7	14.039	582300	basement	5.551	27.1	798.52	1.12145	41723.5	41732.2	-8.65225
8	14.039	583661	basement	5.551	27.1	806.559	1.13274	41828.7	41837.3	-8.59609
9	14.039	584942	basement	5.551	27.1	793.493	1.11439	41924.5	41933.2	-8.66436
10	14.039	586148	basement	5.551	27.1	760.348	1.06784	42011.4	42020.1	-8.72032
11	14.039	587280	basement	5.551	27.1	708.789	0.99543	42089.5	42098.4	-8.8728
12	14.039	588340	basement	5.551	27.1	641.081	0.90034	42159.2	42168.3	-9.05567
13	14.039	589344	basement	5.551	27.1	628.399	0.88253	42223.6	42232.7	-9.11785
14	14.039	590333	basement	5.551	27.1	605.799	0.85079	42290.8	42300	-9.24762
15	14.039	591263	basement	5.551	27.1	532.01	0.74716	42351.3	42360.7	-9.39241
16	14.039	592129	basement	5.551	27.1	452.09	0.63492	42404.3	42413.9	-9.61684
17	14.039	592931	basement	5.551	27.1	369.878	0.51946	42449.8	42459.7	-9.86176
18	14.039	593672	basement	5.551	27.1	289.353	0.40637	42488.2	42498.3	-10.1116
19	14.039	594352	basement	5.551	27.1	210.701	0.29591	42519.4	42529.7	-10.2836
20	14.039	594959	basement	5.551	27.1	113.685	0.15966	42540.7	42551.3	-10.5629
21	14.039	595497	basement	5.551	27.1	59.185	0.08312	42553.4	42564.1	-10.6941
22	14.039	595979	basement	5.551	27.1	21.5963	0.03033	42559.5	42570.2	-10.7304
23	14.039	596405	basement	5.551	27.1	2.81257	0.00395	42558.9	42569.8	-10.8642
24	14.039	596776	basement	5.551	27.1	3.5887	0.00504	42552	42562.8	-10.8281
25	14.039	597092	basement	5.551	27.1	23.3265	0.03276	42538.7	42549.5	-10.7925

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.00151096

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	556.368	-3947.25	8.02409e+007	0	0
2	571.084	-3959.39	216580	-1641.39	-0.434218
3	585.8	-3971.05	416255	-3154.67	-0.434219
4	600.516	-3982.25	599491	-4543.36	-0.434219
5	615.232	-3993.02	766712	-5810.68	-0.434219
6	629.948	-4003.37	918300	-6959.52	-0.434219
7	644.664	-4013.31	1.01198e+006	-7669.46	-0.434217

8	659.38	-4022.86	1.06037e+006	-8036.19	-0.434217
9	674.096	-4032.04	1.09343e+006	-8286.79	-0.43422
10	688.812	-4040.86	1.11149e+006	-8423.63	-0.434218
11	703.528	-4049.32	1.11483e+006	-8448.98	-0.43422
12	718.244	-4057.44	1.10375e+006	-8364.96	-0.434218
13	732.96	-4065.23	1.09464e+006	-8295.92	-0.434218
14	747.676	-4072.7	1.09554e+006	-8302.8	-0.434221
15	762.392	-4079.86	1.08309e+006	-8208.41	-0.434219
16	777.108	-4086.71	1.05749e+006	-8014.39	-0.434219
17	791.824	-4093.26	1.01895e+006	-7722.33	-0.43422
18	806.54	-4099.52	967687	-7333.81	-0.434219
19	821.256	-4105.49	900941	-6827.96	-0.434219
20	835.972	-4111.18	811429	-6149.57	-0.434219
21	850.688	-4116.6	709742	-5378.92	-0.434219
22	865.404	-4121.74	596108	-4517.72	-0.434219
23	880.12	-4126.62	470763	-3567.77	-0.434219
24	894.836	-4131.24	332989	-2523.62	-0.434219
25	909.552	-4135.6	184969	-1401.82	-0.434218
26	924.268	-4139.71	8.82566e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00140441

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	552.859	-3945.63	8.01751e+007	0	0
2	566.898	-3957.25	209799	-231.172	-0.0631327
3	580.937	-3968.42	402764	-880.592	-0.12527
4	594.976	-3979.15	579405	-1875.18	-0.185431
5	609.015	-3989.46	740203	-3135.03	-0.242667
6	623.054	-3999.37	885618	-4576.47	-0.296076
7	637.093	-4008.89	1.01072e+006	-6082.73	-0.344814
8	651.132	-4018.05	1.05737e+006	-7162.62	-0.388115
9	665.171	-4026.84	1.08943e+006	-8086.81	-0.425297
10	679.21	-4035.29	1.10731e+006	-8808.45	-0.455768
11	693.249	-4043.4	1.11136e+006	-9292.39	-0.479055
12	707.288	-4051.19	1.10193e+006	-9516.1	-0.494785
13	721.327	-4058.66	1.07932e+006	-9470.2	-0.502713
14	735.366	-4065.83	1.06641e+006	-9356.92	-0.502713
15	749.405	-4072.69	1.05639e+006	-9122.78	-0.494783
16	763.444	-4079.27	1.0342e+006	-8647.19	-0.479052
17	777.483	-4085.55	1.00002e+006	-7955.01	-0.45577

18	791.522	-4091.56	954007	-7081.55	-0.425296
19	805.561	-4097.3	896265	-6071.31	-0.388116
20	819.6	-4102.77	825415	-4967.54	-0.344815
21	833.639	-4107.97	731568	-3780.41	-0.296076
22	847.678	-4112.92	626008	-2651.37	-0.242667
23	861.717	-4117.62	508724	-1646.43	-0.185431
24	875.756	-4122.06	379686	-830.133	-0.125269
25	889.795	-4126.26	238853	-263.186	-0.0631327
26	903.834	-4130.22	8.78523e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.023293
Factor of Safety, standard deviation: 0.060823
Factor of Safety, minimum: 0.000103
Factor of Safety, maximum: 0.860344
Probability of Failure: 100.000% (= 9823 failed surfaces / 9823 valid surfaces), 177 invalid surfaces
Reliability index: -16.05815 (assuming normal distribution)
Reliability index: -3.33869 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 0.022073
Factor of Safety, standard deviation: 0.060321
Factor of Safety, minimum: 0.000105
Factor of Safety, maximum: 0.861978
Probability of Failure: 100.000% (= 9989 failed surfaces / 9989 valid surfaces), 11 invalid surfaces
Reliability index: -16.21204 (assuming normal distribution)
Reliability index: -3.33984 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-8000
8154	-8000
8154	0
0	0

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 875PC Site 87		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_87_87_1g.sli	

External Boundary

X	Y
8154	-8000
8154	-5135
8062	-5134
7970	-5131
7879	-5129
7787	-5128
7695	-5127
7603	-5127
7512	-5128
7420	-5130
7328	-5128
7236	-5127
7144	-5126
7053	-5124
6961	-5123
6869	-5122
6777	-5121
6685	-5121
6594	-5120
6502	-5119
6410	-5117
6318	-5115
6226	-5114
6135	-5113
6043	-5112
5951	-5111
5859	-5111
5768	-5111
5676	-5111
5584	-5110
5492	-5108
5400	-5104
5309	-5099
5217	-5093
5125	-5086
5033	-5079
4941	-5071

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 875PC Site 87		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_87_87_1g.sli	

4848	-5064
4756	-5056
4664	-5047
4572	-5036
4479	-5022
4387	-5004
4295	-4977
4203	-4945
4111	-4912
4018	-4880
3926	-4849
3834	-4812
3742	-4775
3649	-4735
3557	-4692
3465	-4652
3373	-4614
3281	-4590
3188	-4567
3096	-4539
3004	-4512
2912	-4492
2819	-4475
2727	-4460
2636	-4448
2545	-4434
2455	-4421
2364	-4406
2273	-4394
2182	-4383
2091	-4379
2000	-4377
1909	-4374
1818	-4370
1727	-4364
1636	-4354
1545	-4339
1455	-4319
1364	-4293
1273	-4264

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 875PC Site 87		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_87_87_1g.sli	

1182	-4239
1091	-4210
1000	-4173
909	-4133
818	-4084
727	-4037
636	-3984
545	-3942
455	-3912
364	-3895
273	-3889
182	-3888
91	-3887
0	-3891
0	-8000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 88PC Site 88	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/26/2013	File Name: RR0705_88_88_0g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_88_88_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 88PC Site 88
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/26/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 88PC Site 88	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/26/2013	File Name: RR0705_88_88_0g.sli

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364881134
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	Automatically Calculated
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 88PC Site 88		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_88_88_0g.sli	

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Global Minimums

Method: spencer

FS: 1.014400
Center: 1885.130, -1487.112
Radius: 2178.974
Left Slip Surface Endpoint: 467.446, -3141.833
Right Slip Surface Endpoint: 1288.819, -3582.904
Left Slope Intercept: 467.446 -0.000
Right Slope Intercept: 1288.819 -0.000
Resisting Moment=1.92398e+008 kN-m
Driving Moment=1.89667e+008 kN-m
Resisting Horizontal Force=77549.5 kN
Driving Horizontal Force=76448.7 kN
Total Slice Area=2.79313e+006 m2

Method: gle/morgenstern-price

FS: 1.015290
Center: 1885.470, -1483.801
Radius: 2182.252
Left Slip Surface Endpoint: 465.946, -3141.262
Right Slip Surface Endpoint: 1288.819, -3582.904
Left Slope Intercept: 465.946 -0.000
Right Slope Intercept: 1288.819 -0.000
Resisting Moment=1.94052e+008 kN-m
Driving Moment=1.91129e+008 kN-m
Resisting Horizontal Force=78063.8 kN

Driving Horizontal Force=76887.9 kN
Total Slice Area=2.79806e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2538
Number of Invalid Surfaces: 118

Error Codes:

Error Code -108 reported for 118 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2655
Number of Invalid Surfaces: 1

Error Codes:

Error Code -108 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.0144

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	32.8549	1.06927e+006	basement	5.551	27.1	10.8501	11.0064	32513.5	32503	10.5391
2	32.8549	1.0811e+006	basement	5.551	27.1	40.6679	41.2535	32851.4	32781.6	69.8248
3	32.8549	1.09227e+006	basement	5.551	27.1	69.3461	70.3447	33176	33049.4	126.593
4	32.8549	1.10193e+006	basement	5.551	27.1	86.2526	87.4946	33467.1	33306.9	160.203
5	32.8549	1.11087e+006	basement	5.551	27.1	96.7814	98.1751	33735.4	33554.5	180.912
6	32.8549	1.11932e+006	basement	5.551	27.1	105.527	107.047	33990.8	33792.5	198.276
7	32.8549	1.12725e+006	basement	5.551	27.1	111.917	113.529	34232.5	34021.4	211.096

8	32.8549	1.13473e+006	basement	5.551	27.1	116.425	118.102	34461.5	34241.4	220.071
9	32.8549	1.1419e+006	basement	5.551	27.1	119.669	121.392	34679.3	34453	226.284
10	32.8549	1.1489e+006	basement	5.551	27.1	124.735	126.531	34892.7	34656.3	236.407
11	32.8549	1.15549e+006	basement	5.551	27.1	128.426	130.275	35095.4	34851.6	243.83
12	32.8549	1.16154e+006	basement	5.551	27.1	129.704	131.572	35285.6	35039.2	246.392
13	32.8549	1.16706e+006	basement	5.551	27.1	126.495	128.317	35459.3	35219.3	239.989
14	32.8549	1.17222e+006	basement	5.551	27.1	121.293	123.04	35621.7	35392.1	229.572
15	32.8549	1.17745e+006	basement	5.551	27.1	118.303	120.007	35781.3	35557.7	223.602
16	32.8549	1.18254e+006	basement	5.551	27.1	118.213	119.915	35939.8	35716.3	223.461
17	32.8549	1.18727e+006	basement	5.551	27.1	116.627	118.306	36088.6	35868.2	220.369
18	32.8549	1.19157e+006	basement	5.551	27.1	112.358	113.976	36225.4	36013.4	211.993
19	32.8549	1.19552e+006	basement	5.551	27.1	105.913	107.438	36351.2	36152.1	199.082
20	32.8549	1.1991e+006	basement	5.551	27.1	97.8699	99.2792	36467.7	36284.4	183.333
21	32.8549	1.20216e+006	basement	5.551	27.1	85.5215	86.753	36569.1	36410.5	158.629
22	32.8549	1.20489e+006	basement	5.551	27.1	70.8393	71.8594	36659.9	36530.4	129.533
23	32.8549	1.20736e+006	basement	5.551	27.1	54.6305	55.4172	36741.9	36644.3	97.5944
24	32.8549	1.20961e+006	basement	5.551	27.1	38.2119	38.7622	36817.1	36752.2	64.8678
25	32.8549	1.21157e+006	basement	5.551	27.1	20.2805	20.5725	36883.7	36854.3	29.4242

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.01529

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	32.9149	1.07104e+006	basement	5.551	27.1	17.3876	17.6535	32521	32497.3	23.742
2	32.9149	1.08291e+006	basement	5.551	27.1	44.134	44.8088	32853.1	32776.4	76.7147
3	32.9149	1.09413e+006	basement	5.551	27.1	69.4315	70.4931	33171.4	33044.6	126.824
4	32.9149	1.10385e+006	basement	5.551	27.1	84.2076	85.4951	33458.5	33302.4	156.146
5	32.9149	1.11282e+006	basement	5.551	27.1	93.9836	95.4206	33726	33550.3	175.672
6	32.9149	1.1213e+006	basement	5.551	27.1	102.349	103.914	33980.9	33788.7	192.225
7	32.9149	1.12925e+006	basement	5.551	27.1	108.755	110.418	34222.7	34017.9	204.825
8	32.9149	1.13676e+006	basement	5.551	27.1	113.579	115.316	34452.8	34238.3	214.503
9	32.9149	1.14394e+006	basement	5.551	27.1	117.041	118.831	34671.5	34450.1	221.379
10	32.9149	1.15095e+006	basement	5.551	27.1	122.596	124.47	34886	34653.7	232.328
11	32.9149	1.15757e+006	basement	5.551	27.1	127.092	129.035	35090.7	34849.3	241.387
12	32.9149	1.16364e+006	basement	5.551	27.1	129.805	131.79	35283.9	35037.1	246.788
13	32.9149	1.16918e+006	basement	5.551	27.1	127.647	129.599	35459.9	35217.4	242.476
14	32.9149	1.17435e+006	basement	5.551	27.1	123.219	125.103	35624	35390.4	233.638
15	32.9149	1.17958e+006	basement	5.551	27.1	120.135	121.972	35783.8	35556.2	227.611
16	32.9149	1.18469e+006	basement	5.551	27.1	120.884	122.732	35944	35715.1	228.949
17	32.9149	1.18943e+006	basement	5.551	27.1	120.03	121.865	36094.4	35867.1	227.276
18	32.9149	1.19375e+006	basement	5.551	27.1	116.253	118.031	36232.2	36012.5	219.674

19	32.9149	1.1977e+006	basement	5.551	27.1	109.885	111.565	36358.7	36151.4	207.263
20	32.9149	1.20129e+006	basement	5.551	27.1	101.492	103.044	36474.5	36283.8	190.694
21	32.9149	1.20436e+006	basement	5.551	27.1	88.2028	89.5514	36574.3	36410	164.306
22	32.9149	1.2071e+006	basement	5.551	27.1	72.1174	73.2201	36662.4	36530.1	132.252
23	32.9149	1.20957e+006	basement	5.551	27.1	54.3253	55.1559	36740.9	36644.1	96.8422
24	32.9149	1.21182e+006	basement	5.551	27.1	35.8887	36.4374	36812.4	36752.1	60.3096
25	32.9149	1.21378e+006	basement	5.551	27.1	15.5269	15.7643	36874.2	36854.3	19.8526

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.0144

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	467.446	-3141.83	5.08362e+007	0	0
2	500.301	-3169.43	491480	738.834	0.0861318
3	533.156	-3195.94	954315	1434.61	0.086132
4	566.011	-3221.43	1.28933e+006	1938.22	0.0861314
5	598.866	-3245.93	1.4608e+006	2196	0.0861319
6	631.721	-3269.5	1.60274e+006	2409.38	0.086132
7	664.576	-3292.15	1.7082e+006	2567.91	0.0861318
8	697.431	-3313.94	1.78053e+006	2676.65	0.086132
9	730.286	-3334.88	1.82461e+006	2742.91	0.0861319
10	763.14	-3355.02	1.8965e+006	2850.97	0.0861315
11	795.995	-3374.36	1.95337e+006	2936.47	0.0861318
12	828.85	-3392.95	1.98393e+006	2982.41	0.0861318
13	861.705	-3410.79	1.93264e+006	2905.31	0.0861319
14	894.56	-3427.91	1.8548e+006	2788.29	0.0861317
15	927.415	-3444.33	1.77534e+006	2668.83	0.0861314
16	960.27	-3460.07	1.77142e+006	2662.95	0.0861318
17	993.125	-3475.14	1.74336e+006	2620.76	0.0861316
18	1025.98	-3489.56	1.68138e+006	2527.58	0.0861314
19	1058.83	-3503.34	1.58023e+006	2375.54	0.086132
20	1091.69	-3516.49	1.4554e+006	2187.88	0.0861318
21	1124.54	-3529.03	1.27652e+006	1918.98	0.0861321
22	1157.4	-3540.97	1.05317e+006	1583.22	0.0861321
23	1190.25	-3552.32	806284	1212.07	0.0861315
24	1223.11	-3563.08	556801	837.03	0.0861318
25	1255.96	-3573.28	289755	435.584	0.0861318
26	1288.82	-3582.9	6.61116e+007	0	0

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 88PC Site 88		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_88_88_0g.sli	

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.01529

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	465.946	-3141.26	5.08178e+007	0	0
2	498.861	-3168.89	492111	133.706	0.0155672
3	531.776	-3195.45	955465	515.105	0.030889
4	564.691	-3220.97	1.30031e+006	1037.69	0.0457239
5	597.606	-3245.51	1.47179e+006	1537.07	0.0598371
6	630.521	-3269.11	1.61369e+006	2056.18	0.0730068
7	663.436	-3291.8	1.71946e+006	2551.64	0.0850256
8	696.351	-3313.62	1.79164e+006	2992.64	0.0957031
9	729.266	-3334.59	1.83552e+006	3359.65	0.104871
10	762.18	-3354.75	1.90518e+006	3737.02	0.112386
11	795.095	-3374.12	1.96187e+006	4044.83	0.118128
12	828.01	-3392.73	1.99221e+006	4242.26	0.122007
13	860.925	-3410.59	1.94199e+006	4201.59	0.123962
14	893.84	-3427.74	1.86374e+006	4032.29	0.123962
15	926.755	-3444.18	1.78131e+006	3793.17	0.122007
16	959.67	-3459.94	1.77709e+006	3663.86	0.118128
17	992.585	-3475.03	1.74866e+006	3430.01	0.112386
18	1025.5	-3489.46	1.68664e+006	3087.15	0.104872
19	1058.41	-3503.26	1.58499e+006	2647.47	0.0957033
20	1091.33	-3516.43	1.4596e+006	2166.01	0.0850254
21	1124.24	-3528.98	1.28058e+006	1631.73	0.0730069
22	1157.16	-3540.93	1.05648e+006	1103.34	0.0598371
23	1190.07	-3552.29	808803	645.448	0.0457237
24	1222.99	-3563.07	558406	301.045	0.030889
25	1255.9	-3573.27	290564	78.9461	0.0155672
26	1288.82	-3582.9	6.61116e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.021765
Factor of Safety, standard deviation: 0.169619
Factor of Safety, minimum: 0.534793
Factor of Safety, maximum: 1.645510
Probability of Failure: 46.380% (= 4638 failed surfaces / 10000 valid surfaces)
Reliability index: 0.12832 (assuming normal distribution)

Reliability index: 0.04815 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 1.022850
Factor of Safety, standard deviation: 0.169855
Factor of Safety, minimum: 0.535548
Factor of Safety, maximum: 1.647290
Probability of Failure: 46.010% (= 4601 failed surfaces / 10000 valid surfaces)
Reliability index: 0.13453 (assuming normal distribution)
Reliability index: 0.05452 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
5966	-6000
5966	0
0	0

External Boundary

X	Y
5966	-6000
5966	-4065
5876	-4074
5785	-4084
5695	-4093
5604	-4099
5513	-4102
5423	-4105
5332	-4106
5241	-4105
5151	-4106
5060	-4103
4969	-4102
4879	-4099
4788	-4099

4697	-4097
4607	-4096
4516	-4096
4426	-4095
4335	-4093
4242	-4092
4150	-4091
4058	-4090
3965	-4089
3873	-4087
3780	-4085
3688	-4083
3595	-4079
3503	-4075
3410	-4073
3318	-4070
3226	-4068
3133	-4065
3041	-4060
2948	-4053
2856	-4043
2763	-4032
2671	-4022
2578	-4006
2486	-3997
2393	-3989
2301	-3972
2209	-3944
2117	-3914
2025	-3883
1933	-3853
1841	-3825
1749	-3787
1657	-3751
1565	-3713
1473	-3665
1381	-3622
1289	-3583
1197	-3534
1105	-3483

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 88PC Site 88		
	Drawn By: Jason R. Patton	Company: Oregon State University	
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1013	-3436
921	-3391
829	-3336
736	-3285
644	-3229
552	-3174
460	-3139
368	-3123
276	-3116
184	-3113
92	-3111
0	-3110
0	-6000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 88PC Site 88	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/26/2013	File Name: RR0705_88_88_1g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_88_88_1g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 88PC Site 88
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/26/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 88PC Site 88	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/26/2013	File Name: RR0705_88_88_1g.sli

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364881020
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	Automatically Calculated
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.001204
Center: 3642.364, 1822.053
Radius: 5910.363
Left Slip Surface Endpoint: 418.797, -3131.834
Right Slip Surface Endpoint: 1552.622, -3706.542
Left Slope Intercept: 418.797 -0.000
Right Slope Intercept: 1552.622 -0.000
Resisting Moment=5.48161e+006 kN-m
Driving Moment=4.55468e+009 kN-m
Resisting Horizontal Force=927.899 kN

Driving Horizontal Force=770993 kN
Total Slice Area=3.90578e+006 m2

Method: gle/morgenstern-price

FS: 0.001120
Center: 3617.357, 1734.439
Radius: 5821.184
Left Slip Surface Endpoint: 424.163, -3132.767
Right Slip Surface Endpoint: 1564.637, -3712.811
Left Slope Intercept: 424.163 -0.000
Right Slope Intercept: 1564.637 -0.000
Resisting Moment=5.04324e+006 kN-m
Driving Moment=4.50192e+009 kN-m
Resisting Horizontal Force=870.749 kN
Driving Horizontal Force=777287 kN
Total Slice Area=3.93365e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 871
Number of Invalid Surfaces: 20

Error Codes:

Error Code -108 reported for 16 surfaces
Error Code -112 reported for 4 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 884
Number of Invalid Surfaces: 7

Error Codes:

Error Code -108 reported for 4 surfaces
Error Code -112 reported for 3 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This

screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.00120351

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	45.353	1.47252e+006	basement	5.551	27.1	988.168	1.18927	32568.7	32577.3	-8.56244
2	45.353	1.48998e+006	basement	5.551	27.1	972.821	1.1708	33113.7	33122.3	-8.59601
3	45.353	1.50603e+006	basement	5.551	27.1	1168.48	1.40628	33582.4	33590.5	-8.06934
4	45.353	1.52028e+006	basement	5.551	27.1	907.18	1.0918	33947.6	33956.2	-8.62563
5	45.353	1.53303e+006	basement	5.551	27.1	903.732	1.08765	34229.8	34238.5	-8.69409
6	45.353	1.54532e+006	basement	5.551	27.1	863.499	1.03923	34493.4	34502.3	-8.90527
7	45.353	1.55716e+006	basement	5.551	27.1	825.743	0.99379	34739.5	34748.3	-8.83854
8	45.353	1.56897e+006	basement	5.551	27.1	924.936	1.11317	34993.6	35002.3	-8.69422
9	45.353	1.58074e+006	basement	5.551	27.1	924.155	1.11223	35255.4	35264.2	-8.76059
10	45.353	1.59188e+006	basement	5.551	27.1	787.372	0.94761	35487.2	35496.2	-8.9556
11	45.353	1.60235e+006	basement	5.551	27.1	701.797	0.84462	35686.5	35695.6	-9.08412
12	45.353	1.61299e+006	basement	5.551	27.1	883.017	1.06272	35906.8	35915.5	-8.69019
13	45.353	1.62399e+006	basement	5.551	27.1	915.173	1.10142	36158.3	36167	-8.67246
14	45.353	1.63454e+006	basement	5.551	27.1	861.671	1.03703	36390.7	36399.5	-8.8021
15	45.353	1.64459e+006	basement	5.551	27.1	820.758	0.98779	36601.1	36610.1	-8.95231
16	45.353	1.6541e+006	basement	5.551	27.1	656.413	0.79	36787.1	36796.3	-9.23104
17	45.353	1.66298e+006	basement	5.551	27.1	523.053	0.6295	36941.4	36951	-9.58002
18	45.353	1.6716e+006	basement	5.551	27.1	444.134	0.53452	37088.8	37098.7	-9.87842
19	45.353	1.68004e+006	basement	5.551	27.1	326.063	0.39242	37234.3	37244.4	-10.091
20	45.353	1.68858e+006	basement	5.551	27.1	476.83	0.57387	37394.5	37404.2	-9.66648
21	45.353	1.69761e+006	basement	5.551	27.1	517.702	0.62306	37593.7	37603.4	-9.70325
22	45.353	1.70618e+006	basement	5.551	27.1	369.627	0.44485	37772.7	37782.7	-9.98194
23	45.353	1.71411e+006	basement	5.551	27.1	237.522	0.28586	37919.2	37929.4	-10.2405
24	45.353	1.72153e+006	basement	5.551	27.1	0	0	38034.6	38052.8	-18.2067
25	45.353	1.72821e+006	basement	5.551	27.1	0	0	37924.4	38138.1	-213.721

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00112024

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	45.619	1.48169e+006	basement	5.551	27.1	374.732	0.41979	32579	32589.1	-10.0811
2	45.619	1.49927e+006	basement	5.551	27.1	841.48	0.94266	33118.7	33127.7	-8.9919

3	45.619	1.51562e+006	basement	5.551	27.1	1200.01	1.3443	33593.2	33601.3	-8.14723
4	45.619	1.52988e+006	basement	5.551	27.1	1196.25	1.34009	33947.7	33955.8	-8.12453
5	45.619	1.54291e+006	basement	5.551	27.1	1207.33	1.3525	34236.1	34244.4	-8.26532
6	45.619	1.55545e+006	basement	5.551	27.1	1165.65	1.30581	34504.8	34513	-8.21209
7	45.619	1.56755e+006	basement	5.551	27.1	1124.96	1.26022	34756.6	34765	-8.37279
8	45.619	1.57969e+006	basement	5.551	27.1	1206.63	1.35171	35022.2	35030.5	-8.25919
9	45.619	1.59169e+006	basement	5.551	27.1	1162.91	1.30274	35288.7	35296.9	-8.23716
10	45.619	1.60296e+006	basement	5.551	27.1	942.227	1.05552	35518.7	35527.5	-8.77571
11	45.619	1.61362e+006	basement	5.551	27.1	830.215	0.93004	35722.1	35731.1	-9.04383
12	45.619	1.62468e+006	basement	5.551	27.1	1065.93	1.1941	35959.7	35968.2	-8.46884
13	45.619	1.63586e+006	basement	5.551	27.1	1018.89	1.1414	36214.7	36223.3	-8.61677
14	45.619	1.64653e+006	basement	5.551	27.1	873.241	0.97824	36447.1	36455.9	-8.79273
15	45.619	1.65674e+006	basement	5.551	27.1	758.614	0.84983	36659.9	36669	-9.07385
16	45.619	1.6663e+006	basement	5.551	27.1	477.514	0.53493	36841.5	36851.3	-9.8424
17	45.619	1.67529e+006	basement	5.551	27.1	322.449	0.36122	36997.4	37007.5	-10.1457
18	45.619	1.68408e+006	basement	5.551	27.1	246.626	0.27628	37149.6	37159.9	-10.3395
19	45.619	1.69264e+006	basement	5.551	27.1	130.918	0.14666	37296.5	37307	-10.4955
20	45.619	1.70155e+006	basement	5.551	27.1	348.015	0.38986	37474.4	37484.5	-10.0638
21	45.619	1.7107e+006	basement	5.551	27.1	297.677	0.33347	37675.9	37686	-10.1159
22	45.619	1.71925e+006	basement	5.551	27.1	151.396	0.1696	37848.4	37859	-10.5629
23	45.619	1.72724e+006	basement	5.551	27.1	95.0243	0.10645	37994.5	38005.2	-10.7127
24	45.619	1.73458e+006	basement	5.551	27.1	0	0	38105	38119.6	-14.5572
25	45.619	1.74128e+006	basement	5.551	27.1	0	0	38180.4	38203.1	-22.6712

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.00120351

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	418.797	-3131.83	5.05132e+007	0	0
2	464.15	-3161.05	655203	-10550.7	-0.922551
3	509.503	-3189.69	1.04145e+006	-16770.6	-0.922561
4	554.856	-3217.76	1.4023e+006	-22581.2	-0.922553
5	600.209	-3245.26	1.45603e+006	-23446.5	-0.922556
6	645.562	-3272.21	1.49064e+006	-24003.8	-0.922555
7	690.915	-3298.62	1.49044e+006	-24000.6	-0.922556
8	736.268	-3324.5	1.47061e+006	-23681.2	-0.922553
9	781.621	-3349.85	1.5212e+006	-24495.9	-0.922555
10	826.974	-3374.67	1.55392e+006	-25022.7	-0.922551

11	872.327	-3398.99	1.49573e+006	-24085.8	-0.922556
12	917.68	-3422.8	1.41303e+006	-22754	-0.922553
13	963.033	-3446.11	1.46578e+006	-23603.5	-0.922556
14	1008.39	-3468.93	1.51408e+006	-24381.2	-0.922553
15	1053.74	-3491.27	1.51459e+006	-24389.5	-0.922556
16	1099.09	-3513.13	1.49332e+006	-24047	-0.922557
17	1144.45	-3534.51	1.39322e+006	-22435	-0.922553
18	1189.8	-3555.43	1.26347e+006	-20345.7	-0.922556
19	1235.15	-3575.88	1.1423e+006	-18394.4	-0.922551
20	1280.5	-3595.88	1.0065e+006	-16207.7	-0.922556
21	1325.86	-3615.43	994299	-16011.2	-0.922554
22	1371.21	-3634.52	998539	-16079.5	-0.922556
23	1416.56	-3653.18	930293	-14980.5	-0.922554
24	1461.92	-3671.4	828619	-13343.3	-0.922558
25	1507.27	-3689.19	639681	-10300.8	-0.922556
26	1552.62	-3706.54	7.0753e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00112024

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	424.163	-3132.77	5.05433e+007	0	0
2	469.782	-3162.39	643479	-1810.91	-0.161244
3	515.401	-3191.42	1.04263e+006	-5822.16	-0.319943
4	561.02	-3219.85	1.36919e+006	-11317.6	-0.473591
5	606.639	-3247.71	1.42287e+006	-15391.7	-0.619765
6	652.258	-3274.99	1.45439e+006	-19195.3	-0.756156
7	697.877	-3301.71	1.45295e+006	-22333	-0.880612
8	743.496	-3327.88	1.44632e+006	-25023	-0.991184
9	789.115	-3353.51	1.4967e+006	-28375.4	-1.08612
10	834.734	-3378.6	1.51995e+006	-30880.9	-1.16392
11	880.353	-3403.17	1.45866e+006	-31149.8	-1.22337
12	925.972	-3427.21	1.39518e+006	-30772.6	-1.26353
13	971.591	-3450.74	1.46196e+006	-32762.3	-1.28377
14	1017.21	-3473.77	1.50972e+006	-33832.4	-1.28377
15	1062.83	-3496.29	1.51027e+006	-33311	-1.26353
16	1108.45	-3518.33	1.48818e+006	-31780.1	-1.22337
17	1154.07	-3539.87	1.38406e+006	-28120.1	-1.16392
18	1199.69	-3560.94	1.26136e+006	-23913.5	-1.08611
19	1245.3	-3581.53	1.1506e+006	-19906.8	-0.991189
20	1290.92	-3601.65	1.02652e+006	-15778.5	-0.880616

21	1336.54	-3621.31	1.05333e+006	-13902	-0.756154
22	1382.16	-3640.51	1.06216e+006	-11489.7	-0.619761
23	1427.78	-3659.26	982697	-8122.87	-0.47359
24	1473.4	-3677.55	882519	-4928.07	-0.319942
25	1519.02	-3695.4	668045	-1880.04	-0.161244
26	1564.64	-3712.81	7.09926e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.023588
Factor of Safety, standard deviation: 0.058593
Factor of Safety, minimum: 0.000111
Factor of Safety, maximum: 0.985807
Probability of Failure: 100.000% (= 9732 failed surfaces / 9732 valid surfaces), 268 invalid surfaces
Reliability index: -16.66438 (assuming normal distribution)
Reliability index: -3.37145 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 0.023339
Factor of Safety, standard deviation: 0.058869
Factor of Safety, minimum: 0.000103
Factor of Safety, maximum: 0.988697
Probability of Failure: 100.000% (= 9904 failed surfaces / 9904 valid surfaces), 96 invalid surfaces
Reliability index: -16.59045 (assuming normal distribution)
Reliability index: -3.36593 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
5966	-6000
5966	0
0	0

External Boundary

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 88PC Site 88		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_88_88_1g.sli	

X	Y
5966	-6000
5966	-4065
5876	-4074
5785	-4084
5695	-4093
5604	-4099
5513	-4102
5423	-4105
5332	-4106
5241	-4105
5151	-4106
5060	-4103
4969	-4102
4879	-4099
4788	-4099
4697	-4097
4607	-4096
4516	-4096
4426	-4095
4335	-4093
4242	-4092
4150	-4091
4058	-4090
3965	-4089
3873	-4087
3780	-4085
3688	-4083
3595	-4079
3503	-4075
3410	-4073
3318	-4070
3226	-4068
3133	-4065
3041	-4060
2948	-4053
2856	-4043
2763	-4032
2671	-4022
2578	-4006

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 88PC Site 88		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_88_88_1g.sli	

2486	-3997
2393	-3989
2301	-3972
2209	-3944
2117	-3914
2025	-3883
1933	-3853
1841	-3825
1749	-3787
1657	-3751
1565	-3713
1473	-3665
1381	-3622
1289	-3583
1197	-3534
1105	-3483
1013	-3436
921	-3391
829	-3336
736	-3285
644	-3229
552	-3174
460	-3139
368	-3123
276	-3116
184	-3113
92	-3111
0	-3110
0	-6000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 92PC Site 37	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/26/2013	File Name: RR0705_92_37_0g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_92_37_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 92PC Site 37
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/26/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364880871
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	Automatically Calculated
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 92PC Site 37		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_92_37_0g.sli	

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Global Minimums

Method: spencer

FS: 1.726810
Center: 1012.071, -2433.521
Radius: 1318.081
Left Slip Surface Endpoint: 311.599, -3550.067
Right Slip Surface Endpoint: 939.562, -3749.606
Left Slope Intercept: 311.599 -0.000
Right Slope Intercept: 939.562 -0.000
Resisting Moment=7.2138e+007 kN-m
Driving Moment=4.17753e+007 kN-m
Resisting Horizontal Force=51946.9 kN
Driving Horizontal Force=30082.6 kN
Total Slice Area=2.31037e+006 m2

Method: gle/morgenstern-price

FS: 1.728250
Center: 963.230, -2525.828
Radius: 1211.999
Left Slip Surface Endpoint: 317.938, -3551.763
Right Slip Surface Endpoint: 894.443, -3735.874
Left Slope Intercept: 317.938 -0.000
Right Slope Intercept: 894.443 -0.000
Resisting Moment=5.66867e+007 kN-m
Driving Moment=3.28001e+007 kN-m
Resisting Horizontal Force=44333.2 kN

Driving Horizontal Force=25652.1 kN
Total Slice Area=2.11619e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1858
Number of Invalid Surfaces: 793

Error Codes:

Error Code -108 reported for 793 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2651
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.72681

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	25.1185	921072	basement	5.551	27.1	6.84071	11.8126	36657.1	36644.8	12.2731
2	25.1185	926096	basement	5.551	27.1	18.6675	32.2352	36851.3	36799.3	51.9825
3	25.1185	930765	basement	5.551	27.1	28.9592	50.007	37032.8	36946	86.7541
4	25.1185	935143	basement	5.551	27.1	38.2734	66.0909	37203.6	37085.5	118.091
5	25.1185	939241	basement	5.551	27.1	46.7256	80.6862	37364.6	37217.8	146.85
6	25.1185	942960	basement	5.551	27.1	53.2833	92.0102	37512.3	37343.2	169.061
7	25.1185	946374	basement	5.551	27.1	58.2722	100.625	37647.9	37462	185.857
8	25.1185	949536	basement	5.551	27.1	62.3856	107.728	37773.9	37574.2	199.653
9	25.1185	952445	basement	5.551	27.1	65.5729	113.232	37890.7	37680.2	210.55
10	25.1185	955098	basement	5.551	27.1	67.6814	116.873	37997.4	37780.1	217.33
11	25.1185	957518	basement	5.551	27.1	68.9155	119.004	38095.6	37873.9	221.725

12	25.1185	959712	basement	5.551	27.1	69.2931	119.656	38184.7	37961.8	222.938
13	25.1185	961702	basement	5.551	27.1	69.0145	119.175	38266	38044	221.963
14	25.1185	963479	basement	5.551	27.1	67.9756	117.381	38339.3	38120.6	218.685
15	25.1185	965041	basement	5.551	27.1	66.0878	114.121	38403.8	38191.6	212.164
16	25.1185	966410	basement	5.551	27.1	63.4777	109.614	38460.5	38257.2	203.331
17	25.1185	967593	basement	5.551	27.1	60.3385	104.193	38510.1	38317.3	192.799
18	25.1185	968571	basement	5.551	27.1	56.3576	97.3188	38551.6	38372.2	179.357
19	25.1185	969356	basement	5.551	27.1	51.5674	89.0471	38585	38421.9	163.128
20	25.1185	970002	basement	5.551	27.1	46.6194	80.5029	38612.8	38466.3	146.524
21	25.1185	970459	basement	5.551	27.1	41.0065	70.8104	38633.2	38505.7	127.521
22	25.1185	970720	basement	5.551	27.1	34.5385	59.6414	38645.7	38539.9	105.756
23	25.1185	970780	basement	5.551	27.1	27.1713	46.9196	38650	38569.1	80.8939
24	25.1185	970643	basement	5.551	27.1	18.8852	32.6112	38646.2	38593.4	52.824
25	25.1185	970313	basement	5.551	27.1	9.71728	16.7799	38634.5	38612.6	21.8993

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.72825

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	23.0602	845810	basement	5.551	27.1	7.99593	13.819	36672.2	36656	16.1574
2	23.0602	850050	basement	5.551	27.1	18.0406	31.1786	36848.2	36798.2	50.0422
3	23.0602	853995	basement	5.551	27.1	26.8832	46.4609	37013.2	36933.3	79.9134
4	23.0602	857699	basement	5.551	27.1	35.0029	60.4937	37169	37061.7	107.319
5	23.0602	861170	basement	5.551	27.1	42.4443	73.3543	37316	37183.5	132.474
6	23.0602	864335	basement	5.551	27.1	48.4981	83.8169	37452	37299	152.957
7	23.0602	867225	basement	5.551	27.1	53.0609	91.7025	37576.8	37408.4	168.364
8	23.0602	869903	basement	5.551	27.1	56.9181	98.3687	37693.2	37511.9	181.336
9	23.0602	872374	basement	5.551	27.1	60.067	103.811	37801.5	37609.5	192.04
10	23.0602	874628	basement	5.551	27.1	62.3226	107.709	37901.2	37701.5	199.671
11	23.0602	876680	basement	5.551	27.1	63.7547	110.184	37992.5	37788.1	204.446
12	23.0602	878541	basement	5.551	27.1	64.4317	111.354	38075.9	37869.2	206.738
13	23.0602	880218	basement	5.551	27.1	64.3466	111.207	38151.5	37945	206.486
14	23.0602	881727	basement	5.551	27.1	63.6812	110.057	38219.9	38015.7	204.21
15	23.0602	883057	basement	5.551	27.1	62.2572	107.596	38280.6	38081.2	199.448
16	23.0602	884208	basement	5.551	27.1	60.0073	103.708	38333.6	38141.8	191.802
17	23.0602	885197	basement	5.551	27.1	56.996	98.5033	38379.1	38197.4	181.668
18	23.0602	886035	basement	5.551	27.1	53.455	92.3836	38417.9	38248.2	169.687
19	23.0602	886701	basement	5.551	27.1	49.0586	84.7856	38449	38294.2	154.778
20	23.0602	887199	basement	5.551	27.1	43.7686	75.6431	38472.4	38335.4	136.95
21	23.0602	887573	basement	5.551	27.1	38.046	65.753	38489.5	38371.9	117.613
22	23.0602	887806	basement	5.551	27.1	31.8688	55.0773	38500.5	38403.7	96.7865

23	23.0602	887875	basement	5.551	27.1	24.7953	42.8524	38503.8	38430.9	72.9238
24	23.0602	887779	basement	5.551	27.1	16.8167	29.0634	38499.5	38453.6	45.898
25	23.0602	887517	basement	5.551	27.1	7.87951	13.6178	38487.4	38471.6	15.7607

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.72681

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	311.599	-3550.07	6.49053e+007	0	0
2	336.718	-3565.44	317373	196.025	0.0353887
3	361.836	-3580.05	594736	367.338	0.0353887
4	386.955	-3593.94	839945	518.791	0.0353887
5	412.073	-3607.12	1.06064e+006	655.101	0.0353886
6	437.192	-3619.63	1.24671e+006	770.027	0.0353886
7	462.31	-3631.48	1.37663e+006	850.273	0.0353886
8	487.429	-3642.69	1.48328e+006	916.147	0.0353887
9	512.547	-3653.28	1.56708e+006	967.906	0.0353887
10	537.666	-3663.27	1.62254e+006	1002.16	0.0353887
11	562.784	-3672.66	1.65457e+006	1021.95	0.0353889
12	587.903	-3681.49	1.66478e+006	1028.25	0.0353887
13	613.021	-3689.74	1.65602e+006	1022.84	0.0353887
14	638.14	-3697.45	1.63065e+006	1007.17	0.0353887
15	663.258	-3704.61	1.5843e+006	978.541	0.0353887
16	688.377	-3711.24	1.51722e+006	937.112	0.0353888
17	713.495	-3717.34	1.43999e+006	889.41	0.0353887
18	738.614	-3722.92	1.34322e+006	829.636	0.0353886
19	763.732	-3728	1.22637e+006	757.465	0.0353886
20	788.851	-3732.56	1.10102e+006	680.044	0.0353887
21	813.969	-3736.63	966881	597.193	0.0353887
22	839.088	-3740.2	813233	502.292	0.0353886
23	864.206	-3743.28	640037	395.318	0.0353887
24	889.325	-3745.87	445805	275.351	0.0353887
25	914.443	-3747.98	232425	143.557	0.0353887
26	939.562	-3749.61	7.24066e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.72825

Slice	X coordinate	Y coordinate - Bottom	Interslice Normal Force	Interslice Shear Force	Interslice Force Angle

	[m]	[m]	[kN]	[kN]	[degrees]
1	317.938	-3551.76	6.49673e+007	0	0
2	340.998	-3565.91	292827	29.5748	0.00578673
3	364.059	-3579.36	545659	109.351	0.0114822
4	387.119	-3592.15	771901	228.982	0.0169966
5	410.179	-3604.29	975530	378.713	0.0222429
6	433.239	-3615.81	1.15322e+006	546.229	0.0271385
7	456.299	-3626.72	1.27343e+006	702.462	0.0316061
8	479.359	-3637.05	1.37227e+006	852.048	0.0355752
9	502.42	-3646.81	1.45014e+006	986.655	0.0389832
10	525.48	-3656.01	1.505e+006	1097.35	0.0417764
11	548.54	-3664.68	1.53543e+006	1176.74	0.043911
12	571.6	-3672.81	1.54587e+006	1223.65	0.0453531
13	594.66	-3680.43	1.53661e+006	1235.81	0.0460798
14	617.721	-3687.54	1.51184e+006	1215.88	0.0460795
15	640.781	-3694.15	1.47057e+006	1164.04	0.0453529
16	663.841	-3700.27	1.41036e+006	1080.89	0.0439111
17	686.901	-3705.91	1.33141e+006	970.783	0.0417766
18	709.961	-3711.07	1.24272e+006	845.528	0.0389832
19	733.021	-3715.76	1.13706e+006	706.006	0.0355752
20	756.082	-3719.99	1.01325e+006	558.936	0.0316059
21	779.142	-3723.77	874205	414.072	0.0271385
22	802.202	-3727.08	734993	285.333	0.0222429
23	825.262	-3729.95	578107	171.493	0.0169966
24	848.322	-3732.37	403665	80.8952	0.0114822
25	871.383	-3734.34	211042	21.3147	0.00578673
26	894.443	-3735.87	7.18773e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.740396
Factor of Safety, standard deviation: 0.288943
Factor of Safety, minimum: 0.938453
Factor of Safety, maximum: 2.729920
Probability of Failure: 0.190% (= 19 failed surfaces / 10000 valid surfaces)
Reliability index: 2.56243 (assuming normal distribution)
Reliability index: 3.27797 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price

Factor of Safety, mean: 1.739551
Factor of Safety, standard deviation: 0.286716
Factor of Safety, minimum: 0.934933
Factor of Safety, maximum: 2.723160
Probability of Failure: 0.180% (= 18 failed surfaces / 10000 valid surfaces)
Reliability index: 2.57938 (assuming normal distribution)
Reliability index: 3.29971 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
2316	-6000
2316	0
0	0

External Boundary

X	Y
2316	-6000
2316	-3830
2226	-3830
2135	-3830
2045	-3830
1954	-3830
1863	-3830
1773	-3830
1682	-3830
1592	-3830
1501	-3829
1410	-3827
1319	-3824
1227	-3817
1136	-3802
1045	-3780
954	-3754
862	-3726

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 92PC Site 37		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_92_37_0g.sli	

776	-3700
690	-3672
604	-3643
517	-3613
431	-3584
345	-3559
259	-3536
172	-3518
86	-3502
0	-3486
0	-6000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 92PC Site 37		
	Drawn By	Jason R. Patton	Company	Oregon State University
	Date	3/26/2013	File Name	RR0705_92_37_1g.slim

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_92_37_1g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 92PC Site 37
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/26/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 92PC Site 37		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_92_37_1g.slim	

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364880731
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	Automatically Calculated
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.014493
Center: 1842.323, 311.240
Radius: 4168.206
Left Slip Surface Endpoint: 218.323, -3527.584
Right Slip Surface Endpoint: 1044.971, -3779.992
Left Slope Intercept: 218.323 -0.000
Right Slope Intercept: 1044.971 -0.000
Resisting Moment=1.91516e+007 kN-m
Driving Moment=1.32141e+009 kN-m
Resisting Horizontal Force=4458.65 kN

Driving Horizontal Force=307634 kN
Total Slice Area=3.03333e+006 m2

Method: gle/morgenstern-price

FS: 0.014477
Center: 1820.298, 170.208
Radius: 4025.598
Left Slip Surface Endpoint: 239.240, -3531.912
Right Slip Surface Endpoint: 1045.568, -3780.137
Left Slope Intercept: 239.240 -0.000
Right Slope Intercept: 1045.568 -0.000
Resisting Moment=1.68079e+007 kN-m
Driving Moment=1.16101e+009 kN-m
Resisting Horizontal Force=4049.89 kN
Driving Horizontal Force=279748 kN
Total Slice Area=2.96041e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 835
Number of Invalid Surfaces: 37

Error Codes:

Error Code -108 reported for 31 surfaces
Error Code -112 reported for 6 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 867
Number of Invalid Surfaces: 5

Error Codes:

Error Code -108 reported for 1 surface
Error Code -112 reported for 4 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This

screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.0144934

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	33.0659	1.20442e+006	basement	5.551	27.1	147.275	2.13452	36454.1	36460.8	-6.69595
2	33.0659	1.21022e+006	basement	5.551	27.1	224.953	3.26033	36695.8	36700.3	-4.47196
3	33.0659	1.2156e+006	basement	5.551	27.1	291.433	4.22385	36907.1	36909.7	-2.604
4	33.0659	1.22079e+006	basement	5.551	27.1	358.284	5.19275	37108.8	37109.4	-0.626392
5	33.0659	1.22573e+006	basement	5.551	27.1	409.612	5.93667	37293.7	37292.9	0.830511
6	33.0659	1.23044e+006	basement	5.551	27.1	460.772	6.67816	37465.8	37463.7	2.11548
7	33.0659	1.23494e+006	basement	5.551	27.1	494.816	7.17157	37625.5	37622.2	3.31674
8	33.0659	1.23907e+006	basement	5.551	27.1	507.728	7.3587	37757.9	37754.3	3.61791
9	33.0659	1.243e+006	basement	5.551	27.1	521.13	7.55295	37879.7	37875.9	3.81337
10	33.0659	1.24675e+006	basement	5.551	27.1	524.364	7.59982	37991.7	37987.6	4.12036
11	33.0659	1.25031e+006	basement	5.551	27.1	522.494	7.57271	38093	38089.1	3.94087
12	33.0659	1.25372e+006	basement	5.551	27.1	516.136	7.48057	38186.5	38182.8	3.72245
13	33.0659	1.257e+006	basement	5.551	27.1	508.134	7.36459	38275	38271.6	3.44484
14	33.0659	1.26013e+006	basement	5.551	27.1	492.387	7.13636	38356.3	38353.3	2.99591
15	33.0659	1.26313e+006	basement	5.551	27.1	475.774	6.89558	38431.7	38429	2.72169
16	33.0659	1.26602e+006	basement	5.551	27.1	454.868	6.59258	38503.1	38501.1	1.97424
17	33.0659	1.26876e+006	basement	5.551	27.1	426.763	6.18524	38567.2	38565.9	1.25555
18	33.0659	1.27144e+006	basement	5.551	27.1	409.955	5.94165	38631.3	38630.6	0.67888
19	33.0659	1.27402e+006	basement	5.551	27.1	381.173	5.5245	38692.3	38692.4	-0.141725
20	33.0659	1.27644e+006	basement	5.551	27.1	342.849	4.96905	38745.1	38746.4	-1.28399
21	33.0659	1.2787e+006	basement	5.551	27.1	293.835	4.25867	38789.5	38792.2	-2.65249
22	33.0659	1.28082e+006	basement	5.551	27.1	234.72	3.40189	38826.1	38830.4	-4.26727
23	33.0659	1.28282e+006	basement	5.551	27.1	177.469	2.57213	38858.1	38863.9	-5.78205
24	33.0659	1.28474e+006	basement	5.551	27.1	114.066	1.6532	38889.4	38896.9	-7.53462
25	33.0659	1.28653e+006	basement	5.551	27.1	12.6513	0.18336	38912.2	38922.8	-10.605

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.0144769

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	32.2531	1.17619e+006	basement	5.551	27.1	90.6258	1.31198	36493.4	36501.6	-8.20151
2	32.2531	1.18159e+006	basement	5.551	27.1	191.807	2.77677	36717.1	36722.5	-5.36323

3	32.2531	1.18676e+006	basement	5.551	27.1	284.101	4.1129	36926.2	36929	-2.78012
4	32.2531	1.19173e+006	basement	5.551	27.1	363.613	5.26398	37123.4	37124	-0.579491
5	32.2531	1.19644e+006	basement	5.551	27.1	429.445	6.21703	37303.4	37302.2	1.24476
6	32.2531	1.20098e+006	basement	5.551	27.1	488.747	7.07554	37474.6	37471.6	2.99271
7	32.2531	1.20521e+006	basement	5.551	27.1	504.229	7.29967	37623.1	37619.6	3.52246
8	32.2531	1.20916e+006	basement	5.551	27.1	518.715	7.50939	37752.7	37748.8	3.87052
9	32.2531	1.21294e+006	basement	5.551	27.1	523.13	7.5733	37873.7	37869.7	3.97189
10	32.2531	1.21654e+006	basement	5.551	27.1	514.928	7.45456	37983.5	37979.7	3.7552
11	32.2531	1.21998e+006	basement	5.551	27.1	501.422	7.25904	38084.3	38081	3.33482
12	32.2531	1.22327e+006	basement	5.551	27.1	486.246	7.03933	38178.4	38175.3	3.05773
13	32.2531	1.22644e+006	basement	5.551	27.1	465.789	6.74318	38267	38264.7	2.30134
14	32.2531	1.22946e+006	basement	5.551	27.1	437.784	6.33776	38347.9	38346.5	1.39493
15	32.2531	1.23237e+006	basement	5.551	27.1	417.576	6.0452	38424.6	38423.7	0.903742
16	32.2531	1.23516e+006	basement	5.551	27.1	386.05	5.5888	38496.2	38496.1	0.148198
17	32.2531	1.23781e+006	basement	5.551	27.1	357.583	5.17669	38561	38561.8	-0.757823
18	32.2531	1.24041e+006	basement	5.551	27.1	340.876	4.93482	38627.4	38628.6	-1.21629
19	32.2531	1.24289e+006	basement	5.551	27.1	310.819	4.4997	38688.4	38690.3	-1.88928
20	32.2531	1.24523e+006	basement	5.551	27.1	275.862	3.99363	38741.4	38744.5	-3.08079
21	32.2531	1.24741e+006	basement	5.551	27.1	236.994	3.43094	38786.4	38790.5	-4.09937
22	32.2531	1.24945e+006	basement	5.551	27.1	194.788	2.81992	38823.7	38829.1	-5.4497
23	32.2531	1.25138e+006	basement	5.551	27.1	158.534	2.29508	38857.4	38863.7	-6.29425
24	32.2531	1.25324e+006	basement	5.551	27.1	119.619	1.73171	38889.8	38897.2	-7.38904
25	32.2531	1.25496e+006	basement	5.551	27.1	74.2438	1.07482	38914.8	38923.6	-8.78448

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.0144934

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	218.323	-3527.58	6.40858e+007	0	0
2	251.389	-3541.41	252689	-869.989	-0.197264
3	284.455	-3554.89	440891	-1517.95	-0.197264
4	317.521	-3568.05	602730	-2075.15	-0.197264
5	350.587	-3580.89	749862	-2581.72	-0.197264
6	383.652	-3593.4	863320	-2972.34	-0.197264
7	416.718	-3605.6	966018	-3325.92	-0.197264
8	449.784	-3617.47	1.02569e+006	-3531.36	-0.197264
9	482.85	-3629.04	1.04934e+006	-3612.8	-0.197264
10	515.916	-3640.29	1.06112e+006	-3653.35	-0.197264

11	548.982	-3651.24	1.0519e+006	-3621.62	-0.197265
12	582.048	-3661.88	1.03025e+006	-3547.08	-0.197265
13	615.114	-3672.21	999580	-3441.48	-0.197264
14	648.18	-3682.25	962993	-3315.51	-0.197264
15	681.246	-3691.99	914283	-3147.8	-0.197264
16	714.312	-3701.43	864065	-2974.91	-0.197264
17	747.377	-3710.58	805669	-2773.85	-0.197264
18	780.443	-3719.44	739214	-2545.06	-0.197264
19	813.509	-3728	686047	-2362.01	-0.197264
20	846.575	-3736.28	621207	-2138.77	-0.197264
21	879.641	-3744.27	543407	-1870.91	-0.197264
22	912.707	-3751.98	452904	-1559.31	-0.197264
23	945.773	-3759.4	351005	-1208.48	-0.197264
24	978.839	-3766.55	255540	-879.803	-0.197264
25	1011.9	-3773.41	154906	-533.329	-0.197264
26	1044.97	-3779.99	7.35849e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.0144769

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	239.24	-3531.91	6.42432e+007	0	0
2	271.493	-3545.52	225289	-180.816	-0.0459853
3	303.746	-3558.8	397163	-632.494	-0.0912452
4	336	-3571.76	558815	-1317.33	-0.135067
5	368.253	-3584.39	690310	-2129.61	-0.176757
6	400.506	-3596.7	803425	-3024.09	-0.21566
7	432.759	-3608.7	902700	-3957.1	-0.251162
8	465.012	-3620.39	938982	-4633.06	-0.282703
9	497.265	-3631.77	963815	-5211.17	-0.309785
10	529.518	-3642.84	973682	-5641.74	-0.331981
11	561.771	-3653.6	966500	-5886.25	-0.348943
12	594.025	-3664.07	947758	-5961.64	-0.3604
13	626.278	-3674.24	923721	-5903.55	-0.366175
14	658.531	-3684.11	890978	-5694.28	-0.366175
15	690.784	-3693.68	847046	-5328.14	-0.360401
16	723.037	-3702.96	805196	-4903.86	-0.348942
17	755.29	-3711.96	751870	-4356.5	-0.331981
18	787.543	-3720.66	697078	-3768.97	-0.309785
19	819.796	-3729.08	648920	-3201.85	-0.282702
20	852.05	-3737.21	589362	-2583.54	-0.251161

21	884.303	-3745.06	516624	-1944.57	-0.21566
22	916.556	-3752.63	431568	-1331.39	-0.176757
23	948.809	-3759.92	334893	-789.462	-0.135066
24	981.062	-3766.94	245956	-391.693	-0.0912453
25	1013.32	-3773.68	149231	-119.772	-0.0459853
26	1045.57	-3780.14	7.35906e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.079413
Factor of Safety, standard deviation: 0.103579
Factor of Safety, minimum: 0.000850
Factor of Safety, maximum: 1.765890
Probability of Failure: 99.920% (= 9988 failed surfaces / 9996 valid surfaces), 4 invalid surfaces
Reliability index: -8.88779 (assuming normal distribution)
Reliability index: -3.03953 (assuming lognormal distribution)
* best fit = Beta

Method: gle/morgenstern-price
Factor of Safety, mean: 0.085356
Factor of Safety, standard deviation: 0.104370
Factor of Safety, minimum: 0.000913
Factor of Safety, maximum: 1.771180
Probability of Failure: 99.920% (= 9989 failed surfaces / 9997 valid surfaces), 3 invalid surfaces
Reliability index: -8.76349 (assuming normal distribution)
Reliability index: -3.05172 (assuming lognormal distribution)
* best fit = Beta

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
2316	-6000
2316	0
0	0

External Boundary

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 92PC Site 37		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_92_37_1g.slim	

X	Y
2316	-6000
2316	-3830
2226	-3830
2135	-3830
2045	-3830
1954	-3830
1863	-3830
1773	-3830
1682	-3830
1592	-3830
1501	-3829
1410	-3827
1319	-3824
1227	-3817
1136	-3802
1045	-3780
954	-3754
862	-3726
776	-3700
690	-3672
604	-3643
517	-3613
431	-3584
345	-3559
259	-3536
172	-3518
86	-3502
0	-3486
0	-6000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 93PC Site 90	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/26/2013	File Name: RR0705_93_90_0g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_93_90_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 93PC Site 90
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/26/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364880557
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	Automatically Calculated
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 93PC Site 90		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_93_90_0g.sli	

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Global Minimums

Method: spencer

FS: 1.110250
Center: 1279.664, -2686.107
Radius: 1495.236
Left Slip Surface Endpoint: 337.373, -3847.062
Right Slip Surface Endpoint: 928.151, -4139.437
Left Slope Intercept: 337.373 0.000
Right Slope Intercept: 928.151 0.000
Resisting Moment=7.17883e+007 kN-m
Driving Moment=6.46594e+007 kN-m
Resisting Horizontal Force=42821 kN
Driving Horizontal Force=38568.7 kN
Total Slice Area=2.3753e+006 m2

Method: gle/morgenstern-price

FS: 1.111060
Center: 965.968, -3262.201
Radius: 847.525
Left Slip Surface Endpoint: 358.274, -3852.969
Right Slip Surface Endpoint: 849.021, -4101.619
Left Slope Intercept: 358.274 0.000
Right Slope Intercept: 849.021 0.000
Resisting Moment=4.03949e+007 kN-m
Driving Moment=3.63571e+007 kN-m
Resisting Horizontal Force=42385.6 kN

Driving Horizontal Force=38148.8 kN
Total Slice Area=1.96874e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2516
Number of Invalid Surfaces: 342

Error Codes:

Error Code -108 reported for 341 surfaces
Error Code -112 reported for 1 surface

Method: gle/morgenstern-price

Number of Valid Surfaces: 2858
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.11025

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	23.6311	939464	basement	5.551	27.1	9.58467	10.6414	39731.3	39721.5	9.82124
2	23.6311	945359	basement	5.551	27.1	31.8607	35.3733	39969.2	39911.1	58.1395
3	23.6311	950519	basement	5.551	27.1	45.8091	50.8595	40181.7	40093	88.6826
4	23.6311	955375	basement	5.551	27.1	57.3473	63.6698	40381.3	40267.6	113.702
5	23.6311	959975	basement	5.551	27.1	67.7438	75.2126	40571.3	40435.2	136.099
6	23.6311	964280	basement	5.551	27.1	76.766	85.2294	40751.9	40596	155.874
7	23.6311	968216	basement	5.551	27.1	82.3755	91.4574	40918.3	40750.4	167.875

8	23.6311	971917	basement	5.551	27.1	86.5249	96.0643	41075.1	40898.4	176.705
9	23.6311	975397	basement	5.551	27.1	89.5136	99.3825	41223.7	41040.4	183.26
10	23.6311	978674	basement	5.551	27.1	91.423	101.502	41364	41176.5	187.488
11	23.6311	981764	basement	5.551	27.1	92.6143	102.825	41497.1	41306.9	190.198
12	23.6311	984654	basement	5.551	27.1	92.7007	102.921	41622	41431.7	190.295
13	23.6311	987346	basement	5.551	27.1	91.657	101.762	41739	41551.2	187.843
14	23.6311	989870	basement	5.551	27.1	89.6574	99.5421	41848.9	41665.4	183.489
15	23.6311	992235	basement	5.551	27.1	87.1838	96.7958	41952.9	41774.5	178.375
16	23.6311	994418	basement	5.551	27.1	83.6132	92.8316	42049.2	41878.6	170.563
17	23.6311	996422	basement	5.551	27.1	78.9303	87.6324	42138.1	41977.8	160.339
18	23.6311	998294	basement	5.551	27.1	73.4903	81.5926	42220.9	42072.2	148.718
19	23.6311	1.00004e+006	basement	5.551	27.1	67.9969	75.4936	42298.6	42161.9	136.677
20	23.6311	1.00161e+006	basement	5.551	27.1	61.4083	68.1786	42369.3	42246.9	122.45
21	23.6311	1.00302e+006	basement	5.551	27.1	53.7078	59.6291	42433	42327.5	105.488
22	23.6311	1.00429e+006	basement	5.551	27.1	45.1355	50.1117	42490.8	42403.6	87.2059
23	23.6311	1.00541e+006	basement	5.551	27.1	35.8212	39.7705	42542.1	42475.3	66.766
24	23.6311	1.00637e+006	basement	5.551	27.1	25.3993	28.1996	42586.8	42542.6	44.1919
25	23.6311	1.00717e+006	basement	5.551	27.1	13.8533	15.3807	42625	42605.7	19.2698

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.11106

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	19.6299	781724	basement	5.551	27.1	13.802	15.3349	39805.5	39786.2	19.2737
2	19.6299	786654	basement	5.551	27.1	30.2906	33.6547	40036	39981.2	54.8067
3	19.6299	791155	basement	5.551	27.1	44.577	49.5277	40250	40164.2	85.7811
4	19.6299	795321	basement	5.551	27.1	57.7604	64.1753	40450.7	40336.2	114.532
5	19.6299	799178	basement	5.551	27.1	69.8828	77.644	40638.9	40497.9	140.965
6	19.6299	802713	basement	5.551	27.1	80.9207	89.9078	40815	40650.1	164.86
7	19.6299	805889	basement	5.551	27.1	89.1622	99.0645	40976.2	40793.4	182.779
8	19.6299	808805	basement	5.551	27.1	96.0038	106.666	41126	40928.4	197.591
9	19.6299	811481	basement	5.551	27.1	101.691	112.985	41265.3	41055.4	209.941
10	19.6299	813929	basement	5.551	27.1	106.18	117.972	41394.6	41174.9	219.665
11	19.6299	816171	basement	5.551	27.1	109.459	121.616	41514	41287.2	226.771
12	19.6299	818217	basement	5.551	27.1	111.848	124.27	41624.6	41392.6	232.003
13	19.6299	820064	basement	5.551	27.1	112.891	125.429	41725.7	41491.5	234.232
14	19.6299	821717	basement	5.551	27.1	112.519	125.015	41817.4	41584	233.449
15	19.6299	823188	basement	5.551	27.1	110.591	122.873	41899.6	41670.4	229.242
16	19.6299	824504	basement	5.551	27.1	107.535	119.478	41973.5	41750.8	222.653
17	19.6299	825654	basement	5.551	27.1	103.263	114.731	42038.9	41825.5	213.372
18	19.6299	826634	basement	5.551	27.1	97.3368	108.147	42095.1	41894.6	200.513

19	19.6299	827449	basement	5.551	27.1	89.7044	99.667	42142.2	41958.2	183.952
20	19.6299	828112	basement	5.551	27.1	80.3265	89.2476	42180.1	42016.5	163.612
21	19.6299	828660	basement	5.551	27.1	70.2436	78.0448	42211.3	42069.6	141.674
22	19.6299	829057	basement	5.551	27.1	58.6493	65.1629	42234.1	42117.5	116.553
23	19.6299	829302	basement	5.551	27.1	45.2718	50.2997	42247.9	42160.4	87.4538
24	19.6299	829395	basement	5.551	27.1	30.1085	33.4523	42252.9	42198.4	54.4721
25	19.6299	829350	basement	5.551	27.1	13.3857	14.8724	42249.6	42231.4	18.1742

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.11025

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	337.373	-3847.06	7.62194e+007	0	0
2	361.004	-3865.85	481379	386.097	0.0459549
3	384.635	-3883.88	810665	650.206	0.0459549
4	408.266	-3901.18	1.04903e+006	841.39	0.0459549
5	431.897	-3917.78	1.26112e+006	1011.5	0.0459549
6	455.528	-3933.72	1.44765e+006	1161.11	0.045955
7	479.159	-3949.01	1.5681e+006	1257.72	0.045955
8	502.791	-3963.68	1.64841e+006	1322.13	0.0459549
9	526.422	-3977.76	1.70463e+006	1367.22	0.0459548
10	550.053	-3991.25	1.73727e+006	1393.4	0.0459548
11	573.684	-4004.18	1.75557e+006	1408.08	0.0459549
12	597.315	-4016.57	1.75303e+006	1406.05	0.0459551
13	620.946	-4028.43	1.72835e+006	1386.25	0.045955
14	644.577	-4039.77	1.6819e+006	1348.99	0.0459548
15	668.208	-4050.6	1.62916e+006	1306.69	0.0459549
16	691.839	-4060.95	1.55642e+006	1248.35	0.0459549
17	715.471	-4070.81	1.46302e+006	1173.44	0.045955
18	739.102	-4080.21	1.34938e+006	1082.29	0.0459549
19	762.733	-4089.14	1.24222e+006	996.341	0.0459549
20	786.364	-4097.63	1.11538e+006	894.61	0.0459551
21	809.995	-4105.66	969117	777.294	0.0459549
22	833.626	-4113.26	804851	645.542	0.0459549
23	857.257	-4120.44	631257	506.309	0.0459549
24	880.888	-4127.19	438936	352.055	0.0459549
25	904.52	-4133.52	228080	182.935	0.0459549
26	928.151	-4139.44	8.82449e+007	0	0

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 93PC Site 90		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_93_90_0g.sli	

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.11106

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	358.274	-3852.97	7.64536e+007	0	0
2	377.903	-3872.51	486094	79.5141	0.00937231
3	397.533	-3890.84	840977	272.961	0.0185968
4	417.163	-3908.04	1.15367e+006	554.287	0.0275281
5	436.793	-3924.22	1.42702e+006	897.251	0.0360252
6	456.423	-3939.45	1.66345e+006	1276.1	0.0439539
7	476.053	-3953.78	1.83129e+006	1636.13	0.0511898
8	495.683	-3967.28	1.95245e+006	1963.44	0.0576183
9	515.313	-3979.98	2.04183e+006	2250.03	0.0631381
10	534.943	-3991.94	2.10079e+006	2480.89	0.0676624
11	554.572	-4003.18	2.1308e+006	2644.88	0.071119
12	574.202	-4013.75	2.1411e+006	2744.95	0.0734547
13	593.832	-4023.66	2.12426e+006	2766.99	0.0746315
14	613.462	-4032.94	2.0811e+006	2710.77	0.0746315
15	633.092	-4041.62	2.01238e+006	2579.92	0.0734545
16	652.722	-4049.71	1.92336e+006	2387.39	0.0711189
17	672.352	-4057.24	1.81889e+006	2147.98	0.0676622
18	691.982	-4064.22	1.69078e+006	1863.19	0.0631382
19	711.612	-4070.66	1.53953e+006	1548.2	0.0576184
20	731.241	-4076.57	1.3656e+006	1220.07	0.0511898
21	750.871	-4081.98	1.18278e+006	907.365	0.0439542
22	770.501	-4086.88	986897	620.519	0.0360252
23	790.131	-4091.28	769553	369.736	0.0275281
24	809.761	-4095.21	531061	172.37	0.0185969
25	829.391	-4098.65	271701	44.4443	0.00937233
26	849.021	-4101.62	8.66399e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.117463
Factor of Safety, standard deviation: 0.183249
Factor of Safety, minimum: 0.581965
Factor of Safety, maximum: 1.800510
Probability of Failure: 26.670% (= 2667 failed surfaces / 10000 valid surfaces)
Reliability index: 0.64100 (assuming normal distribution)

Reliability index: 0.60033 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 1.119173
Factor of Safety, standard deviation: 0.185964
Factor of Safety, minimum: 0.585302
Factor of Safety, maximum: 1.795360
Probability of Failure: 26.860% (= 2686 failed surfaces / 10000 valid surfaces)
Reliability index: 0.64084 (assuming normal distribution)
Reliability index: 0.59971 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-7000
4351	-7000
4351	0
0	0

External Boundary

X	Y
4351	-7000
4351	-4707
4258	-4717
4166	-4724
4073	-4728
3980	-4730
3888	-4731
3795	-4729
3703	-4727
3610	-4724
3518	-4720
3425	-4714
3332	-4707
3239	-4698
3147	-4689

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 93PC Site 90		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_93_90_0g.sli	

3054	-4677
2961	-4664
2868	-4649
2776	-4635
2683	-4621
2590	-4606
2497	-4587
2404	-4567
2312	-4544
2219	-4522
2126	-4502
2033	-4484
1940	-4465
1848	-4448
1755	-4431
1662	-4412
1570	-4391
1477	-4365
1385	-4335
1293	-4301
1200	-4264
1108	-4223
1016	-4181
923	-4137
831	-4093
739	-4048
646	-4000
554	-3951
462	-3901
369	-3856
277	-3830
185	-3818
92	-3820
0	-3830
0	-7000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 93PC Site 90	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/26/2013	File Name: RR0705_93_90_1g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_93_90_1g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 93PC Site 90
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/26/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 93PC Site 90		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_93_90_1g.sli	

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364880425
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	Automatically Calculated
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.001689
Center: 1404.951, -2531.633
Radius: 1693.239
Left Slip Surface Endpoint: 339.546, -3847.676
Right Slip Surface Endpoint: 1010.020, -4178.171
Left Slope Intercept: 339.546 0.000
Right Slope Intercept: 1010.020 0.000
Resisting Moment=1.42807e+006 kN-m
Driving Moment=8.4571e+008 kN-m
Resisting Horizontal Force=849.515 kN

Driving Horizontal Force=503086 kN
Total Slice Area=2.71139e+006 m2

Method: gle/morgenstern-price

FS: 0.001533
Center: 1315.035, -2708.761
Radius: 1486.668
Left Slip Surface Endpoint: 370.228, -3856.594
Right Slip Surface Endpoint: 950.650, -4150.082
Left Slope Intercept: 370.228 0.000
Right Slope Intercept: 950.650 0.000
Resisting Moment=780068 kN-m
Driving Moment=5.08716e+008 kN-m
Resisting Horizontal Force=530.488 kN
Driving Horizontal Force=345955 kN
Total Slice Area=2.33925e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1206
Number of Invalid Surfaces: 32

Error Codes:

Error Code -108 reported for 19 surfaces
Error Code -111 reported for 1 surface
Error Code -112 reported for 12 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1228
Number of Invalid Surfaces: 10

Error Codes:

Error Code -108 reported for 5 surfaces
Error Code -112 reported for 5 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.00168861

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	26.8189	1.06683e+006	basement	5.551	27.1	983.377	1.66054	39841.9	39849.4	-7.49666
2	26.8189	1.07424e+006	basement	5.551	27.1	835.486	1.41081	40231.9	40239.9	-7.98046
3	26.8189	1.08082e+006	basement	5.551	27.1	898.739	1.51762	40549.9	40557.7	-7.83259
4	26.8189	1.08706e+006	basement	5.551	27.1	989.678	1.67118	40846.6	40854	-7.40828
5	26.8189	1.09293e+006	basement	5.551	27.1	1019.7	1.72187	41120.3	41127.7	-7.43437
6	26.8189	1.09832e+006	basement	5.551	27.1	998.662	1.68635	41355.3	41362.9	-7.64625
7	26.8189	1.10336e+006	basement	5.551	27.1	1029.02	1.73762	41567.6	41575.2	-7.5659
8	26.8189	1.1081e+006	basement	5.551	27.1	1047.71	1.76918	41761.9	41769.5	-7.57154
9	26.8189	1.11258e+006	basement	5.551	27.1	1082.35	1.82767	41941.4	41948.5	-7.0943
10	26.8189	1.11681e+006	basement	5.551	27.1	1081.96	1.82701	42105.7	42112.9	-7.18075
11	26.8189	1.12077e+006	basement	5.551	27.1	1066.9	1.80157	42253.7	42260.9	-7.1916
12	26.8189	1.12448e+006	basement	5.551	27.1	1063.28	1.79547	42386.7	42394	-7.28247
13	26.8189	1.12798e+006	basement	5.551	27.1	1045.94	1.76619	42509.4	42516.8	-7.39997
14	26.8189	1.13125e+006	basement	5.551	27.1	992.017	1.67513	42617.6	42625.1	-7.45007
15	26.8189	1.13428e+006	basement	5.551	27.1	926.839	1.56507	42710.9	42718.6	-7.70247
16	26.8189	1.13713e+006	basement	5.551	27.1	922.871	1.55837	42796.7	42804.6	-7.85338
17	26.8189	1.1398e+006	basement	5.551	27.1	827.633	1.39755	42872.9	42881	-8.10596
18	26.8189	1.14224e+006	basement	5.551	27.1	706.581	1.19314	42935.2	42943.5	-8.34488
19	26.8189	1.14447e+006	basement	5.551	27.1	587.152	0.99147	42984.8	42993.6	-8.80244
20	26.8189	1.14652e+006	basement	5.551	27.1	429.797	0.72576	43024.1	43033.6	-9.46778
21	26.8189	1.14836e+006	basement	5.551	27.1	222.899	0.37639	43050.9	43060.8	-9.94038
22	26.8189	1.14998e+006	basement	5.551	27.1	0	0	43061.5	43075.2	-13.6828
23	26.8189	1.15142e+006	basement	5.551	27.1	0	0	43026.4	43078.4	-52.0467
24	26.8189	1.15265e+006	basement	5.551	27.1	0	0	42974.5	43069.7	-95.1899
25	26.8189	1.15369e+006	basement	5.551	27.1	0	0	42758.3	43048.7	-290.356

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.0015334

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]

1	23.2169	924968	basement	5.551	27.1	149.987	0.22999	39868.4	39878.9	-10.5313
2	23.2169	930281	basement	5.551	27.1	387.277	0.59385	40171.4	40181	-9.59306
3	23.2169	935322	basement	5.551	27.1	609.919	0.93525	40454.9	40463.8	-8.93863
4	23.2169	940104	basement	5.551	27.1	810.689	1.24311	40719.7	40728.3	-8.61497
5	23.2169	944540	basement	5.551	27.1	914.569	1.4024	40954.8	40963.1	-8.25836
6	23.2169	948655	basement	5.551	27.1	1013.71	1.55443	41163.2	41171	-7.78569
7	23.2169	952541	basement	5.551	27.1	1081.45	1.6583	41354.9	41362.6	-7.66939
8	23.2169	956205	basement	5.551	27.1	1118.22	1.71468	41530.8	41538.5	-7.65905
9	23.2169	959674	basement	5.551	27.1	1143.49	1.75343	41693.9	41701.5	-7.61656
10	23.2169	962950	basement	5.551	27.1	1123.28	1.72243	41843.9	41851.4	-7.45369
11	23.2169	966024	basement	5.551	27.1	1072.67	1.64483	41979.6	41987.1	-7.4774
12	23.2169	968904	basement	5.551	27.1	999.341	1.53239	42101.2	42109	-7.76194
13	23.2169	971624	basement	5.551	27.1	940.44	1.44207	42213.3	42221.1	-7.82696
14	23.2169	974178	basement	5.551	27.1	829.927	1.27261	42314	42322.4	-8.38001
15	23.2169	976551	basement	5.551	27.1	703.789	1.07919	42402	42410.9	-8.88964
16	23.2169	978749	basement	5.551	27.1	576.184	0.88352	42478	42487	-8.97645
17	23.2169	980824	basement	5.551	27.1	509.9	0.78188	42547.6	42556.8	-9.22392
18	23.2169	982761	basement	5.551	27.1	383.716	0.58839	42609	42618.6	-9.55841
19	23.2169	984534	basement	5.551	27.1	263.415	0.40392	42658.7	42668.6	-9.93896
20	23.2169	986145	basement	5.551	27.1	158.582	0.24317	42697	42707.2	-10.2042
21	23.2169	987617	basement	5.551	27.1	89.2918	0.13692	42726.2	42737	-10.791
22	23.2169	988944	basement	5.551	27.1	21.1947	0.0325	42746.4	42757.1	-10.687
23	23.2169	990117	basement	5.551	27.1	0	0	42752.3	42766.2	-13.8888
24	23.2169	991138	basement	5.551	27.1	0	0	42748.8	42764.6	-15.7586
25	23.2169	992019	basement	5.551	27.1	0	0	42739.3	42753.7	-14.3639

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.00168861

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	339.546	-3847.68	7.62438e+007	0	0
2	366.365	-3868.94	536745	-8727.47	-0.931547
3	393.184	-3889.35	859347	-13973	-0.931548
4	420.003	-3908.93	1.13441e+006	-18445.4	-0.931542
5	446.822	-3927.72	1.38275e+006	-22483.5	-0.931547
6	473.641	-3945.75	1.57727e+006	-25646.4	-0.931547
7	500.46	-3963.05	1.7091e+006	-27790	-0.931548
8	527.279	-3979.65	1.8138e+006	-29492.4	-0.931548

9	554.098	-3995.57	1.89169e+006	-30758.8	-0.931545
10	580.917	-4010.83	1.95457e+006	-31781.3	-0.931547
11	607.736	-4025.46	1.99131e+006	-32378.7	-0.931547
12	634.555	-4039.46	2.00218e+006	-32555.5	-0.931549
13	661.374	-4052.87	1.99761e+006	-32481	-0.931543
14	688.193	-4065.68	1.97545e+006	-32120.8	-0.931547
15	715.011	-4077.93	1.9285e+006	-31357.4	-0.931547
16	741.83	-4089.62	1.86014e+006	-30245.8	-0.931545
17	768.649	-4100.77	1.79379e+006	-29167	-0.931546
18	795.468	-4111.38	1.70391e+006	-27705.6	-0.931548
19	822.287	-4121.46	1.59086e+006	-25867.3	-0.931544
20	849.106	-4131.04	1.46296e+006	-23787.7	-0.931546
21	875.925	-4140.11	1.3166e+006	-21407.9	-0.931547
22	902.744	-4148.68	1.14843e+006	-18673.4	-0.931544
23	929.563	-4156.77	960070	-15610.7	-0.931545
24	956.382	-4164.37	751445	-12218.5	-0.931548
25	983.201	-4171.51	518137	-8424.9	-0.931546
26	1010.02	-4178.17	8.99041e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.0015334

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	370.228	-3856.59	7.65976e+007	0	0
2	393.444	-3875.32	299399	-511.299	-0.0978468
3	416.661	-3893.29	573201	-1942.33	-0.19415
4	439.878	-3910.54	821861	-4122.41	-0.28739
5	463.095	-3927.11	1.04325e+006	-6848.11	-0.376096
6	486.312	-3943.02	1.18758e+006	-9511.29	-0.45887
7	509.529	-3958.3	1.30758e+006	-12196.3	-0.534404
8	532.746	-3972.96	1.40378e+006	-14737.9	-0.601511
9	555.963	-3987.04	1.47756e+006	-16998.7	-0.659135
10	579.18	-4000.54	1.53788e+006	-18960.3	-0.706356
11	602.396	-4013.49	1.57605e+006	-20423.6	-0.742439
12	625.613	-4025.91	1.59251e+006	-21314.6	-0.766817
13	648.83	-4037.8	1.58955e+006	-21615.9	-0.779103
14	672.047	-4049.19	1.57924e+006	-21475.8	-0.779107
15	695.264	-4060.08	1.54849e+006	-20725.5	-0.76682
16	718.481	-4070.49	1.49755e+006	-19406.5	-0.742445
17	741.698	-4080.43	1.42956e+006	-17624.9	-0.706358
18	764.915	-4089.9	1.36431e+006	-15695.7	-0.65913

19	788.132	-4098.92	1.27955e+006	-13433.7	-0.601513
20	811.349	-4107.5	1.17529e+006	-10962.4	-0.534405
21	834.565	-4115.65	1.05304e+006	-8433.77	-0.458871
22	857.782	-4123.36	919973	-6038.9	-0.376096
23	880.999	-4130.66	767167	-3848.07	-0.28739
24	904.216	-4137.54	594153	-2013.33	-0.19415
25	927.433	-4144.01	401719	-686.036	-0.0978468
26	950.65	-4150.08	8.86994e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.027258
Factor of Safety, standard deviation: 0.064825
Factor of Safety, minimum: 0.000093
Factor of Safety, maximum: 1.073680
Probability of Failure: 99.990% (= 9907 failed surfaces / 9908 valid surfaces), 92 invalid surfaces
Reliability index: -15.00569 (assuming normal distribution)
Reliability index: -3.30495 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 0.025946
Factor of Safety, standard deviation: 0.064603
Factor of Safety, minimum: 0.000088
Factor of Safety, maximum: 1.079770
Probability of Failure: 99.990% (= 9985 failed surfaces / 9986 valid surfaces), 14 invalid surfaces
Reliability index: -15.07763 (assuming normal distribution)
Reliability index: -3.30160 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-7000
4351	-7000
4351	0
0	0

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 93PC Site 90		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_93_90_1g.sli	

External Boundary

X	Y
4351	-7000
4351	-4707
4258	-4717
4166	-4724
4073	-4728
3980	-4730
3888	-4731
3795	-4729
3703	-4727
3610	-4724
3518	-4720
3425	-4714
3332	-4707
3239	-4698
3147	-4689
3054	-4677
2961	-4664
2868	-4649
2776	-4635
2683	-4621
2590	-4606
2497	-4587
2404	-4567
2312	-4544
2219	-4522
2126	-4502
2033	-4484
1940	-4465
1848	-4448
1755	-4431
1662	-4412
1570	-4391
1477	-4365
1385	-4335
1293	-4301
1200	-4264
1108	-4223
1016	-4181

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 93PC Site 90		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_93_90_1g.sli	

923	-4137
831	-4093
739	-4048
646	-4000
554	-3951
462	-3901
369	-3856
277	-3830
185	-3818
92	-3820
0	-3830
0	-7000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 94PC Site 93		
	Drawn By	Jason R. Patton	Company	Oregon State University
	Date	3/26/2013	File Name	RR0705_94_93_0g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_94_93_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 94PC Site 93
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/26/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364857769
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 100
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 94PC Site 93		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_94_93_0g.sli	

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 30000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	5.8
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Global Minimums

Method: spencer

FS: 1.061120
Center: 859.803, -2513.054
Radius: 611.984
Left Slip Surface Endpoint: 412.224, -2930.424
Right Slip Surface Endpoint: 752.025, -3115.473
Left Slope Intercept: 412.224 0.000
Right Slope Intercept: 752.025 0.000
Resisting Moment=1.44533e+007 kN-m
Driving Moment=1.36207e+007 kN-m
Resisting Horizontal Force=20675.5 kN
Driving Horizontal Force=19484.5 kN
Total Slice Area=1.03533e+006 m2

Method: gle/morgenstern-price

FS: 1.060380
Center: 859.803, -2513.054
Radius: 611.984
Left Slip Surface Endpoint: 412.224, -2930.424
Right Slip Surface Endpoint: 752.025, -3115.473
Left Slope Intercept: 412.224 0.000
Right Slope Intercept: 752.025 0.000
Resisting Moment=1.44432e+007 kN-m
Driving Moment=1.36207e+007 kN-m
Resisting Horizontal Force=20669.8 kN

Driving Horizontal Force=19492.8 kN
Total Slice Area=1.03533e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 19255
Number of Invalid Surfaces: 4671

Error Codes:

Error Code -108 reported for 4671 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 23926
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.06112

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	13.5921	411544	basement	5.551	27.1	5.35372	5.68094	30256.3	30256.1	0.202688
2	13.5921	414030	basement	5.551	27.1	19.7745	20.9831	30427.2	30397	30.1728
3	13.5921	416338	basement	5.551	27.1	33.1592	35.1859	30587.4	30529.5	57.8575
4	13.5921	418428	basement	5.551	27.1	45.1643	47.9247	30737	30654.1	82.8562
5	13.5921	420313	basement	5.551	27.1	53.7505	57.0357	30872.2	30771.6	100.626
6	13.5921	422057	basement	5.551	27.1	61.2557	64.9997	30998.6	30882.4	116.172
7	13.5921	423671	basement	5.551	27.1	67.6994	71.8372	31116.5	30986.9	129.56
8	13.5921	425162	basement	5.551	27.1	73.0991	77.5669	31226.3	31085.6	140.715
9	13.5921	426536	basement	5.551	27.1	77.4703	82.2053	31328.5	31178.7	149.834
10	13.5921	427799	basement	5.551	27.1	80.8482	85.7896	31423.5	31266.6	156.851
11	13.5921	428950	basement	5.551	27.1	83.0456	88.1213	31510.9	31349.5	161.355

12	13.5921	429998	basement	5.551	27.1	84.0849	89.2242	31591.1	31427.6	163.486
13	13.5921	430949	basement	5.551	27.1	84.1315	89.2736	31664.8	31501.1	163.661
14	13.5921	431809	basement	5.551	27.1	83.1913	88.276	31732	31570.3	161.656
15	13.5921	432579	basement	5.551	27.1	81.2694	86.2366	31792.8	31635.2	157.602
16	13.5921	433263	basement	5.551	27.1	78.3683	83.1582	31847.6	31696	151.619
17	13.5921	433865	basement	5.551	27.1	74.4822	79.0345	31896.4	31752.8	143.567
18	13.5921	434390	basement	5.551	27.1	69.7392	74.0017	31939.5	31805.8	133.704
19	13.5921	434837	basement	5.551	27.1	64.0516	67.9664	31976.9	31855	121.928
20	13.5921	435206	basement	5.551	27.1	57.3819	60.8891	32008.7	31900.5	108.188
21	13.5921	435501	basement	5.551	27.1	49.7243	52.7634	32034.8	31942.5	92.3047
22	13.5921	435722	basement	5.551	27.1	41.0709	43.5812	32055.3	31981	74.292
23	13.5921	435871	basement	5.551	27.1	31.4122	33.3321	32070.3	32016	54.3165
24	13.5921	436002	basement	5.551	27.1	21.0955	22.3849	32080.6	32047.7	32.8781
25	13.5921	436119	basement	5.551	27.1	12.9061	13.6949	32092	32076	15.9595

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.06038

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	13.5921	411544	basement	5.551	27.1	9.77675	10.3671	30265.5	30256.1	9.38683
2	13.5921	414030	basement	5.551	27.1	22.23	23.5723	30432.2	30397	35.2282
3	13.5921	416338	basement	5.551	27.1	33.9228	35.9711	30588.9	30529.5	59.4285
4	13.5921	418428	basement	5.551	27.1	44.1492	46.8149	30734.8	30654.1	80.6833
5	13.5921	420313	basement	5.551	27.1	51.9309	55.0665	30868.3	30771.6	96.7453
6	13.5921	422057	basement	5.551	27.1	58.9294	62.4876	30993.7	30882.4	111.27
7	13.5921	423671	basement	5.551	27.1	65.1495	69.0832	31111.1	30986.9	124.198
8	13.5921	425162	basement	5.551	27.1	70.5844	74.8463	31221	31085.6	135.432
9	13.5921	426536	basement	5.551	27.1	75.2176	79.7592	31323.8	31178.7	145.074
10	13.5921	427799	basement	5.551	27.1	79.0518	83.825	31419.6	31266.6	152.955
11	13.5921	428950	basement	5.551	27.1	81.8633	86.8062	31508.3	31349.5	158.801
12	13.5921	429998	basement	5.551	27.1	83.5882	88.6353	31590	31427.6	162.385
13	13.5921	430949	basement	5.551	27.1	84.3508	89.4439	31665.1	31501.1	163.987
14	13.5921	431809	basement	5.551	27.1	84.1027	89.1808	31733.7	31570.3	163.38
15	13.5921	432579	basement	5.551	27.1	82.7945	87.7936	31795.9	31635.2	160.688
16	13.5921	433263	basement	5.551	27.1	80.3777	85.2309	31851.7	31696	155.688
17	13.5921	433865	basement	5.551	27.1	76.7964	81.4334	31901.1	31752.8	148.292
18	13.5921	434390	basement	5.551	27.1	72.1499	76.5063	31944.4	31805.8	138.61
19	13.5921	434837	basement	5.551	27.1	66.3129	70.3169	31981.5	31855	126.526
20	13.5921	435206	basement	5.551	27.1	59.2192	62.7949	32012.4	31900.5	111.908
21	13.5921	435501	basement	5.551	27.1	50.8469	53.917	32037.1	31942.5	94.5659
22	13.5921	435722	basement	5.551	27.1	41.1822	43.6688	32055.5	31981	74.5039

23	13.5921	435871	basement	5.551	27.1	30.2212	32.046	32067.8	32016	51.8099
24	13.5921	436002	basement	5.551	27.1	19.4622	20.6373	32077.2	32047.7	29.4953
25	13.5921	436119	basement	5.551	27.1	9.92117	10.5202	32085.7	32076	9.74261

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.06112

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	412.224	-2930.42	4.4225e+007	0	0
2	425.816	-2944.54	239929	222.538	0.0531427
3	439.408	-2957.79	455432	422.421	0.0531428
4	453	-2970.26	648392	601.395	0.0531428
5	466.592	-2982	776978	720.661	0.0531428
6	480.184	-2993.07	885705	821.507	0.0531428
7	493.776	-3003.51	975723	905	0.0531428
8	507.368	-3013.37	1.04802e+006	972.061	0.053143
9	520.96	-3022.67	1.10347e+006	1023.49	0.0531429
10	534.552	-3031.45	1.14283e+006	1060	0.0531431
11	548.144	-3039.74	1.16535e+006	1080.89	0.0531432
12	561.736	-3047.55	1.16982e+006	1085.03	0.0531429
13	575.328	-3054.9	1.15995e+006	1075.88	0.0531431
14	588.921	-3061.82	1.13623e+006	1053.87	0.0531427
15	602.513	-3068.33	1.09907e+006	1019.41	0.053143
16	616.105	-3074.42	1.04886e+006	972.838	0.0531429
17	629.697	-3080.13	985946	914.482	0.0531428
18	643.289	-3085.46	911876	845.781	0.0531428
19	656.881	-3090.42	826497	766.591	0.0531429
20	670.473	-3095.02	729271	676.412	0.0531429
21	684.065	-3099.26	620431	575.461	0.0531429
22	697.657	-3103.17	500191	463.936	0.0531428
23	711.249	-3106.73	368742	342.014	0.0531427
24	724.841	-3109.97	226260	209.86	0.0531428
25	738.433	-3112.88	118138	109.575	0.0531428
26	752.025	-3115.47	4.99868e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.06038

Slice	X coordinate	Y coordinate - Bottom	Interslice Normal Force	Interslice Shear Force	Interslice Force Angle

	[m]	[m]	[kN]	[kN]	[degrees]
1	412.224	-2930.42	4.4225e+007	0	0
2	425.816	-2944.54	239998	35.6317	0.00850651
3	439.408	-2957.79	455535	134.197	0.0168789
4	453	-2970.26	648504	282.794	0.024985
5	466.592	-2982	777078	443.458	0.0326972
6	480.184	-2993.07	885787	616.753	0.0398937
7	493.776	-3003.51	975785	791.263	0.0464611
8	507.368	-3013.37	1.04807e+006	956.605	0.0522956
9	520.96	-3022.67	1.1035e+006	1103.69	0.0573056
10	534.552	-3031.45	1.14285e+006	1224.95	0.0614118
11	548.144	-3039.74	1.16536e+006	1312.9	0.0645497
12	561.736	-3047.55	1.16982e+006	1361.2	0.0666692
13	575.328	-3054.9	1.15996e+006	1371.35	0.0677373
14	588.921	-3061.82	1.13623e+006	1343.3	0.0677375
15	602.513	-3068.33	1.09907e+006	1278.88	0.0666695
16	616.105	-3074.42	1.04886e+006	1181.65	0.0645496
17	629.697	-3080.13	985942	1056.77	0.0614118
18	643.289	-3085.46	911866	912.022	0.0573056
19	656.881	-3090.42	826478	754.353	0.0522957
20	670.473	-3095.02	729243	591.341	0.046461
21	684.065	-3099.26	620394	431.966	0.0398937
22	697.657	-3103.17	500147	285.421	0.0326972
23	711.249	-3106.73	368697	160.778	0.024985
24	724.841	-3109.97	226223	66.6436	0.0168789
25	738.433	-3112.88	118114	17.536	0.00850652
26	752.025	-3115.47	4.99868e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.068243
Factor of Safety, standard deviation: 0.176978
Factor of Safety, minimum: 0.519154
Factor of Safety, maximum: 1.718540
Probability of Failure: 36.297% (= 10889 failed surfaces / 30000 valid surfaces)
Reliability index: 0.38560 (assuming normal distribution)
Reliability index: 0.31891 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price

Factor of Safety, mean: 1.067872
Factor of Safety, standard deviation: 0.177398
Factor of Safety, minimum: 0.518940
Factor of Safety, maximum: 1.717690
Probability of Failure: 36.513% (= 10954 failed surfaces / 30000 valid surfaces)
Reliability index: 0.38260 (assuming normal distribution)
Reliability index: 0.31551 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-7000
7350	-7000
7350	0
0	0

External Boundary

X	Y
7350	-7000
7350	-4512
7270	-4510
7190	-4507
7111	-4506
7031	-4504
6952	-4502
6861	-4499
6771	-4494
6680	-4487
6590	-4479
6500	-4471
6409	-4463
6321	-4451
6233	-4439
6144	-4427
6056	-4413
5968	-4397

5880	-4381
5791	-4366
5703	-4353
5615	-4342
5527	-4330
5443	-4320
5360	-4314
5276	-4309
5193	-4305
5110	-4303
5026	-4301
4942	-4293
4858	-4284
4774	-4278
4690	-4266
4606	-4256
4522	-4247
4438	-4237
4354	-4231
4270	-4224
4178	-4212
4086	-4198
3994	-4180
3902	-4159
3809	-4141
3717	-4125
3625	-4107
3533	-4088
3440	-4070
3348	-4049
3256	-4030
3171	-4013
3087	-3997
3002	-3983
2918	-3965
2833	-3949
2749	-3928
2664	-3909
2580	-3887
2495	-3865

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 94PC Site 93		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_94_93_0g.sli	

2411	-3841
2328	-3818
2245	-3793
2163	-3766
2080	-3737
1997	-3704
1915	-3667
1823	-3624
1731	-3583
1639	-3540
1547	-3494
1455	-3447
1364	-3405
1272	-3360
1180	-3314
1088	-3270
997	-3229
907	-3186
816	-3145
725	-3103
635	-3052
544	-3000
453	-2949
363	-2908
272	-2886
181	-2875
91	-2857
0	-2828
0	-7000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 94PC Site 93	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/26/2013	File Name: RR0705_94_93_1g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_94_93_1g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 94PC Site 93
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/26/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 94PC Site 93		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_94_93_1g.sli	

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364857641
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 100
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 30000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	5.8
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.001658
Center: 1472.033, -1568.133
Radius: 1737.084
Left Slip Surface Endpoint: 370.832, -2911.568
Right Slip Surface Endpoint: 1051.450, -3253.532
Left Slope Intercept: 370.832 0.000
Right Slope Intercept: 1051.450 0.000
Resisting Moment=1.24104e+006 kN-m
Driving Moment=7.48519e+008 kN-m
Resisting Horizontal Force=718.4 kN

Driving Horizontal Force=433295 kN
Total Slice Area=2.11952e+006 m2

Method: gle/morgenstern-price

FS: 0.001616
Center: 1472.033, -1568.133
Radius: 1737.084
Left Slip Surface Endpoint: 370.832, -2911.568
Right Slip Surface Endpoint: 1051.450, -3253.532
Left Slope Intercept: 370.832 0.000
Right Slope Intercept: 1051.450 0.000
Resisting Moment=1.20954e+006 kN-m
Driving Moment=7.48519e+008 kN-m
Resisting Horizontal Force=704.805 kN
Driving Horizontal Force=436166 kN
Total Slice Area=2.11952e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 8619
Number of Invalid Surfaces: 37

Error Codes:

Error Code -108 reported for 24 surfaces
Error Code -111 reported for 1 surface
Error Code -112 reported for 12 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 8647
Number of Invalid Surfaces: 9

Error Codes:

Error Code -108 reported for 3 surfaces
Error Code -112 reported for 6 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.00165799

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	27.2247	820232	basement	5.551	27.1	656.777	1.08893	30168.3	30176.9	-8.59036
2	27.2247	827614	basement	5.551	27.1	778.798	1.29124	30532.6	30541	-8.43577
3	27.2247	834624	basement	5.551	27.1	896.049	1.48564	30874.6	30882.6	-8.00199
4	27.2247	841069	basement	5.551	27.1	795.415	1.31879	31172.4	31180.7	-8.29753
5	27.2247	846947	basement	5.551	27.1	836.863	1.38751	31426.6	31434.7	-8.08247
6	27.2247	852498	basement	5.551	27.1	871.043	1.44418	31660.6	31668.8	-8.15111
7	27.2247	857723	basement	5.551	27.1	877.629	1.4551	31874.8	31882.9	-8.13599
8	27.2247	862610	basement	5.551	27.1	872.49	1.44658	32066.9	32075	-8.06662
9	27.2247	867201	basement	5.551	27.1	861.103	1.4277	32241	32249.1	-8.1119
10	27.2247	871507	basement	5.551	27.1	837.852	1.38915	32398	32405.9	-7.9455
11	27.2247	875551	basement	5.551	27.1	805.162	1.33495	32539.1	32547.5	-8.35184
12	27.2247	879331	basement	5.551	27.1	747.067	1.23863	32665	32673.4	-8.4189
13	27.2247	882851	basement	5.551	27.1	669.25	1.10961	32774.8	32783.5	-8.6745
14	27.2247	886330	basement	5.551	27.1	910.53	1.50965	32892.6	32900.5	-7.88641
15	27.2247	889783	basement	5.551	27.1	883.697	1.46516	33017.7	33025.7	-8.01763
16	27.2247	892994	basement	5.551	27.1	835.638	1.38548	33128	33136.2	-8.15747
17	27.2247	895978	basement	5.551	27.1	793.153	1.31504	33225.1	33233.3	-8.24325
18	27.2247	898762	basement	5.551	27.1	725.475	1.20283	33311.4	33319.9	-8.47005
19	27.2247	901322	basement	5.551	27.1	620.583	1.02892	33384.2	33393	-8.82035
20	27.2247	903654	basement	5.551	27.1	453.441	0.7518	33442.7	33452.1	-9.38296
21	27.2247	905686	basement	5.551	27.1	187.546	0.31095	33479.2	33489.5	-10.2702
22	27.2247	907475	basement	5.551	27.1	0	0	33492.6	33511	-18.404
23	27.2247	909052	basement	5.551	27.1	0	0	33460.3	33519.6	-59.3242
24	27.2247	910476	basement	5.551	27.1	0	0	33440.2	33521.5	-81.3063
25	27.2247	911751	basement	5.551	27.1	0	0	33226.5	33516.8	-290.292

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00161591

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]

1	27.2247	820232	basement	5.551	27.1	126.894	0.20505	30166.6	30176.9	-10.3088
2	27.2247	827614	basement	5.551	27.1	326.596	0.52775	30531.1	30541	-9.89042
3	27.2247	834624	basement	5.551	27.1	519.843	0.84002	30873.4	30882.6	-9.1831
4	27.2247	841069	basement	5.551	27.1	641.434	1.0365	31171.8	31180.7	-8.89643
5	27.2247	846947	basement	5.551	27.1	741.923	1.19888	31426.3	31434.7	-8.38593
6	27.2247	852498	basement	5.551	27.1	824.836	1.33286	31660.6	31668.8	-8.15111
7	27.2247	857723	basement	5.551	27.1	882.073	1.42535	31874.8	31882.9	-8.13599
8	27.2247	862610	basement	5.551	27.1	914.828	1.47828	32066.9	32075	-8.06662
9	27.2247	867201	basement	5.551	27.1	928.251	1.49997	32241	32249.1	-8.1119
10	27.2247	871507	basement	5.551	27.1	921.722	1.48942	32398	32405.9	-7.9455
11	27.2247	875551	basement	5.551	27.1	898.54	1.45196	32539.5	32547.5	-8.02751
12	27.2247	879331	basement	5.551	27.1	852.646	1.3778	32665.3	32673.4	-8.12431
13	27.2247	882851	basement	5.551	27.1	787.717	1.27288	32775.1	32783.5	-8.37732
14	27.2247	886330	basement	5.551	27.1	871.008	1.40747	32892.4	32900.5	-8.08617
15	27.2247	889783	basement	5.551	27.1	849.206	1.37224	33017.5	33025.7	-8.18541
16	27.2247	892994	basement	5.551	27.1	811.908	1.31197	33127.9	33136.2	-8.2927
17	27.2247	895978	basement	5.551	27.1	772.815	1.2488	33225	33233.3	-8.34538
18	27.2247	898762	basement	5.551	27.1	724.415	1.17059	33311.4	33319.9	-8.53859
19	27.2247	901322	basement	5.551	27.1	662.531	1.07059	33384.3	33393	-8.71688
20	27.2247	903654	basement	5.551	27.1	583.739	0.94327	33443.1	33452.1	-9.03601
21	27.2247	905686	basement	5.551	27.1	474.828	0.76728	33480.1	33489.5	-9.36307
22	27.2247	907475	basement	5.551	27.1	376.593	0.60854	33501.3	33511	-9.70557
23	27.2247	909052	basement	5.551	27.1	271.816	0.43923	33509.6	33519.6	-9.97697
24	27.2247	910476	basement	5.551	27.1	181.341	0.29303	33511.2	33521.5	-10.2705
25	27.2247	911751	basement	5.551	27.1	73.4509	0.11869	33506.2	33516.8	-10.6065

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.00165799

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	370.832	-2911.57	4.36577e+007	0	0
2	398.057	-2933.43	280067	-5942.54	-1.21554
3	425.282	-2954.41	541946	-11499.2	-1.21554
4	452.506	-2974.56	785450	-16665.9	-1.21554
5	479.731	-2993.9	926675	-19662.4	-1.21553
6	506.956	-3012.46	1.04563e+006	-22186.5	-1.21554
7	534.18	-3030.29	1.14384e+006	-24270.4	-1.21554
8	561.405	-3047.4	1.21557e+006	-25792.4	-1.21554

9	588.63	-3063.81	1.26321e+006	-26803.1	-1.21553
10	615.854	-3079.56	1.29003e+006	-27372.3	-1.21554
11	643.079	-3094.66	1.29731e+006	-27526.7	-1.21554
12	670.304	-3109.14	1.28682e+006	-27304.1	-1.21554
13	697.528	-3123	1.25596e+006	-26649.2	-1.21553
14	724.753	-3136.26	1.2049e+006	-25565.8	-1.21553
15	751.978	-3148.95	1.22123e+006	-25912.5	-1.21554
16	779.203	-3161.07	1.21996e+006	-25885.4	-1.21553
17	806.427	-3172.64	1.20039e+006	-25470.2	-1.21553
18	833.652	-3183.66	1.16867e+006	-24797.1	-1.21553
19	860.877	-3194.16	1.12233e+006	-23813.9	-1.21553
20	888.101	-3204.13	1.05836e+006	-22456.6	-1.21554
21	915.326	-3213.59	970015	-20582	-1.21553
22	942.551	-3222.55	848617	-18006.2	-1.21554
23	969.775	-3231.02	709705	-15058.7	-1.21553
24	997	-3239	550430	-11679.2	-1.21554
25	1024.22	-3246.5	395849	-8399.23	-1.21553
26	1051.45	-3253.53	5.45152e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00161591

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	370.832	-2911.57	4.36577e+007	0	0
2	398.057	-2933.43	287166	-323.521	-0.0645494
3	425.282	-2954.41	555178	-1241.06	-0.12808
4	452.506	-2974.56	803869	-2660.01	-0.189592
5	479.731	-2993.9	947363	-4102.47	-0.248113
6	506.956	-3012.46	1.06783e+006	-5641.91	-0.302721
7	534.18	-3030.29	1.16694e+006	-7180.53	-0.352554
8	561.405	-3047.4	1.23891e+006	-8580.73	-0.396826
9	588.63	-3063.81	1.28629e+006	-9762.36	-0.434841
10	615.854	-3079.56	1.31254e+006	-10675.3	-0.465994
11	643.079	-3094.66	1.31901e+006	-11276.1	-0.489805
12	670.304	-3109.14	1.30757e+006	-11545.4	-0.505889
13	697.528	-3123	1.27559e+006	-11443.4	-0.51399
14	724.753	-3136.26	1.22322e+006	-10973.6	-0.513991
15	751.978	-3148.95	1.24038e+006	-10952.1	-0.505888
16	779.203	-3161.07	1.23985e+006	-10599.3	-0.489801
17	806.427	-3172.64	1.22087e+006	-9929.76	-0.465996
18	833.652	-3183.66	1.18969e+006	-9029.15	-0.434838

19	860.877	-3194.16	1.14361e+006	-7920.64	-0.396824
20	888.101	-3204.13	1.0793e+006	-6641.25	-0.352553
21	915.326	-3213.59	989413	-5227.57	-0.30272
22	942.551	-3222.55	864338	-3742.93	-0.248112
23	969.775	-3231.02	720586	-2384.43	-0.189592
24	997	-3239	558158	-1247.73	-0.128081
25	1024.22	-3246.5	401745	-452.605	-0.0645493
26	1051.45	-3253.53	5.45152e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.026521
Factor of Safety, standard deviation: 0.063571
Factor of Safety, minimum: 0.000120
Factor of Safety, maximum: 0.984797
Probability of Failure: 100.000% (= 29364 failed surfaces / 29364 valid surfaces), 636 invalid surfaces
Reliability index: -15.31317 (assuming normal distribution)
Reliability index: -3.31801 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 0.025767
Factor of Safety, standard deviation: 0.063576
Factor of Safety, minimum: 0.000077
Factor of Safety, maximum: 0.986454
Probability of Failure: 100.000% (= 29976 failed surfaces / 29976 valid surfaces), 24 invalid surfaces
Reliability index: -15.32387 (assuming normal distribution)
Reliability index: -3.31412 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-7000
7350	-7000
7350	0
0	0

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 94PC Site 93		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_94_93_1g.sli	

External Boundary

X	Y
7350	-7000
7350	-4512
7270	-4510
7190	-4507
7111	-4506
7031	-4504
6952	-4502
6861	-4499
6771	-4494
6680	-4487
6590	-4479
6500	-4471
6409	-4463
6321	-4451
6233	-4439
6144	-4427
6056	-4413
5968	-4397
5880	-4381
5791	-4366
5703	-4353
5615	-4342
5527	-4330
5443	-4320
5360	-4314
5276	-4309
5193	-4305
5110	-4303
5026	-4301
4942	-4293
4858	-4284
4774	-4278
4690	-4266
4606	-4256
4522	-4247
4438	-4237
4354	-4231
4270	-4224

4178	-4212
4086	-4198
3994	-4180
3902	-4159
3809	-4141
3717	-4125
3625	-4107
3533	-4088
3440	-4070
3348	-4049
3256	-4030
3171	-4013
3087	-3997
3002	-3983
2918	-3965
2833	-3949
2749	-3928
2664	-3909
2580	-3887
2495	-3865
2411	-3841
2328	-3818
2245	-3793
2163	-3766
2080	-3737
1997	-3704
1915	-3667
1823	-3624
1731	-3583
1639	-3540
1547	-3494
1455	-3447
1364	-3405
1272	-3360
1180	-3314
1088	-3270
997	-3229
907	-3186
816	-3145
725	-3103

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 94PC Site 93		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/26/2013	File Name: RR0705_94_93_1g.sli	

635	-3052
544	-3000
453	-2949
363	-2908
272	-2886
181	-2875
91	-2857
0	-2828
0	-7000

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_94_95_0g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 94PC Site 95
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/26/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364790398
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 94PC Site 95		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/26/2013		File Name: RR0705_94_95_0g.slim

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 1000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Global Minimums

Method: spencer

FS: 1.074150
Center: 2004.926, -2149.119
Radius: 1475.687
Left Slip Surface Endpoint: 1057.888, -3280.830
Right Slip Surface Endpoint: 1625.854, -3575.287
Left Slope Intercept: 1057.888 0.000
Right Slope Intercept: 1625.854 0.000
Resisting Moment=6.47407e+007 kN-m
Driving Moment=6.02717e+007 kN-m
Resisting Horizontal Force=38817.7 kN
Driving Horizontal Force=36138.1 kN
Total Slice Area=1.962e+006 m2

Method: gle/morgenstern-price

FS: 1.073610
Center: 1739.889, -2727.523
Radius: 848.789
Left Slip Surface Endpoint: 1124.435, -3312.039
Right Slip Surface Endpoint: 1604.601, -3565.461
Left Slope Intercept: 1124.435 0.000
Right Slope Intercept: 1604.601 0.000
Resisting Moment=3.83887e+007 kN-m
Driving Moment=3.57565e+007 kN-m
Resisting Horizontal Force=39922.2 kN

Driving Horizontal Force=37184.9 kN
Total Slice Area=1.66737e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2584
Number of Invalid Surfaces: 455

Error Codes:

Error Code -108 reported for 455 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 3039
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.07415

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	22.7186	770418	basement	5.551	27.1	7.84116	8.42258	33894.1	33888.5	5.602
2	22.7186	775677	basement	5.551	27.1	23.2807	25.007	34114.6	34076.6	38.0045
3	22.7186	780652	basement	5.551	27.1	37.4749	40.2537	34325.1	34257.2	67.8586
4	22.7186	785326	basement	5.551	27.1	49.6151	53.2941	34524.1	34430.8	93.2824
5	22.7186	789760	basement	5.551	27.1	60.5701	65.0614	34713.8	34597.5	116.293
6	22.7186	793964	basement	5.551	27.1	70.431	75.6535	34894.7	34757.7	136.987
7	22.7186	797912	basement	5.551	27.1	79.0067	84.865	35066.6	34911.6	154.963
8	22.7186	801561	basement	5.551	27.1	84.8585	91.1508	35226.7	35059.4	167.285
9	22.7186	805001	basement	5.551	27.1	89.4112	96.041	35378.2	35201.4	176.785
10	22.7186	808241	basement	5.551	27.1	92.8594	99.7449	35521.7	35337.7	184.034
11	22.7186	811277	basement	5.551	27.1	95.1537	102.209	35657.3	35468.4	188.916

12	22.7186	814094	basement	5.551	27.1	95.7368	102.836	35784	35593.9	190.11
13	22.7186	816726	basement	5.551	27.1	95.1254	102.179	35903	35714.2	188.799
14	22.7186	819182	basement	5.551	27.1	93.4137	100.34	36014.6	35829.4	185.182
15	22.7186	821461	basement	5.551	27.1	90.5946	97.3122	36118.9	35939.6	179.341
16	22.7186	823559	basement	5.551	27.1	86.4434	92.8532	36215.7	36045.1	170.607
17	22.7186	825490	basement	5.551	27.1	81.139	87.1555	36305.3	36145.9	159.424
18	22.7186	827260	basement	5.551	27.1	74.7338	80.2753	36388	36242	146.025
19	22.7186	828882	basement	5.551	27.1	67.2421	72.2281	36464	36333.7	130.255
20	22.7186	830395	basement	5.551	27.1	59.5136	63.9265	36535	36420.9	114.09
21	22.7186	831763	basement	5.551	27.1	50.9312	54.7078	36599.8	36503.8	96.044
22	22.7186	832981	basement	5.551	27.1	41.2547	44.3137	36658.2	36582.4	75.7613
23	22.7186	834077	basement	5.551	27.1	30.474	32.7336	36710	36656.8	53.1621
24	22.7186	835181	basement	5.551	27.1	21.3924	22.9786	36761.2	36727.1	34.0916
25	22.7186	836167	basement	5.551	27.1	12.1805	13.0837	36808.1	36793.4	14.6665

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.07361

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	19.2067	657701	basement	5.551	27.1	11.5503	12.4005	34228.2	34214.8	13.4101
2	19.2067	662485	basement	5.551	27.1	27.4291	29.4482	34457	34410.3	46.6925
3	19.2067	666917	basement	5.551	27.1	42.1675	45.2714	34671.5	34593.8	77.6745
4	19.2067	671025	basement	5.551	27.1	55.842	59.9525	34872.8	34766.5	106.281
5	19.2067	674783	basement	5.551	27.1	67.9765	72.9802	35060.8	34929	131.791
6	19.2067	678225	basement	5.551	27.1	78.0803	83.8278	35235.2	35082.2	152.977
7	19.2067	681405	basement	5.551	27.1	87.1122	93.5245	35398.5	35226.6	171.897
8	19.2067	684342	basement	5.551	27.1	95.0644	102.062	35551.3	35362.7	188.625
9	19.2067	687046	basement	5.551	27.1	101.965	109.471	35694.2	35491.1	203.066
10	19.2067	689507	basement	5.551	27.1	107.432	115.34	35826.6	35612	214.596
11	19.2067	691752	basement	5.551	27.1	111.338	119.534	35948.7	35725.9	222.803
12	19.2067	693796	basement	5.551	27.1	113.974	122.364	36061.4	35833.1	228.305
13	19.2067	695650	basement	5.551	27.1	115.274	123.759	36164.8	35933.8	231.037
14	19.2067	697318	basement	5.551	27.1	115.197	123.677	36259.2	36028.3	230.909
15	19.2067	698799	basement	5.551	27.1	113.469	121.821	36344.1	36116.9	227.193
16	19.2067	700107	basement	5.551	27.1	110.074	118.177	36419.7	36199.6	220.07
17	19.2067	701248	basement	5.551	27.1	105.055	112.788	36486.2	36276.7	209.54
18	19.2067	702227	basement	5.551	27.1	98.3514	105.591	36543.8	36348.3	195.535
19	19.2067	703057	basement	5.551	27.1	89.8977	96.5151	36592.4	36414.7	177.74
20	19.2067	703767	basement	5.551	27.1	80.5447	86.4736	36633.9	36475.8	158.13
21	19.2067	704328	basement	5.551	27.1	69.6064	74.7301	36667	36531.9	135.132
22	19.2067	704742	basement	5.551	27.1	56.8672	61.0532	36691.4	36582.9	108.483

23	19.2067	705011	basement	5.551	27.1	42.3166	45.4315	36707	36629.1	77.9309
24	19.2067	705190	basement	5.551	27.1	26.9794	28.9654	36716.2	36670.5	45.7484
25	19.2067	705320	basement	5.551	27.1	12.4848	13.4038	36722.5	36707.1	15.3643

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.07415

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	1057.89	-3280.83	5.54338e+007	0	0
2	1080.61	-3299.46	275735	243.326	0.0505614
3	1103.33	-3317.35	528891	466.728	0.0505615
4	1126.04	-3334.54	743669	656.261	0.0505614
5	1148.76	-3351.05	932761	823.128	0.0505614
6	1171.48	-3366.91	1.10099e+006	971.582	0.0505613
7	1194.2	-3382.15	1.24886e+006	1102.08	0.0505617
8	1216.92	-3396.79	1.35142e+006	1192.58	0.0505615
9	1239.64	-3410.86	1.42561e+006	1258.05	0.0505615
10	1262.36	-3424.36	1.48051e+006	1306.5	0.0505616
11	1285.07	-3437.32	1.5165e+006	1338.26	0.0505616
12	1307.79	-3449.76	1.5252e+006	1345.94	0.0505617
13	1330.51	-3461.68	1.51176e+006	1334.08	0.0505617
14	1353.23	-3473.11	1.4803e+006	1306.32	0.0505618
15	1375.95	-3484.05	1.43112e+006	1262.91	0.0505614
16	1398.67	-3494.52	1.36157e+006	1201.54	0.0505616
17	1421.39	-3504.53	1.27287e+006	1123.26	0.0505614
18	1444.1	-3514.08	1.16716e+006	1029.98	0.0505616
19	1466.82	-3523.2	1.04467e+006	921.883	0.0505614
20	1489.54	-3531.88	915455	807.857	0.0505615
21	1512.26	-3540.14	777955	686.518	0.0505615
22	1534.98	-3547.98	624392	551.004	0.0505615
23	1557.7	-3555.4	454943	401.471	0.0505615
24	1580.42	-3562.43	299141	263.981	0.0505614
25	1603.14	-3569.05	157105	138.639	0.0505613
26	1625.85	-3575.29	6.58308e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.07361

Slice	X coordinate	Y coordinate - Bottom	Interslice Normal Force	Interslice Shear Force	Interslice Force Angle

	[m]	[m]	[kN]	[kN]	[degrees]
1	1124.43	-3312.04	5.64934e+007	0	0
2	1143.64	-3331.62	349019	64.5062	0.0105895
3	1162.85	-3349.99	659701	241.931	0.021012
4	1182.05	-3367.26	934878	507.5	0.0311031
5	1201.26	-3383.51	1.17503e+006	834.758	0.0407037
6	1220.47	-3398.82	1.35705e+006	1176.25	0.0496622
7	1239.67	-3413.25	1.50948e+006	1523.77	0.0578382
8	1258.88	-3426.86	1.63383e+006	1856.41	0.0651013
9	1278.09	-3439.69	1.73138e+006	2155.71	0.0713379
10	1297.29	-3451.78	1.80035e+006	2402.19	0.0764492
11	1316.5	-3463.18	1.83693e+006	2576.23	0.0803553
12	1335.71	-3473.9	1.84967e+006	2679.29	0.0829942
13	1354.91	-3483.99	1.83937e+006	2707.07	0.0843243
14	1374.12	-3493.46	1.80674e+006	2659.04	0.0843241
15	1393.33	-3502.34	1.75064e+006	2535.84	0.0829941
16	1412.53	-3510.65	1.67109e+006	2343.64	0.0803551
17	1431.74	-3518.4	1.5709e+006	2096.04	0.0764493
18	1450.95	-3525.62	1.45055e+006	1806.05	0.0713378
19	1470.15	-3532.31	1.31047e+006	1488.99	0.0651009
20	1489.36	-3538.5	1.16075e+006	1171.73	0.0578377
21	1508.57	-3544.18	997492	864.599	0.0496624
22	1527.77	-3549.38	815659	579.456	0.0407037
23	1546.98	-3554.1	615551	334.153	0.0311031
24	1566.19	-3558.35	397440	145.752	0.0210119
25	1585.39	-3562.13	203761	37.6594	0.0105895
26	1604.6	-3565.46	6.54694e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.081216
Factor of Safety, standard deviation: 0.174856
Factor of Safety, minimum: 0.632876
Factor of Safety, maximum: 1.665890
Probability of Failure: 32.500% (= 325 failed surfaces / 1000 valid surfaces)
Reliability index: 0.46447 (assuming normal distribution)
Reliability index: 0.40564 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price

Factor of Safety, mean: 1.080682
Factor of Safety, standard deviation: 0.176780
Factor of Safety, minimum: 0.634367
Factor of Safety, maximum: 1.679640
Probability of Failure: 33.700% (= 337 failed surfaces / 1000 valid surfaces)
Reliability index: 0.45640 (assuming normal distribution)
Reliability index: 0.39623 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-8000
7781	-8000
7781	0
0	0

External Boundary

X	Y
7781	-8000
7781	-4669
7691	-4669
7602	-4668
7512	-4667
7422	-4666
7332	-4664
7242	-4663
7153	-4662
7063	-4660
6973	-4659
6883	-4658
6794	-4656
6704	-4655
6614	-4653
6524	-4650
6432	-4647
6340	-4644

Project	Sumatra Submarine Slide		
Analysis Description	RR0705 94PC Site 95		
Drawn By: Jason R. Patton	Scale:	Company: Oregon State University	
Date: 3/26/2013		File Name: RR0705_94_95_0g.slim	

SLIDEINTERPRET 6.020

6247	-4639
6155	-4633
6063	-4627
5970	-4619
5878	-4610
5786	-4603
5693	-4594
5601	-4585
5509	-4576
5416	-4568
5324	-4560
5232	-4553
5139	-4544
5047	-4535
4955	-4526
4862	-4514
4770	-4500
4678	-4484
4585	-4463
4493	-4436
4401	-4406
4308	-4374
4217	-4341
4126	-4310
4035	-4275
3944	-4238
3853	-4204
3762	-4171
3671	-4138
3580	-4107
3489	-4079
3398	-4055
3307	-4034
3216	-4013
3125	-3991
3034	-3965
2943	-3940
2851	-3914
2760	-3888
2669	-3866

2578	-3844
2487	-3827
2396	-3811
2305	-3798
2214	-3783
2123	-3767
2031	-3747
1939	-3719
1846	-3679
1754	-3633
1662	-3592
1569	-3549
1477	-3500
1385	-3449
1292	-3398
1200	-3349
1108	-3304
1015	-3261
923	-3220
831	-3187
738	-3166
646	-3154
554	-3145
462	-3137
369	-3129
277	-3123
185	-3118
92	-3113
0	-3109
0	-8000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 94PC Site 95		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/26/2013		File Name: RR0705_94_95.slim

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_94_95.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 94PC Site 95
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/26/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 94PC Site 95		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/26/2013		File Name: RR0705_94_95.slim

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364790201
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 1000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.001283
Center: 1909.800, -2372.112
Radius: 1227.358
Left Slip Surface Endpoint: 1115.161, -3307.503
Right Slip Surface Endpoint: 1581.325, -3554.699
Left Slope Intercept: 1115.161 0.000
Right Slope Intercept: 1581.325 0.000
Resisting Moment=403622 kN-m
Driving Moment=3.14714e+008 kN-m
Resisting Horizontal Force=333.792 kN

Driving Horizontal Force=260266 kN
Total Slice Area=1.60955e+006 m2

Method: gle/morgenstern-price

FS: 0.001251
Center: 1704.387, -2829.090
Radius: 735.971
Left Slip Surface Endpoint: 1168.578, -3333.631
Right Slip Surface Endpoint: 1581.325, -3554.699
Left Slope Intercept: 1168.578 0.000
Right Slope Intercept: 1581.325 0.000
Resisting Moment=261927 kN-m
Driving Moment=2.09389e+008 kN-m
Resisting Horizontal Force=369.382 kN
Driving Horizontal Force=295291 kN
Total Slice Area=1.43354e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1309
Number of Invalid Surfaces: 32

Error Codes:

Error Code -108 reported for 14 surfaces
Error Code -111 reported for 2 surfaces
Error Code -112 reported for 16 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1329
Number of Invalid Surfaces: 12

Error Codes:

Error Code -108 reported for 2 surfaces
Error Code -112 reported for 10 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.0012825

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	18.6466	637063	basement	5.551	27.1	269.739	0.34594	34188	34198.2	-10.2307
2	18.6466	640623	basement	5.551	27.1	356.881	0.4577	34442	34451.9	-9.90165
3	18.6466	644007	basement	5.551	27.1	441.458	0.56617	34680.4	34690.1	-9.73099
4	18.6466	647222	basement	5.551	27.1	523.158	0.67095	34903.8	34913.4	-9.55829
5	18.6466	650267	basement	5.551	27.1	587.096	0.75295	35111.7	35121.1	-9.39349
6	18.6466	653094	basement	5.551	27.1	632.265	0.81088	35296.1	35305.4	-9.25163
7	18.6466	655759	basement	5.551	27.1	686.136	0.87997	35465.5	35474.6	-9.07211
8	18.6466	658280	basement	5.551	27.1	734.402	0.94187	35622.2	35631.1	-8.94968
9	18.6466	660661	basement	5.551	27.1	776.546	0.99592	35766.5	35775.4	-8.92207
10	18.6466	662905	basement	5.551	27.1	804.444	1.0317	35898.2	35907.1	-8.85467
11	18.6466	664995	basement	5.551	27.1	820	1.05165	36015	36023.8	-8.76379
12	18.6466	666956	basement	5.551	27.1	832.608	1.06782	36120	36128.8	-8.75529
13	18.6466	668793	basement	5.551	27.1	835.891	1.07203	36214.2	36223	-8.79644
14	18.6466	670511	basement	5.551	27.1	828.959	1.06314	36297.8	36306.6	-8.78697
15	18.6466	672111	basement	5.551	27.1	807.127	1.03514	36370.8	36379.6	-8.78746
16	18.6466	673589	basement	5.551	27.1	770.698	0.98842	36432.4	36441.3	-8.91596
17	18.6466	674954	basement	5.551	27.1	722.854	0.92706	36483.9	36493	-9.06411
18	18.6466	676210	basement	5.551	27.1	659.485	0.84579	36525.9	36535	-9.12965
19	18.6466	677361	basement	5.551	27.1	578.815	0.74233	36558.3	36567.7	-9.35084
20	18.6466	678414	basement	5.551	27.1	498.113	0.63883	36582.7	36592.3	-9.60382
21	18.6466	679396	basement	5.551	27.1	402.121	0.51572	36602.8	36612.6	-9.79975
22	18.6466	680282	basement	5.551	27.1	272.507	0.34949	36614.5	36624.6	-10.1307
23	18.6466	681068	basement	5.551	27.1	116.593	0.14953	36617.3	36627.9	-10.5909
24	18.6466	681757	basement	5.551	27.1	0	0	36601.8	36622.5	-20.7495
25	18.6466	682380	basement	5.551	27.1	0	0	36529.3	36613.2	-83.9014

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00125091

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]

1	16.5099	568745	basement	5.551	27.1	155.91	0.19503	34484.1	34494.6	-10.4703
2	16.5099	572317	basement	5.551	27.1	416.401	0.52088	34787.5	34797.3	-9.84168
3	16.5099	575590	basement	5.551	27.1	642.396	0.80358	35057.9	35067.2	-9.31328
4	16.5099	578595	basement	5.551	27.1	849.997	1.06327	35299.6	35308.4	-8.75297
5	16.5099	581378	basement	5.551	27.1	1033.16	1.29239	35519.2	35527.5	-8.28471
6	16.5099	583955	basement	5.551	27.1	1187.5	1.48545	35718.1	35726.1	-8.00175
7	16.5099	586339	basement	5.551	27.1	1309.44	1.63799	35897.7	35905.4	-7.68497
8	16.5099	588539	basement	5.551	27.1	1384.69	1.73212	36058.5	36066	-7.45799
9	16.5099	590550	basement	5.551	27.1	1416.03	1.77132	36199.1	36206.5	-7.42236
10	16.5099	592395	basement	5.551	27.1	1418.48	1.77439	36322.9	36330.3	-7.41741
11	16.5099	594086	basement	5.551	27.1	1384.51	1.7319	36431.2	36438.6	-7.44382
12	16.5099	595630	basement	5.551	27.1	1316.11	1.64634	36524.6	36532.3	-7.67503
13	16.5099	597032	basement	5.551	27.1	1216.43	1.52164	36603.9	36611.8	-7.88817
14	16.5099	598294	basement	5.551	27.1	1076.66	1.34681	36668.9	36677.1	-8.23088
15	16.5099	599419	basement	5.551	27.1	923.376	1.15506	36719.8	36728.4	-8.61452
16	16.5099	600418	basement	5.551	27.1	756.297	0.94606	36757.9	36767	-9.06686
17	16.5099	601294	basement	5.551	27.1	581.017	0.7268	36783.9	36793.3	-9.43643
18	16.5099	602050	basement	5.551	27.1	405.225	0.5069	36797.8	36807.7	-9.88595
19	16.5099	602691	basement	5.551	27.1	253.256	0.3168	36800.5	36810.8	-10.2625
20	16.5099	603243	basement	5.551	27.1	141.033	0.17642	36796.1	36806.6	-10.5212
21	16.5099	603691	basement	5.551	27.1	17.795	0.02226	36781.9	36792.7	-10.8259
22	16.5099	604031	basement	5.551	27.1	0	0	36749.4	36767.9	-18.534
23	16.5099	604264	basement	5.551	27.1	0	0	36709.5	36732.5	-23.0022
24	16.5099	604392	basement	5.551	27.1	0	0	36663.9	36686.6	-22.6998
25	16.5099	604446	basement	5.551	27.1	0	0	36618.8	36635.5	-16.7423

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.0012825

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	1115.16	-3307.5	5.63388e+007	0	0
2	1133.81	-3323.03	218287	-1399.97	-0.367458
3	1152.45	-3337.95	419731	-2691.92	-0.367458
4	1171.1	-3352.28	604608	-3877.62	-0.367458
5	1189.75	-3366.06	773172	-4958.69	-0.367458
6	1208.39	-3379.3	913130	-5856.3	-0.367458
7	1227.04	-3392.04	1.02162e+006	-6552.08	-0.367457
8	1245.69	-3404.28	1.11402e+006	-7144.73	-0.36746

9	1264.33	-3416.04	1.19056e+006	-7635.58	-0.367458
10	1282.98	-3427.34	1.25142e+006	-8025.88	-0.367457
11	1301.63	-3438.19	1.29151e+006	-8282.99	-0.367457
12	1320.27	-3448.62	1.31124e+006	-8409.55	-0.367458
13	1338.92	-3458.62	1.31571e+006	-8438.22	-0.367458
14	1357.57	-3468.22	1.3051e+006	-8370.18	-0.367458
15	1376.21	-3477.41	1.27959e+006	-8206.57	-0.367458
16	1394.86	-3486.22	1.23729e+006	-7935.32	-0.36746
17	1413.51	-3494.65	1.17859e+006	-7558.82	-0.367458
18	1432.15	-3502.71	1.1055e+006	-7090.08	-0.367459
19	1450.8	-3510.41	1.01823e+006	-6530.35	-0.367458
20	1469.45	-3517.75	916982	-5881.01	-0.367458
21	1488.09	-3524.75	810553	-5198.43	-0.367458
22	1506.74	-3531.4	696537	-4467.2	-0.367458
23	1525.39	-3537.72	569367	-3651.6	-0.367458
24	1544.03	-3543.7	429309	-2753.35	-0.367458
25	1562.68	-3549.36	276007	-1770.15	-0.367457
26	1581.32	-3554.7	6.50748e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00125091

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	1168.58	-3333.63	5.72324e+007	0	0
2	1185.09	-3350.61	307977	-463.595	-0.0862468
3	1201.6	-3366.54	582266	-1739.14	-0.171133
4	1218.11	-3381.53	804720	-3557.9	-0.25332
5	1234.62	-3395.63	999205	-5781.41	-0.33151
6	1251.13	-3408.92	1.16722e+006	-8239.94	-0.40447
7	1267.64	-3421.46	1.31007e+006	-10770.9	-0.471054
8	1284.15	-3433.28	1.42896e+006	-13223.7	-0.530204
9	1300.66	-3444.44	1.52022e+006	-15416	-0.580996
10	1317.17	-3454.96	1.58519e+006	-17226.7	-0.622625
11	1333.68	-3464.88	1.62903e+006	-18607.5	-0.654429
12	1350.19	-3474.22	1.65253e+006	-19495.8	-0.675918
13	1366.7	-3483.01	1.65641e+006	-19854.8	-0.686751
14	1383.21	-3491.28	1.64134e+006	-19674.1	-0.686749
15	1399.72	-3499.04	1.60481e+006	-18932.8	-0.675918
16	1416.23	-3506.3	1.54996e+006	-17704.4	-0.654432
17	1432.74	-3513.09	1.47759e+006	-16057.4	-0.622625
18	1449.25	-3519.42	1.38803e+006	-14075.5	-0.580995

19	1465.76	-3525.3	1.28152e+006	-11859.3	-0.530205
20	1482.27	-3530.74	1.16227e+006	-9555.72	-0.471052
21	1498.78	-3535.76	1.03504e+006	-7306.85	-0.404472
22	1515.29	-3540.35	891314	-5157.15	-0.33151
23	1531.8	-3544.54	730520	-3229.84	-0.25332
24	1548.31	-3548.32	552698	-1650.82	-0.171133
25	1564.82	-3551.7	357988	-538.876	-0.0862467
26	1581.32	-3554.7	6.50748e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.023462
Factor of Safety, standard deviation: 0.058134
Factor of Safety, minimum: 0.000103
Factor of Safety, maximum: 0.509193
Probability of Failure: 100.000% (= 985 failed surfaces / 985 valid surfaces), 15 invalid surfaces
Reliability index: -16.79798 (assuming normal distribution)
Reliability index: -3.37743 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 0.026590
Factor of Safety, standard deviation: 0.063388
Factor of Safety, minimum: 0.000128
Factor of Safety, maximum: 0.505534
Probability of Failure: 100.000% (= 997 failed surfaces / 997 valid surfaces), 3 invalid surfaces
Reliability index: -15.35639 (assuming normal distribution)
Reliability index: -3.32089 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-8000
7781	-8000
7781	0
0	0

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 94PC Site 95		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 3/26/2013		File Name: RR0705_94_95.slim

External Boundary

X	Y
7781	-8000
7781	-4669
7691	-4669
7602	-4668
7512	-4667
7422	-4666
7332	-4664
7242	-4663
7153	-4662
7063	-4660
6973	-4659
6883	-4658
6794	-4656
6704	-4655
6614	-4653
6524	-4650
6432	-4647
6340	-4644
6247	-4639
6155	-4633
6063	-4627
5970	-4619
5878	-4610
5786	-4603
5693	-4594
5601	-4585
5509	-4576
5416	-4568
5324	-4560
5232	-4553
5139	-4544
5047	-4535
4955	-4526
4862	-4514
4770	-4500
4678	-4484
4585	-4463
4493	-4436

4401	-4406
4308	-4374
4217	-4341
4126	-4310
4035	-4275
3944	-4238
3853	-4204
3762	-4171
3671	-4138
3580	-4107
3489	-4079
3398	-4055
3307	-4034
3216	-4013
3125	-3991
3034	-3965
2943	-3940
2851	-3914
2760	-3888
2669	-3866
2578	-3844
2487	-3827
2396	-3811
2305	-3798
2214	-3783
2123	-3767
2031	-3747
1939	-3719
1846	-3679
1754	-3633
1662	-3592
1569	-3549
1477	-3500
1385	-3449
1292	-3398
1200	-3349
1108	-3304
1015	-3261
923	-3220
831	-3187

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 94PC Site 95		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 3/26/2013		File Name: RR0705_94_95.slim

738	-3166
646	-3154
554	-3145
462	-3137
369	-3129
277	-3123
185	-3118
92	-3113
0	-3109
0	-8000

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_95_26_0g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 95PC Site 26
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/31/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364790888
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 95PC Site 26		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_95_26_0g.slim

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Global Minimums

Method: spencer

FS: 1.223180
Center: 1784.493, -1269.213
Radius: 2091.829
Left Slip Surface Endpoint: 519.944, -2935.546
Right Slip Surface Endpoint: 1392.835, -3324.050
Left Slope Intercept: 519.944 0.000
Right Slope Intercept: 1392.835 0.000
Resisting Moment=2.09567e+008 kN-m
Driving Moment=1.7133e+008 kN-m
Resisting Horizontal Force=91208.1 kN
Driving Horizontal Force=74566.3 kN
Total Slice Area=2.76722e+006 m2

Method: gle/morgenstern-price

FS: 1.223960
Center: 1783.382, -1265.619
Radius: 2094.875
Left Slip Surface Endpoint: 517.211, -2934.544
Right Slip Surface Endpoint: 1391.560, -3323.525
Left Slope Intercept: 517.211 0.000
Right Slope Intercept: 1391.560 0.000
Resisting Moment=2.11299e+008 kN-m
Driving Moment=1.72636e+008 kN-m
Resisting Horizontal Force=91792.1 kN

Driving Horizontal Force=74996 kN
Total Slice Area=2.77123e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2550
Number of Invalid Surfaces: 124

Error Codes:

Error Code -108 reported for 124 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2674
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.22318

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	34.9157	1.06164e+006	basement	5.551	27.1	9.8143	12.0047	30382.2	30369.7	12.4825
2	34.9157	1.07295e+006	basement	5.551	27.1	30.9954	37.913	30694.2	30631.1	63.1424
3	34.9157	1.08359e+006	basement	5.551	27.1	49.4172	60.4461	30988.5	30881.4	107.135
4	34.9157	1.09363e+006	basement	5.551	27.1	66.1724	80.9408	31268.3	31121	147.297
5	34.9157	1.10305e+006	basement	5.551	27.1	80.55	98.5271	31532.1	31350.5	181.636
6	34.9157	1.11192e+006	basement	5.551	27.1	93.3305	114.16	31782.4	31570.1	212.262
7	34.9157	1.12011e+006	basement	5.551	27.1	103.356	126.423	32016.3	31780.2	236.078
8	34.9157	1.12772e+006	basement	5.551	27.1	110.371	135.004	32234.2	31981.1	253.115
9	34.9157	1.13485e+006	basement	5.551	27.1	115.821	141.67	32439.2	32173.2	266.014
10	34.9157	1.14155e+006	basement	5.551	27.1	120.011	146.795	32632.6	32356.6	275.953
11	34.9157	1.1478e+006	basement	5.551	27.1	122.732	150.123	32814.2	32531.7	282.48

12	34.9157	1.15363e+006	basement	5.551	27.1	124.035	151.717	32984.2	32698.6	285.624
13	34.9157	1.15907e+006	basement	5.551	27.1	124.21	151.931	33143.5	32857.6	285.937
14	34.9157	1.1641e+006	basement	5.551	27.1	122.873	150.296	33291.6	33008.8	282.815
15	34.9157	1.16882e+006	basement	5.551	27.1	120.923	147.91	33430.6	33152.4	278.154
16	34.9157	1.17314e+006	basement	5.551	27.1	117.756	144.037	33559.2	33288.6	270.631
17	34.9157	1.17696e+006	basement	5.551	27.1	112.353	137.428	33675.4	33417.6	257.767
18	34.9157	1.18031e+006	basement	5.551	27.1	104.066	127.292	33777.4	33539.4	238.005
19	34.9157	1.18332e+006	basement	5.551	27.1	94.305	115.352	33868.6	33654.2	214.448
20	34.9157	1.18608e+006	basement	5.551	27.1	84.3652	103.194	33953	33762.1	190.895
21	34.9157	1.18848e+006	basement	5.551	27.1	73.1453	89.4699	34027.2	33863.2	164.008
22	34.9157	1.19054e+006	basement	5.551	27.1	60.5798	74.1	34091.6	33957.7	133.865
23	34.9157	1.19226e+006	basement	5.551	27.1	46.6662	57.0812	34146.3	34045.6	100.726
24	34.9157	1.19369e+006	basement	5.551	27.1	31.3818	38.3856	34191.2	34126.9	64.2747
25	34.9157	1.19491e+006	basement	5.551	27.1	16.3836	20.0401	34230.3	34201.9	28.3617

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.22396

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	34.974	1.06307e+006	basement	5.551	27.1	14.1882	17.3658	30382.5	30359.5	23.0218
2	34.974	1.07443e+006	basement	5.551	27.1	33.241	40.6856	30689.8	30621.3	68.5475
3	34.974	1.08511e+006	basement	5.551	27.1	50.0842	61.3011	30980.9	30871.9	109.018
4	34.974	1.09518e+006	basement	5.551	27.1	65.5157	80.1886	31257.8	31111.9	145.944
5	34.974	1.10462e+006	basement	5.551	27.1	78.956	96.639	31519.7	31341.7	178.046
6	34.974	1.11352e+006	basement	5.551	27.1	91.0798	111.478	31768.5	31561.6	206.877
7	34.974	1.12176e+006	basement	5.551	27.1	101.014	123.637	32002.9	31772	230.858
8	34.974	1.12938e+006	basement	5.551	27.1	108.111	132.324	32221	31973.2	247.826
9	34.974	1.13654e+006	basement	5.551	27.1	113.856	139.355	32427	32165.5	261.524
10	34.974	1.14325e+006	basement	5.551	27.1	118.512	145.054	32621.9	32349.2	272.693
11	34.974	1.14952e+006	basement	5.551	27.1	121.875	149.17	32805.1	32524.5	280.579
12	34.974	1.15536e+006	basement	5.551	27.1	123.849	151.586	32977	32691.6	285.367
13	34.974	1.16081e+006	basement	5.551	27.1	124.786	152.733	33138.4	32850.7	287.716
14	34.974	1.16586e+006	basement	5.551	27.1	124.145	151.949	33288.1	33002.1	286.031
15	34.974	1.17058e+006	basement	5.551	27.1	122.801	150.304	33428.7	33145.9	282.824
16	34.974	1.17492e+006	basement	5.551	27.1	120.216	147.139	33559.1	33282.3	276.774
17	34.974	1.17876e+006	basement	5.551	27.1	115.447	141.303	33676.6	33411.4	265.233
18	34.974	1.18212e+006	basement	5.551	27.1	107.268	131.292	33779	33533.3	245.726
19	34.974	1.18513e+006	basement	5.551	27.1	97.3128	119.107	33870.1	33648.3	221.777
20	34.974	1.18788e+006	basement	5.551	27.1	86.9252	106.393	33953.4	33756.3	197.095
21	34.974	1.19029e+006	basement	5.551	27.1	75.0074	91.806	34026	33857.5	168.513
22	34.974	1.19235e+006	basement	5.551	27.1	61.4366	75.1959	34088.2	33952.1	136.102

23	34.974	1.19407e+006	basement	5.551	27.1	46.1961	56.5422	34139.7	34040	99.6597
24	34.974	1.19549e+006	basement	5.551	27.1	29.5765	36.2004	34181.5	34121.4	60.0558
25	34.974	1.19671e+006	basement	5.551	27.1	12.9382	15.8359	34216.6	34196.4	20.2195

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.22318

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	519.944	-2935.55	4.43798e+007	0	0
2	554.859	-2961.48	381171	568.467	0.0854491
3	589.775	-2986.3	698215	1041.3	0.0854494
4	624.691	-3010.08	987070	1472.09	0.0854493
5	659.606	-3032.84	1.23574e+006	1842.95	0.0854493
6	694.522	-3054.63	1.45239e+006	2166.05	0.0854491
7	729.438	-3075.48	1.63524e+006	2438.76	0.0854496
8	764.353	-3095.43	1.75505e+006	2617.43	0.0854492
9	799.269	-3114.5	1.84791e+006	2755.92	0.0854492
10	834.185	-3132.72	1.9177e+006	2860	0.0854491
11	869.1	-3150.12	1.96413e+006	2929.25	0.0854493
12	904.016	-3166.71	1.98458e+006	2959.74	0.0854491
13	938.932	-3182.53	1.98786e+006	2964.65	0.0854496
14	973.847	-3197.58	1.96602e+006	2932.07	0.0854493
15	1008.76	-3211.89	1.92938e+006	2877.43	0.0854495
16	1043.68	-3225.47	1.87687e+006	2799.12	0.0854495
17	1078.59	-3238.34	1.79741e+006	2680.61	0.0854494
18	1113.51	-3250.51	1.66302e+006	2480.18	0.0854492
19	1148.43	-3261.99	1.5042e+006	2243.33	0.0854496
20	1183.34	-3272.8	1.33867e+006	1996.46	0.0854495
21	1218.26	-3282.95	1.15917e+006	1728.76	0.0854496
22	1253.17	-3292.44	957332	1427.74	0.0854494
23	1288.09	-3301.29	736955	1099.07	0.0854489
24	1323	-3309.5	493385	735.821	0.0854493
25	1357.92	-3317.09	253384	377.89	0.0854493
26	1392.84	-3324.05	5.69039e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.22396

Slice	X coordinate	Y coordinate - Bottom	Interslice Normal Force	Interslice Shear Force	Interslice Force Angle

	[m]	[m]	[kN]	[kN]	[degrees]
1	517.211	-2934.54	4.43495e+007	0	0
2	552.185	-2960.51	385747	99.0039	0.0147052
3	587.159	-2985.37	703082	358.053	0.0291786
4	622.133	-3009.18	992156	747.925	0.0431917
5	657.106	-3031.97	1.2422e+006	1225.47	0.0565241
6	692.08	-3053.79	1.45894e+006	1756.07	0.0689647
7	727.054	-3074.67	1.64477e+006	2305.64	0.0803172
8	762.028	-3094.65	1.76455e+006	2784.18	0.0904036
9	797.002	-3113.74	1.85736e+006	3211.37	0.0990641
10	831.976	-3131.99	1.92665e+006	3569.87	0.106163
11	866.95	-3149.41	1.97298e+006	3842.48	0.111586
12	901.924	-3166.02	1.99328e+006	4009.51	0.115251
13	936.898	-3181.86	1.99588e+006	4079.06	0.117098
14	971.872	-3196.93	1.97383e+006	4034	0.117098
15	1006.85	-3211.25	1.93588e+006	3894.04	0.115251
16	1041.82	-3224.85	1.8831e+006	3667.45	0.111587
17	1076.79	-3237.73	1.80502e+006	3344.5	0.106163
18	1111.77	-3249.92	1.67022e+006	2887.81	0.0990643
19	1146.74	-3261.41	1.51096e+006	2384.06	0.0904038
20	1181.72	-3272.23	1.34366e+006	1883.54	0.0803171
21	1216.69	-3282.39	1.16366e+006	1400.64	0.0689641
22	1251.66	-3291.89	961012	948.063	0.0565237
23	1286.64	-3300.75	740073	557.896	0.0431918
24	1321.61	-3308.97	495920	252.554	0.0291787
25	1356.59	-3316.56	253945	65.1762	0.0147052
26	1391.56	-3323.52	5.68859e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.231106
Factor of Safety, standard deviation: 0.205378
Factor of Safety, minimum: 0.607088
Factor of Safety, maximum: 1.939760
Probability of Failure: 12.860% (= 1286 failed surfaces / 10000 valid surfaces)
Reliability index: 1.12527 (assuming normal distribution)
Reliability index: 1.17206 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price

Factor of Safety, mean: 1.231673
Factor of Safety, standard deviation: 0.205430
Factor of Safety, minimum: 0.607587
Factor of Safety, maximum: 1.943350
Probability of Failure: 12.740% (= 1274 failed surfaces / 10000 valid surfaces)
Reliability index: 1.12774 (assuming normal distribution)
Reliability index: 1.17511 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
2868	-6000
2868	0
0	0

External Boundary

X	Y
2868	-6000
2868	-3417
2776	-3417
2685	-3417
2593	-3417
2502	-3417
2411	-3417
2319	-3417
2228	-3417
2136	-3417
2045	-3417
1954	-3417
1862	-3417
1771	-3414
1679	-3407
1588	-3391
1502	-3366
1417	-3334

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 95PC Site 26		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_95_26_0g.slim

1332	-3299
1246	-3261
1161	-3223
1076	-3183
990	-3145
905	-3106
815	-3064
724	-3021
634	-2982
543	-2944
453	-2911
362	-2891
272	-2890
181	-2908
91	-2934
0	-2964
0	-6000

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_95_26.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 95PC Site 26
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/31/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364790743
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.003241
Center: 2170.363, -415.816
Radius: 3011.652
Left Slip Surface Endpoint: 521.927, -2936.273
Right Slip Surface Endpoint: 1401.855, -3327.764
Left Slope Intercept: 521.927 0.000
Right Slope Intercept: 1401.855 0.000
Resisting Moment=5.7549e+006 kN-m
Driving Moment=1.77577e+009 kN-m
Resisting Horizontal Force=1896.8 kN

Driving Horizontal Force=585290 kN
Total Slice Area=2.78082e+006 m2

Method: gle/morgenstern-price

FS: 0.002952
Center: 2175.476, -301.369
Radius: 3128.968
Left Slip Surface Endpoint: 447.208, -2909.727
Right Slip Surface Endpoint: 1440.088, -3342.692
Left Slope Intercept: 447.208 0.000
Right Slope Intercept: 1440.088 0.000
Resisting Moment=7.84228e+006 kN-m
Driving Moment=2.65617e+009 kN-m
Resisting Horizontal Force=2492.32 kN
Driving Horizontal Force=844147 kN
Total Slice Area=3.13805e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 974
Number of Invalid Surfaces: 10

Error Codes:

Error Code -108 reported for 8 surfaces
Error Code -112 reported for 2 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 981
Number of Invalid Surfaces: 3

Error Codes:

Error Code -112 reported for 3 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with

many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.00324078

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	35.1971	1.06953e+006	basement	5.551	27.1	97.2019	0.31501	30425.6	30435.7	-10.1307
2	35.1971	1.07919e+006	basement	5.551	27.1	220.614	0.71496	30782.8	30792.2	-9.37782
3	35.1971	1.08842e+006	basement	5.551	27.1	335.904	1.08859	31117.2	31125.9	-8.70398
4	35.1971	1.09723e+006	basement	5.551	27.1	444.643	1.44099	31431.4	31439.4	-8.03341
5	35.1971	1.10562e+006	basement	5.551	27.1	543.243	1.76053	31722.9	31730.4	-7.46909
6	35.1971	1.11365e+006	basement	5.551	27.1	636.057	2.06132	31997.1	32004	-6.85983
7	35.1971	1.12114e+006	basement	5.551	27.1	706.793	2.29056	32240.1	32246.5	-6.37659
8	35.1971	1.12823e+006	basement	5.551	27.1	763.693	2.47496	32461.1	32467.2	-6.10437
9	35.1971	1.13499e+006	basement	5.551	27.1	813.628	2.63679	32667.5	32673.2	-5.67953
10	35.1971	1.14146e+006	basement	5.551	27.1	858.053	2.78076	32861.2	32866.5	-5.31098
11	35.1971	1.14762e+006	basement	5.551	27.1	893.853	2.89678	33040.1	33045.3	-5.22057
12	35.1971	1.1535e+006	basement	5.551	27.1	923.472	2.99277	33207	33212.1	-5.0636
13	35.1971	1.1591e+006	basement	5.551	27.1	945.254	3.06336	33361.6	33366.4	-4.81139
14	35.1971	1.16443e+006	basement	5.551	27.1	959.34	3.10901	33504.3	33509	-4.70123
15	35.1971	1.16954e+006	basement	5.551	27.1	971.55	3.14858	33639.9	33644.5	-4.55098
16	35.1971	1.17437e+006	basement	5.551	27.1	971.68	3.149	33761.8	33766.4	-4.61594
17	35.1971	1.17877e+006	basement	5.551	27.1	941.539	3.05132	33858.9	33863.7	-4.77542
18	35.1971	1.18283e+006	basement	5.551	27.1	888.481	2.87937	33938.2	33943.5	-5.32723
19	35.1971	1.18667e+006	basement	5.551	27.1	825.326	2.6747	34009.1	34014.9	-5.75103
20	35.1971	1.19035e+006	basement	5.551	27.1	757.728	2.45563	34075.7	34081.8	-6.07856
21	35.1971	1.19376e+006	basement	5.551	27.1	671.07	2.17479	34129.9	34136.5	-6.57778
22	35.1971	1.19692e+006	basement	5.551	27.1	566.509	1.83593	34173.4	34180.8	-7.38036
23	35.1971	1.19983e+006	basement	5.551	27.1	438.74	1.42186	34205.2	34213.2	-8.01628
24	35.1971	1.20258e+006	basement	5.551	27.1	300.539	0.97398	34232.6	34241.6	-8.95737
25	35.1971	1.20518e+006	basement	5.551	27.1	154.046	0.49923	34256.7	34266.5	-9.75745

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00295247

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	39.7152	1.197e+006	basement	5.551	27.1	214.458	0.63318	30196.5	30206	-9.47267
2	39.7152	1.20985e+006	basement	5.551	27.1	548.205	1.61856	30634.9	30642.6	-7.73094
3	39.7152	1.22209e+006	basement	5.551	27.1	841.069	2.48323	31044.8	31050.7	-5.88409

4	39.7152	1.23348e+006	basement	5.551	27.1	1074.62	3.17277	31409.2	31413.8	-4.57796
5	39.7152	1.24433e+006	basement	5.551	27.1	1284.95	3.79378	31749.6	31753.1	-3.54847
6	39.7152	1.25459e+006	basement	5.551	27.1	1442.61	4.25926	32062.5	32065.1	-2.63
7	39.7152	1.26435e+006	basement	5.551	27.1	1574.22	4.64784	32353.2	32355	-1.77082
8	39.7152	1.27345e+006	basement	5.551	27.1	1568.28	4.63029	32610.7	32612.6	-1.90421
9	39.7152	1.28195e+006	basement	5.551	27.1	1576.46	4.65445	32838.1	32839.8	-1.7082
10	39.7152	1.29001e+006	basement	5.551	27.1	1561.15	4.60926	33047.9	33049.6	-1.74939
11	39.7152	1.29768e+006	basement	5.551	27.1	1508.44	4.45363	33241.8	33244	-2.20995
12	39.7152	1.30493e+006	basement	5.551	27.1	1431.58	4.2267	33418.8	33421.4	-2.61362
13	39.7152	1.31181e+006	basement	5.551	27.1	1333.97	3.9385	33582.1	33585.2	-3.11369
14	39.7152	1.31831e+006	basement	5.551	27.1	1219.56	3.6007	33729.4	33733.3	-3.8729
15	39.7152	1.32451e+006	basement	5.551	27.1	1117.91	3.30061	33867.9	33872.3	-4.4434
16	39.7152	1.33034e+006	basement	5.551	27.1	949.168	2.80239	33991.9	33997.1	-5.23456
17	39.7152	1.33562e+006	basement	5.551	27.1	688.139	2.03171	34087.3	34094.1	-6.79178
18	39.7152	1.34043e+006	basement	5.551	27.1	503.758	1.48733	34160.9	34168.9	-7.98149
19	39.7152	1.34497e+006	basement	5.551	27.1	407.503	1.20314	34227.5	34235.8	-8.34574
20	39.7152	1.34923e+006	basement	5.551	27.1	255.708	0.75497	34284.9	34294.3	-9.38351
21	39.7152	1.35314e+006	basement	5.551	27.1	132.973	0.3926	34328.6	34338.7	-10.0862
22	39.7152	1.35672e+006	basement	5.551	27.1	20.3423	0.06006	34359.3	34370	-10.6657
23	39.7152	1.36001e+006	basement	5.551	27.1	0	0	34375.7	34391.4	-15.7059
24	39.7152	1.36312e+006	basement	5.551	27.1	0	0	34389	34411.3	-22.347
25	39.7152	1.36595e+006	basement	5.551	27.1	0	0	34394.6	34421.1	-26.4594

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.00324078

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	521.927	-2936.27	4.44018e+007	0	0
2	557.124	-2958.95	277447	10.5783	0.00218453
3	592.322	-2980.93	509213	19.4149	0.00218453
4	627.519	-3002.26	726920	27.7155	0.00218453
5	662.716	-3022.93	915932	34.922	0.00218453
6	697.913	-3042.97	1.08617e+006	41.4126	0.00218453
7	733.11	-3062.39	1.22912e+006	46.8631	0.00218454
8	768.307	-3081.2	1.32286e+006	50.4372	0.00218454
9	803.504	-3099.42	1.39854e+006	53.3225	0.00218453
10	838.701	-3117.06	1.46026e+006	55.6757	0.00218453
11	873.898	-3134.13	1.5056e+006	57.4046	0.00218454

12	909.095	-3150.64	1.53324e+006	58.4582	0.00218453
13	944.292	-3166.6	1.54985e+006	59.0915	0.00218453
14	979.49	-3182.02	1.54752e+006	59.0028	0.00218453
15	1014.69	-3196.91	1.53977e+006	58.7074	0.00218454
16	1049.88	-3211.27	1.51896e+006	57.9139	0.00218454
17	1085.08	-3225.12	1.47065e+006	56.0719	0.00218453
18	1120.28	-3238.47	1.37831e+006	52.5511	0.00218453
19	1155.48	-3251.31	1.26639e+006	48.2839	0.00218453
20	1190.67	-3263.67	1.1583e+006	44.163	0.00218454
21	1225.87	-3275.53	1.03558e+006	39.4838	0.00218453
22	1261.07	-3286.92	896668	34.1875	0.00218453
23	1296.26	-3297.83	742705	28.3174	0.00218454
24	1331.46	-3308.27	570431	21.749	0.00218453
25	1366.66	-3318.25	415788	15.8529	0.00218454
26	1401.85	-3327.76	5.70312e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00295247

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	447.208	-2909.73	4.36025e+007	0	0
2	486.924	-2935.61	369307	-1089.23	-0.168987
3	526.639	-2960.65	696375	-4075.39	-0.335308
4	566.354	-2984.87	969894	-8402.07	-0.496334
5	606.069	-3008.29	1.19891e+006	-13591.9	-0.649528
6	645.784	-3030.93	1.4023e+006	-19396.7	-0.792468
7	685.499	-3052.81	1.57193e+006	-25322.3	-0.922901
8	725.215	-3073.95	1.71937e+006	-31175.7	-1.03878
9	764.93	-3094.36	1.80016e+006	-35767.7	-1.13827
10	804.645	-3114.07	1.85934e+006	-39590.6	-1.2198
11	844.36	-3133.08	1.90227e+006	-42574.2	-1.28211
12	884.075	-3151.41	1.92584e+006	-44517	-1.32419
13	923.79	-3169.07	1.93283e+006	-45394.5	-1.3454
14	963.506	-3186.08	1.92397e+006	-45186.4	-1.3454
15	1003.22	-3202.45	1.90121e+006	-43947.7	-1.32419
16	1042.94	-3218.18	1.87171e+006	-41890.1	-1.2821
17	1082.65	-3233.29	1.81572e+006	-38661.7	-1.2198
18	1122.37	-3247.79	1.70892e+006	-33954.7	-1.13827
19	1162.08	-3261.69	1.58082e+006	-28663.5	-1.03878
20	1201.8	-3274.98	1.45912e+006	-23505.1	-0.922903
21	1241.51	-3287.7	1.31497e+006	-18188.7	-0.792466

22	1281.23	-3299.83	1.15365e+006	-13078.7	-0.649523
23	1320.94	-3311.39	969361	-8397.45	-0.496334
24	1360.66	-3322.38	788701	-4615.7	-0.335307
25	1400.37	-3332.81	593873	-1751.57	-0.168988
26	1440.09	-3342.69	5.7544e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.032916
Factor of Safety, standard deviation: 0.066817
Factor of Safety, minimum: 0.000233
Factor of Safety, maximum: 0.990781
Probability of Failure: 100.000% (= 9983 failed surfaces / 9983 valid surfaces), 17 invalid surfaces
Reliability index: -14.47355 (assuming normal distribution)
Reliability index: -3.31021 (assuming lognormal distribution)
* best fit = Beta

Method: gle/morgenstern-price
Factor of Safety, mean: 0.033590
Factor of Safety, standard deviation: 0.068468
Factor of Safety, minimum: 0.000166
Factor of Safety, maximum: 0.980393
Probability of Failure: 100.000% (= 9996 failed surfaces / 9996 valid surfaces), 4 invalid surfaces
Reliability index: -14.11473 (assuming normal distribution)
Reliability index: -3.29025 (assuming lognormal distribution)
* best fit = Beta

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
2868	-6000
2868	0
0	0

External Boundary

X	Y

2868	-6000
2868	-3417
2776	-3417
2685	-3417
2593	-3417
2502	-3417
2411	-3417
2319	-3417
2228	-3417
2136	-3417
2045	-3417
1954	-3417
1862	-3417
1771	-3414
1679	-3407
1588	-3391
1502	-3366
1417	-3334
1332	-3299
1246	-3261
1161	-3223
1076	-3183
990	-3145
905	-3106
815	-3064
724	-3021
634	-2982
543	-2944
453	-2911
362	-2891
272	-2890
181	-2908
91	-2934
0	-2964
0	-6000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 95PC Site 27		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_95_27_0g.slim

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_95_27_0g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 95PC Site 27
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/31/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364791356
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 95PC Site 27		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_95_27_0g.slim

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 1000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Global Minimums

Method: spencer

FS: 1.334090
Center: 1876.108, -658.782
Radius: 1875.472
Left Slip Surface Endpoint: 778.247, -2179.341
Right Slip Surface Endpoint: 1590.980, -2512.454
Left Slope Intercept: 778.247 0.000
Right Slope Intercept: 1590.980 0.000
Resisting Moment=1.63854e+008 kN-m
Driving Moment=1.22821e+008 kN-m
Resisting Horizontal Force=80513.1 kN
Driving Horizontal Force=60350.4 kN
Total Slice Area=1.93716e+006 m2

Method: gle/morgenstern-price

FS: 1.335190
Center: 1829.280, -719.816
Radius: 1799.595
Left Slip Surface Endpoint: 774.918, -2178.194
Right Slip Surface Endpoint: 1554.009, -2498.234
Left Slope Intercept: 774.918 0.000
Right Slope Intercept: 1554.009 0.000
Resisting Moment=1.47239e+008 kN-m
Driving Moment=1.10276e+008 kN-m
Resisting Horizontal Force=75360 kN

Driving Horizontal Force=56441.6 kN
Total Slice Area=1.84977e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2637
Number of Invalid Surfaces: 217

Error Codes:

Error Code -108 reported for 217 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2853
Number of Invalid Surfaces: 1

Error Codes:

Error Code -108 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.33409

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	32.5093	734656	basement	5.551	27.1	8.78935	11.7258	22577.5	22565.4	12.0845
2	32.5093	744105	basement	5.551	27.1	27.8547	37.1607	22858.4	22796.6	61.7564
3	32.5093	752857	basement	5.551	27.1	43.3367	57.815	23119.7	23017.6	102.119
4	32.5093	761114	basement	5.551	27.1	57.3335	76.488	23367.4	23228.8	138.602
5	32.5093	768847	basement	5.551	27.1	69.6266	92.8881	23601.2	23430.6	170.649
6	32.5093	776085	basement	5.551	27.1	79.9789	106.699	23820.9	23623.3	197.646
7	32.5093	782878	basement	5.551	27.1	88.9858	118.715	24028.4	23807.2	221.172

8	32.5093	789172	basement	5.551	27.1	96.0048	128.079	24222.1	23982.7	239.429
9	32.5093	795028	basement	5.551	27.1	101.25	135.077	24403	24149.9	253.13
10	32.5093	800474	basement	5.551	27.1	105.132	140.256	24572.4	24309.1	263.268
11	32.5093	805481	basement	5.551	27.1	107.17	142.975	24729.1	24460.6	268.534
12	32.5093	810100	basement	5.551	27.1	107.697	143.678	24874.4	24604.5	269.896
13	32.5093	814370	basement	5.551	27.1	106.947	142.677	25008.9	24740.9	268.01
14	32.5093	818343	basement	5.551	27.1	105.617	140.902	25134.7	24870.2	264.487
15	32.5093	821966	basement	5.551	27.1	103.06	137.491	25250.2	24992.4	257.797
16	32.5093	825279	basement	5.551	27.1	99.3509	132.543	25355.8	25107.6	248.163
17	32.5093	828314	basement	5.551	27.1	95.1615	126.954	25453.3	25216	237.278
18	32.5093	831014	basement	5.551	27.1	89.6911	119.656	25540.8	25317.8	222.986
19	32.5093	833384	basement	5.551	27.1	82.8932	110.587	25618.2	25413	205.227
20	32.5093	835429	basement	5.551	27.1	74.7634	99.7411	25685.7	25501.7	184.027
21	32.5093	837154	basement	5.551	27.1	65.2956	87.1102	25743.4	25584	159.373
22	32.5093	838562	basement	5.551	27.1	54.4818	72.6836	25791.2	25660	131.205
23	32.5093	839659	basement	5.551	27.1	42.3128	56.4491	25829.3	25729.8	99.4862
24	32.5093	840461	basement	5.551	27.1	28.7678	38.3789	25857.6	25793.5	64.1043
25	32.5093	841055	basement	5.551	27.1	14.9078	19.8883	25879	25851	28.0228

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.33519

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	31.1636	703690	basement	5.551	27.1	12.0862	16.1374	22569.6	22548.9	20.6522
2	31.1636	712422	basement	5.551	27.1	28.7504	38.3872	22834.9	22770.8	64.1496
3	31.1636	720488	basement	5.551	27.1	42.4507	56.6797	23082.8	22982.9	99.9482
4	31.1636	728090	basement	5.551	27.1	54.8944	73.2944	23318.1	23185.7	132.364
5	31.1636	735232	basement	5.551	27.1	66.1089	88.268	23541.1	23379.4	161.655
6	31.1636	741899	basement	5.551	27.1	75.6481	101.005	23751	23564.4	186.568
7	31.1636	748160	basement	5.551	27.1	84.0689	112.248	23949.6	23741.1	208.471
8	31.1636	753990	basement	5.551	27.1	91.2477	121.833	24136.8	23909.5	227.275
9	31.1636	759385	basement	5.551	27.1	96.587	128.962	24311.3	24070.1	241.199
10	31.1636	764411	basement	5.551	27.1	100.762	134.536	24475.1	24223.1	252.03
11	31.1636	769050	basement	5.551	27.1	103.658	138.403	24628.1	24368.5	259.638
12	31.1636	773308	basement	5.551	27.1	104.838	139.978	24769.4	24506.7	262.732
13	31.1636	777225	basement	5.551	27.1	104.73	139.835	24900.3	24637.9	262.36
14	31.1636	780857	basement	5.551	27.1	103.572	138.288	25021.4	24762	259.426
15	31.1636	784199	basement	5.551	27.1	101.749	135.854	25134.1	24879.5	254.585
16	31.1636	787223	basement	5.551	27.1	98.5186	131.541	25236.4	24990.2	246.211
17	31.1636	789989	basement	5.551	27.1	94.2682	125.866	25329.6	25094.4	235.164
18	31.1636	792484	basement	5.551	27.1	89.2667	119.188	25414.3	25192.3	222.041

19	31.1636	794676	basement	5.551	27.1	82.7897	110.54	25489	25283.8	205.164
20	31.1636	796570	basement	5.551	27.1	74.8058	99.88	25553.5	25369.1	184.368
21	31.1636	798169	basement	5.551	27.1	65.2899	87.1744	25607.9	25448.4	159.469
22	31.1636	799478	basement	5.551	27.1	54.2249	72.4006	25652.2	25521.5	130.672
23	31.1636	800500	basement	5.551	27.1	41.603	55.5479	25686.4	25588.7	97.7339
24	31.1636	801238	basement	5.551	27.1	27.425	36.6176	25710.8	25650.1	60.6624
25	31.1636	801703	basement	5.551	27.1	11.7874	15.7384	25725.4	25705.5	19.9484

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.33409

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	778.247	-2179.34	2.44601e+007	0	0
2	810.756	-2202.29	265896	475.891	0.102546
3	843.265	-2224.23	480408	859.814	0.102545
4	875.775	-2245.2	671138	1201.17	0.102545
5	908.284	-2265.24	842326	1507.56	0.102545
6	940.793	-2284.38	984096	1761.3	0.102546
7	973.303	-2302.66	1.10728e+006	1981.76	0.102545
8	1005.81	-2320.1	1.208e+006	2162.03	0.102546
9	1038.32	-2336.73	1.28102e+006	2292.72	0.102546
10	1070.83	-2352.57	1.33568e+006	2390.55	0.102546
11	1103.34	-2367.65	1.36782e+006	2448.07	0.102546
12	1135.85	-2381.98	1.37752e+006	2465.44	0.102546
13	1168.36	-2395.59	1.36912e+006	2450.39	0.102545
14	1200.87	-2408.48	1.35139e+006	2418.65	0.102545
15	1233.38	-2420.68	1.31955e+006	2361.69	0.102546
16	1265.89	-2432.2	1.2701e+006	2273.17	0.102545
17	1298.4	-2443.06	1.21525e+006	2175	0.102545
18	1330.91	-2453.26	1.14488e+006	2049.07	0.102546
19	1363.41	-2462.82	1.05736e+006	1892.41	0.102545
20	1395.92	-2471.74	952770	1705.23	0.102546
21	1428.43	-2480.04	831224	1487.69	0.102545
22	1460.94	-2487.73	692823	1239.99	0.102546
23	1493.45	-2494.8	537668	962.296	0.102546
24	1525.96	-2501.28	365863	654.807	0.102546
25	1558.47	-2507.16	186269	333.377	0.102546
26	1590.98	-2512.45	3.2509e+007	0	0

rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 95PC Site 27		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
SLIDEINTERPRET 6.020	Date	3/31/2013		File Name: RR0705_95_27_0g.slim

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.33519

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	774.918	-2178.19	2.44343e+007	0	0
2	806.081	-2200.22	255434	74.765	0.0167704
3	837.245	-2221.29	467074	271.267	0.0332762
4	868.409	-2241.42	650201	558.979	0.0492573
5	899.572	-2260.66	815286	917.251	0.0644615
6	930.736	-2279.04	953659	1309.08	0.0786494
7	961.9	-2296.58	1.07191e+006	1713.61	0.0915959
8	993.063	-2313.33	1.17246e+006	2109.76	0.1031
9	1024.23	-2329.3	1.24392e+006	2452.77	0.112976
10	1055.39	-2344.51	1.29662e+006	2739.88	0.121071
11	1086.55	-2358.99	1.33189e+006	2958.2	0.127257
12	1117.72	-2372.76	1.3418e+006	3078.08	0.131436
13	1148.88	-2385.83	1.33432e+006	3109.97	0.133542
14	1180.05	-2398.22	1.31046e+006	3054.34	0.133541
15	1211.21	-2409.94	1.28062e+006	2937.74	0.131436
16	1242.37	-2421.02	1.234e+006	2740.77	0.127256
17	1273.54	-2431.45	1.17218e+006	2476.93	0.121071
18	1304.7	-2441.26	1.10562e+006	2180.07	0.112976
19	1335.86	-2450.45	1.02272e+006	1840.31	0.103099
20	1367.03	-2459.03	923589	1476.5	0.0915961
21	1398.19	-2467.02	808325	1109.58	0.0786493
22	1429.35	-2474.41	677037	761.711	0.0644615
23	1460.52	-2481.22	529829	455.495	0.0492573
24	1491.68	-2487.46	366810	213.036	0.0332763
25	1522.85	-2493.13	188089	55.0532	0.0167703
26	1554.01	-2498.23	3.2142e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.342633
Factor of Safety, standard deviation: 0.223581
Factor of Safety, minimum: 0.759632
Factor of Safety, maximum: 2.088130
Probability of Failure: 5.700% (= 57 failed surfaces / 1000 valid surfaces)
Reliability index: 1.53248 (assuming normal distribution)

Reliability index: 1.69878 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 1.343736
Factor of Safety, standard deviation: 0.223571
Factor of Safety, minimum: 0.761107
Factor of Safety, maximum: 2.089290
Probability of Failure: 5.600% (= 56 failed surfaces / 1000 valid surfaces)
Reliability index: 1.53748 (assuming normal distribution)
Reliability index: 1.70534 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
4880	-6000
4880	0
0	0

External Boundary

X	Y
4880	-6000
4880	-3095
4793	-3100
4706	-3103
4619	-3108
4532	-3118
4445	-3128
4359	-3138
4272	-3144
4186	-3143
4100	-3137
4014	-3126
3930	-3113
3846	-3099
3763	-3088

3679	-3076
3595	-3065
3512	-3052
3420	-3035
3328	-3016
3235	-2993
3143	-2969
3051	-2946
2959	-2922
2867	-2898
2781	-2877
2694	-2853
2608	-2828
2521	-2802
2435	-2782
2349	-2765
2262	-2745
2176	-2716
2089	-2690
1998	-2662
1907	-2632
1816	-2599
1725	-2564
1634	-2529
1543	-2494
1452	-2457
1361	-2420
1270	-2383
1178	-2344
1087	-2304
996	-2265
906	-2228
815	-2192
725	-2161
634	-2136
543	-2101
453	-2056
362	-2028
272	-2023
181	-2032

rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 95PC Site 27		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_95_27_0g.slim

SLIDEINTERPRET 6.020

91	-2054
0	-2092
0	-6000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 95PC Site 27		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_95_27_1g.slim

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_95_27_1g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 95PC Site 27
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/31/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 95PC Site 27		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_95_27_1g.slim

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364791255
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 1000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.003647
Center: 2788.707, 1686.268
Radius: 4373.178
Left Slip Surface Endpoint: 693.576, -2152.367
Right Slip Surface Endpoint: 1657.801, -2538.154
Left Slope Intercept: 693.576 0.000
Right Slope Intercept: 1657.801 0.000
Resisting Moment=8.87405e+006 kN-m
Driving Moment=2.4332e+009 kN-m
Resisting Horizontal Force=1989.32 kN

Driving Horizontal Force=545458 kN
Total Slice Area=2.28276e+006 m2

Method: gle/morgenstern-price

FS: 0.003482
Center: 2864.953, 1827.567
Radius: 4533.534
Left Slip Surface Endpoint: 694.425, -2152.600
Right Slip Surface Endpoint: 1694.498, -2552.268
Left Slope Intercept: 694.425 0.000
Right Slope Intercept: 1694.498 0.000
Resisting Moment=9.24692e+006 kN-m
Driving Moment=2.65566e+009 kN-m
Resisting Horizontal Force=1989.7 kN
Driving Horizontal Force=571428 kN
Total Slice Area=2.37563e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1191
Number of Invalid Surfaces: 20

Error Codes:

Error Code -108 reported for 11 surfaces
Error Code -112 reported for 9 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1196
Number of Invalid Surfaces: 15

Error Codes:

Error Code -108 reported for 5 surfaces
Error Code -112 reported for 10 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This

screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.00364706

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	38.569	860274	basement	5.551	27.1	105.724	0.38558	22346.8	22356.9	-10.0933
2	38.569	870202	basement	5.551	27.1	238.129	0.86847	22689.2	22698.4	-9.17705
3	38.569	879636	basement	5.551	27.1	353.863	1.29056	23004.4	23012.8	-8.35709
4	38.569	888619	basement	5.551	27.1	455.679	1.66189	23295.4	23303.1	-7.6918
5	38.569	897043	basement	5.551	27.1	532.846	1.94332	23554.3	23561.4	-7.06091
6	38.569	905158	basement	5.551	27.1	603.851	2.20228	23799.2	23805.8	-6.58677
7	38.569	912893	basement	5.551	27.1	661.939	2.41413	24024.9	24031	-6.09257
8	38.569	920330	basement	5.551	27.1	712.771	2.59952	24237.1	24242.8	-5.71941
9	38.569	927398	basement	5.551	27.1	749.648	2.73401	24430.6	24436.1	-5.50417
10	38.569	934142	basement	5.551	27.1	774.852	2.82593	24608.6	24614	-5.42497
11	38.569	940588	basement	5.551	27.1	789.886	2.88076	24773	24778.2	-5.19101
12	38.569	946708	basement	5.551	27.1	790.886	2.88441	24921.4	24926.5	-5.13099
13	38.569	952575	basement	5.551	27.1	783.661	2.85806	25059.3	25064.5	-5.2103
14	38.569	958280	basement	5.551	27.1	776.335	2.83134	25193.2	25198.5	-5.275
15	38.569	963749	basement	5.551	27.1	761.347	2.77668	25317.6	25323.1	-5.51112
16	38.569	969043	basement	5.551	27.1	743.986	2.71336	25436.9	25442.6	-5.65102
17	38.569	974150	basement	5.551	27.1	723.043	2.63698	25550.6	25556.2	-5.63868
18	38.569	979008	basement	5.551	27.1	690.888	2.51971	25653.3	25659.1	-5.84101
19	38.569	983619	basement	5.551	27.1	646.628	2.35829	25745.2	25751.5	-6.27692
20	38.569	987987	basement	5.551	27.1	589.28	2.14914	25826.9	25833.4	-6.51156
21	38.569	992112	basement	5.551	27.1	517.746	1.88825	25898	25905	-7.04283
22	38.569	995997	basement	5.551	27.1	430.802	1.57116	25958.6	25966.4	-7.77156
23	38.569	999732	basement	5.551	27.1	337.987	1.23266	26015.6	26024	-8.42198
24	38.569	1.00333e+006	basement	5.551	27.1	240.898	0.87857	26069.6	26078.6	-9.03217
25	38.569	1.00669e+006	basement	5.551	27.1	129.746	0.47319	26113.4	26123.2	-9.83755

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00348197

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	40.0029	892543	basement	5.551	27.1	222.271	0.77394	22356.3	22365.6	-9.32591
2	40.0029	903186	basement	5.551	27.1	530.725	1.84797	22710.3	22717.5	-7.18129

3	40.0029	913322	basement	5.551	27.1	815.105	2.83817	23037.7	23043.1	-5.3984
4	40.0029	922917	basement	5.551	27.1	973.061	3.38817	23335.5	23339.7	-4.17593
5	40.0029	931962	basement	5.551	27.1	1129.14	3.93164	23603.6	23606.7	-3.14631
6	40.0029	940663	basement	5.551	27.1	1222.32	4.25608	23856	23858.5	-2.47496
7	40.0029	948960	basement	5.551	27.1	1278.94	4.45323	24088.6	24090.7	-2.05365
8	40.0029	956933	basement	5.551	27.1	1279.26	4.45434	24306.9	24308.9	-2.04627
9	40.0029	964492	basement	5.551	27.1	1218.02	4.2411	24504.1	24506.6	-2.5273
10	40.0029	971734	basement	5.551	27.1	1142.14	3.97691	24687.4	24690.4	-2.9916
11	40.0029	978622	basement	5.551	27.1	995.436	3.46608	24853.7	24857.8	-4.07923
12	40.0029	985191	basement	5.551	27.1	856.064	2.98079	25006.1	25011.1	-5.02016
13	40.0029	991536	basement	5.551	27.1	773.7	2.694	25151.3	25156.8	-5.46788
14	40.0029	997683	basement	5.551	27.1	623.291	2.17028	25290.4	25296.9	-6.53057
15	40.0029	1.00358e+006	basement	5.551	27.1	513.227	1.78704	25420.4	25427.6	-7.24649
16	40.0029	1.00932e+006	basement	5.551	27.1	390.268	1.3589	25547.1	25555.2	-8.09999
17	40.0029	1.01481e+006	basement	5.551	27.1	234.488	0.81648	25663.3	25672.5	-9.19233
18	40.0029	1.02002e+006	basement	5.551	27.1	87.2064	0.30365	25768.4	25778.8	-10.3628
19	40.0029	1.02497e+006	basement	5.551	27.1	0	0	25853.6	25874.1	-20.4553
20	40.0029	1.02966e+006	basement	5.551	27.1	0	0	25915.7	25958.6	-42.906
21	40.0029	1.03408e+006	basement	5.551	27.1	0	0	25974.2	26032.4	-58.1694
22	40.0029	1.03831e+006	basement	5.551	27.1	0	0	26044.3	26099.9	-55.5509
23	40.0029	1.04241e+006	basement	5.551	27.1	0	0	26111.3	26166.2	-54.8869
24	40.0029	1.04627e+006	basement	5.551	27.1	0	0	26171.8	26222.3	-50.5306
25	40.0029	1.04987e+006	basement	5.551	27.1	0	0	26227.6	26268.1	-40.4637

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.00364706

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	693.576	-2152.37	2.38583e+007	0	0
2	732.145	-2173.17	218669	34.4841	0.00903554
3	770.714	-2193.47	384513	60.6377	0.00903554
4	809.283	-2213.29	544953	85.939	0.00903554
5	847.852	-2232.63	660846	104.215	0.00903551
6	886.421	-2251.5	762028	120.172	0.00903556
7	924.99	-2269.9	847786	133.696	0.00903555
8	963.559	-2287.84	917116	144.629	0.00903553
9	1002.13	-2305.33	974024	153.603	0.00903551
10	1040.7	-2322.37	1.0071e+006	158.819	0.00903551

11	1079.27	-2338.97	1.02906e+006	162.283	0.00903556
12	1117.84	-2355.13	1.03148e+006	162.665	0.00903558
13	1156.4	-2370.86	1.01995e+006	160.847	0.00903559
14	1194.97	-2386.16	1.00273e+006	158.13	0.00903551
15	1233.54	-2401.05	981671	154.809	0.00903551
16	1272.11	-2415.52	949415	149.723	0.00903556
17	1310.68	-2429.57	920655	145.187	0.00903553
18	1349.25	-2443.22	879939	138.766	0.00903552
19	1387.82	-2456.46	827170	130.445	0.00903556
20	1426.39	-2469.3	762291	120.213	0.00903552
21	1464.96	-2481.75	685280	108.069	0.00903557
22	1503.53	-2493.8	596156	94.0138	0.00903554
23	1542.09	-2505.47	494981	78.0585	0.00903554
24	1580.66	-2516.75	403300	63.6004	0.00903554
25	1619.23	-2527.64	300648	47.4121	0.00903553
26	1657.8	-2538.15	3.31775e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00348197

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	694.425	-2152.6	2.38635e+007	0	0
2	734.428	-2174.16	220690	-1453.58	-0.377375
3	774.431	-2195.2	385706	-5040.88	-0.748769
4	814.434	-2215.74	541329	-10472.5	-1.1083
5	854.437	-2235.77	643182	-16283.6	-1.45026
6	894.44	-2255.32	734202	-22679.1	-1.76927
7	934.443	-2274.39	805646	-28982.8	-2.0603
8	974.446	-2292.98	863264	-34955.5	-2.31877
9	1014.45	-2311.1	904343	-40127	-2.54063
10	1054.45	-2328.75	927932	-44123.9	-2.72241
11	1094.45	-2345.95	940556	-47009.3	-2.86128
12	1134.46	-2362.7	936567	-48347	-2.95507
13	1174.46	-2378.99	923594	-48441.3	-3.00234
14	1214.46	-2394.85	913833	-47929.3	-3.00233
15	1254.47	-2410.27	896542	-46280.9	-2.95507
16	1294.47	-2425.26	879487	-43957	-2.86128
17	1334.47	-2439.82	859378	-40864.1	-2.72241
18	1374.47	-2453.95	830071	-36831.4	-2.54063
19	1414.48	-2467.67	790944	-32027.1	-2.31877
20	1454.48	-2480.97	739969	-26620.1	-2.06031

21	1494.48	-2493.86	674422	-20832.6	-1.76928
22	1534.49	-2506.34	594043	-15039.6	-1.45027
23	1574.49	-2518.42	516796	-9997.85	-1.1083
24	1614.49	-2530.1	430015	-5619.97	-0.74877
25	1654.5	-2541.38	328614	-2164.43	-0.377376
26	1694.5	-2552.27	3.35475e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.044323
Factor of Safety, standard deviation: 0.079532
Factor of Safety, minimum: 0.000265
Factor of Safety, maximum: 0.681249
Probability of Failure: 100.000% (= 996 failed surfaces / 996 valid surfaces), 4 invalid surfaces
Reliability index: -12.01622 (assuming normal distribution)
Reliability index: -3.19703 (assuming lognormal distribution)
* best fit = Beta

Method: gle/morgenstern-price
Factor of Safety, mean: 0.044734
Factor of Safety, standard deviation: 0.080477
Factor of Safety, minimum: 0.000266
Factor of Safety, maximum: 0.682798
Probability of Failure: 100.000% (= 1000 failed surfaces / 1000 valid surfaces)
Reliability index: -11.87008 (assuming normal distribution)
Reliability index: -3.18662 (assuming lognormal distribution)
* best fit = Beta

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
4880	-6000
4880	0
0	0

External Boundary

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 95PC Site 27		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_95_27_1g.slim

X	Y
4880	-6000
4880	-3095
4793	-3100
4706	-3103
4619	-3108
4532	-3118
4445	-3128
4359	-3138
4272	-3144
4186	-3143
4100	-3137
4014	-3126
3930	-3113
3846	-3099
3763	-3088
3679	-3076
3595	-3065
3512	-3052
3420	-3035
3328	-3016
3235	-2993
3143	-2969
3051	-2946
2959	-2922
2867	-2898
2781	-2877
2694	-2853
2608	-2828
2521	-2802
2435	-2782
2349	-2765
2262	-2745
2176	-2716
2089	-2690
1998	-2662
1907	-2632
1816	-2599
1725	-2564
1634	-2529

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 95PC Site 27		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_95_27_1g.slim

1543	-2494
1452	-2457
1361	-2420
1270	-2383
1178	-2344
1087	-2304
996	-2265
906	-2228
815	-2192
725	-2161
634	-2136
543	-2101
453	-2056
362	-2028
272	-2023
181	-2032
91	-2054
0	-2092
0	-6000

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_95_28_0g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 95PC Site 28
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/31/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364791769
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 95PC Site 28		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_95_28_0g.slim

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 1000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Global Minimums

Method: spencer

FS: 1.460340
Center: 2296.393, -1205.191
Radius: 1597.084
Left Slip Surface Endpoint: 1392.350, -2521.771
Right Slip Surface Endpoint: 2109.679, -2791.323
Left Slope Intercept: 1392.350 -0.000
Right Slope Intercept: 2109.679 -0.000
Resisting Moment=1.13667e+008 kN-m
Driving Moment=7.78358e+007 kN-m
Resisting Horizontal Force=66356.6 kN
Driving Horizontal Force=45439 kN
Total Slice Area=1.92948e+006 m2

Method: gle/morgenstern-price

FS: 1.461770
Center: 2284.822, -1207.714
Radius: 1590.940
Left Slip Surface Endpoint: 1383.315, -2518.582
Right Slip Surface Endpoint: 2097.124, -2787.543
Left Slope Intercept: 1383.315 -0.000
Right Slope Intercept: 2097.124 -0.000
Resisting Moment=1.1404e+008 kN-m
Driving Moment=7.80155e+007 kN-m
Resisting Horizontal Force=66808.9 kN

Driving Horizontal Force=45704.2 kN
Total Slice Area=1.9174e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 3145
Number of Invalid Surfaces: 182

Error Codes:

Error Code -108 reported for 177 surfaces
Error Code -112 reported for 5 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 3327
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.46034

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	28.6932	748860	basement	5.551	27.1	7.497	10.9482	26083.9	26073.4	10.5074
2	28.6932	755814	basement	5.551	27.1	21.7203	31.719	26318.2	26267.1	51.1407
3	28.6932	762367	basement	5.551	27.1	34.7351	50.7251	26540.2	26451.9	88.314
4	28.6932	768539	basement	5.551	27.1	46.5593	67.9924	26750.2	26628.2	122.038
5	28.6932	774347	basement	5.551	27.1	57.2461	83.5988	26948.8	26796.3	152.495
6	28.6932	779771	basement	5.551	27.1	66.6182	97.2852	27135.6	26956.4	179.234
7	28.6932	784819	basement	5.551	27.1	74.3628	108.595	27310.2	27108.8	201.351

8	28.6932	789536	basement	5.551	27.1	80.9825	118.262	27474	27253.7	220.31
9	28.6932	793924	basement	5.551	27.1	86.4477	126.243	27627.3	27391.5	235.823
10	28.6932	797978	basement	5.551	27.1	90.5474	132.23	27769.7	27522.2	247.543
11	28.6932	801729	basement	5.551	27.1	93.5173	136.567	27902	27646	256.034
12	28.6932	805180	basement	5.551	27.1	95.3819	139.29	28024.5	27763.2	261.302
13	28.6932	808328	basement	5.551	27.1	95.9975	140.189	28136.9	27873.8	263.08
14	28.6932	811190	basement	5.551	27.1	95.4723	139.422	28239.6	27978	261.604
15	28.6932	813768	basement	5.551	27.1	93.8747	137.089	28333	28075.9	257.078
16	28.6932	815982	basement	5.551	27.1	90.2783	131.837	28414.5	28167.7	246.834
17	28.6932	817896	basement	5.551	27.1	85.0186	124.156	28485.3	28253.5	231.777
18	28.6932	819547	basement	5.551	27.1	78.6481	114.853	28546.9	28333.3	213.575
19	28.6932	820910	basement	5.551	27.1	70.9472	103.607	28598.8	28407.2	191.639
20	28.6932	821996	basement	5.551	27.1	61.7632	90.1953	28640.8	28475.4	165.41
21	28.6932	822829	basement	5.551	27.1	51.4417	75.1223	28673.8	28537.9	135.906
22	28.6932	823524	basement	5.551	27.1	40.5942	59.2813	28699.7	28594.7	104.992
23	28.6932	824185	basement	5.551	27.1	31.5788	46.1158	28725.2	28645.9	79.2906
24	28.6932	824606	basement	5.551	27.1	21.6504	31.6169	28742.6	28691.6	50.9885
25	28.6932	824825	basement	5.551	27.1	10.7413	15.686	28751.7	28731.9	19.7698

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.46177

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	28.5524	744237	basement	5.551	27.1	9.82379	14.3601	26057.4	26040.2	17.214
2	28.5524	751137	basement	5.551	27.1	22.9212	33.5055	26287.9	26233.3	54.5997
3	28.5524	757642	basement	5.551	27.1	34.9846	51.1394	26506.6	26417.5	89.104
4	28.5524	763767	basement	5.551	27.1	46.0172	67.2665	26713.8	26593.2	120.616
5	28.5524	769531	basement	5.551	27.1	56.0963	81.9999	26910.2	26760.8	149.36
6	28.5524	774934	basement	5.551	27.1	65.1865	95.2877	27095.7	26920.4	175.315
7	28.5524	779949	basement	5.551	27.1	72.8302	106.461	27269.5	27072.3	197.232
8	28.5524	784633	basement	5.551	27.1	79.4386	116.121	27432.9	27216.9	216.046
9	28.5524	788997	basement	5.551	27.1	85.103	124.401	27586.5	27354.2	232.291
10	28.5524	793030	basement	5.551	27.1	89.5825	130.949	27729.6	27484.6	245.04
11	28.5524	796757	basement	5.551	27.1	92.9613	135.888	27862.8	27608.1	254.713
12	28.5524	800189	basement	5.551	27.1	95.3262	139.345	27986.4	27725	261.445
13	28.5524	803324	basement	5.551	27.1	96.5549	141.141	28100.3	27835.3	265.005
14	28.5524	806171	basement	5.551	27.1	96.5733	141.168	28204.4	27939.3	265.069
15	28.5524	808743	basement	5.551	27.1	95.4685	139.553	28299	28037.1	261.867
16	28.5524	810992	basement	5.551	27.1	92.9387	135.855	28383.4	28128.7	254.693
17	28.5524	812901	basement	5.551	27.1	88.0398	128.694	28455	28214.4	240.604
18	28.5524	814549	basement	5.551	27.1	81.8453	119.639	28517	28294.1	222.936

19	28.5524	815929	basement	5.551	27.1	74.3168	108.634	28569.4	28368	201.393
20	28.5524	817020	basement	5.551	27.1	65.0173	95.0403	28611	28436.1	174.865
21	28.5524	817859	basement	5.551	27.1	54.3085	79.3866	28642.8	28498.6	144.229
22	28.5524	818477	basement	5.551	27.1	42.3989	61.9775	28665.7	28555.4	110.282
23	28.5524	819091	basement	5.551	27.1	32.0476	46.8462	28687.4	28606.7	80.6995
24	28.5524	819522	basement	5.551	27.1	21.4032	31.2866	28702.8	28652.5	50.2942
25	28.5524	819717	basement	5.551	27.1	9.52542	13.924	28709.2	28692.9	16.3336

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.46034

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	1392.35	-2521.77	3.27505e+007	0	0
2	1421.04	-2541.02	238307	285.938	0.0687476
3	1449.74	-2559.39	456181	547.359	0.0687476
4	1478.43	-2576.91	653105	783.643	0.0687476
5	1507.12	-2593.62	830532	996.532	0.0687476
6	1535.82	-2609.54	988751	1186.38	0.0687479
7	1564.51	-2624.71	1.11725e+006	1340.56	0.0687477
8	1593.2	-2639.14	1.2265e+006	1471.65	0.0687479
9	1621.9	-2652.85	1.3172e+006	1580.47	0.0687475
10	1650.59	-2665.88	1.38561e+006	1662.56	0.0687478
11	1679.28	-2678.23	1.43455e+006	1721.28	0.0687477
12	1707.97	-2689.93	1.46551e+006	1758.43	0.0687478
13	1736.67	-2700.98	1.47703e+006	1772.24	0.0687473
14	1765.36	-2711.41	1.46932e+006	1763	0.0687477
15	1794.05	-2721.22	1.44412e+006	1732.76	0.0687476
16	1822.75	-2730.42	1.39477e+006	1673.54	0.0687473
17	1851.44	-2739.04	1.31259e+006	1574.94	0.0687476
18	1880.13	-2747.07	1.21318e+006	1455.67	0.068748
19	1908.83	-2754.54	1.09613e+006	1315.22	0.0687478
20	1937.52	-2761.43	954002	1144.68	0.0687476
21	1966.21	-2767.77	794974	953.868	0.0687476
22	1994.91	-2773.56	619177	742.933	0.0687476
23	2023.6	-2778.8	474765	569.658	0.0687477
24	2052.29	-2783.51	324567	389.439	0.0687476
25	2080.99	-2787.68	158356	190.007	0.0687476
26	2109.68	-2791.32	4.01261e+007	0	0

rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 95PC Site 28		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
SLIDEINTERPRET 6.020	Date	3/31/2013		File Name: RR0705_95_28_0g.slim

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.46177

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	1383.31	-2518.58	3.26678e+007	0	0
2	1411.87	-2537.77	237679	48.118	0.0115995
3	1440.42	-2556.07	455298	182.896	0.0230161
4	1468.97	-2573.54	651967	387.678	0.0340697
5	1497.52	-2590.19	829065	645.155	0.044586
6	1526.08	-2606.07	987067	937.165	0.0543991
7	1554.63	-2621.19	1.11935e+006	1237.71	0.0633542
8	1583.18	-2635.58	1.2287e+006	1529.25	0.0713108
9	1611.73	-2649.26	1.31963e+006	1799.75	0.0781416
10	1640.29	-2662.25	1.39028e+006	2031.97	0.0837408
11	1668.84	-2674.57	1.43974e+006	2211.77	0.0880194
12	1697.39	-2686.23	1.47134e+006	2334.54	0.0909098
13	1725.94	-2697.26	1.48481e+006	2393.66	0.0923664
14	1754.5	-2707.66	1.47801e+006	2382.7	0.0923664
15	1783.05	-2717.45	1.45383e+006	2306.76	0.0909099
16	1811.6	-2726.64	1.41242e+006	2169.8	0.0880193
17	1840.15	-2735.25	1.33354e+006	1949.04	0.0837408
18	1868.71	-2743.27	1.23567e+006	1685.25	0.0781419
19	1897.26	-2750.73	1.12082e+006	1394.98	0.0713107
20	1925.81	-2757.62	983458	1087.45	0.0633543
21	1954.36	-2763.95	826385	784.606	0.0543991
22	1982.91	-2769.75	652661	507.882	0.0445859
23	2011.47	-2774.99	485714	288.819	0.0340697
24	2040.02	-2779.71	337368	135.523	0.0230161
25	2068.57	-2783.89	173135	35.0511	0.0115995
26	2097.12	-2787.54	4.00175e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.469664
Factor of Safety, standard deviation: 0.242417
Factor of Safety, minimum: 0.816906
Factor of Safety, maximum: 2.229130
Probability of Failure: 2.200% (= 22 failed surfaces / 1000 valid surfaces)
Reliability index: 1.93742 (assuming normal distribution)

Reliability index: 2.26812 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 1.471097
Factor of Safety, standard deviation: 0.242806
Factor of Safety, minimum: 0.817303
Factor of Safety, maximum: 2.231760
Probability of Failure: 2.200% (= 22 failed surfaces / 1000 valid surfaces)
Reliability index: 1.94022 (assuming normal distribution)
Reliability index: 2.27256 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
5620	-6000
5620	0
0	0

External Boundary

X	Y
5620	-6000
5620	-3406
5532	-3406
5444	-3405
5356	-3403
5268	-3402
5181	-3401
5093	-3400
5005	-3398
4917	-3396
4829	-3393
4742	-3391
4654	-3388
4566	-3380
4478	-3365

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 95PC Site 28		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 3/31/2013		File Name: RR0705_95_28_0g.slim

4387	-3346
4296	-3328
4205	-3315
4115	-3307
4024	-3299
3933	-3287
3842	-3268
3751	-3248
3660	-3225
3569	-3203
3478	-3181
3386	-3158
3293	-3138
3201	-3115
3109	-3081
3016	-3034
2924	-2989
2832	-2956
2739	-2929
2647	-2902
2555	-2880
2462	-2863
2370	-2850
2277	-2836
2185	-2814
2092	-2786
2000	-2754
1907	-2715
1814	-2677
1722	-2642
1629	-2607
1537	-2573
1444	-2540
1359	-2510
1273	-2480
1188	-2450
1103	-2416
1017	-2384
932	-2352
847	-2333

rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 95PC Site 28		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_95_28_0g.slim

SLIDEINTERPRET 6.020

761	-2315
676	-2280
591	-2248
505	-2218
421	-2194
337	-2177
253	-2167
169	-2160
84	-2150
0	-2143
0	-6000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 95PC Site 28		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_95_28_1g.slim

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_95_28_1g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 95PC Site 28
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/31/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364791800
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.002873
Center: 3202.523, -2663.029
Radius: 426.277
Left Slip Surface Endpoint: 2933.357, -2993.577
Right Slip Surface Endpoint: 3101.319, -3077.118
Left Slope Intercept: 2933.357 -0.000
Right Slope Intercept: 3101.319 -0.000
Resisting Moment=39195.6 kN-m
Driving Moment=1.36432e+007 kN-m
Resisting Horizontal Force=90.9441 kN

Driving Horizontal Force=31655.7 kN
Total Slice Area=511130 m2

Method: gle/morgenstern-price

FS: 0.002670
Center: 3202.523, -2663.029
Radius: 426.277
Left Slip Surface Endpoint: 2933.357, -2993.577
Right Slip Surface Endpoint: 3101.319, -3077.118
Left Slope Intercept: 2933.357 -0.000
Right Slope Intercept: 3101.319 -0.000
Resisting Moment=36421.7 kN-m
Driving Moment=1.36432e+007 kN-m
Resisting Horizontal Force=84.5529 kN
Driving Horizontal Force=31672.6 kN
Total Slice Area=511130 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1242
Number of Invalid Surfaces: 26

Error Codes:

Error Code -108 reported for 10 surfaces
Error Code -111 reported for 3 surfaces
Error Code -112 reported for 13 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1251
Number of Invalid Surfaces: 17

Error Codes:

Error Code -108 reported for 3 surfaces
Error Code -112 reported for 14 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.00287291

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	6.71847	207381	basement	5.551	27.1	87.9352	0.25263	30867.5	30877.9	-10.353
2	6.71847	207818	basement	5.551	27.1	110.358	0.31705	30953	30963.2	-10.2111
3	6.71847	208232	basement	5.551	27.1	131.95	0.37908	31032.9	31043	-10.0801
4	6.71847	208626	basement	5.551	27.1	152.612	0.43844	31107.5	31117.5	-10.0444
5	6.71847	208998	basement	5.551	27.1	172.226	0.49479	31177	31186.9	-9.91574
6	6.71847	209350	basement	5.551	27.1	190.681	0.54781	31241.6	31251.4	-9.78528
7	6.71847	209683	basement	5.551	27.1	207.852	0.59714	31301.5	31311.2	-9.74396
8	6.71847	209998	basement	5.551	27.1	223.61	0.64241	31356.8	31366.4	-9.61708
9	6.71847	210295	basement	5.551	27.1	237.804	0.68319	31407.8	31417.3	-9.48198
10	6.71847	210574	basement	5.551	27.1	250.279	0.71903	31454.5	31463.9	-9.40627
11	6.71847	210837	basement	5.551	27.1	260.854	0.74941	31497	31506.4	-9.41342
12	6.71847	211083	basement	5.551	27.1	269.34	0.77379	31535.5	31544.8	-9.31738
13	6.71847	211312	basement	5.551	27.1	271.756	0.78073	31569.7	31579	-9.3427
14	6.71847	211523	basement	5.551	27.1	271.606	0.7803	31598.8	31608.1	-9.2971
15	6.71847	211719	basement	5.551	27.1	269.685	0.77478	31624.1	31633.4	-9.25662
16	6.71847	211900	basement	5.551	27.1	264.342	0.75943	31645.8	31655.2	-9.43662
17	6.71847	212066	basement	5.551	27.1	255.177	0.7331	31664	31673.3	-9.34624
18	6.71847	212219	basement	5.551	27.1	241.713	0.69442	31678.5	31688	-9.46949
19	6.71847	212357	basement	5.551	27.1	223.397	0.6418	31689.8	31699.3	-9.49431
20	6.71847	212482	basement	5.551	27.1	199.582	0.57338	31697.6	31707.3	-9.67668
21	6.71847	212594	basement	5.551	27.1	169.473	0.48688	31702.1	31712	-9.94147
22	6.71847	212692	basement	5.551	27.1	132.141	0.37963	31703.4	31713.5	-10.071
23	6.71847	212777	basement	5.551	27.1	86.435	0.24832	31701.4	31711.8	-10.3533
24	6.71847	212850	basement	5.551	27.1	30.9477	0.08891	31696.2	31707	-10.7876
25	6.71847	212910	basement	5.551	27.1	0	0	31678	31699	-21.0169

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00266959

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]

1	6.71847	207381	basement	5.551	27.1	53.1392	0.14186	30867.3	30877.9	-10.5857
2	6.71847	207818	basement	5.551	27.1	109.785	0.29308	30953	30963.2	-10.2111
3	6.71847	208232	basement	5.551	27.1	162.044	0.43259	31033	31043	-9.96016
4	6.71847	208626	basement	5.551	27.1	208.815	0.55745	31107.7	31117.5	-9.80108
5	6.71847	208998	basement	5.551	27.1	249.166	0.66517	31177.4	31186.9	-9.54595
6	6.71847	209350	basement	5.551	27.1	282.324	0.75369	31242	31251.4	-9.41082
7	6.71847	209683	basement	5.551	27.1	307.744	0.82155	31302	31311.2	-9.23872
8	6.71847	209998	basement	5.551	27.1	325.087	0.86785	31357.3	31366.4	-9.1061
9	6.71847	210295	basement	5.551	27.1	334.269	0.89236	31408.2	31417.3	-9.09462
10	6.71847	210574	basement	5.551	27.1	335.445	0.8955	31454.8	31463.9	-9.1454
11	6.71847	210837	basement	5.551	27.1	329.017	0.87834	31497.2	31506.4	-9.15002
12	6.71847	211083	basement	5.551	27.1	315.644	0.84264	31535.6	31544.8	-9.18447
13	6.71847	211312	basement	5.551	27.1	288.142	0.76922	31569.7	31579	-9.3427
14	6.71847	211523	basement	5.551	27.1	257.968	0.68867	31598.5	31608.1	-9.56744
15	6.71847	211719	basement	5.551	27.1	227.544	0.60745	31623.7	31633.4	-9.6653
16	6.71847	211900	basement	5.551	27.1	195.202	0.52111	31645.4	31655.2	-9.84832
17	6.71847	212066	basement	5.551	27.1	162.501	0.43381	31663.3	31673.3	-10.0372
18	6.71847	212219	basement	5.551	27.1	131.035	0.34981	31677.8	31688	-10.1651
19	6.71847	212357	basement	5.551	27.1	102.401	0.27337	31689	31699.3	-10.3342
20	6.71847	212482	basement	5.551	27.1	78.1056	0.20851	31696.9	31707.3	-10.3807
21	6.71847	212594	basement	5.551	27.1	59.5222	0.1589	31701.5	31712	-10.5078
22	6.71847	212692	basement	5.551	27.1	47.7939	0.12759	31702.9	31713.5	-10.6403
23	6.71847	212777	basement	5.551	27.1	43.7595	0.11682	31701.2	31711.8	-10.6393
24	6.71847	212850	basement	5.551	27.1	47.8463	0.12773	31696.4	31707	-10.6439
25	6.71847	212910	basement	5.551	27.1	59.9568	0.16006	31688.5	31699	-10.4833

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.00287291

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	2933.36	-2993.58	4.61517e+007	0	0
2	2940.08	-2998.94	63804.7	-168.057	-0.150913
3	2946.79	-3004.08	121376	-319.697	-0.150913
4	2953.51	-3009.01	172931	-455.488	-0.150913
5	2960.23	-3013.75	218663	-575.944	-0.150913
6	2966.95	-3018.3	258752	-681.536	-0.150913
7	2973.67	-3022.66	293360	-772.689	-0.150913
8	2980.39	-3026.85	322634	-849.796	-0.150913

9	2987.1	-3030.87	346712	-913.216	-0.150913
10	2993.82	-3034.72	365720	-963.281	-0.150913
11	3000.54	-3038.42	379774	-1000.3	-0.150913
12	3007.26	-3041.95	388983	-1024.55	-0.150912
13	3013.98	-3045.34	393447	-1036.31	-0.150912
14	3020.7	-3048.58	390885	-1029.56	-0.150912
15	3027.42	-3051.68	382727	-1008.08	-0.150913
16	3034.13	-3054.64	370078	-974.76	-0.150913
17	3040.85	-3057.46	353019	-929.828	-0.150913
18	3047.57	-3060.15	331627	-873.483	-0.150913
19	3054.29	-3062.7	305977	-805.922	-0.150913
20	3061.01	-3065.13	276141	-727.335	-0.150913
21	3067.73	-3067.43	242190	-637.91	-0.150912
22	3074.44	-3069.61	204194	-537.832	-0.150913
23	3081.16	-3071.67	162223	-427.285	-0.150913
24	3087.88	-3073.6	116350	-306.458	-0.150913
25	3094.6	-3075.42	66648.7	-175.548	-0.150913
26	3101.32	-3077.12	4.87636e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00266959

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	2933.36	-2993.58	4.61517e+007	0	0
2	2940.08	-2998.94	63955.9	-45.5878	-0.0408405
3	2946.79	-3004.08	121560	-171.93	-0.081037
4	2953.51	-3009.01	173042	-362.282	-0.119955
5	2960.23	-3013.75	218612	-598.963	-0.156981
6	2966.95	-3018.3	258468	-864.025	-0.191532
7	2973.67	-3022.66	292794	-1139.9	-0.223062
8	2980.39	-3026.85	321761	-1409.99	-0.251074
9	2987.1	-3030.87	345531	-1659.2	-0.275126
10	2993.82	-3034.72	364253	-1874.43	-0.294839
11	3000.54	-3038.42	378065	-2044.91	-0.309903
12	3007.26	-3041.95	387098	-2162.52	-0.320079
13	3013.98	-3045.34	391468	-2221.98	-0.325208
14	3020.7	-3048.58	388922	-2207.52	-0.325207
15	3027.42	-3051.68	380889	-2127.84	-0.32008
16	3034.13	-3054.64	368469	-1993.01	-0.309904
17	3040.85	-3057.46	351736	-1810.02	-0.294839
18	3047.57	-3060.15	330755	-1588.25	-0.275126

19	3054.29	-3062.7	305577	-1339.06	-0.251073
20	3061.01	-3065.13	276246	-1075.47	-0.223061
21	3067.73	-3067.43	242795	-811.632	-0.191532
22	3074.44	-3069.61	205248	-562.349	-0.156982
23	3081.16	-3071.67	163623	-342.564	-0.119955
24	3087.88	-3073.6	117931	-166.797	-0.0810369
25	3094.6	-3075.42	68176.2	-48.596	-0.0408404
26	3101.32	-3077.12	4.87636e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.036456
Factor of Safety, standard deviation: 0.078134
Factor of Safety, minimum: 0.000240
Factor of Safety, maximum: 1.180740
Probability of Failure: 99.960% (= 9985 failed surfaces / 9989 valid surfaces), 11 invalid surfaces
Reliability index: -12.33199 (assuming normal distribution)
Reliability index: -3.17999 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 0.035272
Factor of Safety, standard deviation: 0.078483
Factor of Safety, minimum: 0.000267
Factor of Safety, maximum: 1.182900
Probability of Failure: 99.960% (= 9991 failed surfaces / 9995 valid surfaces), 5 invalid surfaces
Reliability index: -12.29213 (assuming normal distribution)
Reliability index: -3.17218 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
5620	-6000
5620	0
0	0

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 95PC Site 28		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_95_28_1g.slim

External Boundary

X	Y
5620	-6000
5620	-3406
5532	-3406
5444	-3405
5356	-3403
5268	-3402
5181	-3401
5093	-3400
5005	-3398
4917	-3396
4829	-3393
4742	-3391
4654	-3388
4566	-3380
4478	-3365
4387	-3346
4296	-3328
4205	-3315
4115	-3307
4024	-3299
3933	-3287
3842	-3268
3751	-3248
3660	-3225
3569	-3203
3478	-3181
3386	-3158
3293	-3138
3201	-3115
3109	-3081
3016	-3034
2924	-2989
2832	-2956
2739	-2929
2647	-2902
2555	-2880
2462	-2863
2370	-2850

2277	-2836
2185	-2814
2092	-2786
2000	-2754
1907	-2715
1814	-2677
1722	-2642
1629	-2607
1537	-2573
1444	-2540
1359	-2510
1273	-2480
1188	-2450
1103	-2416
1017	-2384
932	-2352
847	-2333
761	-2315
676	-2280
591	-2248
505	-2218
421	-2194
337	-2177
253	-2167
169	-2160
84	-2150
0	-2143
0	-6000

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_96_18_0g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 96PC Site 18
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/31/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364792097
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 96PC Site 18		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_96_18_0g.slim

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Global Minimums

Method: spencer

FS: 1.186710
Center: 877.263, -2619.904
Radius: 684.482
Left Slip Surface Endpoint: 393.421, -3104.066
Right Slip Surface Endpoint: 801.042, -3300.130
Left Slope Intercept: 393.421 -0.000
Right Slope Intercept: 801.042 -0.000
Resisting Moment=2.28949e+007 kN-m
Driving Moment=1.92927e+007 kN-m
Resisting Horizontal Force=30004.6 kN
Driving Horizontal Force=25283.8 kN
Total Slice Area=1.31688e+006 m2

Method: gle/morgenstern-price

FS: 1.184980
Center: 878.114, -2618.661
Radius: 686.065
Left Slip Surface Endpoint: 393.187, -3103.976
Right Slip Surface Endpoint: 801.805, -3300.469
Left Slope Intercept: 393.187 -0.000
Right Slope Intercept: 801.805 -0.000
Resisting Moment=2.30197e+007 kN-m
Driving Moment=1.94263e+007 kN-m
Resisting Horizontal Force=30128.9 kN

Driving Horizontal Force=25425.7 kN
Total Slice Area=1.32018e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2164
Number of Invalid Surfaces: 587

Error Codes:

Error Code -108 reported for 587 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2751
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.18671

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	16.3048	523052	basement	5.551	27.1	5.67077	6.72956	32055.3	32053.1	2.24298
2	16.3048	526401	basement	5.551	27.1	21.9123	26.0035	32250.3	32210.3	39.9512
3	16.3048	529415	basement	5.551	27.1	34.8968	41.4124	32427.7	32357.6	70.1376
4	16.3048	532197	basement	5.551	27.1	46.3529	55.0074	32592.6	32495.9	96.6945
5	16.3048	534767	basement	5.551	27.1	56.6088	67.1782	32746.3	32625.9	120.414
6	16.3048	537141	basement	5.551	27.1	65.6884	77.9531	32889.5	32748	141.461
7	16.3048	539318	basement	5.551	27.1	73.638	87.387	33022.7	32862.7	159.952
8	16.3048	541282	basement	5.551	27.1	79.5153	94.3616	33144.1	32970.6	173.486
9	16.3048	543079	basement	5.551	27.1	84.0354	99.7257	33255.9	33071.9	184.001
10	16.3048	544718	basement	5.551	27.1	87.4233	103.746	33358.8	33166.9	191.931
11	16.3048	546208	basement	5.551	27.1	89.6925	106.439	33453.2	33256.1	197.114

12	16.3048	547555	basement	5.551	27.1	90.8529	107.816	33539.4	33339.5	199.851
13	16.3048	548764	basement	5.551	27.1	90.9135	107.888	33617.5	33417.5	200.019
14	16.3048	549841	basement	5.551	27.1	89.8813	106.663	33687.8	33490.2	197.646
15	16.3048	550789	basement	5.551	27.1	87.7602	104.146	33750.5	33557.8	192.706
16	16.3048	551614	basement	5.551	27.1	84.5517	100.338	33805.8	33620.5	185.28
17	16.3048	552322	basement	5.551	27.1	80.2523	95.2362	33853.7	33678.4	175.258
18	16.3048	552925	basement	5.551	27.1	75.2326	89.2793	33895.2	33731.6	163.612
19	16.3048	553414	basement	5.551	27.1	69.1903	82.1088	33929.8	33780.3	149.544
20	16.3048	553790	basement	5.551	27.1	62.0559	73.6424	33957.5	33824.4	133.11
21	16.3048	554057	basement	5.551	27.1	53.8207	63.8696	33978.2	33864.2	113.967
22	16.3048	554235	basement	5.551	27.1	44.4733	52.7769	33992	33899.7	92.282
23	16.3048	554357	basement	5.551	27.1	35.575	42.2172	34002.6	33930.9	71.7102
24	16.3048	554376	basement	5.551	27.1	25.8003	30.6175	34007	33958	48.9683
25	16.3048	554291	basement	5.551	27.1	14.9024	17.6848	34004.6	33980.9	23.7068

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.18498

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	16.3447	524321	basement	5.551	27.1	10.515	12.4601	32065.8	32052.3	13.5069
2	16.3447	527686	basement	5.551	27.1	24.3027	28.7982	32255.3	32209.9	45.4291
3	16.3447	530715	basement	5.551	27.1	35.5906	42.1741	32429.2	32357.6	71.5668
4	16.3447	533510	basement	5.551	27.1	45.8309	54.3087	32591.5	32496.2	95.3157
5	16.3447	536092	basement	5.551	27.1	55.1832	65.391	32743.4	32626.4	116.971
6	16.3447	538477	basement	5.551	27.1	63.6692	75.4467	32885.4	32748.8	136.583
7	16.3447	540664	basement	5.551	27.1	71.3118	84.503	33018.1	32863.8	154.288
8	16.3447	542637	basement	5.551	27.1	77.22	91.5042	33139.9	32971.9	167.952
9	16.3447	544442	basement	5.551	27.1	82.0199	97.1919	33252.5	33073.4	179.096
10	16.3447	546089	basement	5.551	27.1	85.8729	101.758	33356.7	33168.7	188.032
11	16.3447	547586	basement	5.551	27.1	88.7447	105.161	33452.7	33258.1	194.605
12	16.3447	548939	basement	5.551	27.1	90.5931	107.351	33540.6	33341.7	198.92
13	16.3447	550154	basement	5.551	27.1	91.372	108.274	33620.6	33419.9	200.695
14	16.3447	551235	basement	5.551	27.1	91.0302	107.869	33692.7	33492.7	200.004
15	16.3447	552188	basement	5.551	27.1	89.5163	106.075	33756.9	33560.5	196.446
16	16.3447	553015	basement	5.551	27.1	86.7782	102.83	33813.4	33623.3	190.127
17	16.3447	553726	basement	5.551	27.1	82.7614	98.0706	33862.1	33681.3	180.824
18	16.3447	554332	basement	5.551	27.1	77.8283	92.225	33904	33734.6	169.384
19	16.3447	554823	basement	5.551	27.1	71.614	84.8612	33938.3	33783.4	154.94
20	16.3447	555201	basement	5.551	27.1	64.023	75.866	33965	33827.6	137.422
21	16.3447	555468	basement	5.551	27.1	55.0284	65.2075	33984.1	33867.5	116.598
22	16.3447	555649	basement	5.551	27.1	44.9213	53.2308	33996.2	33903	93.2091

23	16.3447	555772	basement	5.551	27.1	34.9586	41.4252	34004.5	33934.3	70.1627
24	16.3447	555790	basement	5.551	27.1	23.7461	28.1386	34005.6	33961.4	44.1988
25	16.3447	555705	basement	5.551	27.1	11.1559	13.2195	33999.3	33984.4	14.9484

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.18671

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	393.421	-3104.07	4.96214e+007	0	0
2	409.726	-3119.83	304010	305.705	0.0576152
3	426.03	-3134.59	545648	548.69	0.0576152
4	442.335	-3148.44	747882	752.052	0.0576152
5	458.64	-3161.45	924085	929.237	0.0576152
6	474.945	-3173.67	1.07581e+006	1081.81	0.0576153
7	491.25	-3185.16	1.20439e+006	1211.11	0.0576154
8	507.555	-3195.95	1.29852e+006	1305.76	0.0576152
9	523.859	-3206.1	1.36479e+006	1372.4	0.0576152
10	540.164	-3215.62	1.41085e+006	1418.71	0.057615
11	556.469	-3224.56	1.43746e+006	1445.48	0.0576154
12	572.774	-3232.93	1.44532e+006	1453.38	0.0576153
13	589.079	-3240.76	1.43505e+006	1443.05	0.0576152
14	605.384	-3248.07	1.40718e+006	1415.02	0.057615
15	621.688	-3254.88	1.3622e+006	1369.8	0.0576154
16	637.993	-3261.2	1.30056e+006	1307.82	0.0576156
17	654.298	-3267.05	1.22666e+006	1229.47	0.0576149
18	670.603	-3272.44	1.13361e+006	1139.93	0.0576152
19	686.908	-3277.39	1.03094e+006	1036.69	0.0576153
20	703.213	-3281.89	913003	918.093	0.0576152
21	719.517	-3285.96	780053	784.401	0.0576151
22	735.822	-3289.61	632327	635.853	0.0576153
23	752.127	-3292.85	490263	492.997	0.0576153
24	768.432	-3295.68	340889	342.79	0.0576153
25	784.737	-3298.1	177418	178.408	0.0576155
26	801.042	-3300.13	5.60879e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.18498

Slice	X coordinate	Y coordinate - Bottom	Interslice Normal Force	Interslice Shear Force	Interslice Force Angle

	[m]	[m]	[kN]	[kN]	[degrees]
1	393.187	-3103.98	4.96185e+007	0	0
2	409.532	-3119.77	304773	47.8502	0.0089956
3	425.876	-3134.57	547470	170.553	0.0178493
4	442.221	-3148.46	750144	345.924	0.0264216
5	458.566	-3161.49	926708	559.255	0.0345772
6	474.911	-3173.74	1.07873e+006	794.278	0.0421874
7	491.255	-3185.25	1.20754e+006	1035.49	0.0491323
8	507.6	-3196.07	1.30181e+006	1256.52	0.0553024
9	523.945	-3206.24	1.36817e+006	1447.08	0.0606003
10	540.289	-3215.79	1.41426e+006	1603.02	0.064943
11	556.634	-3224.74	1.44088e+006	1716.63	0.0682608
12	572.979	-3233.13	1.4487e+006	1782.62	0.0705022
13	589.324	-3240.98	1.43834e+006	1798.23	0.0716318
14	605.668	-3248.31	1.41034e+006	1763.22	0.0716317
15	622.013	-3255.13	1.36519e+006	1679.86	0.0705022
16	638.358	-3261.47	1.30333e+006	1552.76	0.068261
17	654.702	-3267.33	1.22516e+006	1388.68	0.0649429
18	671.047	-3272.73	1.13599e+006	1201.51	0.0606004
19	687.392	-3277.68	1.03299e+006	997.05	0.0553023
20	703.737	-3282.2	914669	784.349	0.0491324
21	720.081	-3286.28	781302	575.28	0.0421874
22	736.426	-3289.94	633125	382.082	0.0345772
23	752.771	-3293.18	491651	226.722	0.0264216
24	769.115	-3296.01	341834	106.492	0.0178494
25	785.46	-3298.44	177899	27.9307	0.00899562
26	801.805	-3300.47	5.60994e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.194544
Factor of Safety, standard deviation: 0.196809
Factor of Safety, minimum: 0.590810
Factor of Safety, maximum: 1.923330
Probability of Failure: 16.290% (= 1629 failed surfaces / 10000 valid surfaces)
Reliability index: 0.98849 (assuming normal distribution)
Reliability index: 1.00439 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price

Factor of Safety, mean: 1.194583
Factor of Safety, standard deviation: 0.198081
Factor of Safety, minimum: 0.593284
Factor of Safety, maximum: 1.922170
Probability of Failure: 16.490% (= 1649 failed surfaces / 10000 valid surfaces)
Reliability index: 0.98234 (assuming normal distribution)
Reliability index: 0.99722 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
1850	-6000
1850	0
0	0

External Boundary

X	Y
1850	-6000
1850	-3400
1764	-3401
1677	-3402
1590	-3404
1503	-3406
1417	-3407
1330	-3408
1243	-3407
1156	-3404
1070	-3395
983	-3374
902	-3344
821	-3309
740	-3273
659	-3233
578	-3192
497	-3151

rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 96PC Site 18		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_96_18_0g.slim

SLIDEINTERPRET 6.020

414	-3112
331	-3080
249	-3057
166	-3038
83	-3023
0	-3012
0	-6000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 96PC Site 18		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_96_18_1g.slim

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_96_18_1g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 96PC Site 18
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/31/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 96PC Site 18		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_96_18_1g.slim

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364792215
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.002702
Center: 1076.008, -2194.304
Radius: 1145.431
Left Slip Surface Endpoint: 366.886, -3093.836
Right Slip Surface Endpoint: 830.545, -3313.124
Left Slope Intercept: 366.886 -0.000
Right Slope Intercept: 830.545 -0.000
Resisting Moment=751056 kN-m
Driving Moment=2.7794e+008 kN-m
Resisting Horizontal Force=659.46 kN

Driving Horizontal Force=244043 kN
Total Slice Area=1.49527e+006 m2

Method: gle/morgenstern-price

FS: 0.002263
Center: 1089.377, -2172.079
Radius: 1171.884
Left Slip Surface Endpoint: 364.600, -3092.954
Right Slip Surface Endpoint: 839.592, -3317.034
Left Slope Intercept: 364.600 -0.000
Right Slope Intercept: 839.592 -0.000
Resisting Moment=671229 kN-m
Driving Moment=2.96652e+008 kN-m
Resisting Horizontal Force=575.276 kN
Driving Horizontal Force=254245 kN
Total Slice Area=1.53279e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1319
Number of Invalid Surfaces: 46

Error Codes:

Error Code -108 reported for 38 surfaces
Error Code -111 reported for 1 surface
Error Code -112 reported for 7 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1358
Number of Invalid Surfaces: 7

Error Codes:

Error Code -108 reported for 3 surfaces
Error Code -112 reported for 4 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.00270222

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	18.5464	592747	basement	5.551	27.1	74.4018	0.20105	31986.7	31997.2	-10.4745
2	18.5464	596139	basement	5.551	27.1	168.658	0.45575	32240.8	32250.8	-9.95489
3	18.5464	599342	basement	5.551	27.1	260.023	0.70264	32477.2	32486.7	-9.53384
4	18.5464	602261	basement	5.551	27.1	333.814	0.90204	32680.3	32689.4	-9.12878
5	18.5464	605000	basement	5.551	27.1	402.528	1.08772	32865.8	32874.5	-8.72213
6	18.5464	607587	basement	5.551	27.1	468.522	1.26605	33037.9	33046.3	-8.40755
7	18.5464	610029	basement	5.551	27.1	531.482	1.43618	33197.1	33205.1	-8.04327
8	18.5464	612298	basement	5.551	27.1	584.982	1.58075	33338.5	33346.3	-7.78149
9	18.5464	614394	basement	5.551	27.1	628.509	1.69837	33462.4	33469.9	-7.5172
10	18.5464	616358	basement	5.551	27.1	666.792	1.80182	33574.5	33581.8	-7.32256
11	18.5464	618195	basement	5.551	27.1	699.262	1.88956	33675.2	33682.4	-7.18091
12	18.5464	619908	basement	5.551	27.1	725.285	1.95988	33764.9	33771.9	-7.00788
13	18.5464	621500	basement	5.551	27.1	744.151	2.01086	33843.8	33850.7	-6.89915
14	18.5464	622974	basement	5.551	27.1	755.035	2.04027	33912.1	33919	-6.86793
15	18.5464	624332	basement	5.551	27.1	756.992	2.04556	33970.3	33977.1	-6.84252
16	18.5464	625579	basement	5.551	27.1	749.166	2.02441	34018.4	34025.3	-6.90293
17	18.5464	626732	basement	5.551	27.1	734.256	1.98412	34059.2	34066.2	-7.00626
18	18.5464	627784	basement	5.551	27.1	708.532	1.91461	34091.4	34098.5	-7.10382
19	18.5464	628729	basement	5.551	27.1	668.88	1.80746	34114.1	34121.4	-7.31945
20	18.5464	629571	basement	5.551	27.1	613.222	1.65706	34127.4	34135.1	-7.65926
21	18.5464	630347	basement	5.551	27.1	551.724	1.49088	34137.4	34145.3	-7.92912
22	18.5464	631080	basement	5.551	27.1	488.065	1.31886	34147.1	34155.4	-8.30329
23	18.5464	631714	basement	5.551	27.1	403.231	1.08962	34148	34156.7	-8.72722
24	18.5464	632250	basement	5.551	27.1	293.148	0.79215	34140.1	34149.4	-9.33775
25	18.5464	632693	basement	5.551	27.1	147.915	0.3997	34123.8	34133.9	-10.0749

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00226268

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]

1	18.9997	607103	basement	5.551	27.1	158.299	0.35818	31980.9	31991	-10.1389
2	18.9997	610655	basement	5.551	27.1	416.409	0.9422	32241.2	32250.2	-9.00017
3	18.9997	614014	basement	5.551	27.1	641.947	1.45252	32483.8	32491.8	-7.99468
4	18.9997	617076	basement	5.551	27.1	795.066	1.79898	32692.4	32699.8	-7.37913
5	18.9997	619943	basement	5.551	27.1	940.274	2.12754	32882.1	32888.8	-6.66078
6	18.9997	622652	basement	5.551	27.1	1058.43	2.39488	33058	33064.2	-6.18066
7	18.9997	625208	basement	5.551	27.1	1145.08	2.59095	33220.5	33226.3	-5.8021
8	18.9997	627578	basement	5.551	27.1	1132.86	2.56331	33364	33369.8	-5.82063
9	18.9997	629771	basement	5.551	27.1	1128.9	2.55435	33490	33495.9	-5.88217
10	18.9997	631826	basement	5.551	27.1	1093.59	2.47444	33603.9	33609.9	-5.99377
11	18.9997	633747	basement	5.551	27.1	1028.7	2.32763	33706.1	33712.4	-6.34117
12	18.9997	635538	basement	5.551	27.1	937.097	2.12035	33796.8	33803.5	-6.69219
13	18.9997	637202	basement	5.551	27.1	822.591	1.86126	33876.4	33883.6	-7.18962
14	18.9997	638742	basement	5.551	27.1	689.943	1.56112	33945.2	33953	-7.75168
15	18.9997	640161	basement	5.551	27.1	544.708	1.2325	34003.5	34011.9	-8.39928
16	18.9997	641465	basement	5.551	27.1	411.052	0.93008	34052	34061.1	-9.07533
17	18.9997	642672	basement	5.551	27.1	281.41	0.63674	34093.4	34103	-9.62978
18	18.9997	643769	basement	5.551	27.1	141.191	0.31947	34125.3	34135.5	-10.21
19	18.9997	644755	basement	5.551	27.1	14.0188	0.03172	34147.6	34158.4	-10.7733
20	18.9997	645634	basement	5.551	27.1	0	0	34151.3	34172.2	-20.9021
21	18.9997	646474	basement	5.551	27.1	0	0	34167.9	34186.9	-19.0048
22	18.9997	647237	basement	5.551	27.1	0	0	34171.2	34196.8	-25.6175
23	18.9997	647896	basement	5.551	27.1	0	0	34170.3	34197.5	-27.1899
24	18.9997	648452	basement	5.551	27.1	0	0	34165	34189.4	-24.3957
25	18.9997	648918	basement	5.551	27.1	0	0	34157.1	34174.2	-17.1428

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.00270222

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	366.886	-3093.84	4.92949e+007	0	0
2	385.432	-3108.15	230063	-32.4978	-0.00809338
3	403.979	-3121.87	445209	-62.8883	-0.00809335
4	422.525	-3135.03	622480	-87.9289	-0.00809336
5	441.071	-3147.65	757396	-106.987	-0.00809339
6	459.618	-3159.74	877104	-123.896	-0.00809336
7	478.164	-3171.34	981774	-138.681	-0.00809335
8	496.71	-3182.45	1.07156e+006	-151.364	-0.00809336

9	515.257	-3193.09	1.12496e+006	-158.907	-0.00809335
10	533.803	-3203.28	1.16311e+006	-164.297	-0.00809341
11	552.35	-3213.03	1.18652e+006	-167.603	-0.00809337
12	570.896	-3222.35	1.19533e+006	-168.848	-0.00809339
13	589.442	-3231.25	1.18969e+006	-168.051	-0.00809338
14	607.989	-3239.76	1.16975e+006	-165.234	-0.00809336
15	626.535	-3247.86	1.13565e+006	-160.417	-0.00809335
16	645.081	-3255.58	1.08755e+006	-153.622	-0.00809332
17	663.628	-3262.93	1.0275e+006	-145.141	-0.0080934
18	682.174	-3269.9	959556	-135.543	-0.00809337
19	700.72	-3276.51	878173	-124.047	-0.00809336
20	719.267	-3282.76	783538	-110.679	-0.00809334
21	737.813	-3288.67	675849	-95.4676	-0.00809336
22	756.36	-3294.23	582634	-82.3005	-0.00809337
23	774.906	-3299.45	480652	-67.8949	-0.00809336
24	793.452	-3304.34	366500	-51.7702	-0.00809335
25	811.999	-3308.89	240453	-33.9653	-0.00809334
26	830.545	-3313.12	5.65305e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00226268

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	364.6	-3092.95	4.92668e+007	0	0
2	383.6	-3107.6	234299	-504.419	-0.123351
3	402.599	-3121.63	452144	-1931.48	-0.244756
4	421.599	-3135.09	633351	-4004.92	-0.362298
5	440.599	-3147.99	767626	-6352.28	-0.474125
6	459.598	-3160.36	885808	-8943.62	-0.578471
7	478.598	-3172.21	988269	-11620.7	-0.673689
8	497.598	-3183.57	1.0747e+006	-14224	-0.758284
9	516.597	-3194.45	1.12487e+006	-16314.3	-0.830918
10	535.597	-3204.86	1.16026e+006	-18033.4	-0.890451
11	554.597	-3214.83	1.18125e+006	-19297.6	-0.935935
12	573.596	-3224.35	1.18818e+006	-20048.2	-0.966662
13	592.596	-3233.46	1.18137e+006	-20252.7	-0.982148
14	611.596	-3242.14	1.16108e+006	-19904.9	-0.98215
15	630.595	-3250.43	1.12754e+006	-19025.1	-0.966666
16	649.595	-3258.31	1.08092e+006	-17658.6	-0.935937
17	668.595	-3265.81	1.02513e+006	-15933.1	-0.890449
18	687.594	-3272.94	960202	-13926.1	-0.83092

19	706.594	-3279.68	882424	-11679.2	-0.758286
20	725.594	-3286.07	791713	-9309.49	-0.673691
21	744.594	-3292.1	694697	-7014.05	-0.578471
22	763.593	-3297.77	608057	-5031.81	-0.474125
23	782.593	-3303.09	507935	-3211.87	-0.362299
24	801.593	-3308.08	394370	-1684.68	-0.244756
25	820.592	-3312.72	267393	-575.666	-0.123351
26	839.592	-3317.03	5.6664e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.030492
Factor of Safety, standard deviation: 0.068633
Factor of Safety, minimum: 0.000178
Factor of Safety, maximum: 0.918275
Probability of Failure: 100.000% (= 9991 failed surfaces / 9991 valid surfaces), 9 invalid surfaces
Reliability index: -14.12595 (assuming normal distribution)
Reliability index: -3.27085 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 0.031486
Factor of Safety, standard deviation: 0.069823
Factor of Safety, minimum: 0.000127
Factor of Safety, maximum: 0.918140
Probability of Failure: 100.000% (= 9998 failed surfaces / 9998 valid surfaces), 2 invalid surfaces
Reliability index: -13.87092 (assuming normal distribution)
Reliability index: -3.26023 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
1850	-6000
1850	0
0	0

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 96PC Site 18		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_96_18_1g.slim

External Boundary

X	Y
1850	-6000
1850	-3400
1764	-3401
1677	-3402
1590	-3404
1503	-3406
1417	-3407
1330	-3408
1243	-3407
1156	-3404
1070	-3395
983	-3374
902	-3344
821	-3309
740	-3273
659	-3233
578	-3192
497	-3151
414	-3112
331	-3080
249	-3057
166	-3038
83	-3023
0	-3012
0	-6000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 96PC Site 21		
	Drawn By	Jason R. Patton	Company	Oregon State University
	Date	3/31/2013	File Name	RR0705_96_21_02g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_96_21_02g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 96PC Site 21
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/31/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 96PC Site 21		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/31/2013	File Name: RR0705_96_21_02g.sli	

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364949948
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.2
Seismic Load Coefficient (Vertical): 0.2

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	0.2	0	0.4	0.1
Vertical Seismic Coefficient		Normal	0.2	0	0.4	0.1

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.343048
Center: 2880.006, 1547.677
Radius: 4706.101
Left Slip Surface Endpoint: 638.440, -2590.290
Right Slip Surface Endpoint: 1680.571, -3003.009
Left Slope Intercept: 638.440 0.000
Right Slope Intercept: 1680.571 0.000
Resisting Moment=2.89316e+008 kN-m
Driving Moment=8.43368e+008 kN-m
Resisting Horizontal Force=57009.1 kN

Driving Horizontal Force=166184 kN
Total Slice Area=2.93948e+006 m2

Method: gle/morgenstern-price

FS: 0.337165
Center: 3043.746, 2166.364
Radius: 5349.723
Left Slip Surface Endpoint: 524.965, -2553.305
Right Slip Surface Endpoint: 1719.694, -3016.919
Left Slope Intercept: 524.965 0.000
Right Slope Intercept: 1719.694 0.000
Resisting Moment=4.47118e+008 kN-m
Driving Moment=1.32611e+009 kN-m
Resisting Horizontal Force=77751.9 kN
Driving Horizontal Force=230605 kN
Total Slice Area=3.36033e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2764
Number of Invalid Surfaces: 137

Error Codes:

Error Code -108 reported for 137 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2897
Number of Invalid Surfaces: 4

Error Codes:

Error Code -108 reported for 3 surfaces
Error Code -112 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with

many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.343048

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	41.6852	1.11773e+006	basement	5.551	27.1	0	0	26765.2	26805.5	-40.3322
2	41.6852	1.1287e+006	basement	5.551	27.1	7.82949	2.68589	27047.5	27053	-5.51387
3	41.6852	1.13934e+006	basement	5.551	27.1	38.8476	13.3266	27309	27293.7	15.321
4	41.6852	1.14964e+006	basement	5.551	27.1	68.6484	23.5497	27562.8	27527.6	35.207
5	41.6852	1.15966e+006	basement	5.551	27.1	96.2877	33.0313	27808.8	27755.1	53.6682
6	41.6852	1.16935e+006	basement	5.551	27.1	125.174	42.9407	28049.2	27976.1	73.1167
7	41.6852	1.17858e+006	basement	5.551	27.1	155.594	53.3763	28281.9	28188.4	93.5361
8	41.6852	1.18739e+006	basement	5.551	27.1	175.208	60.1048	28499.6	28392.9	106.74
9	41.6852	1.19591e+006	basement	5.551	27.1	191.288	65.621	28708.5	28591.2	117.344
10	41.6852	1.20414e+006	basement	5.551	27.1	207.891	71.3165	28912.1	28783.5	128.61
11	41.6852	1.21201e+006	basement	5.551	27.1	226.948	77.854	29110.1	28968.8	141.292
12	41.6852	1.21942e+006	basement	5.551	27.1	237.93	81.6215	29294.5	29145.7	148.758
13	41.6852	1.22649e+006	basement	5.551	27.1	247.09	84.7637	29470.7	29315.9	154.773
14	41.6852	1.2331e+006	basement	5.551	27.1	251.068	86.1283	29635.3	29477.8	157.526
15	41.6852	1.23938e+006	basement	5.551	27.1	246.561	84.5824	29787.7	29633.2	154.461
16	41.6852	1.24543e+006	basement	5.551	27.1	239.12	82.0297	29933	29783.5	149.509
17	41.6852	1.25122e+006	basement	5.551	27.1	233.283	80.0274	30073.8	29928.3	145.536
18	41.6852	1.25663e+006	basement	5.551	27.1	228.985	78.553	30208.5	30065.9	142.65
19	41.6852	1.26168e+006	basement	5.551	27.1	213.766	73.3321	30329.2	30196.6	132.56
20	41.6852	1.26646e+006	basement	5.551	27.1	194.133	66.5968	30441.1	30321.8	119.266
21	41.6852	1.27099e+006	basement	5.551	27.1	174.245	59.7745	30547.7	30441.8	105.872
22	41.6852	1.27529e+006	basement	5.551	27.1	147.175	50.4881	30644.4	30556.6	87.7799
23	41.6852	1.27946e+006	basement	5.551	27.1	123.034	42.2064	30739.4	30667.9	71.5484
24	41.6852	1.28341e+006	basement	5.551	27.1	93.0059	31.9055	30825.7	30774.3	51.4422
25	41.6852	1.2874e+006	basement	5.551	27.1	63.5246	21.792	30911.1	30879.3	31.8122

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.337165

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	47.7892	1.2644e+006	basement	5.551	27.1	22.7671	7.67628	26449.4	26445.3	4.10651
2	47.7892	1.27925e+006	basement	5.551	27.1	49.0573	16.5404	26753.9	26732.5	21.4331
3	47.7892	1.29324e+006	basement	5.551	27.1	76.887	25.9236	27046.7	27006.9	39.7554

4	47.7892	1.30644e+006	basement	5.551	27.1	95.9162	32.3396	27321.6	27269.2	52.3858
5	47.7892	1.31923e+006	basement	5.551	27.1	115.378	38.9013	27589.1	27523.9	65.1617
6	47.7892	1.3316e+006	basement	5.551	27.1	135.917	45.8264	27849.8	27771.1	78.662
7	47.7892	1.3436e+006	basement	5.551	27.1	157.484	53.0982	28104.4	28011.4	92.9819
8	47.7892	1.35516e+006	basement	5.551	27.1	185.557	62.5634	28355.4	28243.9	111.455
9	47.7892	1.36607e+006	basement	5.551	27.1	211.68	71.3711	28594.8	28466.1	128.679
10	47.7892	1.37653e+006	basement	5.551	27.1	231.51	78.057	28822.3	28680.7	141.64
11	47.7892	1.38664e+006	basement	5.551	27.1	252.29	85.0632	29043.9	28888.6	155.332
12	47.7892	1.3963e+006	basement	5.551	27.1	279.463	94.2253	29262	29088.8	173.242
13	47.7892	1.40535e+006	basement	5.551	27.1	298.875	100.77	29465.5	29279.4	186.128
14	47.7892	1.41392e+006	basement	5.551	27.1	317.355	107.001	29660.1	29461.9	198.237
15	47.7892	1.42189e+006	basement	5.551	27.1	323.637	109.119	29837.3	29635	202.347
16	47.7892	1.4295e+006	basement	5.551	27.1	317.999	107.218	30000.2	29801.6	198.57
17	47.7892	1.43682e+006	basement	5.551	27.1	311.87	105.152	30157	29962.4	194.61
18	47.7892	1.44368e+006	basement	5.551	27.1	305.422	102.978	30305.9	30115.5	190.361
19	47.7892	1.45003e+006	basement	5.551	27.1	282.871	95.3742	30435.7	30260.2	175.526
20	47.7892	1.45603e+006	basement	5.551	27.1	250.033	84.3025	30552.5	30398.7	153.767
21	47.7892	1.4617e+006	basement	5.551	27.1	212.446	71.6294	30660.2	30531	129.218
22	47.7892	1.46713e+006	basement	5.551	27.1	165.299	55.733	30756.5	30658.4	98.134
23	47.7892	1.47235e+006	basement	5.551	27.1	120.493	40.6261	30849.6	30781.1	68.5257
24	47.7892	1.4775e+006	basement	5.551	27.1	72.5114	24.4483	30937.7	30900.9	36.7914
25	47.7892	1.48255e+006	basement	5.551	27.1	32.7443	11.0402	31028	31017.3	10.7233

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.343048

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	638.44	-2590.29	3.45545e+007	0	0
2	680.125	-2612.6	179285	2457.69	0.785378
3	721.81	-2634.38	350101	4799.28	0.785377
4	763.496	-2655.63	512323	7023.07	0.785378
5	805.181	-2676.36	664476	9108.83	0.785378
6	846.866	-2696.58	811014	11117.6	0.785377
7	888.551	-2716.3	942406	12918.8	0.78538
8	930.237	-2735.52	1.03696e+006	14214.9	0.785375
9	971.922	-2754.25	1.11861e+006	15334.2	0.785376
10	1013.61	-2772.5	1.19413e+006	16369.4	0.785374
11	1055.29	-2790.27	1.25751e+006	17238.3	0.785377

12	1096.98	-2807.57	1.29018e+006	17686.2	0.78538
13	1138.66	-2824.41	1.30066e+006	17829.8	0.785377
14	1180.35	-2840.78	1.28511e+006	17616.6	0.785375
15	1222.03	-2856.7	1.24128e+006	17015.8	0.785377
16	1263.72	-2872.17	1.18657e+006	16265.9	0.785381
17	1305.4	-2887.19	1.12751e+006	15456.2	0.785376
18	1347.09	-2901.77	1.05311e+006	14436.3	0.785376
19	1388.77	-2915.91	944084	12941.8	0.785379
20	1430.46	-2929.62	820433	11246.7	0.785376
21	1472.14	-2942.9	688561	9439	0.785378
22	1513.83	-2955.76	543523	7450.78	0.785379
23	1555.52	-2968.2	400972	5496.65	0.785379
24	1597.2	-2980.21	254900	3494.24	0.785377
25	1638.89	-2991.82	117405	1609.42	0.785377
26	1680.57	-3003.01	4.6443e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.337165

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	524.965	-2553.3	3.35747e+007	0	0
2	572.754	-2578.5	270959	620.003	0.131103
3	620.543	-2603.08	522803	2373.67	0.260137
4	668.332	-2627.06	692593	4654.75	0.385065
5	716.121	-2650.45	850453	7479.96	0.503919
6	763.911	-2673.25	999442	10725.1	0.614822
7	811.7	-2695.48	1.1379e+006	14221	0.716021
8	859.489	-2717.13	1.2688e+006	17848.3	0.805931
9	907.278	-2738.23	1.37022e+006	21121.6	0.88313
10	955.067	-2758.77	1.44063e+006	23798.1	0.946396
11	1002.86	-2778.77	1.50059e+006	26055	0.994736
12	1050.65	-2798.22	1.54918e+006	27782	1.0274
13	1098.43	-2817.14	1.56359e+006	28489.8	1.04386
14	1146.22	-2835.53	1.5502e+006	28245.7	1.04385
15	1194.01	-2853.4	1.49928e+006	26887.2	1.0274
16	1241.8	-2870.75	1.42199e+006	24690.2	0.994734
17	1289.59	-2887.59	1.33941e+006	22125.9	0.946391
18	1337.38	-2903.93	1.24353e+006	19168.7	0.88313
19	1385.17	-2919.76	1.11024e+006	15617.8	0.805929
20	1432.96	-2935.1	956021	11948	0.716024
21	1480.75	-2949.94	792936	8509.04	0.614821

22	1528.54	-2964.3	614130	5401.44	0.503919
23	1576.33	-2978.17	449740	3022.59	0.385065
24	1624.12	-2991.56	273113	1240.01	0.260137
25	1671.9	-3004.48	142088	325.123	0.131103
26	1719.69	-3016.92	4.68743e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.374125
Factor of Safety, standard deviation: 0.188630
Factor of Safety, minimum: 0.087003
Factor of Safety, maximum: 1.584750
Probability of Failure: 98.900% (= 9890 failed surfaces / 10000 valid surfaces)
Reliability index: -3.31801 (assuming normal distribution)
Reliability index: -2.30377 (assuming lognormal distribution) * best fit = Lognormal

Method: gle/morgenstern-price
Factor of Safety, mean: 0.372915
Factor of Safety, standard deviation: 0.188640
Factor of Safety, minimum: 0.088115
Factor of Safety, maximum: 1.586480
Probability of Failure: 98.900% (= 9890 failed surfaces / 10000 valid surfaces)
Reliability index: -3.32425 (assuming normal distribution)
Reliability index: -2.30518 (assuming lognormal distribution) * best fit = Lognormal

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
3586	-6000
3586	0
0	0

External Boundary

X	Y
3586	-6000
3586	-3343

3498	-3340
3411	-3340
3324	-3340
3237	-3341
3149	-3342
3062	-3344
2975	-3345
2887	-3347
2798	-3346
2709	-3341
2620	-3329
2531	-3306
2442	-3278
2353	-3247
2264	-3212
2175	-3179
2083	-3144
1991	-3111
1899	-3079
1806	-3046
1714	-3015
1622	-2982
1530	-2945
1438	-2906
1345	-2866
1253	-2828
1161	-2789
1069	-2752
977	-2717
884	-2681
796	-2649
707	-2616
619	-2583
531	-2555
442	-2530
354	-2506
265	-2486
177	-2474
88	-2470
0	-2474

rocscience SLIDEINTERPRET 6.020	*Project* Sumatra Submarine Slide		
	Analysis Description RR0705 96PC Site 21		
	Drawn By Jason R. Patton	*Company*	Oregon State University
	Date 3/31/2013	*File Name*	RR0705_96_21_02g.sli

0 -6000

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_96_21_0g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 96PC Site 21
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/31/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364792585
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 96PC Site 21		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_96_21_0g.slim

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Global Minimums

Method: spencer

FS: 1.352950
Center: 1918.967, -1335.927
Radius: 1681.734
Left Slip Surface Endpoint: 937.956, -2701.886
Right Slip Surface Endpoint: 1669.579, -2999.066
Left Slope Intercept: 937.956 0.000
Right Slope Intercept: 1669.579 0.000
Resisting Moment=1.20693e+008 kN-m
Driving Moment=8.92073e+007 kN-m
Resisting Horizontal Force=66244.7 kN
Driving Horizontal Force=48963.3 kN
Total Slice Area=2.11025e+006 m2

Method: gle/morgenstern-price

FS: 1.353760
Center: 1921.275, -1326.295
Radius: 1691.825
Left Slip Surface Endpoint: 934.527, -2700.559
Right Slip Surface Endpoint: 1670.664, -2999.456
Left Slope Intercept: 934.527 0.000
Right Slope Intercept: 1670.664 0.000
Resisting Moment=1.22952e+008 kN-m
Driving Moment=9.08227e+007 kN-m
Resisting Horizontal Force=67055.7 kN

Driving Horizontal Force=49533 kN
Total Slice Area=2.12308e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2781
Number of Invalid Surfaces: 99

Error Codes:

Error Code -108 reported for 96 surfaces
Error Code -112 reported for 3 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2879
Number of Invalid Surfaces: 1

Error Codes:

Error Code -108 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.35295

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	29.2649	818278	basement	5.551	27.1	7.71067	10.4322	27944.8	27935.3	9.50491
2	29.2649	825779	basement	5.551	27.1	22.9024	30.9858	28191.9	28142.2	49.746
3	29.2649	832889	basement	5.551	27.1	37.1063	50.203	28427.3	28340	87.2882
4	29.2649	839603	basement	5.551	27.1	50.1196	67.8093	28650.7	28529.1	121.625

5	29.2649	845920	basement	5.551	27.1	61.8854	83.7278	28862.4	28709.6	152.768
6	29.2649	851791	basement	5.551	27.1	71.5987	96.8695	29060.4	28882	178.411
7	29.2649	857293	basement	5.551	27.1	79.8566	108.042	29246.8	29046.5	200.251
8	29.2649	862443	basement	5.551	27.1	86.9175	117.595	29422.3	29203.3	218.977
9	29.2649	867181	basement	5.551	27.1	92.0027	124.475	29585.2	29352.8	232.366
10	29.2649	871575	basement	5.551	27.1	95.5069	129.216	29736.7	29495	241.691
11	29.2649	875653	basement	5.551	27.1	97.793	132.309	29878	29630.3	247.675
12	29.2649	879459	basement	5.551	27.1	99.2069	134.222	30010.2	29758.7	251.466
13	29.2649	882979	basement	5.551	27.1	99.6984	134.887	30133.2	29880.5	252.741
14	29.2649	886205	basement	5.551	27.1	99.0207	133.97	30246.7	29995.7	251.002
15	29.2649	889096	basement	5.551	27.1	96.7855	130.946	30349.7	30104.6	245.092
16	29.2649	891670	basement	5.551	27.1	92.7847	125.533	30441.8	30207.3	234.473
17	29.2649	893968	basement	5.551	27.1	87.5871	118.501	30524.6	30303.8	220.751
18	29.2649	896006	basement	5.551	27.1	81.2632	109.945	30598.3	30394.3	204.018
19	29.2649	897793	basement	5.551	27.1	74.0041	100.124	30663.7	30478.9	184.805
20	29.2649	899317	basement	5.551	27.1	65.5512	88.6875	30720.1	30557.6	162.496
21	29.2649	900612	basement	5.551	27.1	56.0395	75.8187	30767.9	30630.6	137.334
22	29.2649	901722	basement	5.551	27.1	46.3118	62.6576	30809.5	30697.9	111.617
23	29.2649	902580	basement	5.551	27.1	35.476	47.9973	30842.6	30759.6	82.9563
24	29.2649	903229	basement	5.551	27.1	23.5536	31.8669	30867.2	30815.8	51.3993
25	29.2649	903782	basement	5.551	27.1	12.4183	16.8014	30888.4	30866.4	21.9998

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.35376

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	29.4455	822947	basement	5.551	27.1	10.4418	14.1357	27938.9	27922.2	16.7398
2	29.4455	830537	basement	5.551	27.1	24.4571	33.109	28184.3	28130.4	53.8869
3	29.4455	837731	basement	5.551	27.1	37.6206	50.9292	28418.1	28329.4	88.6719
4	29.4455	844526	basement	5.551	27.1	49.7779	67.3873	28640.4	28519.5	120.856
5	29.4455	850924	basement	5.551	27.1	60.897	82.4399	28851.4	28701.1	150.293
6	29.4455	856870	basement	5.551	27.1	70.2558	95.1095	29049.5	28874.5	175.034
7	29.4455	862438	basement	5.551	27.1	78.3337	106.045	29236.4	29040	196.364
8	29.4455	867651	basement	5.551	27.1	85.4273	115.648	29412.9	29197.8	215.104
9	29.4455	872451	basement	5.551	27.1	90.8123	122.938	29577.5	29348.1	229.383
10	29.4455	876897	basement	5.551	27.1	94.6726	128.164	29730.8	29491.2	239.57
11	29.4455	881024	basement	5.551	27.1	97.4072	131.866	29874	29627.2	246.837
12	29.4455	884872	basement	5.551	27.1	99.2739	134.393	30008.2	29756.4	251.781
13	29.4455	888434	basement	5.551	27.1	100.312	135.798	30133.4	29878.9	254.5
14	29.4455	891698	basement	5.551	27.1	100.17	135.606	30248.9	29994.8	254.148
15	29.4455	894624	basement	5.551	27.1	98.5071	133.355	30354.1	30104.3	249.766

16	29.4455	897229	basement	5.551	27.1	94.8676	128.428	30447.7	30207.6	240.078
17	29.4455	899552	basement	5.551	27.1	89.8882	121.687	30531.6	30304.6	226.959
18	29.4455	901613	basement	5.551	27.1	83.6005	113.175	30605.9	30395.6	210.331
19	29.4455	903421	basement	5.551	27.1	76.1967	103.152	30671.4	30480.7	190.711
20	29.4455	904961	basement	5.551	27.1	67.3804	91.2169	30727.3	30559.9	167.351
21	29.4455	906271	basement	5.551	27.1	57.3532	77.6425	30774.1	30633.2	140.916
22	29.4455	907392	basement	5.551	27.1	46.9003	63.4918	30814.2	30700.9	113.253
23	29.4455	908258	basement	5.551	27.1	35.0956	47.511	30845	30763	81.9522
24	29.4455	908916	basement	5.551	27.1	22.3339	30.2348	30867.6	30819.4	48.2243
25	29.4455	909476	basement	5.551	27.1	10.209	13.8205	30886.5	30870.3	16.162

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.35295

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	937.956	-2701.89	3.7596e+007	0	0
2	967.221	-2722.44	258104	318.001	0.0705921
3	996.486	-2742.08	497535	612.996	0.0705922
4	1025.75	-2760.85	716943	883.32	0.0705921
5	1055.02	-2778.78	914892	1127.21	0.0705923
6	1084.28	-2795.9	1.0823e+006	1333.46	0.0705919
7	1113.55	-2812.25	1.22016e+006	1503.31	0.0705918
8	1142.81	-2827.84	1.33738e+006	1647.73	0.0705917
9	1172.08	-2842.7	1.4273e+006	1758.53	0.0705922
10	1201.34	-2856.86	1.48563e+006	1830.4	0.0705924
11	1230.6	-2870.33	1.52395e+006	1877.6	0.0705919
12	1259.87	-2883.12	1.54465e+006	1903.11	0.0705921
13	1289.13	-2895.27	1.55294e+006	1913.32	0.070592
14	1318.4	-2906.77	1.54195e+006	1899.78	0.070592
15	1347.66	-2917.65	1.51053e+006	1861.07	0.070592
16	1376.93	-2927.91	1.44674e+006	1782.48	0.0705922
17	1406.19	-2937.58	1.36411e+006	1680.67	0.070592
18	1435.46	-2946.66	1.26279e+006	1555.84	0.0705921
19	1464.72	-2955.15	1.14794e+006	1414.33	0.0705918
20	1493.99	-2963.08	1.01524e+006	1250.84	0.070592
21	1523.25	-2970.44	864378	1064.97	0.0705921
22	1552.52	-2977.25	710390	875.246	0.070592
23	1581.78	-2983.51	543108	669.143	0.0705919

24	1611.05	-2989.23	358217	441.346	0.070592
25	1640.31	-2994.41	180357	222.212	0.0705922
26	1669.58	-2999.07	4.63212e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.35376

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	934.527	-2700.56	3.7559e+007	0	0
2	963.973	-2721.23	259513	54.7314	0.0120837
3	993.418	-2740.99	499635	209.085	0.0239769
4	1022.86	-2759.87	720203	446.13	0.0354919
5	1052.31	-2777.9	919185	745.143	0.0464472
6	1081.75	-2795.13	1.08906e+006	1077.17	0.0566702
7	1111.2	-2811.57	1.22762e+006	1414.1	0.0659992
8	1140.65	-2827.26	1.34542e+006	1744.41	0.074287
9	1170.09	-2842.21	1.43706e+006	2041.72	0.0814036
10	1199.54	-2856.45	1.49564e+006	2277.22	0.0872369
11	1228.98	-2869.99	1.53409e+006	2455.1	0.0916939
12	1258.43	-2882.86	1.55436e+006	2569.23	0.0947052
13	1287.87	-2895.08	1.56261e+006	2624.24	0.0962222
14	1317.32	-2906.65	1.55146e+006	2605.51	0.096222
15	1346.76	-2917.59	1.52021e+006	2512.78	0.094705
16	1376.21	-2927.91	1.45593e+006	2330.01	0.0916937
17	1405.65	-2937.63	1.37267e+006	2089.99	0.0872369
18	1435.1	-2946.76	1.27061e+006	1805.24	0.0814039
19	1464.55	-2955.3	1.15486e+006	1497.34	0.0742871
20	1493.99	-2963.27	1.0212e+006	1176.32	0.065999
21	1523.44	-2970.68	869255	859.76	0.0566699
22	1552.88	-2977.52	714309	579.058	0.0464471
23	1582.33	-2983.82	545836	338.118	0.0354919
24	1611.77	-2989.57	359650	150.505	0.0239769
25	1641.22	-2994.78	181604	38.3004	0.0120837
26	1670.66	-2999.46	4.63332e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.361597
Factor of Safety, standard deviation: 0.225980
Factor of Safety, minimum: 0.704587

Factor of Safety, maximum: 2.172830
Probability of Failure: 4.930% (= 493 failed surfaces / 10000 valid surfaces)
Reliability index: 1.60013 (assuming normal distribution)
Reliability index: 1.79004 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 1.362428
Factor of Safety, standard deviation: 0.226193
Factor of Safety, minimum: 0.705100
Factor of Safety, maximum: 2.174060
Probability of Failure: 4.900% (= 490 failed surfaces / 10000 valid surfaces)
Reliability index: 1.60230 (assuming normal distribution)
Reliability index: 1.79311 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
3586	-6000
3586	0
0	0

External Boundary

X	Y
3586	-6000
3586	-3343
3498	-3340
3411	-3340
3324	-3340
3237	-3341
3149	-3342
3062	-3344
2975	-3345
2887	-3347
2798	-3346
2709	-3341
2620	-3329

2531	-3306
2442	-3278
2353	-3247
2264	-3212
2175	-3179
2083	-3144
1991	-3111
1899	-3079
1806	-3046
1714	-3015
1622	-2982
1530	-2945
1438	-2906
1345	-2866
1253	-2828
1161	-2789
1069	-2752
977	-2717
884	-2681
796	-2649
707	-2616
619	-2583
531	-2555
442	-2530
354	-2506
265	-2486
177	-2474
88	-2470
0	-2474
0	-6000

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_96_21_1g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 96PC Site 21
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/31/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364792701
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.003969
Center: 2752.065, 982.241
Radius: 4127.424
Left Slip Surface Endpoint: 777.042, -2641.971
Right Slip Surface Endpoint: 1687.899, -3005.638
Left Slope Intercept: 777.042 0.000
Right Slope Intercept: 1687.899 0.000
Resisting Moment=7.91089e+006 kN-m
Driving Moment=1.99336e+009 kN-m
Resisting Horizontal Force=1875.61 kN

Driving Horizontal Force=472611 kN
Total Slice Area=2.59118e+006 m2

Method: gle/morgenstern-price

FS: 0.003890
Center: 2844.582, 1292.607
Radius: 4452.787
Left Slip Surface Endpoint: 721.077, -2621.220
Right Slip Surface Endpoint: 1706.220, -3012.209
Left Slope Intercept: 721.077 0.000
Right Slope Intercept: 1706.220 0.000
Resisting Moment=9.7794e+006 kN-m
Driving Moment=2.51395e+009 kN-m
Resisting Horizontal Force=2150.47 kN
Driving Horizontal Force=552811 kN
Total Slice Area=2.79721e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1138
Number of Invalid Surfaces: 21

Error Codes:

Error Code -108 reported for 14 surfaces
Error Code -112 reported for 7 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1135
Number of Invalid Surfaces: 24

Error Codes:

Error Code -108 reported for 17 surfaces
Error Code -112 reported for 7 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This

screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.00396862

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	36.4343	995771	basement	5.551	27.1	147.623	0.58586	27352.7	27362.4	-9.69436
2	36.4343	1.00429e+006	basement	5.551	27.1	246.005	0.9763	27650.2	27659.1	-8.89044
3	36.4343	1.01255e+006	basement	5.551	27.1	339.652	1.34795	27935.8	27944.1	-8.31957
4	36.4343	1.02044e+006	basement	5.551	27.1	412.839	1.6384	28201.9	28209.6	-7.69896
5	36.4343	1.028e+006	basement	5.551	27.1	485.083	1.92511	28450.3	28457.3	-7.0114
6	36.4343	1.03531e+006	basement	5.551	27.1	555.012	2.20263	28687.4	28693.9	-6.48276
7	36.4343	1.0424e+006	basement	5.551	27.1	623.522	2.47452	28915.9	28922	-6.08918
8	36.4343	1.04925e+006	basement	5.551	27.1	686.176	2.72317	29133.7	29139.2	-5.50407
9	36.4343	1.05577e+006	basement	5.551	27.1	725.302	2.87845	29333.9	29339.2	-5.30406
10	36.4343	1.06197e+006	basement	5.551	27.1	761.151	3.02072	29516.8	29521.7	-4.86203
11	36.4343	1.06791e+006	basement	5.551	27.1	783.28	3.10854	29687.2	29692	-4.82932
12	36.4343	1.07349e+006	basement	5.551	27.1	784.721	3.11426	29837.4	29842.1	-4.67547
13	36.4343	1.07881e+006	basement	5.551	27.1	781.77	3.10255	29975.1	29979.8	-4.7218
14	36.4343	1.08394e+006	basement	5.551	27.1	779.651	3.09414	30104.9	30109.8	-4.88406
15	36.4343	1.08888e+006	basement	5.551	27.1	767.471	3.0458	30227.9	30232.9	-4.95924
16	36.4343	1.09359e+006	basement	5.551	27.1	739.27	2.93388	30339.8	30345	-5.24529
17	36.4343	1.09798e+006	basement	5.551	27.1	687.204	2.72725	30434.1	30439.5	-5.40989
18	36.4343	1.10212e+006	basement	5.551	27.1	626.845	2.48771	30516.3	30522.3	-6.01335
19	36.4343	1.10606e+006	basement	5.551	27.1	559.134	2.21899	30589.9	30596.5	-6.56346
20	36.4343	1.10981e+006	basement	5.551	27.1	477.854	1.89642	30655.8	30663	-7.19356
21	36.4343	1.11335e+006	basement	5.551	27.1	387.679	1.53855	30712.6	30720.5	-7.9222
22	36.4343	1.1168e+006	basement	5.551	27.1	303.03	1.20261	30768.9	30777.5	-8.59578
23	36.4343	1.12007e+006	basement	5.551	27.1	195.607	0.77629	30818.3	30827.6	-9.34648
24	36.4343	1.12323e+006	basement	5.551	27.1	115.695	0.45915	30866.4	30876.4	-9.96155
25	36.4343	1.1264e+006	basement	5.551	27.1	0	0	30902.4	30932.3	-29.9193

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00389006

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	39.4057	1.0689e+006	basement	5.551	27.1	101.623	0.39532	27149.1	27159.1	-10.037
2	39.4057	1.07876e+006	basement	5.551	27.1	242.953	0.9451	27464.8	27473.7	-8.91217

3	39.4057	1.08833e+006	basement	5.551	27.1	383.128	1.49039	27769.8	27777.7	-7.92712
4	39.4057	1.09762e+006	basement	5.551	27.1	516.696	2.00998	28063.9	28070.7	-6.82896
5	39.4057	1.10654e+006	basement	5.551	27.1	622.379	2.42109	28339.2	28345.4	-6.21955
6	39.4057	1.11502e+006	basement	5.551	27.1	711.968	2.7696	28592.9	28598.5	-5.56739
7	39.4057	1.12321e+006	basement	5.551	27.1	793.97	3.08859	28834.8	28839.5	-4.73603
8	39.4057	1.13116e+006	basement	5.551	27.1	867.46	3.37447	29067.3	29071.5	-4.17384
9	39.4057	1.13882e+006	basement	5.551	27.1	921.122	3.58322	29288	29291.8	-3.82105
10	39.4057	1.14608e+006	basement	5.551	27.1	932.256	3.62653	29487.7	29491.4	-3.65822
11	39.4057	1.15299e+006	basement	5.551	27.1	941.484	3.66243	29670.9	29674.6	-3.74864
12	39.4057	1.15955e+006	basement	5.551	27.1	907.531	3.53035	29837.6	29841.5	-3.87386
13	39.4057	1.16572e+006	basement	5.551	27.1	866.534	3.37087	29983.9	29988.1	-4.18709
14	39.4057	1.17163e+006	basement	5.551	27.1	827.234	3.21799	30119.5	30124.2	-4.71011
15	39.4057	1.17735e+006	basement	5.551	27.1	785.312	3.05491	30249.3	30254.1	-4.80756
16	39.4057	1.1828e+006	basement	5.551	27.1	724.444	2.81813	30368.3	30373.6	-5.2959
17	39.4057	1.1879e+006	basement	5.551	27.1	631.671	2.45724	30469.3	30475.3	-6.01357
18	39.4057	1.19269e+006	basement	5.551	27.1	547.711	2.13063	30555.7	30562.4	-6.67732
19	39.4057	1.19724e+006	basement	5.551	27.1	467.034	1.81679	30632.6	30640	-7.40513
20	39.4057	1.20156e+006	basement	5.551	27.1	381.395	1.48365	30701.6	30709.4	-7.83253
21	39.4057	1.20566e+006	basement	5.551	27.1	302.625	1.17723	30761.4	30769.9	-8.48207
22	39.4057	1.20965e+006	basement	5.551	27.1	234.097	0.91065	30821.1	30830.1	-8.9773
23	39.4057	1.21342e+006	basement	5.551	27.1	156.741	0.60973	30872.4	30882.1	-9.65037
24	39.4057	1.21717e+006	basement	5.551	27.1	110.291	0.42904	30930.5	30940.7	-10.1586
25	39.4057	1.22083e+006	basement	5.551	27.1	51.0378	0.19854	30988.6	30999.1	-10.4579

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.00396862

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	777.042	-2641.97	3.59471e+007	0	0
2	813.477	-2661.59	169727	-915.339	-0.308994
3	849.911	-2680.74	335418	-1808.92	-0.308995
4	886.345	-2699.43	491438	-2650.33	-0.308994
5	922.78	-2717.67	616609	-3325.38	-0.308994
6	959.214	-2735.46	732089	-3948.17	-0.308994
7	995.648	-2752.81	840949	-4535.25	-0.308994
8	1032.08	-2769.73	942789	-5084.48	-0.308994
9	1068.52	-2786.22	1.034e+006	-5576.4	-0.308995
10	1104.95	-2802.29	1.09212e+006	-5889.8	-0.308993

11	1141.39	-2817.93	1.13818e+006	-6138.22	-0.308994
12	1177.82	-2833.17	1.16181e+006	-6265.68	-0.308995
13	1214.25	-2848	1.16071e+006	-6259.72	-0.308994
14	1250.69	-2862.43	1.14672e+006	-6184.3	-0.308995
15	1287.12	-2876.46	1.13048e+006	-6096.7	-0.308994
16	1323.56	-2890.1	1.10205e+006	-5943.39	-0.308995
17	1359.99	-2903.34	1.05315e+006	-5679.64	-0.308993
18	1396.43	-2916.2	980256	-5286.54	-0.308994
19	1432.86	-2928.68	893956	-4821.12	-0.308994
20	1469.29	-2940.78	800025	-4314.55	-0.308994
21	1505.73	-2952.51	693807	-3741.71	-0.308994
22	1542.16	-2963.87	582358	-3140.67	-0.308994
23	1578.6	-2974.85	473877	-2555.63	-0.308995
24	1615.03	-2985.48	352826	-1902.8	-0.308995
25	1651.47	-2995.74	258175	-1392.34	-0.308994
26	1687.9	-3005.64	4.65244e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00389006

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	721.077	-2621.22	3.53846e+007	0	0
2	760.483	-2642.34	177399	-267.259	-0.0863184
3	799.888	-2662.96	346480	-1035.74	-0.171275
4	839.294	-2683.09	512971	-2269.88	-0.25353
5	878.7	-2702.72	669594	-3877.51	-0.331787
6	918.106	-2721.87	793899	-5609.18	-0.404808
7	957.511	-2740.54	903649	-7435.65	-0.471446
8	996.917	-2758.74	1.00564e+006	-9314.05	-0.530648
9	1036.32	-2776.49	1.0997e+006	-11160.9	-0.581477
10	1075.73	-2793.77	1.17803e+006	-12812.6	-0.623141
11	1115.13	-2810.6	1.22453e+006	-13998.9	-0.65498
12	1154.54	-2826.99	1.25856e+006	-14860.3	-0.676482
13	1193.95	-2842.94	1.25978e+006	-15113.1	-0.687323
14	1233.35	-2858.45	1.24383e+006	-14921.7	-0.68732
15	1272.76	-2873.53	1.22056e+006	-14411.6	-0.676481
16	1312.16	-2888.18	1.18998e+006	-13603.9	-0.654979
17	1351.57	-2902.42	1.14271e+006	-12428.5	-0.623144
18	1390.97	-2916.23	1.06542e+006	-10813.1	-0.581483
19	1430.38	-2929.64	973792	-9019.08	-0.530648
20	1469.79	-2942.63	873375	-7186.54	-0.471446

21	1509.19	-2955.22	759667	-5367.32	-0.404809
22	1548.6	-2967.41	643134	-3724.28	-0.331786
23	1588	-2979.2	525397	-2324.87	-0.253531
24	1627.41	-2990.59	400021	-1195.79	-0.171275
25	1666.81	-3001.6	305274	-459.91	-0.0863188
26	1706.22	-3012.21	4.6728e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.046638
Factor of Safety, standard deviation: 0.080201
Factor of Safety, minimum: 0.000316
Factor of Safety, maximum: 1.175980
Probability of Failure: 99.960% (= 9993 failed surfaces / 9997 valid surfaces), 3 invalid surfaces
Reliability index: -11.88714 (assuming normal distribution)
Reliability index: -3.20004 (assuming lognormal distribution)
* best fit = Beta

Method: gle/morgenstern-price
Factor of Safety, mean: 0.049256
Factor of Safety, standard deviation: 0.082090
Factor of Safety, minimum: 0.000288
Factor of Safety, maximum: 1.176510
Probability of Failure: 99.960% (= 9994 failed surfaces / 9998 valid surfaces), 2 invalid surfaces
Reliability index: -11.58170 (assuming normal distribution)
Reliability index: -3.18796 (assuming lognormal distribution)
* best fit = Beta

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
3586	-6000
3586	0
0	0

External Boundary

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 96PC Site 21		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_96_21_1g.slim

X	Y
3586	-6000
3586	-3343
3498	-3340
3411	-3340
3324	-3340
3237	-3341
3149	-3342
3062	-3344
2975	-3345
2887	-3347
2798	-3346
2709	-3341
2620	-3329
2531	-3306
2442	-3278
2353	-3247
2264	-3212
2175	-3179
2083	-3144
1991	-3111
1899	-3079
1806	-3046
1714	-3015
1622	-2982
1530	-2945
1438	-2906
1345	-2866
1253	-2828
1161	-2789
1069	-2752
977	-2717
884	-2681
796	-2649
707	-2616
619	-2583
531	-2555
442	-2530
354	-2506
265	-2486

rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 96PC Site 21		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_96_21_1g.slim

SLIDEINTERPRET 6.020

177	-2474
88	-2470
0	-2474
0	-6000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 95PC Site 27		
	Drawn By	Jason R. Patton	Company	Oregon State University
	Date	3/31/2013	File Name	RR0705_96_22_02g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_96_22_02g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 95PC Site 27
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/31/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 95PC Site 27		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/31/2013	File Name: RR0705_96_22_02g.sli	

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364949742
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.2
Seismic Load Coefficient (Vertical): 0.2

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	0.2	0	0.4	0.1
Vertical Seismic Coefficient		Normal	0.2	0	0.4	0.1

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.360512
Center: 2979.108, -1357.181
Radius: 2043.691
Left Slip Surface Endpoint: 2007.849, -3155.327
Right Slip Surface Endpoint: 2560.575, -3357.557
Left Slope Intercept: 2007.849 -0.000
Right Slope Intercept: 2560.575 -0.000
Resisting Moment=4.40886e+007 kN-m
Driving Moment=1.22294e+008 kN-m
Resisting Horizontal Force=20203.2 kN

Driving Horizontal Force=56040.2 kN
Total Slice Area=1.80827e+006 m2

Method: gle/morgenstern-price

FS: 0.360516
Center: 2979.108, -1357.181
Radius: 2043.691
Left Slip Surface Endpoint: 2007.849, -3155.327
Right Slip Surface Endpoint: 2560.575, -3357.557
Left Slope Intercept: 2007.849 -0.000
Right Slope Intercept: 2560.575 -0.000
Resisting Moment=4.4089e+007 kN-m
Driving Moment=1.22294e+008 kN-m
Resisting Horizontal Force=20203.3 kN
Driving Horizontal Force=56040 kN
Total Slice Area=1.80827e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2312
Number of Invalid Surfaces: 52

Error Codes:

Error Code -108 reported for 52 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2363
Number of Invalid Surfaces: 1

Error Codes:

Error Code -108 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

rocscience	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 95PC Site 27	
	Drawn By	Jason R. Patton	Company: Oregon State University
SLIDEINTERPRET 6.020	Date	3/31/2013	File Name: RR0705_96_22_02g.sli

Global Minimum Query (spencer) - Safety Factor: 0.360512

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	22.109	720337	basement	5.551	27.1	15.7939	5.69389	32572.5	32572.2	0.286353
2	22.109	723727	basement	5.551	27.1	45.6631	16.4621	32732.2	32710.9	21.2724
3	22.109	726953	basement	5.551	27.1	71.5186	25.7833	32883.3	32843.8	39.5447
4	22.109	730062	basement	5.551	27.1	96.4426	34.7687	33029.4	32972.3	57.0666
5	22.109	733042	basement	5.551	27.1	120.961	43.6079	33170.3	33096	74.3173
6	22.109	735694	basement	5.551	27.1	137.715	49.648	33295.9	33209.8	86.1412
7	22.109	738157	basement	5.551	27.1	147.679	53.2402	33410.5	33317.3	93.2166
8	22.109	740511	basement	5.551	27.1	156.317	56.3542	33520	33420.7	99.252
9	22.109	742751	basement	5.551	27.1	163.977	59.1158	33624.4	33519.7	104.682
10	22.109	744741	basement	5.551	27.1	165.959	59.8301	33717.1	33611	106.092
11	22.109	746561	basement	5.551	27.1	161.608	58.2616	33799.6	33696.6	102.985
12	22.109	748278	basement	5.551	27.1	155.59	56.092	33877	33778.2	98.7509
13	22.109	749892	basement	5.551	27.1	147.82	53.291	33949.2	33855.9	93.2734
14	22.109	751424	basement	5.551	27.1	138.831	50.0504	34017.1	33930.2	86.9271
15	22.109	752868	basement	5.551	27.1	128.901	46.4704	34080.9	34000.9	80.0224
16	22.109	754212	basement	5.551	27.1	117.175	42.243	34139.6	34067.9	71.7318
17	22.109	755460	basement	5.551	27.1	103.405	37.2789	34193.2	34131.2	61.972
18	22.109	756733	basement	5.551	27.1	90.6325	32.6741	34246.8	34193.8	53.0282
19	22.109	758001	basement	5.551	27.1	82.9714	29.9122	34302.7	34255.1	47.633
20	22.109	759174	basement	5.551	27.1	73.5681	26.5222	34353.8	34312.8	41.0325
21	22.109	760254	basement	5.551	27.1	62.3605	22.4817	34400	34366.9	33.1214
22	22.109	761317	basement	5.551	27.1	50.6693	18.2669	34444.3	34419.5	24.805
23	22.109	762364	basement	5.551	27.1	43.0412	15.5169	34489.9	34470.4	19.4501
24	22.109	763319	basement	5.551	27.1	33.6517	12.1318	34530.7	34517.8	12.875
25	22.109	764184	basement	5.551	27.1	22.4646	8.09874	34566.7	34561.7	5.00098

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.360516

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	22.109	720337	basement	5.551	27.1	23.8462	8.59692	32578.2	32572.2	5.95599
2	22.109	723727	basement	5.551	27.1	49.3715	17.7992	32734.8	32710.9	23.8843
3	22.109	726953	basement	5.551	27.1	72.6564	26.1938	32884.2	32843.8	40.3533
4	22.109	730062	basement	5.551	27.1	95.3431	34.3727	33028.6	32972.3	56.2938
5	22.109	733042	basement	5.551	27.1	117.772	42.4586	33168.1	33096	72.0673
6	22.109	735694	basement	5.551	27.1	133.095	47.983	33292.7	33209.8	82.8915

7	22.109	738157	basement	5.551	27.1	142.936	51.5308	33407.2	33317.3	89.8667
8	22.109	740511	basement	5.551	27.1	151.789	54.7222	33516.8	33420.7	96.0512
9	22.109	742751	basement	5.551	27.1	160.071	57.7083	33621.6	33519.7	101.925
10	22.109	744741	basement	5.551	27.1	163.407	58.9107	33715.3	33611	104.287
11	22.109	746561	basement	5.551	27.1	160.275	57.7816	33798.7	33696.6	102.057
12	22.109	748278	basement	5.551	27.1	155.461	56.046	33876.9	33778.2	98.6662
13	22.109	749892	basement	5.551	27.1	148.781	53.6379	33949.9	33855.9	93.954
14	22.109	751424	basement	5.551	27.1	140.626	50.6978	34018.4	33930.2	88.2084
15	22.109	752868	basement	5.551	27.1	131.396	47.3705	34082.7	34000.9	81.7803
16	22.109	754212	basement	5.551	27.1	120.062	43.2843	34141.7	34067.9	73.7545
17	22.109	755460	basement	5.551	27.1	106.284	38.317	34195.2	34131.2	64.002
18	22.109	756733	basement	5.551	27.1	93.1335	33.5761	34248.6	34193.8	54.7619
19	22.109	758001	basement	5.551	27.1	85.2656	30.7396	34304.4	34255.1	49.2854
20	22.109	759174	basement	5.551	27.1	75.2971	27.1458	34355.1	34312.8	42.2539
21	22.109	760254	basement	5.551	27.1	63.1384	22.7624	34400.6	34366.9	33.6902
22	22.109	761317	basement	5.551	27.1	51.2862	18.4895	34444.7	34419.5	25.2438
23	22.109	762364	basement	5.551	27.1	42.6239	15.3666	34489.5	34470.4	19.1421
24	22.109	763319	basement	5.551	27.1	31.8557	11.4845	34529.4	34517.8	11.5958
25	22.109	764184	basement	5.551	27.1	18.9357	6.82661	34564.2	34561.7	2.52467

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.360512

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	2007.85	-3155.33	5.12739e+007	0	0
2	2029.96	-3167.09	227250	263.554	0.066449
3	2052.07	-3178.52	408749	474.047	0.0664488
4	2074.18	-3189.6	580307	673.011	0.0664487
5	2096.29	-3200.36	741965	860.494	0.0664488
6	2118.39	-3210.78	870441	1009.5	0.0664491
7	2140.5	-3220.89	931507	1080.32	0.066449
8	2162.61	-3230.68	982364	1139.3	0.0664489
9	2184.72	-3240.16	1.02307e+006	1186.5	0.0664484
10	2206.83	-3249.34	1.0412e+006	1207.53	0.0664487
11	2228.94	-3258.21	1.00448e+006	1164.95	0.066449
12	2251.05	-3266.79	957404	1110.35	0.0664488
13	2273.16	-3275.07	900033	1043.81	0.0664485
14	2295.27	-3283.07	833644	966.82	0.0664488

15	2317.38	-3290.77	764141	886.213	0.0664488
16	2339.49	-3298.2	684571	793.932	0.0664488
17	2361.59	-3305.35	594993	690.044	0.0664488
18	2383.7	-3312.22	499968	579.839	0.0664489
19	2405.81	-3318.81	449176	520.932	0.0664488
20	2427.92	-3325.14	388852	450.971	0.0664487
21	2450.03	-3331.2	319045	370.013	0.0664489
22	2472.14	-3336.99	240072	278.424	0.0664489
23	2494.25	-3342.52	193707	224.652	0.0664488
24	2516.36	-3347.79	138174	160.247	0.0664486
25	2538.47	-3352.8	73516.2	85.2605	0.0664488
26	2560.58	-3357.56	5.80569e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.360516

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	2007.85	-3155.33	5.12739e+007	0	0
2	2029.96	-3167.09	227138	42.8483	0.0108085
3	2052.07	-3178.52	408584	152.938	0.0214465
4	2074.18	-3189.6	580126	321.436	0.0317464
5	2096.29	-3200.36	741800	537.884	0.0415455
6	2118.39	-3210.78	870324	769.975	0.0506895
7	2140.5	-3220.89	931459	959.718	0.059034
8	2162.61	-3230.68	982389	1139.31	0.0664478
9	2184.72	-3240.16	1.02316e+006	1300.27	0.0728136
10	2206.83	-3249.34	1.04136e+006	1418.21	0.0780301
11	2228.94	-3258.21	1.00468e+006	1438.17	0.0820172
12	2251.05	-3266.79	957622	1415.83	0.0847109
13	2273.16	-3275.07	900253	1352.33	0.0860677
14	2295.27	-3283.07	833849	1252.58	0.0860677
15	2317.38	-3290.77	764316	1130.03	0.0847109
16	2339.49	-3298.2	684703	980.135	0.0820174
17	2361.59	-3305.35	595076	810.428	0.0780305
18	2383.7	-3312.22	500001	635.417	0.0728132
19	2405.81	-3318.81	449165	520.91	0.0664476
20	2427.92	-3325.14	388800	400.596	0.0590341
21	2450.03	-3331.2	318962	282.186	0.0506896
22	2472.14	-3336.99	239975	174.008	0.0415457
23	2494.25	-3342.52	193599	107.269	0.0317463
24	2516.36	-3347.79	138073	51.6826	0.0214466

25	2538.47	-3352.8	73449.1	13.8557	0.0108085
26	2560.58	-3357.56	5.80569e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.409596
Factor of Safety, standard deviation: 0.198523
Factor of Safety, minimum: 0.082143
Factor of Safety, maximum: 1.718900
Probability of Failure: 98.260% (= 9826 failed surfaces / 10000 valid surfaces)
Reliability index: -2.97398 (assuming normal distribution)
Reliability index: -2.17282 (assuming lognormal distribution) * best fit = Lognormal

Method: gle/morgenstern-price
Factor of Safety, mean: 0.409002
Factor of Safety, standard deviation: 0.198730
Factor of Safety, minimum: 0.085358
Factor of Safety, maximum: 1.719110
Probability of Failure: 98.240% (= 9824 failed surfaces / 10000 valid surfaces)
Reliability index: -2.97388 (assuming normal distribution)
Reliability index: -2.17213 (assuming lognormal distribution) * best fit = Lognormal

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
4864	-6000
4864	0
0	0

External Boundary

X	Y
4864	-6000
4864	-3400
4772	-3398
4679	-3393
4587	-3387

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 95PC Site 27		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/31/2013	File Name: RR0705_96_22_02g.sli	

4495	-3377
4402	-3364
4310	-3350
4218	-3341
4125	-3341
4033	-3349
3941	-3359
3848	-3369
3756	-3376
3663	-3382
3571	-3385
3479	-3387
3386	-3389
3294	-3390
3202	-3391
3109	-3392
3017	-3394
2925	-3393
2832	-3392
2742	-3388
2652	-3378
2562	-3358
2472	-3330
2382	-3297
2292	-3257
2202	-3216
2112	-3182
2022	-3158
1932	-3141
1842	-3121
1752	-3094
1662	-3065
1572	-3042
1480	-3018
1387	-2993
1295	-2969
1202	-2943
1110	-2918
1017	-2893
925	-2869

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 95PC Site 27		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/31/2013	File Name: RR0705_96_22_02g.sli	

832	-2842
740	-2814
647	-2786
555	-2760
462	-2736
370	-2714
277	-2695
185	-2679
92	-2664
0	-2650
0	-6000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 95PC Site 27		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_96_22_0g.slim

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_96_22_0g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 95PC Site 27
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/31/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364793110
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 95PC Site 27		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_96_22_0g.slim

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Global Minimums

Method: spencer

FS: 1.386500
Center: 2441.370, -2859.810
Radius: 451.602
Left Slip Surface Endpoint: 2133.351, -3190.066
Right Slip Surface Endpoint: 2419.916, -3310.902
Left Slope Intercept: 2133.351 -0.000
Right Slope Intercept: 2419.916 -0.000
Resisting Moment=7.88895e+006 kN-m
Driving Moment=5.68981e+006 kN-m
Resisting Horizontal Force=15947.4 kN
Driving Horizontal Force=11501.8 kN
Total Slice Area=937226 m2

Method: gle/morgenstern-price

FS: 1.383820
Center: 2436.659, -2874.583
Radius: 435.073
Left Slip Surface Endpoint: 2139.544, -3192.406
Right Slip Surface Endpoint: 2415.051, -3309.119
Left Slope Intercept: 2139.544 -0.000
Right Slope Intercept: 2415.051 -0.000
Resisting Moment=7.04334e+006 kN-m
Driving Moment=5.08977e+006 kN-m
Resisting Horizontal Force=14792.7 kN

Driving Horizontal Force=10689.8 kN
Total Slice Area=900925 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1893
Number of Invalid Surfaces: 594

Error Codes:

Error Code -108 reported for 594 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2469
Number of Invalid Surfaces: 18

Error Codes:

Error Code -108 reported for 18 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.3865

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	11.4626	377437	basement	5.551	27.1	4.40602	6.10894	32911.9	32910.9	1.04214
2	11.4626	378980	basement	5.551	27.1	13.7632	19.0827	33040.2	33013.8	26.4143
3	11.4626	380404	basement	5.551	27.1	22.3354	30.9681	33159.7	33110	49.6746
4	11.4626	381718	basement	5.551	27.1	30.1427	41.7929	33270.8	33200	70.8194
5	11.4626	382931	basement	5.551	27.1	37.2035	51.5826	33374.2	33284.2	89.9899
6	11.4626	384048	basement	5.551	27.1	43.54	60.3682	33470.2	33363.1	107.12
7	11.4626	385047	basement	5.551	27.1	48.9109	67.8149	33558.6	33436.9	121.655

8	11.4626	385932	basement	5.551	27.1	52.2994	72.5131	33636.7	33505.9	130.835
9	11.4626	386738	basement	5.551	27.1	54.9628	76.2059	33708.4	33570.3	138.059
10	11.4626	387467	basement	5.551	27.1	56.912	78.9085	33773.8	33630.4	143.422
11	11.4626	388122	basement	5.551	27.1	58.1565	80.634	33833.1	33686.4	146.727
12	11.4626	388707	basement	5.551	27.1	58.7039	81.3929	33886.6	33738.4	148.183
13	11.4626	389223	basement	5.551	27.1	58.5601	81.1936	33934.4	33786.6	147.792
14	11.4626	389674	basement	5.551	27.1	57.7193	80.0278	33976.5	33831	145.498
15	11.4626	390067	basement	5.551	27.1	56.286	78.0406	34013.5	33871.8	141.687
16	11.4626	390400	basement	5.551	27.1	54.3261	75.3232	34045.5	33909.1	136.414
17	11.4626	390673	basement	5.551	27.1	51.6879	71.6653	34072.3	33943.1	129.152
18	11.4626	390887	basement	5.551	27.1	48.3696	67.0645	34093.9	33973.6	120.252
19	11.4626	391043	basement	5.551	27.1	44.368	61.5162	34110.3	34000.9	109.417
20	11.4626	391142	basement	5.551	27.1	39.6783	55.014	34121.7	34025	96.6931
21	11.4626	391186	basement	5.551	27.1	34.2943	47.549	34128	34045.9	82.117
22	11.4626	391176	basement	5.551	27.1	28.0963	38.9555	34129	34063.7	65.284
23	11.4626	391153	basement	5.551	27.1	22.1999	30.7802	34127.8	34078.4	49.3759
24	11.4626	391090	basement	5.551	27.1	16.4697	22.8353	34123.9	34090.1	33.8059
25	11.4626	390973	basement	5.551	27.1	10.036	13.9149	34115.1	34098.7	16.3894

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.38382

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	11.0203	363110	basement	5.551	27.1	7.02071	9.7154	32941.2	32933	8.18941
2	11.0203	364541	basement	5.551	27.1	14.9048	20.6256	33061.7	33032.2	29.4766
3	11.0203	365861	basement	5.551	27.1	22.209	30.7332	33174.1	33124.9	49.2461
4	11.0203	367080	basement	5.551	27.1	28.9634	40.0801	33279.1	33211.7	67.4476
5	11.0203	368204	basement	5.551	27.1	35.1913	48.6984	33377.2	33292.9	84.3347
6	11.0203	369238	basement	5.551	27.1	40.9693	56.6941	33468.9	33368.9	99.9506
7	11.0203	370151	basement	5.551	27.1	45.4144	62.8454	33552.1	33440.1	111.951
8	11.0203	370973	basement	5.551	27.1	48.7436	67.4524	33627.6	33506.6	121.013
9	11.0203	371721	basement	5.551	27.1	51.5081	71.2779	33697.3	33568.8	128.462
10	11.0203	372398	basement	5.551	27.1	53.6933	74.3019	33761.2	33626.8	134.363
11	11.0203	373008	basement	5.551	27.1	55.28	76.4976	33819.5	33680.9	138.597
12	11.0203	373552	basement	5.551	27.1	56.2446	77.8324	33872.3	33731.1	141.196
13	11.0203	374033	basement	5.551	27.1	56.5605	78.2696	33919.7	33777.6	142.053
14	11.0203	374453	basement	5.551	27.1	56.1866	77.7521	33961.6	33820.5	141.078
15	11.0203	374820	basement	5.551	27.1	55.1889	76.3715	33998.3	33860	138.335
16	11.0203	375132	basement	5.551	27.1	53.6232	74.2048	34030.3	33896.1	134.161
17	11.0203	375388	basement	5.551	27.1	51.3026	70.9936	34056.8	33928.9	127.872
18	11.0203	375589	basement	5.551	27.1	48.201	66.7015	34078	33958.5	119.463

19	11.0203	375737	basement	5.551	27.1	44.2949	61.2961	34093.9	33985	108.869
20	11.0203	375833	basement	5.551	27.1	39.5645	54.7502	34104.5	34008.3	96.1945
21	11.0203	375876	basement	5.551	27.1	33.9942	47.0418	34109.7	34028.7	81.0483
22	11.0203	375869	basement	5.551	27.1	27.5727	38.1556	34109.7	34046	63.7312
23	11.0203	375838	basement	5.551	27.1	20.9573	29.0011	34106.2	34060.4	45.7985
24	11.0203	375783	basement	5.551	27.1	14.731	20.385	34100.8	34071.8	28.9865
25	11.0203	375679	basement	5.551	27.1	7.68961	10.641	34090.3	34080.4	9.90062

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.3865

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	2133.35	-3190.07	5.24091e+007	0	0
2	2144.81	-3200.4	197559	134.556	0.0390237
3	2156.28	-3210.05	373703	254.526	0.0390237
4	2167.74	-3219.07	530002	360.979	0.0390236
5	2179.2	-3227.52	667775	454.815	0.0390236
6	2190.66	-3235.43	788145	536.798	0.0390236
7	2202.13	-3242.83	891746	607.36	0.0390236
8	2213.59	-3249.76	950483	647.365	0.0390236
9	2225.05	-3256.23	994231	677.161	0.0390236
10	2236.51	-3262.28	1.02363e+006	697.182	0.0390235
11	2247.98	-3267.91	1.03922e+006	707.805	0.0390237
12	2259.44	-3273.15	1.04151e+006	709.366	0.0390238
13	2270.9	-3278	1.03094e+006	702.161	0.0390235
14	2282.36	-3282.49	1.00787e+006	686.452	0.0390237
15	2293.83	-3286.63	973348	662.938	0.0390236
16	2305.29	-3290.42	930587	633.814	0.0390236
17	2316.75	-3293.88	876274	596.822	0.0390236
18	2328.22	-3297.01	810650	552.126	0.0390236
19	2339.68	-3299.81	733930	499.872	0.0390235
20	2351.14	-3302.31	646301	440.19	0.0390237
21	2362.6	-3304.49	547933	373.192	0.0390236
22	2374.07	-3306.37	438970	298.978	0.0390236
23	2385.53	-3307.95	328864	223.986	0.0390236
24	2396.99	-3309.23	229415	156.252	0.0390235
25	2408.45	-3310.21	119769	81.5735	0.0390236
26	2419.92	-3310.9	5.64547e+007	0	0

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 95PC Site 27		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_96_22_0g.slim

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.38382

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	2139.54	-3192.41	5.2486e+007	0	0
2	2150.56	-3202.36	190878	19.1457	0.00574696
3	2161.58	-3211.66	361078	71.8634	0.0114033
4	2172.6	-3220.36	512131	150.877	0.0168797
5	2183.63	-3228.51	645321	248.799	0.02209
6	2194.65	-3236.13	761740	358.322	0.0269519
7	2205.67	-3243.27	852875	467.237	0.0313888
8	2216.69	-3249.95	909965	561.116	0.0353306
9	2227.71	-3256.19	952638	643.706	0.0387153
10	2238.73	-3262.02	981509	710.736	0.0414893
11	2249.75	-3267.46	997119	758.93	0.0436091
12	2260.77	-3272.52	999943	786.071	0.0450411
13	2271.79	-3277.21	990401	791.045	0.0457628
14	2282.81	-3281.55	968867	773.846	0.0457628
15	2293.83	-3285.54	936354	736.083	0.0450411
16	2304.85	-3289.21	895910	681.897	0.0436091
17	2315.87	-3292.55	844374	611.433	0.0414893
18	2326.89	-3295.58	781982	528.392	0.0387152
19	2337.91	-3298.3	708939	437.157	0.0353306
20	2348.93	-3300.72	625430	342.634	0.0313888
21	2359.95	-3302.84	531619	250.073	0.0269519
22	2370.97	-3304.67	427647	164.877	0.0220901
23	2381.99	-3306.21	313641	92.4009	0.0168797
24	2393.01	-3307.46	218825	43.5516	0.0114033
25	2404.03	-3308.43	114262	11.4608	0.00574693
26	2415.05	-3309.12	5.63939e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.395282
Factor of Safety, standard deviation: 0.227513
Factor of Safety, minimum: 0.717120
Factor of Safety, maximum: 2.217030
Probability of Failure: 3.690% (= 369 failed surfaces / 10000 valid surfaces)
Reliability index: 1.73740 (assuming normal distribution)

Reliability index: 1.97528 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 1.392913
Factor of Safety, standard deviation: 0.226883
Factor of Safety, minimum: 0.719438
Factor of Safety, maximum: 2.214350
Probability of Failure: 3.750% (= 375 failed surfaces / 10000 valid surfaces)
Reliability index: 1.73178 (assuming normal distribution)
Reliability index: 1.96704 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
4864	-6000
4864	0
0	0

External Boundary

X	Y
4864	-6000
4864	-3400
4772	-3398
4679	-3393
4587	-3387
4495	-3377
4402	-3364
4310	-3350
4218	-3341
4125	-3341
4033	-3349
3941	-3359
3848	-3369
3756	-3376
3663	-3382

3571	-3385
3479	-3387
3386	-3389
3294	-3390
3202	-3391
3109	-3392
3017	-3394
2925	-3393
2832	-3392
2742	-3388
2652	-3378
2562	-3358
2472	-3330
2382	-3297
2292	-3257
2202	-3216
2112	-3182
2022	-3158
1932	-3141
1842	-3121
1752	-3094
1662	-3065
1572	-3042
1480	-3018
1387	-2993
1295	-2969
1202	-2943
1110	-2918
1017	-2893
925	-2869
832	-2842
740	-2814
647	-2786
555	-2760
462	-2736
370	-2714
277	-2695
185	-2679
92	-2664
0	-2650

rocscience	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 95PC Site 27		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
SLIDEINTERPRET 6.020	Date: 3/31/2013		File Name: RR0705_96_22_0g.slim

0 -6000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 95PC Site 27		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_96_22_1g.slim

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_96_22_1g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 95PC Site 27
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/31/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 95PC Site 27		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_96_22_1g.slim

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364793246
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.005506
Center: 2940.550, -1669.890
Radius: 1723.205
Left Slip Surface Endpoint: 2118.980, -3184.637
Right Slip Surface Endpoint: 2448.022, -3321.208
Left Slope Intercept: 2118.980 -0.000
Right Slope Intercept: 2448.022 -0.000
Resisting Moment=471722 kN-m
Driving Moment=8.56793e+007 kN-m
Resisting Horizontal Force=263.379 kN

Driving Horizontal Force=47837.7 kN
Total Slice Area=1.07254e+006 m2

Method: gle/morgenstern-price

FS: 0.005427
Center: 2940.550, -1669.890
Radius: 1723.205
Left Slip Surface Endpoint: 2118.980, -3184.637
Right Slip Surface Endpoint: 2448.022, -3321.208
Left Slope Intercept: 2118.980 -0.000
Right Slope Intercept: 2448.022 -0.000
Resisting Moment=464979 kN-m
Driving Moment=8.56793e+007 kN-m
Resisting Horizontal Force=259.615 kN
Driving Horizontal Force=47837.8 kN
Total Slice Area=1.07254e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 925
Number of Invalid Surfaces: 3

Error Codes:

Error Code -112 reported for 3 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 925
Number of Invalid Surfaces: 3

Error Codes:

Error Code -108 reported for 1 surface
Error Code -112 reported for 2 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with

many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.00550567

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	13.1617	432281	basement	5.551	27.1	80.5987	0.44375	32844.8	32854.8	-9.97006
2	13.1617	433378	basement	5.551	27.1	108.247	0.59597	32949.2	32958.9	-9.69021
3	13.1617	434445	basement	5.551	27.1	134.925	0.74285	33049.8	33059.2	-9.36998
4	13.1617	435481	basement	5.551	27.1	160.574	0.88407	33146.7	33155.8	-9.05695
5	13.1617	436488	basement	5.551	27.1	185.144	1.01934	33239.9	33248.7	-8.83674
6	13.1617	437466	basement	5.551	27.1	208.57	1.14832	33329.4	33338	-8.62513
7	13.1617	438397	basement	5.551	27.1	211.649	1.16527	33411.1	33419.7	-8.56524
8	13.1617	439245	basement	5.551	27.1	209.515	1.15352	33477.6	33486.2	-8.57839
9	13.1617	440062	basement	5.551	27.1	211.328	1.1635	33540	33548.5	-8.53799
10	13.1617	440851	basement	5.551	27.1	210.957	1.16146	33598.8	33607.3	-8.54699
11	13.1617	441613	basement	5.551	27.1	208.283	1.14674	33654	33662.6	-8.55929
12	13.1617	442347	basement	5.551	27.1	203.18	1.11864	33705.9	33714.6	-8.66007
13	13.1617	443055	basement	5.551	27.1	195.511	1.07642	33754.4	33763.2	-8.77529
14	13.1617	443739	basement	5.551	27.1	189.292	1.04218	33800.5	33809.2	-8.74643
15	13.1617	444405	basement	5.551	27.1	179.419	0.98782	33844.6	33853.5	-8.92834
16	13.1617	445044	basement	5.551	27.1	166.125	0.91463	33885.4	33894.5	-9.08621
17	13.1617	445657	basement	5.551	27.1	149.747	0.82446	33923	33932.2	-9.18154
18	13.1617	446245	basement	5.551	27.1	130.097	0.71627	33957.4	33966.8	-9.44819
19	13.1617	446807	basement	5.551	27.1	106.968	0.58893	33988.4	33998.2	-9.75022
20	13.1617	447344	basement	5.551	27.1	80.6296	0.44392	34016.4	34026.4	-9.98085
21	13.1617	447896	basement	5.551	27.1	92.0669	0.50689	34050	34059.9	-9.89596
22	13.1617	448458	basement	5.551	27.1	81.0165	0.44605	34088.2	34098.1	-9.94613
23	13.1617	448997	basement	5.551	27.1	66.7076	0.36727	34123.2	34133.4	-10.1834
24	13.1617	449511	basement	5.551	27.1	48.9078	0.26927	34155.1	34165.5	-10.3525
25	13.1617	450001	basement	5.551	27.1	15.168	0.08351	34184	34194.6	-10.6271

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00542698

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	13.1617	432281	basement	5.551	27.1	51.7618	0.28091	32844.5	32854.8	-10.3048
2	13.1617	433378	basement	5.551	27.1	100.524	0.54554	32949.1	32958.9	-9.75747
3	13.1617	434445	basement	5.551	27.1	146.374	0.79437	33050	33059.2	-9.23487

4	13.1617	435481	basement	5.551	27.1	188.657	1.02384	33147	33155.8	-8.78556
5	13.1617	436488	basement	5.551	27.1	226.8	1.23084	33240.3	33248.7	-8.42791
6	13.1617	437466	basement	5.551	27.1	260.334	1.41283	33329.9	33338	-8.14618
7	13.1617	438397	basement	5.551	27.1	261.166	1.41734	33411.6	33419.7	-8.08435
8	13.1617	439245	basement	5.551	27.1	251.363	1.36414	33478	33486.2	-8.16457
9	13.1617	440062	basement	5.551	27.1	245.621	1.33298	33540.3	33548.5	-8.19182
10	13.1617	440851	basement	5.551	27.1	235.661	1.27893	33599	33607.3	-8.33851
11	13.1617	441613	basement	5.551	27.1	221.913	1.20432	33654.2	33662.6	-8.41979
12	13.1617	442347	basement	5.551	27.1	204.908	1.11203	33705.9	33714.6	-8.66007
13	13.1617	443055	basement	5.551	27.1	185.239	1.00529	33754.3	33763.2	-8.91576
14	13.1617	443739	basement	5.551	27.1	170.876	0.92734	33800.2	33809.2	-8.95785
15	13.1617	444405	basement	5.551	27.1	151.465	0.822	33844.2	33853.5	-9.28186
16	13.1617	445044	basement	5.551	27.1	130.072	0.7059	33885	33894.5	-9.5118
17	13.1617	445657	basement	5.551	27.1	108.399	0.58828	33922.5	33932.2	-9.6796
18	13.1617	446245	basement	5.551	27.1	87.0355	0.47234	33956.9	33966.8	-9.94775
19	13.1617	446807	basement	5.551	27.1	66.4845	0.36081	33988	33998.2	-10.1797
20	13.1617	447344	basement	5.551	27.1	47.7245	0.259	34016.1	34026.4	-10.3397
21	13.1617	447896	basement	5.551	27.1	71.1906	0.38635	34049.8	34059.9	-10.1119
22	13.1617	448458	basement	5.551	27.1	64.2291	0.34857	34088	34098.1	-10.0905
23	13.1617	448997	basement	5.551	27.1	57.837	0.31388	34123.1	34133.4	-10.2557
24	13.1617	449511	basement	5.551	27.1	52.0934	0.28271	34155.2	34165.5	-10.28
25	13.1617	450001	basement	5.551	27.1	46.9027	0.25454	34184.3	34194.6	-10.3362

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.00550567

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	2118.98	-3184.64	5.22309e+007	0	0
2	2132.14	-3191.7	68262.2	-209.388	-0.175749
3	2145.3	-3198.62	132353	-405.981	-0.175749
4	2158.47	-3205.4	192261	-589.743	-0.175749
5	2171.63	-3212.03	247975	-760.639	-0.175749
6	2184.79	-3218.52	299484	-918.639	-0.175749
7	2197.95	-3224.88	346781	-1063.72	-0.175749
8	2211.11	-3231.09	366461	-1124.08	-0.175748
9	2224.27	-3237.18	371294	-1138.91	-0.175749
10	2237.44	-3243.12	371641	-1139.97	-0.175748
11	2250.6	-3248.94	367508	-1127.29	-0.175748

12	2263.76	-3254.63	358904	-1100.9	-0.175748
13	2276.92	-3260.18	345839	-1060.83	-0.175749
14	2290.08	-3265.61	328326	-1007.11	-0.175749
15	2303.24	-3270.91	310549	-952.579	-0.175749
16	2316.41	-3276.09	289094	-886.768	-0.175749
17	2329.57	-3281.14	263267	-807.545	-0.175748
18	2342.73	-3286.07	233084	-714.962	-0.175749
19	2355.89	-3290.88	198565	-609.08	-0.175749
20	2369.05	-3295.57	159732	-489.963	-0.175749
21	2382.21	-3300.13	117167	-359.4	-0.175749
22	2395.37	-3304.58	104338	-320.048	-0.175749
23	2408.54	-3308.91	87440.7	-268.216	-0.175749
24	2421.7	-3313.13	66491.1	-203.955	-0.175749
25	2434.86	-3317.22	41508.8	-127.324	-0.175748
26	2448.02	-3321.21	5.68067e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00542698

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	2118.98	-3184.64	5.22309e+007	0	0
2	2132.14	-3191.7	68546.5	-52.5268	-0.0439054
3	2145.3	-3198.62	132726	-201.81	-0.0871182
4	2158.47	-3205.4	192543	-433.364	-0.128958
5	2171.63	-3212.03	248013	-730.514	-0.168762
6	2184.79	-3218.52	299153	-1075.08	-0.205906
7	2197.95	-3224.88	345987	-1448.08	-0.239802
8	2211.11	-3231.09	365228	-1720.57	-0.269915
9	2224.27	-3237.18	369693	-1908.45	-0.295773
10	2237.44	-3243.12	369743	-2045.48	-0.316967
11	2250.6	-3248.94	365405	-2124.76	-0.33316
12	2263.76	-3254.63	356700	-2142.25	-0.3441
13	2276.92	-3260.18	343647	-2096.93	-0.349614
14	2290.08	-3265.61	326258	-1990.82	-0.349613
15	2303.24	-3270.91	308682	-1853.87	-0.344101
16	2316.41	-3276.09	287517	-1671.86	-0.333161
17	2329.57	-3281.14	262055	-1449.73	-0.316966
18	2342.73	-3286.07	232285	-1199.12	-0.295774
19	2355.89	-3290.88	198193	-933.681	-0.269917
20	2369.05	-3295.57	159760	-668.651	-0.239801
21	2382.21	-3300.13	117519	-422.333	-0.205905

22	2395.37	-3304.58	104901	-308.981	-0.168762
23	2408.54	-3308.91	88173.6	-198.455	-0.128957
24	2421.7	-3313.13	67317.4	-102.356	-0.0871181
25	2434.86	-3317.22	42311.6	-32.4231	-0.0439054
26	2448.02	-3321.21	5.68067e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.059912
Factor of Safety, standard deviation: 0.096836
Factor of Safety, minimum: 0.000454
Factor of Safety, maximum: 1.392650
Probability of Failure: 99.940% (= 9971 failed surfaces / 9977 valid surfaces), 23 invalid surfaces
Reliability index: -9.70801 (assuming normal distribution)
Reliability index: -3.05043 (assuming lognormal distribution)
* best fit = Beta

Method: gle/morgenstern-price
Factor of Safety, mean: 0.064878
Factor of Safety, standard deviation: 0.097632
Factor of Safety, minimum: 0.000413
Factor of Safety, maximum: 1.393570
Probability of Failure: 99.940% (= 9980 failed surfaces / 9986 valid surfaces), 14 invalid surfaces
Reliability index: -9.57803 (assuming normal distribution)
Reliability index: -3.05852 (assuming lognormal distribution)
* best fit = Beta

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
4864	-6000
4864	0
0	0

External Boundary

X	Y

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 95PC Site 27		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 3/31/2013		File Name: RR0705_96_22_1g.slim

4864	-6000
4864	-3400
4772	-3398
4679	-3393
4587	-3387
4495	-3377
4402	-3364
4310	-3350
4218	-3341
4125	-3341
4033	-3349
3941	-3359
3848	-3369
3756	-3376
3663	-3382
3571	-3385
3479	-3387
3386	-3389
3294	-3390
3202	-3391
3109	-3392
3017	-3394
2925	-3393
2832	-3392
2742	-3388
2652	-3378
2562	-3358
2472	-3330
2382	-3297
2292	-3257
2202	-3216
2112	-3182
2022	-3158
1932	-3141
1842	-3121
1752	-3094
1662	-3065
1572	-3042
1480	-3018
1387	-2993

rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 95PC Site 27		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_96_22_1g.slim

SLIDEINTERPRET 6.020

1295	-2969
1202	-2943
1110	-2918
1017	-2893
925	-2869
832	-2842
740	-2814
647	-2786
555	-2760
462	-2736
370	-2714
277	-2695
185	-2679
92	-2664
0	-2650
0	-6000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 96PC Site 24		
	Drawn By	Jason R. Patton	Company	Oregon State University
	Date	3/25/2013	File Name	RR0705_96_24_02g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_96_24_02g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 96PC Site 24
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/25/2013
Comments:

http://earthjay.com
http://activetectonics.oregonstate.edu

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide	
	Analysis Description	RR0705 96PC Site 24	
	Drawn By	Jason R. Patton	Company: Oregon State University
	Date	3/25/2013	File Name: RR0705_96_24_02g.sli

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364949316
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 100
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.2
Seismic Load Coefficient (Vertical): 0.2

Material Properties

Property	Basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.55
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	Automatically Calculated
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
Basement	Cohesion	Normal	5.55	0.55	10.55	2.6
Basement	Phi	Normal	27.1	14.8	39.4	4.1
Basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	0.2	0	0.4	0.1
Vertical Seismic Coefficient		Normal	0.2	0	0.4	0.1

Seismic Coefficient Correlation: 0.5

Correlation Coefficients

Material	Correlation
Basement	-0.5

Global Minimums

Method: spencer

FS: 0.263887
Center: 3991.471, 2982.696
Radius: 6246.446

Left Slip Surface Endpoint: 620.685, -2276.190
Right Slip Surface Endpoint: 2236.000, -3012.000
Left Slope Intercept: 620.685 -0.000
Right Slope Intercept: 2236.000 -0.000
Resisting Moment=8.60557e+008 kN-m
Driving Moment=3.26109e+009 kN-m
Resisting Horizontal Force=125610 kN
Driving Horizontal Force=475999 kN
Total Slice Area=4.34599e+006 m2

Method: gle/morgenstern-price

FS: 0.263976
Center: 3991.471, 2982.696
Radius: 6246.446
Left Slip Surface Endpoint: 620.685, -2276.190
Right Slip Surface Endpoint: 2236.000, -3012.000
Left Slope Intercept: 620.685 -0.000
Right Slope Intercept: 2236.000 -0.000
Resisting Moment=8.60847e+008 kN-m
Driving Moment=3.26109e+009 kN-m
Resisting Horizontal Force=125643 kN
Driving Horizontal Force=475966 kN
Total Slice Area=4.34599e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 15267
Number of Invalid Surfaces: 71

Error Codes:

Error Code -108 reported for 70 surfaces
Error Code -112 reported for 1 surface

Method: gle/morgenstern-price

Number of Valid Surfaces: 15338
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving

force is very small (0.1 is an arbitrary number).

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.263887

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	64.6126	1.533e+006	Basement	5.55	27.1	49.2632	12.9999	23709.9	23695.4	14.5398
2	64.6126	1.56655e+006	Basement	5.55	27.1	148.466	39.1783	24235.4	24169.7	65.6898
3	64.6126	1.59631e+006	Basement	5.55	27.1	210.629	55.5822	24703.6	24605.9	97.6655
4	64.6126	1.62367e+006	Basement	5.55	27.1	242.599	64.0187	25130.5	25016.3	114.223
5	64.6126	1.64992e+006	Basement	5.55	27.1	268.48	70.8483	25539.9	25412.2	127.665
6	64.6126	1.67568e+006	Basement	5.55	27.1	296.732	78.3036	25941.5	25799.4	142.124
7	64.6126	1.70091e+006	Basement	5.55	27.1	327.327	86.3773	26335.3	26177.4	157.945
8	64.6126	1.72553e+006	Basement	5.55	27.1	361.025	95.2698	26721.2	26545.8	175.379
9	64.6126	1.74925e+006	Basement	5.55	27.1	392.059	103.459	27093.4	26902	191.358
10	64.6126	1.77174e+006	Basement	5.55	27.1	415.64	109.682	27446.6	27243.2	203.446
11	64.6126	1.79322e+006	Basement	5.55	27.1	432.223	114.058	27783.4	27571.4	211.988
12	64.6126	1.8138e+006	Basement	5.55	27.1	445.388	117.532	28106.4	27887.6	218.822
13	64.6126	1.83326e+006	Basement	5.55	27.1	450.541	118.892	28411.6	28190.1	221.503
14	64.6126	1.8517e+006	Basement	5.55	27.1	448.654	118.394	28700.1	28479.6	220.507
15	64.6126	1.86899e+006	Basement	5.55	27.1	438.741	115.778	28970.6	28755.1	215.486
16	64.6126	1.885e+006	Basement	5.55	27.1	414.367	109.346	29218.5	29015.6	202.927
17	64.6126	1.90044e+006	Basement	5.55	27.1	388.235	102.45	29456.8	29267.3	189.46
18	64.6126	1.91524e+006	Basement	5.55	27.1	359.907	94.9749	29684.5	29509.8	174.686
19	64.6126	1.92915e+006	Basement	5.55	27.1	327.372	86.3893	29898.6	29740.7	157.877
20	64.6126	1.94189e+006	Basement	5.55	27.1	280.89	74.1231	30091.8	29957.7	134.081
21	64.6126	1.95409e+006	Basement	5.55	27.1	231.889	61.1925	30275.2	30166.4	108.768
22	64.6126	1.96577e+006	Basement	5.55	27.1	180.92	47.7425	30449.4	30367	82.4172
23	64.6126	1.97703e+006	Basement	5.55	27.1	129.411	34.15	30616.3	30560.4	55.8565
24	64.6126	1.98812e+006	Basement	5.55	27.1	82.8893	21.8734	30780.8	30748.9	31.938
25	64.6126	1.99912e+006	Basement	5.55	27.1	43.3204	11.4317	30944.7	30933.2	11.5244

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.263976

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]

1	64.6126	1.533e+006	Basement	5.55	27.1	67.3637	17.7824	23719.4	23695.4	23.958
2	64.6126	1.56655e+006	Basement	5.55	27.1	154.955	40.9044	24238.8	24169.7	69.1167
3	64.6126	1.59631e+006	Basement	5.55	27.1	207.471	54.7673	24702	24605.9	96.0722
4	64.6126	1.62367e+006	Basement	5.55	27.1	237.087	62.5854	25127.7	25016.3	111.415
5	64.6126	1.64992e+006	Basement	5.55	27.1	261.562	69.046	25536.4	25412.2	124.165
6	64.6126	1.67568e+006	Basement	5.55	27.1	288.91	76.2652	25937.6	25799.4	138.194
7	64.6126	1.70091e+006	Basement	5.55	27.1	318.686	84.1254	26331	26177.4	153.58
8	64.6126	1.72553e+006	Basement	5.55	27.1	351.969	92.9115	26716.5	26545.8	170.712
9	64.6126	1.74925e+006	Basement	5.55	27.1	383.419	101.213	27088.9	26902	186.939
10	64.6126	1.77174e+006	Basement	5.55	27.1	408.477	107.828	27443	27243.2	199.835
11	64.6126	1.79322e+006	Basement	5.55	27.1	426.815	112.669	27780.7	27571.4	209.335
12	64.6126	1.8138e+006	Basement	5.55	27.1	442.495	116.808	28105	27887.6	217.418
13	64.6126	1.83326e+006	Basement	5.55	27.1	450.514	118.925	28411.6	28190.1	221.503
14	64.6126	1.8517e+006	Basement	5.55	27.1	451.515	119.189	28701.7	28479.6	222.068
15	64.6126	1.86899e+006	Basement	5.55	27.1	444.862	117.433	28973.7	28755.1	218.622
16	64.6126	1.885e+006	Basement	5.55	27.1	422.36	111.493	29222.7	29015.6	207.08
17	64.6126	1.90044e+006	Basement	5.55	27.1	397.276	104.871	29461.5	29267.3	194.207
18	64.6126	1.91524e+006	Basement	5.55	27.1	369.369	97.5045	29689.4	29509.8	179.598
19	64.6126	1.92915e+006	Basement	5.55	27.1	336.44	88.8122	29903.4	29740.7	162.665
20	64.6126	1.94189e+006	Basement	5.55	27.1	288.05	76.0382	30095.4	29957.7	137.723
21	64.6126	1.95409e+006	Basement	5.55	27.1	236.171	62.3436	30277.4	30166.4	110.961
22	64.6126	1.96577e+006	Basement	5.55	27.1	181.77	47.9829	30450	30367	83.0043
23	64.6126	1.97703e+006	Basement	5.55	27.1	126.955	33.513	30615.1	30560.4	54.6781
24	64.6126	1.98812e+006	Basement	5.55	27.1	77.304	20.4064	30778	30748.9	29.1296
25	64.6126	1.99912e+006	Basement	5.55	27.1	34.6422	9.1447	30940.3	30933.2	7.07555

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.263887

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	620.685	-2276.19	2.66824e+007	0	0
2	685.298	-2317.05	541414	1630.31	0.172529
3	749.91	-2356.81	927238	2792.11	0.172529
4	814.523	-2395.51	1.09275e+006	3290.51	0.17253
5	879.136	-2433.16	1.23018e+006	3704.34	0.17253
6	943.748	-2469.78	1.359e+006	4092.23	0.172529
7	1008.36	-2505.39	1.50284e+006	4525.38	0.17253
8	1072.97	-2540.03	1.66916e+006	5026.18	0.172529

9	1137.59	-2573.69	1.82098e+006	5483.35	0.172529
10	1202.2	-2606.4	1.94688e+006	5862.47	0.172529
11	1266.81	-2638.19	2.02756e+006	6105.42	0.172529
12	1331.42	-2669.05	2.09168e+006	6298.47	0.172529
13	1396.04	-2699.01	2.1214e+006	6387.97	0.172529
14	1460.65	-2728.08	2.11442e+006	6366.96	0.172529
15	1525.26	-2756.28	2.07314e+006	6242.67	0.172529
16	1589.87	-2783.62	1.96245e+006	5909.36	0.172529
17	1654.49	-2810.11	1.82853e+006	5506.07	0.172529
18	1719.1	-2835.76	1.68608e+006	5077.12	0.172528
19	1783.71	-2860.58	1.53477e+006	4621.52	0.172529
20	1848.32	-2884.59	1.32243e+006	3982.1	0.172528
21	1912.94	-2907.79	1.08462e+006	3266.01	0.172529
22	1977.55	-2930.19	839189	2526.97	0.172529
23	2042.16	-2951.8	597802	1800.11	0.172529
24	2106.77	-2972.64	376908	1134.95	0.172529
25	2171.39	-2992.7	177127	533.368	0.17253
26	2236	-3012	4.67215e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.263976

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	620.685	-2276.19	2.66824e+007	0	0
2	685.298	-2317.05	540627	284.596	0.0301615
3	749.91	-2356.81	926163	967.41	0.0598474
4	814.523	-2395.51	1.09182e+006	1688.14	0.088589
5	879.136	-2433.16	1.22949e+006	2487.8	0.115934
6	943.748	-2469.78	1.35862e+006	3354.14	0.141451
7	1008.36	-2505.39	1.50282e+006	4320.91	0.164736
8	1072.97	-2540.03	1.66953e+006	5403.05	0.185424
9	1137.59	-2573.69	1.82177e+006	6460.57	0.203188
10	1202.2	-2606.4	1.94808e+006	7403.51	0.217747
11	1266.81	-2638.19	2.0291e+006	8105.41	0.228872
12	1331.42	-2669.05	2.09347e+006	8637.14	0.236387
13	1396.04	-2699.01	2.12333e+006	8900.69	0.240174
14	1460.65	-2728.08	2.11634e+006	8871.41	0.240175
15	1525.26	-2756.28	2.07492e+006	8560.59	0.236386
16	1589.87	-2783.62	1.96391e+006	7845	0.228871
17	1654.49	-2810.11	1.82957e+006	6953.11	0.217746
18	1719.1	-2835.76	1.68665e+006	5981.36	0.203187

19	1783.71	-2860.58	1.53485e+006	4967.19	0.185424
20	1848.32	-2884.59	1.32202e+006	3801.08	0.164737
21	1912.94	-2907.79	1.08383e+006	2675.76	0.141452
22	1977.55	-2930.19	838174	1695.99	0.115934
23	2042.16	-2951.8	596739	922.665	0.0885894
24	2106.77	-2972.64	375974	392.718	0.0598474
25	2171.39	-2992.7	176495	92.9101	0.0301615
26	2236	-3012	4.67215e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.305852
Factor of Safety, standard deviation: 0.160116
Factor of Safety, minimum: 0.061322
Factor of Safety, maximum: 1.298730
Probability of Failure: 99.710% (= 9971 failed surfaces / 10000 valid surfaces)
Reliability index: -4.33528 (assuming normal distribution)
Reliability index: -2.65319 (assuming lognormal distribution) * best fit = Lognormal

Method: gle/morgenstern-price
Factor of Safety, mean: 0.305495
Factor of Safety, standard deviation: 0.159424
Factor of Safety, minimum: 0.050920
Factor of Safety, maximum: 1.298890
Probability of Failure: 99.710% (= 9971 failed surfaces / 10000 valid surfaces)
Reliability index: -4.35635 (assuming normal distribution)
Reliability index: -2.66165 (assuming lognormal distribution) * best fit = Lognormal

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
4978	-6000
4978	0
0	0

External Boundary

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 96PC Site 24		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/25/2013	File Name: RR0705_96_24_02g.sli	

X	Y
4978	-6000
4978	-3292
4885	-3290
4792	-3289
4700	-3288
4607	-3286
4514	-3284
4421	-3281
4328	-3278
4235	-3275
4143	-3271
4050	-3266
3956	-3262
3863	-3259
3770	-3255
3677	-3253
3584	-3250
3491	-3247
3398	-3245
3305	-3242
3212	-3239
3119	-3237
3025	-3232
2932	-3225
2839	-3212
2753	-3192
2667	-3166
2581	-3135
2494	-3104
2408	-3072
2322	-3043
2236	-3012
2148	-2978
2061	-2941
1974	-2901
1886	-2859
1799	-2816
1712	-2775
1625	-2733

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 96PC Site 24		
	Drawn By: Jason R. Patton	Company: Oregon State University	
	Date: 3/25/2013	File Name: RR0705_96_24_02g.sli	

1537	-2689
1450	-2648
1362	-2607
1274	-2567
1187	-2527
1099	-2488
1012	-2449
924	-2407
832	-2360
739	-2313
647	-2281
554	-2264
462	-2257
370	-2252
277	-2246
185	-2237
92	-2227
0	-2215
0	-6000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 96PC Site 24		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/25/2013		File Name: RR0705_96_24_0g.slim

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_96_24_0g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 96PC Site 24
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/25/2013
Comments:

http://earthjay.com
http://activetectonics.oregonstate.edu

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364793694
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 100
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	Basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.55
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	Automatically Calculated
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 96PC Site 24		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/25/2013		File Name: RR0705_96_24_0g.slim

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
Basement	Cohesion	Normal	5.55	0.55	10.55	2.6
Basement	Phi	Normal	27.1	14.8	39.4	4.1
Basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Correlation Coefficients

Material	Correlation
Basement	-0.5

Global Minimums

Method: spencer

FS: 1.152780
Center: 2901.616, 571.427
Radius: 3628.587
Left Slip Surface Endpoint: 668.187, -2288.369
Right Slip Surface Endpoint: 2148.219, -2978.085
Left Slope Intercept: 668.187 -0.000
Right Slope Intercept: 2148.219 -0.000
Resisting Moment=1.01603e+009 kN-m
Driving Moment=8.8138e+008 kN-m
Resisting Horizontal Force=253217 kN
Driving Horizontal Force=219659 kN
Total Slice Area=3.99864e+006 m2

Method: gle/morgenstern-price

FS: 1.153180
Center: 2904.641, 564.843
Radius: 3623.303

Left Slip Surface Endpoint: 673.918, -2290.363
Right Slip Surface Endpoint: 2151.324, -2979.284
Left Slope Intercept: 673.918 -0.000
Right Slope Intercept: 2151.324 -0.000
Resisting Moment=1.0049e+009 kN-m
Driving Moment=8.71421e+008 kN-m
Resisting Horizontal Force=250739 kN
Driving Horizontal Force=217433 kN
Total Slice Area=3.99372e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 23359
Number of Invalid Surfaces: 59

Error Codes:

Error Code -108 reported for 59 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 23417
Number of Invalid Surfaces: 1

Error Codes:

Error Code -108 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.15278

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	59.2013	1.41328e+006	Basement	5.55	27.1	15.7395	18.1442	23827.9	23803.3	24.5601

2	59.2013	1.44717e+006	Basement	5.55	27.1	58.5958	67.5481	24381	24259.8	121.216
3	59.2013	1.47729e+006	Basement	5.55	27.1	84.803	97.7592	24877.5	24697.4	180.109
4	59.2013	1.50563e+006	Basement	5.55	27.1	106.645	122.938	25346.1	25116.8	229.326
5	59.2013	1.53248e+006	Basement	5.55	27.1	125.563	144.746	25790.7	25518.7	271.965
6	59.2013	1.55829e+006	Basement	5.55	27.1	144.639	166.737	26218.9	25903.9	314.973
7	59.2013	1.58303e+006	Basement	5.55	27.1	163.134	188.058	26629.4	26272.8	356.62
8	59.2013	1.60655e+006	Basement	5.55	27.1	180.747	208.361	27022.5	26626.2	396.311
9	59.2013	1.62875e+006	Basement	5.55	27.1	196.24	226.221	27395.7	26964.4	431.272
10	59.2013	1.64939e+006	Basement	5.55	27.1	208.071	239.86	27745.9	27288	457.871
11	59.2013	1.66867e+006	Basement	5.55	27.1	216.334	249.385	28073.9	27597.4	476.498
12	59.2013	1.68674e+006	Basement	5.55	27.1	222.494	256.487	28383.3	27892.9	490.43
13	59.2013	1.70343e+006	Basement	5.55	27.1	225.249	259.662	28671.6	28174.9	496.66
14	59.2013	1.71883e+006	Basement	5.55	27.1	224.648	258.97	28939	28443.8	495.203
15	59.2013	1.73295e+006	Basement	5.55	27.1	220.962	254.72	29186.7	28699.9	486.815
16	59.2013	1.74552e+006	Basement	5.55	27.1	212.312	244.749	29410.8	28943.3	467.454
17	59.2013	1.75695e+006	Basement	5.55	27.1	199.712	230.224	29613.6	29174.5	439.071
18	59.2013	1.76751e+006	Basement	5.55	27.1	186.121	214.556	29802.2	29393.7	408.461
19	59.2013	1.77717e+006	Basement	5.55	27.1	170.903	197.013	29975.2	29601	374.186
20	59.2013	1.78562e+006	Basement	5.55	27.1	153.097	176.487	30130.8	29796.7	334.089
21	59.2013	1.79279e+006	Basement	5.55	27.1	130.056	149.926	30263	29980.9	282.119
22	59.2013	1.79918e+006	Basement	5.55	27.1	105.698	121.847	30381.1	30153.9	227.219
23	59.2013	1.80476e+006	Basement	5.55	27.1	79.6856	91.86	30484.5	30315.8	168.735
24	59.2013	1.8096e+006	Basement	5.55	27.1	52.6532	60.6975	30574.5	30466.8	107.702
25	59.2013	1.81397e+006	Basement	5.55	27.1	26.2607	30.2728	30655.2	30606.9	48.3444

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.15318

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	59.0962	1.41196e+006	Basement	5.55	27.1	24.6715	28.4507	23868.3	23823.5	44.8012
2	59.0962	1.4455e+006	Basement	5.55	27.1	60.1748	69.3924	24404.2	24279.4	124.782
3	59.0962	1.47549e+006	Basement	5.55	27.1	83.109	95.8396	24892.7	24716.4	176.347
4	59.0962	1.50373e+006	Basement	5.55	27.1	103.027	118.809	25356.5	25135.2	221.337
5	59.0962	1.53055e+006	Basement	5.55	27.1	120.926	139.449	25798.2	25536.6	261.618
6	59.0962	1.55631e+006	Basement	5.55	27.1	139.169	160.487	26224.1	25921.2	302.856
7	59.0962	1.58101e+006	Basement	5.55	27.1	157.288	181.381	26633.3	26289.8	343.526
8	59.0962	1.60447e+006	Basement	5.55	27.1	174.625	201.374	27025.4	26642.7	382.691
9	59.0962	1.62661e+006	Basement	5.55	27.1	190.347	219.504	27398.5	26980.5	418.029
10	59.0962	1.64717e+006	Basement	5.55	27.1	202.759	233.818	27749.7	27303.7	446.033
11	59.0962	1.6664e+006	Basement	5.55	27.1	212.055	244.538	28079.7	27612.6	467.072
12	59.0962	1.68443e+006	Basement	5.55	27.1	219.571	253.205	28391.8	27907.8	483.999

13	59.0962	1.70106e+006	Basement	5.55	27.1	223.78	258.059	28682.9	28189.5	493.404
14	59.0962	1.71641e+006	Basement	5.55	27.1	224.725	259.148	28953.7	28458.1	495.612
15	59.0962	1.73048e+006	Basement	5.55	27.1	222.54	256.629	29204.5	28713.9	490.606
16	59.0962	1.743e+006	Basement	5.55	27.1	214.972	247.901	29430.7	28957.1	473.595
17	59.0962	1.75443e+006	Basement	5.55	27.1	203.155	234.274	29635	29188	447.032
18	59.0962	1.76498e+006	Basement	5.55	27.1	190.016	219.123	29824.3	29407	417.347
19	59.0962	1.77462e+006	Basement	5.55	27.1	174.813	201.591	29997.1	29614.1	383.025
20	59.0962	1.78303e+006	Basement	5.55	27.1	156.088	179.997	30150.5	29809.6	340.92
21	59.0962	1.7902e+006	Basement	5.55	27.1	131.625	151.787	30279.5	29993.7	285.815
22	59.0962	1.79659e+006	Basement	5.55	27.1	105.464	121.619	30393.4	30166.6	226.757
23	59.0962	1.80219e+006	Basement	5.55	27.1	77.352	89.2008	30491.8	30328.4	163.408
24	59.0962	1.80705e+006	Basement	5.55	27.1	47.9674	55.315	30576.4	30479.2	97.2316
25	59.0962	1.81144e+006	Basement	5.55	27.1	19.0804	22.0031	30651.5	30619.3	32.1576

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.15278

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	668.187	-2288.37	2.69687e+007	0	0
2	727.388	-2333.63	590073	1920.26	0.186456
3	786.59	-2377.01	972173	3163.72	0.186456
4	845.791	-2418.59	1.2749e+006	4148.88	0.186456
5	904.992	-2458.45	1.53662e+006	5000.61	0.186457
6	964.193	-2496.64	1.79648e+006	5846.24	0.186456
7	1023.39	-2533.23	2.04555e+006	6656.78	0.186456
8	1082.6	-2568.29	2.29487e+006	7468.15	0.186456
9	1141.8	-2601.85	2.51501e+006	8184.53	0.186455
10	1201	-2633.97	2.69616e+006	8774.06	0.186456
11	1260.2	-2664.68	2.82199e+006	9183.54	0.186456
12	1319.4	-2694.03	2.91786e+006	9495.53	0.186456
13	1378.6	-2722.06	2.97418e+006	9678.83	0.186456
14	1437.8	-2748.8	2.98065e+006	9699.86	0.186456
15	1497	-2774.27	2.94305e+006	9577.51	0.186456
16	1556.21	-2798.52	2.85088e+006	9277.56	0.186456
17	1615.41	-2821.55	2.68856e+006	8749.31	0.186455
18	1674.61	-2843.41	2.51193e+006	8174.52	0.186456
19	1733.81	-2864.1	2.30911e+006	7514.49	0.186456
20	1793.01	-2883.66	2.08085e+006	6771.66	0.186456

21	1852.21	-2902.1	1.77914e+006	5789.83	0.186456
22	1911.41	-2919.44	1.44787e+006	4711.79	0.186456
23	1970.61	-2935.69	1.09571e+006	3565.74	0.186455
24	2029.82	-2950.87	735380	2393.13	0.186456
25	2089.02	-2965	369256	1201.66	0.186455
26	2148.22	-2978.08	4.56753e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.15318

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	673.918	-2290.36	2.70157e+007	0	0
2	733.015	-2335.56	590335	318.35	0.0308979
3	792.111	-2378.89	951265	1017.89	0.0613087
4	851.207	-2420.41	1.25305e+006	1984.74	0.0907523
5	910.303	-2460.21	1.51452e+006	3139.36	0.118765
6	969.4	-2498.35	1.77856e+006	4498.09	0.144904
7	1028.5	-2534.9	2.0312e+006	5982.7	0.168759
8	1087.59	-2569.91	2.2804e+006	7560.19	0.189951
9	1146.69	-2603.43	2.50112e+006	9086.29	0.208148
10	1205.78	-2635.5	2.68019e+006	10434.5	0.223062
11	1264.88	-2666.18	2.80609e+006	11482.8	0.234459
12	1323.98	-2695.5	2.90274e+006	12268.4	0.242159
13	1383.07	-2723.49	2.95791e+006	12701.9	0.246039
14	1442.17	-2750.2	2.96465e+006	12730.8	0.246038
15	1501.27	-2775.65	2.92676e+006	12369.9	0.242158
16	1560.36	-2799.86	2.83165e+006	11587.4	0.234459
17	1619.46	-2822.87	2.66979e+006	10394	0.223062
18	1678.55	-2844.71	2.49563e+006	9066.32	0.208148
19	1737.65	-2865.38	2.29464e+006	7607.37	0.189951
20	1796.75	-2884.92	2.06698e+006	6088.07	0.168758
21	1855.84	-2903.35	1.76348e+006	4459.96	0.144905
22	1914.94	-2920.67	1.43478e+006	2974.08	0.118765
23	1974.04	-2936.91	1.08352e+006	1716.22	0.0907524
24	2033.13	-2952.09	725941	776.784	0.0613086
25	2092.23	-2966.21	364323	196.469	0.030898
26	2151.32	-2979.28	4.57121e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.157810
Factor of Safety, standard deviation: 0.183542
Factor of Safety, minimum: 0.634607
Factor of Safety, maximum: 1.809210
Probability of Failure: 19.820% (= 1982 failed surfaces / 10000 valid surfaces)
Reliability index: 0.85980 (assuming normal distribution)
Reliability index: 0.85133 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 1.157843
Factor of Safety, standard deviation: 0.183444
Factor of Safety, minimum: 0.634907
Factor of Safety, maximum: 1.808900
Probability of Failure: 19.800% (= 1980 failed surfaces / 10000 valid surfaces)
Reliability index: 0.86044 (assuming normal distribution)
Reliability index: 0.85207 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
4978	-6000
4978	0
0	0

External Boundary

X	Y
4978	-6000
4978	-3292
4885	-3290
4792	-3289
4700	-3288
4607	-3286
4514	-3284
4421	-3281
4328	-3278

4235	-3275
4143	-3271
4050	-3266
3956	-3262
3863	-3259
3770	-3255
3677	-3253
3584	-3250
3491	-3247
3398	-3245
3305	-3242
3212	-3239
3119	-3237
3025	-3232
2932	-3225
2839	-3212
2753	-3192
2667	-3166
2581	-3135
2494	-3104
2408	-3072
2322	-3043
2236	-3012
2148	-2978
2061	-2941
1974	-2901
1886	-2859
1799	-2816
1712	-2775
1625	-2733
1537	-2689
1450	-2648
1362	-2607
1274	-2567
1187	-2527
1099	-2488
1012	-2449
924	-2407
832	-2360
739	-2313

rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 96PC Site 24		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/25/2013		File Name: RR0705_96_24_0g.slim

SLIDEINTERPRET 6.020

647	-2281
554	-2264
462	-2257
370	-2252
277	-2246
185	-2237
92	-2227
0	-2215
0	-6000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 96PC Site 24		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/25/2013		File Name: RR0705_96_24_1g.slim

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_96_24_1g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 96PC Site 24
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/25/2013
Comments:

http://earthjay.com
http://activetectonics.oregonstate.edu

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364793948
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 100
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	Basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.55
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	Automatically Calculated
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
Basement	Cohesion	Normal	5.55	0.55	10.55	2.6
Basement	Phi	Normal	27.1	14.8	39.4	4.1
Basement	Unit Weight	Normal	7.35	5.85	8.85	0.5

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Correlation Coefficients

Material	Correlation
Basement	-0.5

Global Minimums

Method: spencer

FS: 0.002201
Center: 4053.258, 3168.116
Radius: 6431.490

Left Slip Surface Endpoint: 632.810, -2278.406
Right Slip Surface Endpoint: 2118.573, -2965.485
Left Slope Intercept: 632.810 -0.000
Right Slope Intercept: 2118.573 -0.000
Resisting Moment=2.14795e+007 kN-m
Driving Moment=9.7568e+009 kN-m
Resisting Horizontal Force=3324 kN
Driving Horizontal Force=1.50989e+006 kN
Total Slice Area=3.95261e+006 m2

Method: gle/morgenstern-price

FS: 0.002091
Center: 4022.382, 2990.085
Radius: 6250.448
Left Slip Surface Endpoint: 682.958, -2293.507
Right Slip Surface Endpoint: 2098.146, -2956.798
Left Slope Intercept: 682.958 -0.000
Right Slope Intercept: 2098.146 -0.000
Resisting Moment=1.63645e+007 kN-m
Driving Moment=7.82618e+009 kN-m
Resisting Horizontal Force=2602.51 kN
Driving Horizontal Force=1.24463e+006 kN
Total Slice Area=3.76614e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 7298
Number of Invalid Surfaces: 15

Error Codes:

Error Code -108 reported for 9 surfaces
Error Code -111 reported for 1 surface
Error Code -112 reported for 5 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 7306
Number of Invalid Surfaces: 7

Error Codes:

Error Code -108 reported for 5 surfaces
Error Code -112 reported for 2 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.00220149

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	59.4305	1.40936e+006	Basement	5.55	27.1	186.001	0.40948	23809	23819.1	-10.1034
2	59.4305	1.43693e+006	Basement	5.55	27.1	461.328	1.01561	24437.1	24445.9	-8.82992
3	59.4305	1.46149e+006	Basement	5.55	27.1	624.359	1.37452	24937.7	24946	-8.2649
4	59.4305	1.48425e+006	Basement	5.55	27.1	721.793	1.58902	25368.5	25376.3	-7.83527
5	59.4305	1.50614e+006	Basement	5.55	27.1	804.065	1.77014	25773.4	25780.8	-7.44687
6	59.4305	1.52763e+006	Basement	5.55	27.1	894.749	1.96978	26175.1	26182	-6.9416
7	59.4305	1.54873e+006	Basement	5.55	27.1	996.425	2.19362	26573.5	26580	-6.5033
8	59.4305	1.5695e+006	Basement	5.55	27.1	1112.38	2.4489	26971.1	26977.2	-6.07832
9	59.4305	1.58963e+006	Basement	5.55	27.1	1224.79	2.69637	27353.2	27358.8	-5.60535
10	59.4305	1.60898e+006	Basement	5.55	27.1	1325.11	2.91722	27713	27718.2	-5.23779
11	59.4305	1.62738e+006	Basement	5.55	27.1	1398.82	3.07948	28041.6	28046.4	-4.8186
12	59.4305	1.64512e+006	Basement	5.55	27.1	1462.42	3.2195	28352.7	28357.4	-4.65325
13	59.4305	1.66213e+006	Basement	5.55	27.1	1511.35	3.32723	28643.3	28647.6	-4.29138
14	59.4305	1.67829e+006	Basement	5.55	27.1	1534.46	3.37809	28906.8	28911	-4.15271
15	59.4305	1.69369e+006	Basement	5.55	27.1	1535.63	3.38067	29147.5	29151.7	-4.20178
16	59.4305	1.70822e+006	Basement	5.55	27.1	1505.68	3.31473	29359.6	29364	-4.43154
17	59.4305	1.72171e+006	Basement	5.55	27.1	1427.33	3.14226	29535.7	29540.5	-4.76889
18	59.4305	1.73478e+006	Basement	5.55	27.1	1342.87	2.95632	29704.7	29709.8	-5.12833
19	59.4305	1.74737e+006	Basement	5.55	27.1	1248.04	2.74754	29863.4	29868.9	-5.51817
20	59.4305	1.75942e+006	Basement	5.55	27.1	1139.32	2.5082	30009.6	30015.6	-6.00281
21	59.4305	1.77051e+006	Basement	5.55	27.1	977.974	2.153	30122.2	30128.9	-6.68858
22	59.4305	1.78103e+006	Basement	5.55	27.1	789.038	1.73706	30220	30227.4	-7.43521
23	59.4305	1.79116e+006	Basement	5.55	27.1	589.315	1.29737	30311.2	30319.5	-8.29027
24	59.4305	1.80093e+006	Basement	5.55	27.1	380.415	0.83748	30397.9	30407.1	-9.23266

25	59.4305	1.81048e+006	Basement	5.55	27.1	212.261	0.46729	30485.7	30495.7	-9.9711

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.002091

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	56.6075	1.35004e+006	Basement	5.55	27.1	243.831	0.50985	23919.9	23929.8	-9.92472
2	56.6075	1.3738e+006	Basement	5.55	27.1	504.228	1.05434	24451.1	24459.8	-8.69743
3	56.6075	1.39543e+006	Basement	5.55	27.1	669.393	1.3997	24890.3	24898.5	-8.15396
4	56.6075	1.41627e+006	Basement	5.55	27.1	805.557	1.68442	25304.8	25312.3	-7.49366
5	56.6075	1.43653e+006	Basement	5.55	27.1	963.52	2.01472	25705.8	25712.7	-6.88722
6	56.6075	1.45652e+006	Basement	5.55	27.1	1124.56	2.35145	26107.8	26114	-6.2263
7	56.6075	1.47617e+006	Basement	5.55	27.1	1311.61	2.74258	26507.9	26513.3	-5.42142
8	56.6075	1.49535e+006	Basement	5.55	27.1	1453.82	3.03994	26897.6	26902.5	-4.87224
9	56.6075	1.51392e+006	Basement	5.55	27.1	1562.74	3.26769	27271	27275.5	-4.48727
10	56.6075	1.53166e+006	Basement	5.55	27.1	1584.29	3.31275	27616.5	27621	-4.45732
11	56.6075	1.54865e+006	Basement	5.55	27.1	1608.58	3.36354	27937.9	27942.2	-4.29228
12	56.6075	1.56508e+006	Basement	5.55	27.1	1605.03	3.35612	28244.2	28248.5	-4.33931
13	56.6075	1.58078e+006	Basement	5.55	27.1	1520.96	3.18032	28527.1	28531.8	-4.71714
14	56.6075	1.59576e+006	Basement	5.55	27.1	1427.89	2.98572	28786.5	28791.5	-4.97308
15	56.6075	1.61005e+006	Basement	5.55	27.1	1304.44	2.72758	29024.3	29029.9	-5.59704
16	56.6075	1.62351e+006	Basement	5.55	27.1	1068.88	2.23502	29232.7	29239.2	-6.50882
17	56.6075	1.6361e+006	Basement	5.55	27.1	900.497	1.88294	29410.1	29417.3	-7.24454
18	56.6075	1.64833e+006	Basement	5.55	27.1	767.131	1.60407	29581.8	29589.5	-7.73249
19	56.6075	1.66011e+006	Basement	5.55	27.1	633.673	1.32501	29743.2	29751.5	-8.28581
20	56.6075	1.67143e+006	Basement	5.55	27.1	471.87	0.98668	29893.7	29902.6	-8.92758
21	56.6075	1.6819e+006	Basement	5.55	27.1	270.803	0.56625	30013.2	30022.9	-9.69355
22	56.6075	1.69179e+006	Basement	5.55	27.1	148.097	0.30967	30115.7	30125.9	-10.2345
23	56.6075	1.70133e+006	Basement	5.55	27.1	35.5428	0.07432	30212.8	30223.5	-10.7257
24	56.6075	1.71055e+006	Basement	5.55	27.1	0	0	30296	30315.9	-19.8864
25	56.6075	1.71946e+006	Basement	5.55	27.1	0	0	30371.5	30404.4	-32.8775

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.00220149

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	632.81	-2278.41	2.67343e+007	0	0
2	692.24	-2315.28	449681	278.497	0.0354845

3	751.671	-2351.27	799988	495.449	0.0354844
4	811.102	-2386.39	966081	598.314	0.0354845
5	870.532	-2420.65	1.1124e+006	688.934	0.0354845
6	929.963	-2454.08	1.24441e+006	770.689	0.0354845
7	989.393	-2486.69	1.40481e+006	870.027	0.0354844
8	1048.82	-2518.49	1.57624e+006	976.197	0.0354844
9	1108.25	-2549.49	1.74991e+006	1083.76	0.0354846
10	1167.68	-2579.71	1.91373e+006	1185.21	0.0354844
11	1227.12	-2609.17	2.04239e+006	1264.9	0.0354846
12	1286.55	-2637.86	2.14456e+006	1328.17	0.0354844
13	1345.98	-2665.81	2.23251e+006	1382.64	0.0354845
14	1405.41	-2693.02	2.28543e+006	1415.41	0.0354844
15	1464.84	-2719.51	2.30808e+006	1429.44	0.0354844
16	1524.27	-2745.28	2.29997e+006	1424.42	0.0354845
17	1583.7	-2770.35	2.22904e+006	1380.49	0.0354844
18	1643.13	-2794.71	2.12941e+006	1318.79	0.0354845
19	1702.56	-2818.39	2.02291e+006	1252.83	0.0354845
20	1761.99	-2841.39	1.90613e+006	1180.51	0.0354846
21	1821.42	-2863.71	1.75086e+006	1084.34	0.0354843
22	1880.85	-2885.37	1.54308e+006	955.663	0.0354845
23	1940.28	-2906.37	1.33488e+006	826.719	0.0354845
24	1999.71	-2926.72	1.11585e+006	691.07	0.0354845
25	2059.14	-2946.42	888462	550.243	0.0354845
26	2118.57	-2965.49	4.52896e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.002091

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	682.958	-2293.51	2.70899e+007	0	0
2	739.566	-2328.86	376491	-1345.43	-0.204752
3	796.173	-2363.39	536930	-3807.3	-0.40627
4	852.781	-2397.1	681182	-7149.89	-0.601372
5	909.388	-2430	805857	-11069.4	-0.786976
6	965.996	-2462.13	949333	-15910.3	-0.960156
7	1022.6	-2493.47	1.09751e+006	-21421.7	-1.11818
8	1079.21	-2524.06	1.26398e+006	-27769	-1.25856
9	1135.82	-2553.91	1.42079e+006	-34204.5	-1.37909
10	1192.43	-2583.02	1.56325e+006	-40330.7	-1.47786
11	1249.03	-2611.4	1.66909e+006	-45261.4	-1.55333
12	1305.64	-2639.07	1.76272e+006	-49369.9	-1.60431

13	1362.25	-2666.04	1.84304e+006	-52446.6	-1.63
14	1418.86	-2692.32	1.89e+006	-53783	-1.63
15	1475.46	-2717.92	1.9155e+006	-53649	-1.60431
16	1532.07	-2742.84	1.91802e+006	-52011.7	-1.55333
17	1588.68	-2767.1	1.86178e+006	-48032.4	-1.47786
18	1645.29	-2790.7	1.78924e+006	-43074.5	-1.37908
19	1701.89	-2813.66	1.71142e+006	-37599.1	-1.25856
20	1758.5	-2835.97	1.62579e+006	-31732.8	-1.11818
21	1815.11	-2857.65	1.51021e+006	-25310.3	-0.960156
22	1871.72	-2878.71	1.3437e+006	-18457.3	-0.786975
23	1928.32	-2899.14	1.17122e+006	-12293.4	-0.601368
24	1984.93	-2918.97	984574	-6981.48	-0.40627
25	2041.54	-2938.18	792810	-2833.2	-0.204752
26	2098.15	-2956.8	4.50247e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.029092
Factor of Safety, standard deviation: 0.065245
Factor of Safety, minimum: 0.000135
Factor of Safety, maximum: 0.732967
Probability of Failure: 100.000% (= 9408 failed surfaces / 9408 valid surfaces), 592 invalid surfaces
Reliability index: -14.88095 (assuming normal distribution)
Reliability index: -3.30916 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 0.027530
Factor of Safety, standard deviation: 0.064493
Factor of Safety, minimum: 0.000146
Factor of Safety, maximum: 0.732838
Probability of Failure: 100.000% (= 9966 failed surfaces / 9966 valid surfaces), 34 invalid surfaces
Reliability index: -15.07857 (assuming normal distribution)
Reliability index: -3.31084 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y

0	0
0	-6000
4978	-6000
4978	0
0	0

External Boundary

X	Y
4978	-6000
4978	-3292
4885	-3290
4792	-3289
4700	-3288
4607	-3286
4514	-3284
4421	-3281
4328	-3278
4235	-3275
4143	-3271
4050	-3266
3956	-3262
3863	-3259
3770	-3255
3677	-3253
3584	-3250
3491	-3247
3398	-3245
3305	-3242
3212	-3239
3119	-3237
3025	-3232
2932	-3225
2839	-3212
2753	-3192
2667	-3166
2581	-3135
2494	-3104
2408	-3072
2322	-3043
2236	-3012

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 96PC Site 24		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/25/2013		File Name: RR0705_96_24_1g.slim

2148	-2978
2061	-2941
1974	-2901
1886	-2859
1799	-2816
1712	-2775
1625	-2733
1537	-2689
1450	-2648
1362	-2607
1274	-2567
1187	-2527
1099	-2488
1012	-2449
924	-2407
832	-2360
739	-2313
647	-2281
554	-2264
462	-2257
370	-2252
277	-2246
185	-2237
92	-2227
0	-2215
0	-6000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 103PC Site 10		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_103_10_0g.slim

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_103_10_0g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 103PC Site 10
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/31/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364794942
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 103PC Site 10		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 3/31/2013		File Name: RR0705_103_10_0g.slim

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Global Minimums

Method: spencer

FS: 1.671460
Center: 1724.476, -738.336
Radius: 2302.274
Left Slip Surface Endpoint: 491.653, -2682.716
Right Slip Surface Endpoint: 1581.328, -3036.156
Left Slope Intercept: 491.653 -0.000
Right Slope Intercept: 1581.328 -0.000
Resisting Moment=3.70061e+008 kN-m
Driving Moment=2.214e+008 kN-m
Resisting Horizontal Force=152300 kN
Driving Horizontal Force=91118 kN
Total Slice Area=3.17123e+006 m2

Method: gle/morgenstern-price

FS: 1.672250
Center: 1724.476, -738.336
Radius: 2302.274
Left Slip Surface Endpoint: 491.653, -2682.716
Right Slip Surface Endpoint: 1581.328, -3036.156
Left Slope Intercept: 491.653 -0.000
Right Slope Intercept: 1581.328 -0.000
Resisting Moment=3.70235e+008 kN-m
Driving Moment=2.214e+008 kN-m
Resisting Horizontal Force=152313 kN

Driving Horizontal Force=91082.7 kN
Total Slice Area=3.17123e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2430
Number of Invalid Surfaces: 166

Error Codes:

Error Code -108 reported for 166 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2596
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.67146

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	43.587	1.21234e+006	basement	5.551	27.1	10.0769	16.8431	27792.8	27770.8	22.0202
2	43.587	1.22739e+006	basement	5.551	27.1	30.3346	50.7031	28130	28041.7	88.2753
3	43.587	1.24125e+006	basement	5.551	27.1	46.6912	78.0424	28441.1	28299.4	141.703
4	43.587	1.25411e+006	basement	5.551	27.1	60.7812	101.593	28732	28544.2	187.772
5	43.587	1.266e+006	basement	5.551	27.1	72.2141	120.703	29001.8	28776.7	225.086
6	43.587	1.27731e+006	basement	5.551	27.1	82.9556	138.657	29257.3	28997.3	259.988
7	43.587	1.28802e+006	basement	5.551	27.1	93.7109	156.634	29501.5	29206.2	295.252
8	43.587	1.29802e+006	basement	5.551	27.1	103.097	172.323	29729.9	29403.9	325.994
9	43.587	1.30732e+006	basement	5.551	27.1	111.323	186.072	29943.5	29590.7	352.83
10	43.587	1.31586e+006	basement	5.551	27.1	117.893	197.053	30141.1	29766.8	374.304
11	43.587	1.32367e+006	basement	5.551	27.1	122.599	204.92	30322.1	29932.5	389.635

12	43.587	1.33076e+006	basement	5.551	27.1	125.743	210.175	30487.8	30088	399.828
13	43.587	1.33717e+006	basement	5.551	27.1	127.219	212.641	30638.3	30233.5	404.793
14	43.587	1.34279e+006	basement	5.551	27.1	126.69	211.757	30772.3	30369.3	402.988
15	43.587	1.34757e+006	basement	5.551	27.1	123.138	205.821	30886.7	30495.4	391.343
16	43.587	1.3517e+006	basement	5.551	27.1	117.969	197.181	30986.5	30612.1	374.416
17	43.587	1.35517e+006	basement	5.551	27.1	111.072	185.652	31071.4	30719.5	351.903
18	43.587	1.35809e+006	basement	5.551	27.1	102.851	171.911	31142.7	30817.6	325.149
19	43.587	1.3605e+006	basement	5.551	27.1	93.9143	156.974	31202.8	30906.8	296.001
20	43.587	1.36238e+006	basement	5.551	27.1	83.7202	139.935	31249.5	30987	262.52
21	43.587	1.36379e+006	basement	5.551	27.1	73.0338	122.073	31286	31058.3	227.739
22	43.587	1.36458e+006	basement	5.551	27.1	60.7988	101.623	31308.5	31120.8	187.655
23	43.587	1.36474e+006	basement	5.551	27.1	46.5844	77.8639	31316	31174.6	141.401
24	43.587	1.36438e+006	basement	5.551	27.1	30.9839	51.7883	31310.2	31219.7	90.4786
25	43.587	1.3636e+006	basement	5.551	27.1	15.0903	25.2229	31294.8	31256.3	38.4766

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.67225

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	43.587	1.21234e+006	basement	5.551	27.1	13.3299	22.291	27803.6	27770.8	32.7516
2	43.587	1.22739e+006	basement	5.551	27.1	31.6755	52.9693	28134.3	28041.7	92.6255
3	43.587	1.24125e+006	basement	5.551	27.1	46.9305	78.4795	28441.9	28299.4	142.504
4	43.587	1.25411e+006	basement	5.551	27.1	60.0293	100.384	28729.5	28544.2	185.341
5	43.587	1.266e+006	basement	5.551	27.1	70.8722	118.516	28997.5	28776.7	220.784
6	43.587	1.27731e+006	basement	5.551	27.1	81.263	135.892	29251.9	28997.3	254.606
7	43.587	1.28802e+006	basement	5.551	27.1	91.7375	153.408	29495.2	29206.2	288.982
8	43.587	1.29802e+006	basement	5.551	27.1	101.043	168.969	29723.4	29403.9	319.456
9	43.587	1.30732e+006	basement	5.551	27.1	109.377	182.906	29937.4	29590.7	346.661
10	43.587	1.31586e+006	basement	5.551	27.1	116.255	194.407	30136	29766.8	369.158
11	43.587	1.32367e+006	basement	5.551	27.1	121.394	203.001	30318.2	29932.5	385.746
12	43.587	1.33076e+006	basement	5.551	27.1	125.083	209.17	30485.9	30088	397.87
13	43.587	1.33717e+006	basement	5.551	27.1	127.148	212.623	30638.1	30233.5	404.574
14	43.587	1.34279e+006	basement	5.551	27.1	127.332	212.931	30774.5	30369.3	405.191
15	43.587	1.34757e+006	basement	5.551	27.1	124.327	207.905	30890.7	30495.4	395.329
16	43.587	1.3517e+006	basement	5.551	27.1	119.599	200	30992.1	30612.1	379.981
17	43.587	1.35517e+006	basement	5.551	27.1	112.982	188.934	31077.9	30719.5	358.389
18	43.587	1.35809e+006	basement	5.551	27.1	104.849	175.333	31149.5	30817.6	331.887
19	43.587	1.3605e+006	basement	5.551	27.1	95.8344	160.259	31209.1	30906.8	302.314
20	43.587	1.36238e+006	basement	5.551	27.1	85.3844	142.784	31255.2	30987	268.176
21	43.587	1.36379e+006	basement	5.551	27.1	74.2329	124.136	31289.9	31058.3	231.596
22	43.587	1.36458e+006	basement	5.551	27.1	61.246	102.419	31310	31120.8	189.248

23	43.587	1.36474e+006	basement	5.551	27.1	46.0408	76.9917	31314.2	31174.6	139.577
24	43.587	1.36438e+006	basement	5.551	27.1	29.4286	49.212	31305.2	31219.7	85.4519
25	43.587	1.3636e+006	basement	5.551	27.1	12.2765	20.5293	31285.6	31256.3	29.3232

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.67146

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	491.653	-2682.72	3.70644e+007	0	0
2	535.24	-2709.68	425835	663.301	0.0892466
3	578.827	-2735.32	750738	1169.39	0.0892469
4	622.414	-2759.7	1.04307e+006	1624.73	0.0892463
5	666.001	-2782.86	1.27405e+006	1984.52	0.0892465
6	709.588	-2804.85	1.47587e+006	2298.88	0.0892464
7	753.175	-2825.69	1.69214e+006	2635.75	0.0892463
8	796.762	-2845.42	1.87841e+006	2925.91	0.0892468
9	840.349	-2864.08	2.04456e+006	3184.71	0.0892467
10	883.936	-2881.69	2.18115e+006	3397.47	0.0892467
11	927.523	-2898.27	2.27864e+006	3549.32	0.0892466
12	971.11	-2913.86	2.34644e+006	3654.93	0.0892466
13	1014.7	-2928.47	2.38066e+006	3708.23	0.0892466
14	1058.28	-2942.12	2.38536e+006	3715.55	0.0892466
15	1101.87	-2954.83	2.32536e+006	3622.1	0.0892468
16	1145.46	-2966.61	2.23274e+006	3477.82	0.0892465
17	1189.04	-2977.48	2.10642e+006	3281.06	0.0892466
18	1232.63	-2987.46	1.95037e+006	3037.99	0.0892466
19	1276.22	-2996.55	1.78251e+006	2776.53	0.0892468
20	1319.81	-3004.77	1.58899e+006	2475.09	0.0892467
21	1363.39	-3012.12	1.38749e+006	2161.22	0.0892465
22	1406.98	-3018.61	1.16265e+006	1810.99	0.0892461
23	1450.57	-3024.26	901737	1404.59	0.0892467
24	1494.15	-3029.06	610888	951.548	0.0892465
25	1537.74	-3033.02	315293	491.115	0.0892465
26	1581.33	-3036.16	4.74739e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.67225

Slice	X coordinate	Y coordinate - Bottom	Interslice Normal Force	Interslice Shear Force	Interslice Force Angle

	[m]	[m]	[kN]	[kN]	[degrees]
1	491.653	-2682.72	3.70644e+007	0	0
2	535.24	-2709.68	425980	111.56	0.0150052
3	578.827	-2735.32	750938	390.227	0.0297739
4	622.414	-2759.7	1.04328e+006	802.507	0.0440728
5	666.001	-2782.86	1.27424e+006	1282.71	0.0576766
6	709.588	-2804.85	1.47602e+006	1812.86	0.0703711
7	753.175	-2825.69	1.69225e+006	2420.6	0.081956
8	796.762	-2845.42	1.87849e+006	3024.43	0.092248
9	840.349	-2864.08	2.04461e+006	3607.25	0.101085
10	883.936	-2881.69	2.18117e+006	4123.92	0.108329
11	927.523	-2898.27	2.27865e+006	4528.33	0.113863
12	971.11	-2913.86	2.34644e+006	4816.18	0.117602
13	1014.7	-2928.47	2.38066e+006	4964.72	0.119487
14	1058.28	-2942.12	2.38536e+006	4974.51	0.119486
15	1101.87	-2954.83	2.32537e+006	4772.93	0.117602
16	1145.46	-2966.61	2.23274e+006	4437.09	0.113863
17	1189.04	-2977.48	2.10641e+006	3982.56	0.108328
18	1232.63	-2987.46	1.95034e+006	3440.93	0.101085
19	1276.22	-2996.55	1.78246e+006	2869.81	0.0922477
20	1319.81	-3004.77	1.5889e+006	2272.77	0.0819561
21	1363.39	-3012.12	1.38737e+006	1703.98	0.0703711
22	1406.98	-3018.61	1.1625e+006	1170.23	0.0576767
23	1450.57	-3024.26	901580	693.512	0.044073
24	1494.15	-3029.06	610747	317.376	0.0297739
25	1537.74	-3033.02	315199	82.5478	0.0150053
26	1581.33	-3036.16	4.74739e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.683719
Factor of Safety, standard deviation: 0.283454
Factor of Safety, minimum: 0.858121
Factor of Safety, maximum: 2.659220
Probability of Failure: 0.430% (= 43 failed surfaces / 10000 valid surfaces)
Reliability index: 2.41209 (assuming normal distribution)
Reliability index: 3.03293 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price

Factor of Safety, mean: 1.683745
Factor of Safety, standard deviation: 0.283459
Factor of Safety, minimum: 0.858136
Factor of Safety, maximum: 2.659260
Probability of Failure: 0.430% (= 43 failed surfaces / 10000 valid surfaces)
Reliability index: 2.41215 (assuming normal distribution)
Reliability index: 3.03302 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
3367	-6000
3367	0
0	0

External Boundary

X	Y
3367	-6000
3367	-3075
3274	-3077
3182	-3078
3090	-3079
2997	-3082
2905	-3084
2813	-3085
2726	-3085
2639	-3085
2552	-3086
2465	-3086
2378	-3086
2291	-3085
2204	-3085
2117	-3086
2030	-3086
1943	-3084

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 103PC Site 10		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 3/31/2013		File Name: RR0705_103_10_0g.slim

1856	-3081
1769	-3075
1682	-3061
1594	-3040
1505	-3013
1416	-2984
1328	-2956
1239	-2926
1151	-2895
1062	-2864
974	-2836
885	-2808
797	-2781
708	-2753
620	-2722
531	-2693
443	-2670
354	-2649
266	-2631
177	-2613
89	-2599
0	-2587
0	-6000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 103PC Site 10		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_103_10_1g.slim

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_103_10_1g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 103PC Site 10
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/31/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364795046
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.010215
Center: 2454.187, 1620.762
Radius: 4739.182
Left Slip Surface Endpoint: 440.833, -2669.489
Right Slip Surface Endpoint: 1591.485, -3039.237
Left Slope Intercept: 440.833 -0.000
Right Slope Intercept: 1591.485 -0.000
Resisting Moment=3.53321e+007 kN-m
Driving Moment=3.45881e+009 kN-m
Resisting Horizontal Force=7258.83 kN

Driving Horizontal Force=710598 kN
Total Slice Area=3.31552e+006 m2

Method: gle/morgenstern-price

FS: 0.010116
Center: 2456.457, 1659.983
Radius: 4776.434
Left Slip Surface Endpoint: 437.190, -2668.629
Right Slip Surface Endpoint: 1576.531, -3034.700
Left Slope Intercept: 437.190 -0.000
Right Slope Intercept: 1576.531 -0.000
Resisting Moment=3.44093e+007 kN-m
Driving Moment=3.40139e+009 kN-m
Resisting Horizontal Force=7013.3 kN
Driving Horizontal Force=693270 kN
Total Slice Area=3.27901e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 785
Number of Invalid Surfaces: 19

Error Codes:

Error Code -108 reported for 13 surfaces
Error Code -112 reported for 6 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 797
Number of Invalid Surfaces: 7

Error Codes:

Error Code -108 reported for 3 surfaces
Error Code -112 reported for 4 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This

screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.0102151

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	46.0261	1.27178e+006	basement	5.551	27.1	170.192	1.73853	27672.5	27680	-7.4665
2	46.0261	1.28405e+006	basement	5.551	27.1	299.771	3.06219	28034.1	28039	-4.86084
3	46.0261	1.29547e+006	basement	5.551	27.1	380.032	3.88206	28353.7	28357	-3.32071
4	46.0261	1.30612e+006	basement	5.551	27.1	458.749	4.68617	28636.4	28638.1	-1.73833
5	46.0261	1.31616e+006	basement	5.551	27.1	512.175	5.23192	28891.9	28892.6	-0.653205
6	46.0261	1.32567e+006	basement	5.551	27.1	565.54	5.77704	29125.6	29125.1	0.454593
7	46.0261	1.33506e+006	basement	5.551	27.1	642.12	6.55932	29363.1	29361	2.07323
8	46.0261	1.3442e+006	basement	5.551	27.1	710.006	7.25278	29595	29591.7	3.32812
9	46.0261	1.353e+006	basement	5.551	27.1	778.27	7.95011	29816.7	29812	4.69092
10	46.0261	1.36143e+006	basement	5.551	27.1	837.636	8.55654	30025.3	30019.4	5.91344
11	46.0261	1.3694e+006	basement	5.551	27.1	884.181	9.032	30215.4	30208.6	6.84036
12	46.0261	1.37697e+006	basement	5.551	27.1	923.31	9.4317	30390.2	30382.7	7.51498
13	46.0261	1.38412e+006	basement	5.551	27.1	951.387	9.71851	30549.3	30541.1	8.2146
14	46.0261	1.39083e+006	basement	5.551	27.1	958.248	9.7886	30691	30682.7	8.2673
15	46.0261	1.39691e+006	basement	5.551	27.1	932.059	9.52108	30802.1	30794.4	7.7387
16	46.0261	1.40256e+006	basement	5.551	27.1	896.107	9.15382	30896.6	30889.6	7.00312
17	46.0261	1.40781e+006	basement	5.551	27.1	843	8.61133	30975.5	30969.5	6.02887
18	46.0261	1.41273e+006	basement	5.551	27.1	785.261	8.02152	31043.3	31038.5	4.75663
19	46.0261	1.41742e+006	basement	5.551	27.1	719.786	7.35269	31106.1	31102.5	3.57508
20	46.0261	1.42182e+006	basement	5.551	27.1	649.868	6.63847	31160.2	31158	2.20351
21	46.0261	1.42602e+006	basement	5.551	27.1	570.688	5.82963	31210.9	31210.4	0.526145
22	46.0261	1.42984e+006	basement	5.551	27.1	459.449	4.69332	31247.2	31248.9	-1.65761
23	46.0261	1.43326e+006	basement	5.551	27.1	322.014	3.28941	31266.6	31271	-4.44073
24	46.0261	1.43642e+006	basement	5.551	27.1	189.185	1.93254	31279.9	31287	-7.0977
25	46.0261	1.4394e+006	basement	5.551	27.1	0	0	31280.2	31300.4	-20.1525

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.0101163

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	45.5737	1.25879e+006	basement	5.551	27.1	111.826	1.13127	27660.4	27669.1	-8.71569
2	45.5737	1.27074e+006	basement	5.551	27.1	277.308	2.80533	28016.3	28021.7	-5.36232

3	45.5737	1.28194e+006	basement	5.551	27.1	403.033	4.0772	28335.5	28338.4	-2.89861
4	45.5737	1.29231e+006	basement	5.551	27.1	501.26	5.0709	28613.5	28614.5	-0.973013
5	45.5737	1.30213e+006	basement	5.551	27.1	569.724	5.7635	28866.9	28866.5	0.432896
6	45.5737	1.3114e+006	basement	5.551	27.1	626.257	6.3354	29096	29094.4	1.64051
7	45.5737	1.32051e+006	basement	5.551	27.1	709.856	7.18112	29326.4	29323.2	3.16835
8	45.5737	1.32943e+006	basement	5.551	27.1	778.676	7.87732	29554.7	29550.2	4.4779
9	45.5737	1.33802e+006	basement	5.551	27.1	844.977	8.54804	29772.3	29766.5	5.81533
10	45.5737	1.34627e+006	basement	5.551	27.1	896.065	9.06486	29978.2	29971.4	6.75716
11	45.5737	1.35408e+006	basement	5.551	27.1	925.852	9.3662	30166.5	30159	7.50049
12	45.5737	1.36149e+006	basement	5.551	27.1	946.055	9.57058	30339.1	30331.2	7.87395
13	45.5737	1.36851e+006	basement	5.551	27.1	950.283	9.61335	30496.4	30488.4	7.98489
14	45.5737	1.37513e+006	basement	5.551	27.1	934.582	9.45451	30638.3	30630.6	7.72669
15	45.5737	1.38114e+006	basement	5.551	27.1	873.844	8.84007	30750.9	30744.5	6.41565
16	45.5737	1.38671e+006	basement	5.551	27.1	817.141	8.26644	30844.9	30839.7	5.20866
17	45.5737	1.39188e+006	basement	5.551	27.1	746.778	7.55463	30924	30920	4.00736
18	45.5737	1.39671e+006	basement	5.551	27.1	676.909	6.84781	30990.5	30987.9	2.57766
19	45.5737	1.40133e+006	basement	5.551	27.1	612.255	6.19375	31052.6	31051.4	1.17006
20	45.5737	1.40565e+006	basement	5.551	27.1	541.813	5.48115	31105.6	31105.7	-0.0837207
21	45.5737	1.40979e+006	basement	5.551	27.1	478.131	4.83691	31156.4	31157.8	-1.35734
22	45.5737	1.41361e+006	basement	5.551	27.1	395.742	4.00344	31195.9	31198.8	-2.92353
23	45.5737	1.41702e+006	basement	5.551	27.1	298.01	3.01476	31218.5	31223.5	-4.97214
24	45.5737	1.42013e+006	basement	5.551	27.1	197.392	1.99688	31231	31237.9	-6.8896
25	45.5737	1.4231e+006	basement	5.551	27.1	98.2464	0.99389	31243.4	31252.4	-8.95668

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.0102151

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	440.833	-2669.49	3.66998e+007	0	0
2	486.859	-2690.79	256433	-1406.82	-0.314328
3	532.885	-2711.49	499221	-2738.78	-0.314328
4	578.911	-2731.62	653083	-3582.88	-0.314327
5	624.937	-2751.16	790689	-4337.8	-0.314327
6	670.963	-2770.13	884404	-4851.93	-0.314327
7	716.989	-2788.55	972908	-5337.47	-0.314327
8	763.015	-2806.4	1.08608e+006	-5958.34	-0.314327
9	809.042	-2823.71	1.18741e+006	-6514.26	-0.314328
10	855.068	-2840.48	1.2814e+006	-7029.91	-0.314328

11	901.094	-2856.71	1.3566e+006	-7442.44	-0.314327
12	947.12	-2872.41	1.40937e+006	-7731.95	-0.314327
13	993.146	-2887.59	1.444e+006	-7921.91	-0.314326
14	1039.17	-2902.24	1.45932e+006	-8006	-0.314328
15	1085.2	-2916.39	1.4375e+006	-7886.25	-0.314326
16	1131.22	-2930.02	1.37821e+006	-7560.99	-0.314327
17	1177.25	-2943.15	1.29825e+006	-7122.33	-0.314327
18	1223.28	-2955.78	1.19836e+006	-6574.35	-0.314329
19	1269.3	-2967.91	1.09463e+006	-6005.25	-0.314327
20	1315.33	-2979.55	980833	-5380.95	-0.314327
21	1361.35	-2990.7	869011	-4767.48	-0.314327
22	1407.38	-3001.36	747916	-4103.14	-0.314327
23	1453.41	-3011.55	602126	-3303.32	-0.314327
24	1499.43	-3021.25	438720	-2406.86	-0.314327
25	1545.46	-3030.48	287843	-1579.14	-0.314328
26	1591.48	-3039.24	4.75704e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.0101163

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	437.19	-2668.63	3.66761e+007	0	0
2	482.763	-2689.6	255203	-316.587	-0.0710771
3	528.337	-2709.99	496460	-1222.03	-0.141033
4	573.911	-2729.82	649919	-2368.07	-0.208764
5	619.484	-2749.08	785603	-3746.01	-0.273203
6	665.058	-2767.79	874403	-5087.11	-0.333332
7	710.632	-2785.96	951021	-6443.68	-0.388204
8	756.205	-2803.59	1.05846e+006	-8072.24	-0.436952
9	801.779	-2820.68	1.15277e+006	-9633.7	-0.47881
10	847.352	-2837.25	1.24167e+006	-11120.2	-0.513118
11	892.926	-2853.3	1.31435e+006	-12372.6	-0.539336
12	938.5	-2868.83	1.36399e+006	-13261.4	-0.557041
13	984.073	-2883.85	1.39758e+006	-13805.7	-0.565966
14	1029.65	-2898.36	1.41235e+006	-13951.6	-0.565966
15	1075.22	-2912.38	1.40028e+006	-13614.3	-0.557044
16	1120.79	-2925.9	1.34428e+006	-12654.2	-0.53933
17	1166.37	-2938.93	1.27018e+006	-11375.5	-0.513117
18	1211.94	-2951.47	1.1761e+006	-9828.67	-0.47881
19	1257.52	-2963.53	1.07362e+006	-8187.89	-0.436954
20	1303.09	-2975.11	966663	-6549.67	-0.388204

21	1348.66	-2986.21	854754	-4972.8	-0.333332
22	1394.24	-2996.84	740445	-3530.68	-0.273203
23	1439.81	-3007	604167	-2201.37	-0.208765
24	1485.38	-3016.7	446259	-1098.46	-0.141032
25	1530.96	-3025.93	289821	-359.532	-0.0710772
26	1576.53	-3034.7	4.74284e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.073110
Factor of Safety, standard deviation: 0.095920
Factor of Safety, minimum: 0.000917
Factor of Safety, maximum: 2.123350
Probability of Failure: 99.960% (= 9996 failed surfaces / 10000 valid surfaces)
Reliability index: -9.66319 (assuming normal distribution)
Reliability index: -3.11461 (assuming lognormal distribution)
* best fit = Beta

Method: gle/morgenstern-price
Factor of Safety, mean: 0.074952
Factor of Safety, standard deviation: 0.096923
Factor of Safety, minimum: 0.000837
Factor of Safety, maximum: 2.125650
Probability of Failure: 99.960% (= 9996 failed surfaces / 10000 valid surfaces)
Reliability index: -9.54418 (assuming normal distribution)
Reliability index: -3.10906 (assuming lognormal distribution)
* best fit = Beta

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
3367	-6000
3367	0
0	0

External Boundary

	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 103PC Site 10		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
SLIDEINTERPRET 6.020	Date: 3/31/2013		File Name: RR0705_103_10_1g.slim

X	Y
3367	-6000
3367	-3075
3274	-3077
3182	-3078
3090	-3079
2997	-3082
2905	-3084
2813	-3085
2726	-3085
2639	-3085
2552	-3086
2465	-3086
2378	-3086
2291	-3085
2204	-3085
2117	-3086
2030	-3086
1943	-3084
1856	-3081
1769	-3075
1682	-3061
1594	-3040
1505	-3013
1416	-2984
1328	-2956
1239	-2926
1151	-2895
1062	-2864
974	-2836
885	-2808
797	-2781
708	-2753
620	-2722
531	-2693
443	-2670
354	-2649
266	-2631
177	-2613
89	-2599

rocscience	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 103PC Site 10		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
SLIDEINTERPRET 6.020	Date: 3/31/2013		File Name: RR0705_103_10_1g.slim

0	-2587
0	-6000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 103PC Site 11		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_103_11_0g.slim

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_103_11_0g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 103PC Site 11
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/31/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364795259
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 103PC Site 11		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_103_11_0g.slim

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Global Minimums

Method: spencer

FS: 1.103910
Center: 1027.221, -1483.414
Radius: 640.357
Left Slip Surface Endpoint: 563.737, -1925.274
Right Slip Surface Endpoint: 927.383, -2115.940
Left Slope Intercept: 563.737 -0.000
Right Slope Intercept: 927.383 -0.000
Resisting Moment=1.79616e+007 kN-m
Driving Moment=1.62709e+007 kN-m
Resisting Horizontal Force=24853 kN
Driving Horizontal Force=22513.6 kN
Total Slice Area=744072 m2

Method: gle/morgenstern-price

FS: 1.103170
Center: 1004.170, -1602.621
Radius: 517.126
Left Slip Surface Endpoint: 626.678, -1956.060
Right Slip Surface Endpoint: 915.000, -2112.000
Left Slope Intercept: 626.678 -0.000
Right Slope Intercept: 915.000 -0.000
Resisting Moment=9.65936e+006 kN-m
Driving Moment=8.75597e+006 kN-m
Resisting Horizontal Force=16451.2 kN

Driving Horizontal Force=14912.6 kN
Total Slice Area=592302 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2671
Number of Invalid Surfaces: 246

Error Codes:

Error Code -108 reported for 244 surfaces
Error Code -112 reported for 2 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2899
Number of Invalid Surfaces: 18

Error Codes:

Error Code -108 reported for 18 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.10391

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	14.5458	289867	basement	5.551	27.1	5.97018	6.59054	19908.4	19906.4	2.00862
2	14.5458	292598	basement	5.551	27.1	19.5176	21.5457	20085.1	20053.8	31.3005
3	14.5458	295127	basement	5.551	27.1	31.929	35.2467	20250.3	20192.3	58.0042
4	14.5458	297471	basement	5.551	27.1	43.2245	47.716	20404.9	20322.5	82.3651

5	14.5458	299644	basement	5.551	27.1	53.4245	58.9758	20549.4	20445.1	104.349
6	14.5458	301657	basement	5.551	27.1	62.5705	69.0722	20684.7	20560.5	124.151
7	14.5458	303507	basement	5.551	27.1	70.4016	77.717	20810.4	20669.4	140.987
8	14.5458	305212	basement	5.551	27.1	76.9536	84.9499	20927.1	20772	155.097
9	14.5458	306784	basement	5.551	27.1	82.4652	91.0342	21035.7	20868.7	166.978
10	14.5458	308231	basement	5.551	27.1	86.9495	95.9844	21136.4	20959.8	176.644
11	14.5458	309558	basement	5.551	27.1	90.4177	99.813	21229.7	21045.5	184.238
12	14.5458	310770	basement	5.551	27.1	92.8795	102.531	21315.7	21126.2	189.475
13	14.5458	311849	basement	5.551	27.1	94.18	103.966	21394.3	21202	192.265
14	14.5458	312786	basement	5.551	27.1	93.1224	102.799	21463.1	21273	190.093
15	14.5458	313620	basement	5.551	27.1	90.968	100.421	21524.9	21339.6	185.347
16	14.5458	314356	basement	5.551	27.1	87.7907	96.913	21580.3	21401.7	178.599
17	14.5458	314996	basement	5.551	27.1	83.5913	92.2773	21629.1	21459.6	169.534
18	14.5458	315544	basement	5.551	27.1	78.369	86.5123	21671.6	21513.4	158.205
19	14.5458	315993	basement	5.551	27.1	72.08	79.5698	21707.7	21563.1	144.634
20	14.5458	316341	basement	5.551	27.1	64.2486	70.9247	21736.6	21608.9	127.735
21	14.5458	316602	basement	5.551	27.1	55.3265	61.0755	21759.4	21650.8	108.555
22	14.5458	316777	basement	5.551	27.1	45.3459	50.0578	21776	21689	87.0087
23	14.5458	316870	basement	5.551	27.1	34.2957	37.8594	21786.6	21723.5	63.0699
24	14.5458	316881	basement	5.551	27.1	22.163	24.466	21791.2	21754.3	36.9089
25	14.5458	316921	basement	5.551	27.1	9.58463	10.5806	21791.3	21781.5	9.82341

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.10317

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	11.5329	233269	basement	5.551	27.1	8.30963	9.16694	20215.9	20208.8	7.10909
2	11.5329	235025	basement	5.551	27.1	17.9923	19.8486	20355.9	20327.9	28.013
3	11.5329	236644	basement	5.551	27.1	26.798	29.5628	20486.8	20439.9	46.8501
4	11.5329	238142	basement	5.551	27.1	34.8273	38.4204	20609.4	20545.2	64.2239
5	11.5329	239532	basement	5.551	27.1	42.2174	46.573	20724.5	20644.4	80.1227
6	11.5329	240822	basement	5.551	27.1	48.9857	54.0396	20832.7	20737.9	94.7538
7	11.5329	242016	basement	5.551	27.1	55.1406	60.8295	20934.2	20826.2	107.992
8	11.5329	243123	basement	5.551	27.1	60.6819	66.9425	21029.4	20909.5	119.938
9	11.5329	244145	basement	5.551	27.1	65.601	72.3691	21118.6	20988.1	130.542
10	11.5329	245088	basement	5.551	27.1	69.9532	77.1703	21202.2	21062.2	139.978
11	11.5329	245931	basement	5.551	27.1	73.2247	80.7793	21279.1	21132.1	147.021
12	11.5329	246689	basement	5.551	27.1	74.9364	82.6676	21348.6	21197.9	150.731
13	11.5329	247377	basement	5.551	27.1	75.869	83.6964	21412.6	21259.9	152.719
14	11.5329	247999	basement	5.551	27.1	75.9856	83.825	21471.1	21318.1	153.031
15	11.5329	248557	basement	5.551	27.1	75.2481	83.0114	21524.2	21372.8	151.382

16	11.5329	249053	basement	5.551	27.1	73.6188	81.214	21571.8	21423.9	147.898
17	11.5329	249489	basement	5.551	27.1	71.0613	78.3927	21614.1	21471.7	142.353
18	11.5329	249865	basement	5.551	27.1	67.5637	74.5342	21651.1	21516.3	134.803
19	11.5329	250174	basement	5.551	27.1	62.6864	69.1538	21681.9	21557.6	124.294
20	11.5329	250427	basement	5.551	27.1	56.6471	62.4914	21707.1	21595.8	111.322
21	11.5329	250625	basement	5.551	27.1	49.5582	54.6711	21727	21631	95.98
22	11.5329	250771	basement	5.551	27.1	41.4096	45.6818	21741.7	21663.2	78.4567
23	11.5329	250864	basement	5.551	27.1	32.1984	35.5203	21751.1	21692.5	58.5916
24	11.5329	250906	basement	5.551	27.1	21.9293	24.1917	21755.3	21718.9	36.4185
25	11.5329	250898	basement	5.551	27.1	10.6136	11.7086	21754.5	21742.5	12.0441

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.10391

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	563.737	-1925.27	1.90894e+007	0	0
2	578.283	-1940.05	152638	194.099	0.072859
3	592.829	-1953.9	288837	367.294	0.072859
4	607.375	-1966.93	409734	521.03	0.072859
5	621.921	-1979.18	516280	656.517	0.072859
6	636.467	-1990.73	609284	774.783	0.0728589
7	651.012	-2001.61	688116	875.029	0.072859
8	665.558	-2011.86	751205	955.255	0.072859
9	680.104	-2021.53	802528	1020.52	0.0728591
10	694.65	-2030.64	842544	1071.4	0.0728587
11	709.196	-2039.22	871660	1108.43	0.0728591
12	723.742	-2047.29	890237	1132.05	0.0728589
13	738.287	-2054.88	898596	1142.68	0.0728589
14	752.833	-2062.01	883292	1123.22	0.072859
15	767.379	-2068.68	856376	1088.99	0.0728588
16	781.925	-2074.93	819910	1042.62	0.0728588
17	796.471	-2080.75	774110	984.382	0.072859
18	811.017	-2086.17	719174	914.523	0.072859
19	825.562	-2091.19	655280	833.274	0.072859
20	840.108	-2095.82	577976	734.972	0.072859
21	854.654	-2100.08	491062	624.448	0.0728589
22	869.2	-2103.97	395602	503.059	0.0728589
23	883.746	-2107.49	291724	370.965	0.072859

24	898.292	-2110.66	179547	228.317	0.0728589
25	912.837	-2113.47	59178.8	75.2535	0.072859
26	927.383	-2115.94	2.30576e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.10317

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	626.678	-1956.06	1.97048e+007	0	0
2	638.211	-1967.99	127228	22.4093	0.0100918
3	649.744	-1979.19	239916	83.8489	0.0200245
4	661.277	-1989.72	337069	174.379	0.0296413
5	672.81	-1999.63	422419	285.989	0.0387908
6	684.343	-2008.98	496686	410.28	0.0473283
7	695.875	-2017.8	560483	539.196	0.0551197
8	707.408	-2026.12	614343	665.229	0.0620416
9	718.941	-2033.97	658727	781.623	0.0679852
10	730.474	-2041.38	694040	882.533	0.0728566
11	742.007	-2048.37	718498	960.312	0.0765789
12	753.54	-2054.95	724346	999.919	0.0790936
13	765.073	-2061.15	721999	1012.65	0.080361
14	776.606	-2066.98	711711	998.22	0.0803609
15	788.138	-2072.46	693708	957.625	0.0790936
16	799.671	-2077.59	668195	893.079	0.0765789
17	811.204	-2082.4	635359	807.914	0.0728565
18	822.737	-2086.87	595367	706.441	0.0679851
19	834.27	-2091.04	545986	591.21	0.0620416
20	845.803	-2094.9	487719	469.196	0.0551197
21	857.336	-2098.46	422694	349.161	0.0473284
22	868.869	-2101.73	351029	237.656	0.0387908
23	880.401	-2104.72	272832	141.146	0.0296412
24	891.934	-2107.42	188203	65.7758	0.0200245
25	903.467	-2109.85	97236.2	17.1267	0.0100918
26	915	-2112	2.29718e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.113542
Factor of Safety, standard deviation: 0.183893
Factor of Safety, minimum: 0.554298

Factor of Safety, maximum: 1.785200
Probability of Failure: 27.680% (= 2768 failed surfaces / 10000 valid surfaces)
Reliability index: 0.61744 (assuming normal distribution)
Reliability index: 0.57362 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 1.110404
Factor of Safety, standard deviation: 0.180768
Factor of Safety, minimum: 0.549655
Factor of Safety, maximum: 1.784910
Probability of Failure: 27.820% (= 2782 failed surfaces / 10000 valid surfaces)
Reliability index: 0.61075 (assuming normal distribution) * best fit = Normal
Reliability index: 0.56665 (assuming lognormal distribution)

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
3234	-6000
3234	0
0	0

External Boundary

X	Y
3234	-6000
3234	-2717
3154	-2708
3075	-2694
2996	-2673
2916	-2646
2837	-2617
2758	-2592
2674	-2573
2590	-2556
2507	-2535
2423	-2519
2340	-2511

2265	-2500
2190	-2493
2114	-2485
2039	-2473
1950	-2449
1860	-2426
1770	-2405
1680	-2388
1590	-2363
1509	-2335
1428	-2298
1347	-2259
1266	-2223
1178	-2192
1091	-2163
1003	-2140
915	-2112
828	-2062
740	-2013
647	-1966
555	-1921
462	-1880
370	-1840
277	-1803
185	-1774
93	-1756
0	-1750
0	-6000

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_103_11_1g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 103PC Site 11
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/31/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364795359
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.000760
Center: 913.357, -1998.411
Radius: 113.005
Left Slip Surface Endpoint: 815.596, -2055.093
Right Slip Surface Endpoint: 913.981, -2111.414
Left Slope Intercept: 815.596 -0.000
Right Slope Intercept: 913.981 -0.000
Resisting Moment=2273.34 kN-m
Driving Moment=2.98955e+006 kN-m
Resisting Horizontal Force=21.8985 kN

Driving Horizontal Force=28797.6 kN
Total Slice Area=206127 m2

Method: gle/morgenstern-price

FS: 0.001394
Center: 1129.757, -1351.975
Radius: 789.118
Left Slip Surface Endpoint: 615.717, -1950.698
Right Slip Surface Endpoint: 912.615, -2110.630
Left Slope Intercept: 615.717 -0.000
Right Slope Intercept: 912.615 -0.000
Resisting Moment=127954 kN-m
Driving Moment=9.17663e+007 kN-m
Resisting Horizontal Force=164.349 kN
Driving Horizontal Force=117868 kN
Total Slice Area=607002 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1376
Number of Invalid Surfaces: 42

Error Codes:

Error Code -108 reported for 30 surfaces
Error Code -112 reported for 12 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1400
Number of Invalid Surfaces: 18

Error Codes:

Error Code -108 reported for 10 surfaces
Error Code -112 reported for 8 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This

screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.000760429

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	3.9354	83475.3	basement	5.551	27.1	273.162	0.20772	21222.2	21232.6	-10.4439
2	3.9354	83796.2	basement	5.551	27.1	296.017	0.2251	21341.8	21352.3	-10.459
3	3.9354	84072.6	basement	5.551	27.1	319.793	0.24318	21443	21453.4	-10.3596
4	3.9354	84313.3	basement	5.551	27.1	338.388	0.25732	21529	21539.4	-10.4026
5	3.9354	84524	basement	5.551	27.1	359.363	0.27327	21602.2	21612.5	-10.339
6	3.9354	84710	basement	5.551	27.1	380.141	0.28907	21665.1	21675.4	-10.3275
7	3.9354	84874.7	basement	5.551	27.1	399.393	0.30371	21719	21729.2	-10.1939
8	3.9354	85020.4	basement	5.551	27.1	416.712	0.31688	21764.8	21775.2	-10.3699
9	3.9354	85149.2	basement	5.551	27.1	431.651	0.32824	21803.8	21814	-10.2234
10	3.9354	85262.4	basement	5.551	27.1	443.71	0.33741	21836	21846.3	-10.2863
11	3.9354	85361.4	basement	5.551	27.1	452.297	0.34394	21862.5	21872.6	-10.1204
12	3.9354	85447.2	basement	5.551	27.1	456.676	0.34727	21883.3	21893.5	-10.2079
13	3.9354	85520.6	basement	5.551	27.1	455.914	0.34669	21899	21909.1	-10.1495
14	3.9354	85582.3	basement	5.551	27.1	448.773	0.34126	21909.7	21919.9	-10.2264
15	3.9354	85632.9	basement	5.551	27.1	433.611	0.32973	21915.8	21926	-10.227
16	3.9354	85673	basement	5.551	27.1	408.072	0.31031	21917.4	21927.7	-10.2744
17	3.9354	85702.9	basement	5.551	27.1	368.792	0.28044	21914.8	21925.1	-10.2967
18	3.9354	85723	basement	5.551	27.1	310.614	0.2362	21908	21918.4	-10.3608
19	3.9354	85733.6	basement	5.551	27.1	225.373	0.17138	21897.3	21907.8	-10.5393
20	3.9354	85735	basement	5.551	27.1	99.1414	0.07539	21882.6	21893.2	-10.6399
21	3.9354	85727.3	basement	5.551	27.1	0	0	21857.3	21874.9	-17.5727
22	3.9354	85710.7	basement	5.551	27.1	0	0	21819.4	21852.9	-33.509
23	3.9354	85685.4	basement	5.551	27.1	0	0	21777.1	21827.2	-50.1152
24	3.9354	85651.4	basement	5.551	27.1	0	0	21730.4	21797.9	-67.4834
25	3.9354	85608.7	basement	5.551	27.1	0	0	21647.6	21764.9	-117.274

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00139434

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	11.876	239364	basement	5.551	27.1	91.0108	0.1269	20166.3	20176.9	-10.5551
2	11.876	240829	basement	5.551	27.1	214.775	0.29947	20331.1	20341.4	-10.2856

3	11.876	242220	basement	5.551	27.1	330.335	0.4606	20485.6	20495.6	-9.97376
4	11.876	243534	basement	5.551	27.1	431.344	0.60144	20628.4	20638	-9.63484
5	11.876	244779	basement	5.551	27.1	522.434	0.72845	20761.3	20770.8	-9.4672
6	11.876	245961	basement	5.551	27.1	600.564	0.83739	20885.5	20894.7	-9.16146
7	11.876	247082	basement	5.551	27.1	664.307	0.92627	21001.2	21010.3	-9.07728
8	11.876	248145	basement	5.551	27.1	712.653	0.99368	21108.8	21117.7	-8.88458
9	11.876	249152	basement	5.551	27.1	745.026	1.03882	21208.5	21217.3	-8.84088
10	11.876	250103	basement	5.551	27.1	761.328	1.06155	21300.6	21309.3	-8.71603
11	11.876	250997	basement	5.551	27.1	731.737	1.02029	21383.8	21392.6	-8.79092
12	11.876	251808	basement	5.551	27.1	676.141	0.94277	21452.5	21461.5	-9.00364
13	11.876	252565	basement	5.551	27.1	630.499	0.87913	21513.4	21522.5	-9.1381
14	11.876	253274	basement	5.551	27.1	574.759	0.80141	21567.4	21576.7	-9.31726
15	11.876	253935	basement	5.551	27.1	511.367	0.71302	21614.8	21624.3	-9.4576
16	11.876	254551	basement	5.551	27.1	443.055	0.61777	21655.9	21665.6	-9.68366
17	11.876	255121	basement	5.551	27.1	372.721	0.5197	21690.7	21700.6	-9.85142
18	11.876	255647	basement	5.551	27.1	300.831	0.41946	21719.5	21729.4	-9.94581
19	11.876	256121	basement	5.551	27.1	215.536	0.30053	21740	21750.3	-10.2878
20	11.876	256548	basement	5.551	27.1	154.066	0.21482	21753.5	21763.9	-10.4319
21	11.876	256933	basement	5.551	27.1	102.414	0.1428	21761.3	21771.8	-10.5313
22	11.876	257278	basement	5.551	27.1	62.431	0.08705	21763.4	21774.1	-10.6574
23	11.876	257582	basement	5.551	27.1	35.2783	0.04919	21760.1	21770.8	-10.7221
24	11.876	257847	basement	5.551	27.1	21.1641	0.02951	21751.2	21762	-10.7535
25	11.876	258074	basement	5.551	27.1	19.1847	0.02675	21737.1	21747.9	-10.8148

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.000760429

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	815.596	-2055.09	2.17505e+007	0	0
2	819.531	-2061.39	86971.1	-652.984	-0.430172
3	823.467	-2066.89	157743	-1184.34	-0.430171
4	827.402	-2071.77	215858	-1620.67	-0.430171
5	831.337	-2076.15	262347	-1969.72	-0.430173
6	835.273	-2080.1	299826	-2251.11	-0.430172
7	839.208	-2083.69	329674	-2475.21	-0.430172
8	843.143	-2086.96	352759	-2648.54	-0.430173
9	847.079	-2089.94	369753	-2776.13	-0.430172
10	851.014	-2092.66	381188	-2861.98	-0.430172

11	854.95	-2095.15	387495	-2909.34	-0.430173
12	858.885	-2097.42	389027	-2920.83	-0.430171
13	862.82	-2099.49	386076	-2898.68	-0.430172
14	866.756	-2101.36	378889	-2844.72	-0.430172
15	870.691	-2103.05	367678	-2760.55	-0.430172
16	874.627	-2104.57	352624	-2647.52	-0.430172
17	878.562	-2105.93	333886	-2506.84	-0.430173
18	882.497	-2107.12	311607	-2339.57	-0.430173
19	886.433	-2108.16	285921	-2146.71	-0.430172
20	890.368	-2109.05	256956	-1929.24	-0.430172
21	894.304	-2109.8	224851	-1688.2	-0.430173
22	898.239	-2110.4	189615	-1423.64	-0.430172
23	902.174	-2110.86	151121	-1134.62	-0.43017
24	906.11	-2111.18	109408	-821.441	-0.430172
25	910.045	-2111.37	64504	-484.3	-0.430172
26	913.981	-2111.41	2.29591e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00139434

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	615.717	-1950.7	1.95969e+007	0	0
2	627.593	-1960.69	84596.4	-134.198	-0.0908901
3	639.469	-1970.3	162680	-512.058	-0.180346
4	651.345	-1979.53	232933	-1085.31	-0.266958
5	663.22	-1988.41	294384	-1795.01	-0.349357
6	675.096	-1996.95	349605	-2600.9	-0.426246
7	686.972	-2005.16	398717	-3454.58	-0.496412
8	698.848	-2013.05	441843	-4308.98	-0.558747
9	710.724	-2020.64	479104	-5119.98	-0.612272
10	722.6	-2027.94	510624	-5847.81	-0.656139
11	734.476	-2034.95	536518	-6458.29	-0.68966
12	746.352	-2041.69	550246	-6841.03	-0.712303
13	758.228	-2048.16	552660	-6981.15	-0.723716
14	770.104	-2054.37	549603	-6942.53	-0.723716
15	781.98	-2060.32	541155	-6728.01	-0.712304
16	793.856	-2066.03	527380	-6348.29	-0.68966
17	805.732	-2071.5	508327	-5821.51	-0.656139
18	817.608	-2076.73	484028	-5172.6	-0.612272
19	829.484	-2081.73	453945	-4427.01	-0.558748
20	841.36	-2086.5	414728	-3593.3	-0.496412

21	853.236	-2091.06	370186	-2754.01	-0.426246
22	865.112	-2095.39	320285	-1952.94	-0.349357
23	876.988	-2099.51	264979	-1234.62	-0.266957
24	888.864	-2103.43	204215	-642.796	-0.180346
25	900.74	-2107.13	137939	-218.816	-0.0908896
26	912.615	-2110.63	2.2942e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.074177
Factor of Safety, standard deviation: 0.094718
Factor of Safety, minimum: 0.000314
Factor of Safety, maximum: 1.064830
Probability of Failure: 99.980% (= 9793 failed surfaces / 9795 valid surfaces), 205 invalid surfaces
Reliability index: -9.77457 (assuming normal distribution)
Reliability index: -3.13680 (assuming lognormal distribution)
* best fit = Beta

Method: gle/morgenstern-price
Factor of Safety, mean: 0.024242
Factor of Safety, standard deviation: 0.062288
Factor of Safety, minimum: 0.000097
Factor of Safety, maximum: 0.918691
Probability of Failure: 100.000% (= 9977 failed surfaces / 9977 valid surfaces), 23 invalid surfaces
Reliability index: -15.66536 (assuming normal distribution)
Reliability index: -3.32384 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
3234	-6000
3234	0
0	0

External Boundary

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 103PC Site 11		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 3/31/2013		File Name: RR0705_103_11_1g.slim

X	Y
3234	-6000
3234	-2717
3154	-2708
3075	-2694
2996	-2673
2916	-2646
2837	-2617
2758	-2592
2674	-2573
2590	-2556
2507	-2535
2423	-2519
2340	-2511
2265	-2500
2190	-2493
2114	-2485
2039	-2473
1950	-2449
1860	-2426
1770	-2405
1680	-2388
1590	-2363
1509	-2335
1428	-2298
1347	-2259
1266	-2223
1178	-2192
1091	-2163
1003	-2140
915	-2112
828	-2062
740	-2013
647	-1966
555	-1921
462	-1880
370	-1840
277	-1803
185	-1774
93	-1756

rocscience	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 103PC Site 11		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
SLIDEINTERPRET 6.020	Date: 3/31/2013		File Name: RR0705_103_11_1g.slim

0	-1750
0	-6000

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_103_12_0g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 103PC Site 12
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/31/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364795605
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 103PC Site 12		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_103_12_0g.slim

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Global Minimums

Method: spencer

FS: 1.041830
Center: 588.654, -1342.984
Radius: 802.168
Left Slip Surface Endpoint: 0.142, -1888.076
Right Slip Surface Endpoint: 442.440, -2131.714
Left Slope Intercept: 0.142 -0.000
Right Slope Intercept: 442.440 -0.000
Resisting Moment=2.99882e+007 kN-m
Driving Moment=2.87843e+007 kN-m
Resisting Horizontal Force=32749.2 kN
Driving Horizontal Force=31434.4 kN
Total Slice Area=902746 m2

Method: gle/morgenstern-price

FS: 1.043970
Center: 588.654, -1342.984
Radius: 802.168
Left Slip Surface Endpoint: 0.142, -1888.076
Right Slip Surface Endpoint: 442.440, -2131.714
Left Slope Intercept: 0.142 -0.000
Right Slope Intercept: 442.440 -0.000
Resisting Moment=3.00499e+007 kN-m
Driving Moment=2.87843e+007 kN-m
Resisting Horizontal Force=32776.4 kN

Driving Horizontal Force=31395.9 kN
Total Slice Area=902746 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2651
Number of Invalid Surfaces: 293

Error Codes:

Error Code -108 reported for 286 surfaces
Error Code -112 reported for 7 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2944
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.04183

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	17.6919	346188	basement	5.551	27.1	6.07134	6.3253	19544	19542.5	1.48768
2	17.6919	350288	basement	5.551	27.1	22.4101	23.3475	19762	19727.2	34.7896
3	17.6919	354085	basement	5.551	27.1	37.2982	38.8584	19965.9	19900.9	65.0385
4	17.6919	357605	basement	5.551	27.1	50.7602	52.8835	20156.8	20064.3	92.5362
5	17.6919	360868	basement	5.551	27.1	62.8201	65.4479	20335.5	20218.4	117.089
6	17.6919	363878	basement	5.551	27.1	73.4187	76.4898	20502.4	20363.8	138.646
7	17.6919	366650	basement	5.551	27.1	82.1232	85.5584	20657.4	20501	156.396

8	17.6919	369212	basement	5.551	27.1	89.4672	93.2096	20801.9	20630.6	171.285
9	17.6919	371577	basement	5.551	27.1	95.4744	99.4681	20936.5	20752.9	183.589
10	17.6919	373756	basement	5.551	27.1	100.161	104.351	21061.5	20868.4	193.095
11	17.6919	375752	basement	5.551	27.1	103.514	107.844	21177.3	20977.4	199.898
12	17.6919	377574	basement	5.551	27.1	105.41	109.819	21284	21080.2	203.753
13	17.6919	379233	basement	5.551	27.1	106.014	110.449	21382	21177	204.983
14	17.6919	380735	basement	5.551	27.1	105.338	109.744	21471.7	21268.1	203.556
15	17.6919	382087	basement	5.551	27.1	103.383	107.707	21553.3	21353.6	199.671
16	17.6919	383275	basement	5.551	27.1	100.051	104.236	21626.7	21433.9	192.777
17	17.6919	384301	basement	5.551	27.1	94.6447	98.6037	21690.8	21508.9	181.856
18	17.6919	385190	basement	5.551	27.1	87.9338	91.6121	21747.2	21579	168.173
19	17.6919	385946	basement	5.551	27.1	79.9238	83.267	21796	21644.1	151.929
20	17.6919	386572	basement	5.551	27.1	70.6087	73.5623	21837.5	21704.6	132.881
21	17.6919	387127	basement	5.551	27.1	60.2515	62.7718	21872.1	21760.3	111.837
22	17.6919	387629	basement	5.551	27.1	51.3534	53.5015	21905.2	21811.5	93.7276
23	17.6919	388010	basement	5.551	27.1	41.2577	42.9835	21931.4	21858.3	73.1351
24	17.6919	388271	basement	5.551	27.1	29.8769	31.1267	21950.7	21900.7	49.9508
25	17.6919	388413	basement	5.551	27.1	17.1946	17.9138	21962.9	21938.7	24.1712

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.04397

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	17.6919	346188	basement	5.551	27.1	10.6442	11.1123	19553.3	19542.5	10.8243
2	17.6919	350288	basement	5.551	27.1	24.6403	25.7237	19766.6	19727.2	39.4275
3	17.6919	354085	basement	5.551	27.1	37.5356	39.186	19966.6	19900.9	65.7028
4	17.6919	357605	basement	5.551	27.1	49.3869	51.5584	20154.2	20064.3	89.9354
5	17.6919	360868	basement	5.551	27.1	60.2373	62.8859	20330.5	20218.4	112.065
6	17.6919	363878	basement	5.551	27.1	70.0271	73.1062	20495.8	20363.8	132.033
7	17.6919	366650	basement	5.551	27.1	78.3772	81.8234	20650.1	20501	149.096
8	17.6919	369212	basement	5.551	27.1	85.7296	89.4991	20794.6	20630.6	164.03
9	17.6919	371577	basement	5.551	27.1	92.0682	96.1164	20929.9	20752.9	177.008
10	17.6919	373756	basement	5.551	27.1	97.3589	101.64	21056.2	20868.4	187.8
11	17.6919	375752	basement	5.551	27.1	101.555	106.02	21173.8	20977.4	196.378
12	17.6919	377574	basement	5.551	27.1	104.414	109.005	21282.4	21080.2	202.166
13	17.6919	379233	basement	5.551	27.1	106.049	110.712	21382.5	21177	205.485
14	17.6919	380735	basement	5.551	27.1	106.392	111.07	21474.3	21268.1	206.15
15	17.6919	382087	basement	5.551	27.1	105.37	110.003	21557.7	21353.6	204.147
16	17.6919	383275	basement	5.551	27.1	102.905	107.43	21633	21433.9	199.069
17	17.6919	384301	basement	5.551	27.1	97.9898	102.298	21698	21508.9	189.103
18	17.6919	385190	basement	5.551	27.1	91.4525	95.4737	21754.7	21579	175.698

19	17.6919	385946	basement	5.551	27.1	83.252	86.9126	21803.1	21644.1	159.037
20	17.6919	386572	basement	5.551	27.1	73.3442	76.5691	21843.4	21704.6	138.752
21	17.6919	387127	basement	5.551	27.1	62.3118	65.0517	21876.6	21760.3	116.284
22	17.6919	387629	basement	5.551	27.1	52.3579	54.6601	21907.5	21811.5	96.0203
23	17.6919	388010	basement	5.551	27.1	40.8123	42.6068	21930.7	21858.3	72.4213
24	17.6919	388271	basement	5.551	27.1	27.6116	28.8257	21946.1	21900.7	45.4246
25	17.6919	388413	basement	5.551	27.1	12.7673	13.3287	21953.9	21938.7	15.1872

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.04183

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	0.141673	-1888.08	1.83589e+007	0	0
2	17.8336	-1906.58	175431	304.683	0.0995094
3	35.5255	-1923.95	331401	575.567	0.0995094
4	53.2175	-1940.29	469179	814.855	0.0995094
5	70.9094	-1955.69	589829	1024.4	0.0995098
6	88.6013	-1970.22	694257	1205.76	0.0995091
7	106.293	-1983.92	777173	1349.77	0.0995094
8	123.985	-1996.86	845108	1467.76	0.0995096
9	141.677	-2009.08	898787	1560.99	0.0995097
10	159.369	-2020.62	938728	1630.35	0.0995092
11	177.061	-2031.51	965383	1676.65	0.0995096
12	194.753	-2041.78	977363	1697.45	0.0995092
13	212.445	-2051.46	976818	1696.51	0.0995096
14	230.137	-2060.58	964080	1674.39	0.0995098
15	247.829	-2069.15	939447	1631.6	0.0995093
16	265.521	-2077.19	903189	1568.63	0.0995094
17	283.213	-2084.72	847408	1471.75	0.0995093
18	300.904	-2091.76	780171	1354.98	0.0995097
19	318.596	-2098.33	701913	1219.06	0.0995094
20	336.288	-2104.42	612828	1064.34	0.0995094
21	353.98	-2110.06	513095	891.128	0.0995095
22	371.672	-2115.25	429121	745.285	0.0995096
23	389.364	-2120	336650	584.683	0.0995094
24	407.056	-2124.33	234221	406.789	0.0995097
25	424.748	-2128.23	121964	211.824	0.0995098
26	442.44	-2131.71	2.34026e+007	0	0

rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 103PC Site 12		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
SLIDEINTERPRET 6.020	Date	3/31/2013		File Name: RR0705_103_12_0g.slim

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.04397

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	0.141673	-1888.08	1.83589e+007	0	0
2	17.8336	-1906.58	175523	54.5808	0.0178167
3	35.5255	-1923.95	331534	204.562	0.0353524
4	53.2175	-1940.29	469318	428.649	0.0523308
5	70.9094	-1955.69	589953	705.151	0.0684837
6	88.6013	-1970.22	694354	1012.6	0.0835563
7	106.293	-1983.92	777240	1320.07	0.0973115
8	123.985	-1996.86	845146	1615.67	0.109533
9	141.677	-2009.08	898803	1882.85	0.120025
10	159.369	-2020.62	938728	2107.39	0.128625
11	177.061	-2031.51	965375	2277.94	0.135197
12	194.753	-2041.78	977353	2381.93	0.139637
13	212.445	-2051.46	976811	2418.76	0.141874
14	230.137	-2060.58	964077	2387.23	0.141874
15	247.829	-2069.15	939447	2289.55	0.139637
16	265.521	-2077.19	903191	2131.2	0.135197
17	283.213	-2084.72	847406	1902.38	0.128626
18	300.904	-2091.76	780160	1634.31	0.120025
19	318.596	-2098.33	701890	1341.8	0.109532
20	336.288	-2104.42	612789	1040.77	0.0973119
21	353.98	-2110.06	513041	748.187	0.0835565
22	371.672	-2115.25	429054	512.833	0.0684836
23	389.364	-2120	336575	307.409	0.0523308
24	407.056	-2124.33	234152	144.476	0.0353525
25	424.748	-2128.23	121917	37.9115	0.0178168
26	442.44	-2131.71	2.34026e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.049115
Factor of Safety, standard deviation: 0.173209
Factor of Safety, minimum: 0.519436
Factor of Safety, maximum: 1.680450
Probability of Failure: 40.400% (= 4040 failed surfaces / 10000 valid surfaces)
Reliability index: 0.28356 (assuming normal distribution)

Reliability index: 0.21038 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 1.050923
Factor of Safety, standard deviation: 0.173023
Factor of Safety, minimum: 0.520654
Factor of Safety, maximum: 1.679100
Probability of Failure: 39.840% (= 3984 failed surfaces / 10000 valid surfaces)
Reliability index: 0.29431 (assuming normal distribution)
Reliability index: 0.22194 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
3458	-6000
3458	0
0	0

External Boundary

X	Y
3458	-6000
3458	-3062
3382	-3068
3306	-3070
3230	-3071
3154	-3071
3078	-3071
2990	-3070
2902	-3068
2814	-3062
2727	-3054
2639	-3040
2551	-3020
2463	-2999
2375	-2973

2288	-2943
2201	-2910
2113	-2872
2026	-2834
1939	-2797
1851	-2762
1764	-2722
1677	-2683
1589	-2644
1502	-2598
1415	-2550
1327	-2506
1240	-2470
1153	-2432
1064	-2393
975	-2354
887	-2316
798	-2277
709	-2238
621	-2193
532	-2160
443	-2132
355	-2087
266	-2035
177	-1985
89	-1936
0	-1888
0	-6000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 103PC Site 12		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_103_12_1g.slim

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_103_12_1g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 103PC Site 12
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/31/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364795745
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.000871
Center: 376.661, -1975.792
Radius: 122.900
Left Slip Surface Endpoint: 270.426, -2037.586
Right Slip Surface Endpoint: 377.854, -2098.686
Left Slope Intercept: 270.426 -0.000
Right Slope Intercept: 377.854 -0.000
Resisting Moment=3191.89 kN-m
Driving Moment=3.6628e+006 kN-m
Resisting Horizontal Force=28.2904 kN

Driving Horizontal Force=32464.1 kN
Total Slice Area=223565 m2

Method: gle/morgenstern-price

FS: 0.000991
Center: 736.960, -1051.054
Radius: 1114.299
Left Slip Surface Endpoint: 3.400, -1889.834
Right Slip Surface Endpoint: 415.688, -2118.034
Left Slope Intercept: 3.400 -0.000
Right Slope Intercept: 415.688 -0.000
Resisting Moment=210526 kN-m
Driving Moment=2.12538e+008 kN-m
Resisting Horizontal Force=191.916 kN
Driving Horizontal Force=193750 kN
Total Slice Area=834118 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1579
Number of Invalid Surfaces: 41

Error Codes:

Error Code -108 reported for 21 surfaces
Error Code -111 reported for 2 surfaces
Error Code -112 reported for 18 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1568
Number of Invalid Surfaces: 52

Error Codes:

Error Code -108 reported for 3 surfaces
Error Code -112 reported for 49 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.000871435

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	4.29711	90388.1	basement	5.551	27.1	193.715	0.16881	21046.4	21057	-10.5686
2	4.29711	90766.4	basement	5.551	27.1	220.957	0.19255	21174.9	21185.3	-10.4007
3	4.29711	91091.9	basement	5.551	27.1	248.969	0.21696	21282.9	21293.4	-10.4511
4	4.29711	91375.4	basement	5.551	27.1	277.003	0.24139	21375	21385.4	-10.3751
5	4.29711	91624.5	basement	5.551	27.1	304.544	0.26539	21453.8	21464.1	-10.2598
6	4.29711	91844.3	basement	5.551	27.1	331.189	0.28861	21521.4	21531.6	-10.2014
7	4.29711	92038.6	basement	5.551	27.1	356.573	0.31073	21579.2	21589.4	-10.2363
8	4.29711	92210.3	basement	5.551	27.1	380.35	0.33145	21628.3	21638.5	-10.1537
9	4.29711	92361.8	basement	5.551	27.1	402.141	0.35044	21669.7	21679.8	-10.0554
10	4.29711	92494.8	basement	5.551	27.1	421.546	0.36735	21704	21714.1	-10.1261
11	4.29711	92610.9	basement	5.551	27.1	438.093	0.38177	21731.7	21741.9	-10.1554
12	4.29711	92711.2	basement	5.551	27.1	451.175	0.39317	21753.4	21763.6	-10.1536
13	4.29711	92796.8	basement	5.551	27.1	460.069	0.40092	21769.6	21779.6	-10.0227
14	4.29711	92868.4	basement	5.551	27.1	463.787	0.40416	21780.2	21790.3	-10.0739
15	4.29711	92926.8	basement	5.551	27.1	460.964	0.4017	21786	21796	-9.9941
16	4.29711	92972.6	basement	5.551	27.1	449.752	0.39193	21786.7	21796.8	-10.1058
17	4.29711	93006.3	basement	5.551	27.1	427.398	0.37245	21782.8	21792.9	-10.0829
18	4.29711	93028.2	basement	5.551	27.1	389.702	0.3396	21774.4	21784.6	-10.1596
19	4.29711	93038.9	basement	5.551	27.1	329.927	0.28751	21761.7	21771.9	-10.236
20	4.29711	93038.8	basement	5.551	27.1	268.649	0.23411	21744.9	21755.3	-10.3975
21	4.29711	93033.4	basement	5.551	27.1	228.267	0.19892	21727.6	21738	-10.4135
22	4.29711	93019.1	basement	5.551	27.1	50.0898	0.04365	21707.1	21717.9	-10.7606
23	4.29711	92994.3	basement	5.551	27.1	0	0	21671.1	21693.7	-22.6206
24	4.29711	92959.1	basement	5.551	27.1	0	0	21627.6	21665.6	-37.969
25	4.29711	92913.7	basement	5.551	27.1	0	0	21556.1	21633.5	-77.3947

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.000990536

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]

1	16.4915	322456	basement	5.551	27.1	124.68	0.1235	19569.2	19579.8	-10.5668
2	16.4915	325271	basement	5.551	27.1	311.538	0.30859	19791.5	19801.8	-10.2568
3	16.4915	327947	basement	5.551	27.1	486.131	0.48153	19999.9	20009.8	-9.88151
4	16.4915	330489	basement	5.551	27.1	644.035	0.63794	20194.9	20204.5	-9.5884
5	16.4915	332905	basement	5.551	27.1	781.244	0.77385	20377.1	20386.5	-9.35895
6	16.4915	335189	basement	5.551	27.1	876.455	0.86816	20545.6	20554.8	-9.17364
7	16.4915	337338	basement	5.551	27.1	947.285	0.93832	20699.3	20708.3	-9.0465
8	16.4915	339374	basement	5.551	27.1	992.543	0.98315	20841.5	20850.4	-8.94297
9	16.4915	341300	basement	5.551	27.1	1008.41	0.99887	20972.7	20981.6	-8.90414
10	16.4915	343121	basement	5.551	27.1	995.158	0.98574	21093.3	21102.3	-8.96136
11	16.4915	344839	basement	5.551	27.1	949.102	0.94012	21203.6	21212.6	-9.03997
12	16.4915	346451	basement	5.551	27.1	874.617	0.86634	21302.8	21312	-9.1926
13	16.4915	347967	basement	5.551	27.1	782.869	0.77546	21392.2	21401.6	-9.37041
14	16.4915	349389	basement	5.551	27.1	673.242	0.66687	21472.3	21481.8	-9.51803
15	16.4915	350719	basement	5.551	27.1	550.702	0.54549	21543.2	21552.9	-9.71486
16	16.4915	351961	basement	5.551	27.1	416.805	0.41286	21605.1	21615.2	-10.0632
17	16.4915	353096	basement	5.551	27.1	232.531	0.23033	21654.9	21665.3	-10.3531
18	16.4915	354131	basement	5.551	27.1	101.097	0.10014	21693.9	21704.5	-10.6324
19	16.4915	355084	basement	5.551	27.1	0	0	21721.7	21735.4	-13.7398
20	16.4915	355955	basement	5.551	27.1	0	0	21728.1	21758.2	-30.0503
21	16.4915	356747	basement	5.551	27.1	0	0	21732.1	21773	-40.8518
22	16.4915	357485	basement	5.551	27.1	0	0	21749.5	21784.3	-34.8002
23	16.4915	358227	basement	5.551	27.1	0	0	21770.4	21801.7	-31.3019
24	16.4915	358898	basement	5.551	27.1	0	0	21783.3	21812.5	-29.167
25	16.4915	359495	basement	5.551	27.1	0	0	21792.5	21815.9	-23.3803

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.000871435

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	270.426	-2037.59	2.13815e+007	0	0
2	274.723	-2044.44	91375	-506.106	-0.317345
3	279.02	-2050.43	165307	-915.599	-0.317345
4	283.317	-2055.74	225589	-1249.49	-0.317346
5	287.614	-2060.5	274678	-1521.38	-0.317345
6	291.911	-2064.8	314275	-1740.7	-0.317345
7	296.208	-2068.7	345613	-1914.28	-0.317346
8	300.506	-2072.25	369621	-2047.25	-0.317346

9	304.803	-2075.5	387019	-2143.62	-0.317346
10	309.1	-2078.46	398376	-2206.52	-0.317346
11	313.397	-2081.16	404152	-2238.51	-0.317346
12	317.694	-2083.62	404722	-2241.67	-0.317346
13	321.991	-2085.86	400402	-2217.74	-0.317346
14	326.288	-2087.89	391452	-2168.17	-0.317346
15	330.585	-2089.73	378097	-2094.2	-0.317346
16	334.882	-2091.37	360530	-1996.9	-0.317346
17	339.18	-2092.84	338918	-1877.2	-0.317347
18	343.477	-2094.13	313411	-1735.92	-0.317346
19	347.774	-2095.25	284146	-1573.83	-0.317347
20	352.071	-2096.21	251256	-1391.66	-0.317347
21	356.368	-2097.01	216964	-1201.72	-0.317347
22	360.665	-2097.65	183765	-1017.83	-0.317344
23	364.962	-2098.13	147391	-816.369	-0.317347
24	369.259	-2098.47	107625	-596.11	-0.317345
25	373.556	-2098.65	64393.1	-356.66	-0.317346
26	377.854	-2098.69	2.26831e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.000990536

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	3.40014	-1889.83	1.83931e+007	0	0
2	19.8917	-1903.98	103033	-313.691	-0.17444
3	36.3832	-1917.57	197645	-1193.99	-0.346124
4	52.8747	-1930.65	283859	-2538.38	-0.512348
5	69.3662	-1943.23	361736	-4233.26	-0.67048
6	85.8577	-1955.34	431362	-6159.12	-0.818031
7	102.349	-1966.99	488259	-8119.17	-0.952673
8	118.841	-1978.19	535988	-10032.1	-1.07228
9	135.332	-1988.98	575775	-11809.3	-1.17499
10	151.824	-1999.36	607781	-13358.9	-1.25915
11	168.315	-2009.34	632168	-14604.9	-1.32346
12	184.807	-2018.93	648322	-15469.9	-1.3669
13	201.298	-2028.16	656279	-15910.7	-1.3888
14	217.79	-2037.02	657000	-15928.2	-1.3888
15	234.281	-2045.53	650579	-15523.8	-1.3669
16	250.773	-2053.69	637074	-14718.2	-1.32346
17	267.264	-2061.52	615940	-13538.3	-1.25915
18	283.756	-2069.03	580797	-11912.3	-1.17499

19	300.247	-2076.21	538343	-10076.2	-1.07228
20	316.739	-2083.08	488331	-8120.37	-0.952674
21	333.231	-2089.64	429965	-6139.18	-0.818032
22	349.722	-2095.9	363273	-4251.25	-0.670481
23	366.214	-2101.87	306068	-2736.97	-0.512346
24	382.705	-2107.54	249477	-1507.12	-0.346126
25	399.197	-2112.93	185227	-563.934	-0.17444
26	415.688	-2118.03	2.31032e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.070807
Factor of Safety, standard deviation: 0.095447
Factor of Safety, minimum: 0.000167
Factor of Safety, maximum: 1.177800
Probability of Failure: 99.959% (= 9745 failed surfaces / 9749 valid surfaces), 251 invalid surfaces
Reliability index: -9.73515 (assuming normal distribution)
Reliability index: -3.11061 (assuming lognormal distribution)
* best fit = Beta

Method: gle/morgenstern-price
Factor of Safety, mean: 0.021118
Factor of Safety, standard deviation: 0.059758
Factor of Safety, minimum: 0.000060
Factor of Safety, maximum: 0.986075
Probability of Failure: 100.000% (= 9987 failed surfaces / 9987 valid surfaces), 13 invalid surfaces
Reliability index: -16.38069 (assuming normal distribution)
Reliability index: -3.34326 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
3458	-6000
3458	0
0	0

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 103PC Site 12		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_103_12_1g.slim

External Boundary

X	Y
3458	-6000
3458	-3062
3382	-3068
3306	-3070
3230	-3071
3154	-3071
3078	-3071
2990	-3070
2902	-3068
2814	-3062
2727	-3054
2639	-3040
2551	-3020
2463	-2999
2375	-2973
2288	-2943
2201	-2910
2113	-2872
2026	-2834
1939	-2797
1851	-2762
1764	-2722
1677	-2683
1589	-2644
1502	-2598
1415	-2550
1327	-2506
1240	-2470
1153	-2432
1064	-2393
975	-2354
887	-2316
798	-2277
709	-2238
621	-2193
532	-2160
443	-2132
355	-2087

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 103PC Site 12		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 3/31/2013		File Name: RR0705_103_12_1g.slim

266	-2035
177	-1985
89	-1936
0	-1888
0	-6000

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_103_13_0g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 103PC Site 13
Author: Jason R. Patton
Company: Oregon State University
Date Created: 4/01/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364837577
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 103PC Site 13		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	4/01/2013		File Name: RR0705_103_13_0g.slim

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Global Minimums

Method: spencer

FS: 1.290460
Center: 368.375, -2179.949
Radius: 526.377
Left Slip Surface Endpoint: 0.113, -2556.055
Right Slip Surface Endpoint: 319.686, -2704.069
Left Slope Intercept: 0.113 -0.000
Right Slope Intercept: 319.686 -0.000
Resisting Moment=1.01281e+007 kN-m
Driving Moment=7.84842e+006 kN-m
Resisting Horizontal Force=17407.7 kN
Driving Horizontal Force=13489.5 kN
Total Slice Area=847647 m2

Method: gle/morgenstern-price

FS: 1.292980
Center: 370.200, -2178.010
Radius: 529.039
Left Slip Surface Endpoint: 0.113, -2556.055
Right Slip Surface Endpoint: 321.362, -2704.790
Left Slope Intercept: 0.113 -0.000
Right Slope Intercept: 321.362 -0.000
Resisting Moment=1.02986e+007 kN-m
Driving Moment=7.96499e+006 kN-m
Resisting Horizontal Force=17588.5 kN

Driving Horizontal Force=13603.1 kN
Total Slice Area=852245 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1659
Number of Invalid Surfaces: 877

Error Codes:

Error Code -108 reported for 877 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2536
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.29046

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	12.7829	337549	basement	5.551	27.1	4.69102	6.05358	26390.7	26389.7	0.984635
2	12.7829	339488	basement	5.551	27.1	14.268	18.4123	26535.5	26510.4	25.1186
3	12.7829	341275	basement	5.551	27.1	22.8852	29.5324	26670.3	26623.4	46.9086
4	12.7829	342924	basement	5.551	27.1	30.5671	39.4456	26795.7	26729.4	66.2549
5	12.7829	344444	basement	5.551	27.1	37.3366	48.1814	26912.2	26828.9	83.2536
6	12.7829	345844	basement	5.551	27.1	43.2144	55.7665	27020.4	26922.2	98.1893
7	12.7829	347130	basement	5.551	27.1	48.219	62.2247	27120.6	27009.9	110.728
8	12.7829	348311	basement	5.551	27.1	52.367	67.5775	27213.3	27092.1	121.222
9	12.7829	349390	basement	5.551	27.1	55.6727	71.8434	27298.8	27169.3	129.516
10	12.7829	350374	basement	5.551	27.1	58.1487	75.0386	27377.4	27241.6	135.758
11	12.7829	351266	basement	5.551	27.1	59.8057	77.1768	27449.2	27309.2	139.995

12	12.7829	352070	basement	5.551	27.1	60.6522	78.2693	27514.5	27372.4	142.094
13	12.7829	352789	basement	5.551	27.1	60.6955	78.3251	27573.5	27431.3	142.22
14	12.7829	353427	basement	5.551	27.1	59.9407	77.3511	27626.4	27486.1	140.257
15	12.7829	353991	basement	5.551	27.1	58.3276	75.2694	27673	27536.8	136.242
16	12.7829	354510	basement	5.551	27.1	56.7771	73.2686	27716.1	27583.7	132.362
17	12.7829	354962	basement	5.551	27.1	54.8536	70.7864	27754.3	27626.8	127.503
18	12.7829	355341	basement	5.551	27.1	52.1607	67.3113	27786.9	27666.2	120.717
19	12.7829	355649	basement	5.551	27.1	48.6955	62.8396	27814.1	27702.1	111.954
20	12.7829	355887	basement	5.551	27.1	44.4535	57.3654	27835.6	27734.4	101.226
21	12.7829	356057	basement	5.551	27.1	39.4287	50.8812	27851.8	27763.2	88.5857
22	12.7829	356160	basement	5.551	27.1	33.6086	43.3705	27862.6	27788.6	73.958
23	12.7829	356200	basement	5.551	27.1	27.0394	34.8933	27868.1	27810.7	57.3872
24	12.7829	356177	basement	5.551	27.1	19.7775	25.5221	27868.5	27829.5	38.9942
25	12.7829	356089	basement	5.551	27.1	11.6953	15.0923	27863.7	27845	18.6507

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.29298

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	12.8499	339324	basement	5.551	27.1	7.34203	9.4931	26397.7	26390	7.71447
2	12.8499	341283	basement	5.551	27.1	15.5836	20.1493	26539.8	26511.3	28.5416
3	12.8499	343089	basement	5.551	27.1	23.0926	29.8583	26672.4	26624.9	47.5343
4	12.8499	344754	basement	5.551	27.1	29.9049	38.6664	26796.2	26731.4	64.7641
5	12.8499	346290	basement	5.551	27.1	36.0463	46.6072	26911.6	26831.4	80.213
6	12.8499	347703	basement	5.551	27.1	41.533	53.7014	27019.3	26925.2	94.1273
7	12.8499	349003	basement	5.551	27.1	46.3709	59.9566	27119.6	27013.3	106.346
8	12.8499	350196	basement	5.551	27.1	50.5562	65.3681	27212.9	27096	116.886
9	12.8499	351286	basement	5.551	27.1	54.0766	69.9199	27299.3	27173.5	125.803
10	12.8499	352280	basement	5.551	27.1	56.9119	73.5859	27379.1	27246.1	133.011
11	12.8499	353180	basement	5.551	27.1	59.0353	76.3315	27452.4	27314.1	138.346
12	12.8499	353992	basement	5.551	27.1	60.4146	78.1149	27519.4	27377.6	141.824
13	12.8499	354719	basement	5.551	27.1	61.0135	78.8892	27580.1	27436.8	143.308
14	12.8499	355363	basement	5.551	27.1	60.7932	78.6044	27634.6	27491.8	142.789
15	12.8499	355934	basement	5.551	27.1	59.5853	77.0426	27682.5	27542.8	139.744
16	12.8499	356460	basement	5.551	27.1	58.4509	75.5759	27726.8	27589.9	136.909
17	12.8499	356916	basement	5.551	27.1	56.8277	73.4771	27766	27633.2	132.785
18	12.8499	357299	basement	5.551	27.1	54.2835	70.1875	27799.1	27672.9	126.25
19	12.8499	357609	basement	5.551	27.1	50.7859	65.6651	27826.3	27708.9	117.397
20	12.8499	357850	basement	5.551	27.1	46.3072	59.8743	27847.5	27741.3	106.188
21	12.8499	358021	basement	5.551	27.1	40.8255	52.7865	27862.6	27770.3	92.2658
22	12.8499	358125	basement	5.551	27.1	34.3222	44.3779	27871.7	27795.8	75.9038

23	12.8499	358165	basement	5.551	27.1	26.8951	34.7748	27875.1	27818	57.1216
24	12.8499	358141	basement	5.551	27.1	18.5222	23.9488	27872.8	27836.8	35.9859
25	12.8499	358052	basement	5.551	27.1	9.12812	11.8025	27864.6	27852.4	12.1703

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.29046

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	0.113246	-2556.05	3.36471e+007	0	0
2	12.8962	-2568.16	156342	142.516	0.0522289
3	25.6791	-2579.49	293358	267.415	0.0522288
4	38.462	-2590.11	412441	375.968	0.052229
5	51.2449	-2600.07	514763	469.241	0.0522289
6	64.0278	-2609.42	601319	548.143	0.052229
7	76.8107	-2618.2	672963	613.451	0.0522289
8	89.5936	-2626.44	730430	665.836	0.0522289
9	102.377	-2634.17	774364	705.885	0.052229
10	115.159	-2641.42	805327	734.11	0.052229
11	127.942	-2648.21	823815	750.963	0.052229
12	140.725	-2654.55	830266	756.843	0.0522289
13	153.508	-2660.47	825069	752.106	0.052229
14	166.291	-2665.99	808572	737.067	0.0522289
15	179.074	-2671.11	781085	712.011	0.0522289
16	191.857	-2675.85	750508	684.138	0.0522289
17	204.64	-2680.21	718535	654.993	0.0522289
18	217.423	-2684.22	676394	616.579	0.052229
19	230.206	-2687.87	624286	569.078	0.0522289
20	242.988	-2691.17	562387	512.654	0.052229
21	255.771	-2694.14	490860	447.452	0.052229
22	268.554	-2696.77	409848	373.604	0.0522289
23	281.337	-2699.08	319704	291.431	0.0522288
24	294.12	-2701.06	222241	202.588	0.052229
25	306.903	-2702.72	115644	105.417	0.0522288
26	319.686	-2704.07	3.76568e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.29298

Slice	X coordinate	Y coordinate - Bottom	Interslice Normal Force	Interslice Shear Force	Interslice Force Angle

	[m]	[m]	[kN]	[kN]	[degrees]
1	0.113246	-2556.05	3.36471e+007	0	0
2	12.9632	-2568.22	157148	25.6813	0.00936334
3	25.8131	-2579.61	294848	95.609	0.018579
4	38.6631	-2590.28	414508	198.962	0.0275017
5	51.513	-2600.29	517312	324.953	0.0359907
6	64.3629	-2609.69	604264	463.115	0.0439121
7	77.2129	-2618.51	676225	603.583	0.0511409
8	90.0628	-2626.79	733937	737.363	0.0575632
9	102.913	-2634.56	778047	856.564	0.0630778
10	115.763	-2641.85	809120	954.6	0.0675975
11	128.613	-2648.67	827654	1026.36	0.0710515
12	141.463	-2655.04	834090	1068.3	0.0733842
13	154.313	-2661	828816	1078.56	0.0745605
14	167.162	-2666.54	812180	1056.91	0.0745604
15	180.012	-2671.68	784494	1004.78	0.0733844
16	192.862	-2676.44	754967	936.218	0.0710512
17	205.712	-2680.83	722767	852.72	0.0675975
18	218.562	-2684.85	680339	748.996	0.0630778
19	231.412	-2688.52	627885	630.816	0.0575632
20	244.262	-2691.84	565584	504.828	0.051141
21	257.112	-2694.82	493599	378.3	0.0439121
22	269.962	-2697.47	412076	258.848	0.0359907
23	282.812	-2699.78	321617	154.375	0.0275018
24	295.662	-2701.77	223559	72.4925	0.0185791
25	308.512	-2703.44	116322	19.0096	0.0093634
26	321.362	-2704.79	3.76768e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.299274
Factor of Safety, standard deviation: 0.211791
Factor of Safety, minimum: 0.653046
Factor of Safety, maximum: 2.057350
Probability of Failure: 7.600% (= 760 failed surfaces / 10000 valid surfaces)
Reliability index: 1.41307 (assuming normal distribution)
Reliability index: 1.53572 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price

Factor of Safety, mean: 1.300508
Factor of Safety, standard deviation: 0.212716
Factor of Safety, minimum: 0.652007
Factor of Safety, maximum: 2.055450
Probability of Failure: 7.710% (= 771 failed surfaces / 10000 valid surfaces)
Reliability index: 1.41271 (assuming normal distribution)
Reliability index: 1.53585 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
2087	-6000
2087	0
0	0

External Boundary

X	Y
2087	-6000
2087	-3093
2006	-3092
1925	-3091
1843	-3089
1762	-3085
1681	-3081
1598	-3070
1515	-3055
1432	-3033
1349	-3012
1266	-2989
1183	-2969
1094	-2947
1006	-2924
918	-2904
829	-2878
741	-2849

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 103PC Site 13		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 4/01/2013		File Name: RR0705_103_13_0g.slim

653	-2822
559	-2795
466	-2764
373	-2727
280	-2687
186	-2646
93	-2601
0	-2556
0	-6000

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_103_13_1g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 103PC Site 13
Author: Jason R. Patton
Company: Oregon State University
Date Created: 4/01/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 103PC Site 13		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	4/01/2013		File Name: RR0705_103_13_1g.slim

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364837910
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.001458
Center: 288.809, -2342.892
Radius: 350.852
Left Slip Surface Endpoint: 16.307, -2563.891
Right Slip Surface Endpoint: 295.532, -2693.680
Left Slope Intercept: 16.307 -0.000
Right Slope Intercept: 295.532 -0.000
Resisting Moment=78289.4 kN-m
Driving Moment=5.36983e+007 kN-m
Resisting Horizontal Force=233.609 kN

Driving Horizontal Force=160231 kN
Total Slice Area=741390 m2

Method: gle/morgenstern-price

FS: 0.001852
Center: 591.412, -1975.609
Radius: 817.114
Left Slip Surface Endpoint: 32.615, -2571.781
Right Slip Surface Endpoint: 548.841, -2791.614
Left Slope Intercept: 32.615 -0.000
Right Slope Intercept: 548.841 -0.000
Resisting Moment=508491 kN-m
Driving Moment=2.74536e+008 kN-m
Resisting Horizontal Force=630.499 kN
Driving Horizontal Force=340409 kN
Total Slice Area=1.40303e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1319
Number of Invalid Surfaces: 85

Error Codes:

Error Code -108 reported for 57 surfaces
Error Code -111 reported for 4 surfaces
Error Code -112 reported for 24 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1386
Number of Invalid Surfaces: 18

Error Codes:

Error Code -108 reported for 8 surfaces
Error Code -111 reported for 2 surfaces
Error Code -112 reported for 8 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving

force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.00145795

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	11.169	295945	basement	5.551	27.1	489.708	0.71397	26527.3	26536.7	-9.40604
2	11.169	297827	basement	5.551	27.1	541.445	0.7894	26769	26778.3	-9.29287
3	11.169	299511	basement	5.551	27.1	592.332	0.86359	26981.4	26990.6	-9.18636
4	11.169	301021	basement	5.551	27.1	641.503	0.93528	27168.4	27177.4	-8.97045
5	11.169	302380	basement	5.551	27.1	688.206	1.00337	27332.8	27341.7	-8.88735
6	11.169	303601	basement	5.551	27.1	731.678	1.06675	27477.1	27485.8	-8.7123
7	11.169	304698	basement	5.551	27.1	771.158	1.12431	27603	27611.6	-8.60545
8	11.169	305680	basement	5.551	27.1	805.803	1.17482	27712	27720.5	-8.50748
9	11.169	306557	basement	5.551	27.1	834.658	1.21689	27805.4	27813.9	-8.50345
10	11.169	307336	basement	5.551	27.1	856.593	1.24887	27884.2	27892.7	-8.46929
11	11.169	308022	basement	5.551	27.1	870.222	1.26874	27949.4	27957.8	-8.40481
12	11.169	308620	basement	5.551	27.1	873.802	1.27396	28001.6	28009.9	-8.30078
13	11.169	309134	basement	5.551	27.1	865.091	1.26126	28041.4	28049.8	-8.43573
14	11.169	309569	basement	5.551	27.1	841.106	1.22629	28069.4	28077.9	-8.48484
15	11.169	309927	basement	5.551	27.1	797.798	1.16315	28086.1	28094.7	-8.61677
16	11.169	310222	basement	5.551	27.1	830.09	1.21023	28094.8	28103.3	-8.48713
17	11.169	310468	basement	5.551	27.1	787.853	1.14865	28098.3	28106.9	-8.61345
18	11.169	310644	basement	5.551	27.1	687.362	1.00214	28091.6	28100.4	-8.83847
19	11.169	310752	basement	5.551	27.1	535.149	0.78022	28074.5	28083.9	-9.36809
20	11.169	310793	basement	5.551	27.1	304.51	0.44396	28047.5	28057.5	-9.99131
21	11.169	310769	basement	5.551	27.1	0	0	28004.9	28021.4	-16.5127
22	11.169	310681	basement	5.551	27.1	0	0	27923.8	27975.8	-52.0396
23	11.169	310528	basement	5.551	27.1	0	0	27831.4	27920.8	-89.4395
24	11.169	310312	basement	5.551	27.1	0	0	27728.7	27856.4	-127.692
25	11.169	310036	basement	5.551	27.1	0	0	27511.4	27783.6	-272.185

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00185218

Slice	Width	Weight	Base	Base Cohesion	Base Friction Angle	Shear Stress	Shear Strength	Base Normal Stress	Pore Pressure	Effective Normal Stress

				[kPa]	[degrees]	[kPa]	[kPa]	[kPa]	[kPa]	[kPa]
1	20.649	549472	basement	5.551	27.1	112.165	0.20775	26644.5	26654.9	-10.3972
2	20.649	554256	basement	5.551	27.1	294.847	0.54611	26960.3	26970	-9.73555
3	20.649	558654	basement	5.551	27.1	466.58	0.86419	27245.2	27254.3	-9.13631
4	20.649	562696	basement	5.551	27.1	622.931	1.15378	27501.5	27510.1	-8.56976
5	20.649	566406	basement	5.551	27.1	759.883	1.40744	27731.4	27739.5	-8.05329
6	20.649	569806	basement	5.551	27.1	873.97	1.61875	27936.6	27944.2	-7.63399
7	20.649	572916	basement	5.551	27.1	962.336	1.78242	28118.4	28125.7	-7.32783
8	20.649	575769	basement	5.551	27.1	1055.24	1.95449	28280.8	28287.8	-7.03242
9	20.649	578445	basement	5.551	27.1	1135.89	2.10387	28433.9	28440.7	-6.75507
10	20.649	580883	basement	5.551	27.1	1169.32	2.16579	28568.5	28575.2	-6.65631
11	20.649	583083	basement	5.551	27.1	1173.78	2.17405	28684	28690.6	-6.57658
12	20.649	585054	basement	5.551	27.1	1149.93	2.12988	28781.1	28787.8	-6.71463
13	20.649	586812	basement	5.551	27.1	1111.09	2.05794	28861.6	28868.4	-6.83234
14	20.649	588363	basement	5.551	27.1	1038.27	1.92306	28925.8	28932.9	-7.06382
15	20.649	589708	basement	5.551	27.1	942.209	1.74514	28973.5	28981	-7.46662
16	20.649	590851	basement	5.551	27.1	825.616	1.52919	29005.1	29013	-7.88111
17	20.649	591809	basement	5.551	27.1	731.403	1.35469	29022.5	29030.7	-8.15115
18	20.649	592633	basement	5.551	27.1	638.55	1.18271	29032.6	29041.1	-8.50306
19	20.649	593278	basement	5.551	27.1	501.155	0.92823	29028.8	29037.8	-8.99154
20	20.649	593740	basement	5.551	27.1	356.493	0.66029	29010.3	29019.8	-9.52971
21	20.649	594020	basement	5.551	27.1	208.932	0.38698	28977.3	28987.4	-10.1282
22	20.649	594200	basement	5.551	27.1	221.652	0.41054	28941.4	28951.5	-10.0812
23	20.649	594279	basement	5.551	27.1	115.793	0.21447	28901.4	28911.8	-10.4069
24	20.649	594182	basement	5.551	27.1	17.4497	0.03232	28847.4	28858.2	-10.7599
25	20.649	593913	basement	5.551	27.1	0	0	28777.1	28790.8	-13.7396

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.00145795

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	16.3074	-2563.89	3.38537e+007	0	0
2	27.4764	-2576.99	202458	-3055	-0.864502
3	38.6453	-2588.89	376561	-5682.15	-0.864504
4	49.8143	-2599.76	525731	-7933.07	-0.864505
5	60.9833	-2609.71	652551	-9846.71	-0.864503
6	72.1523	-2618.86	759025	-11453.4	-0.864506
7	83.3213	-2627.27	846751	-12777.1	-0.864502

8	94.4902	-2635.02	917020	-13837.4	-0.864501
9	105.659	-2642.15	970898	-14650.4	-0.864501
10	116.828	-2648.7	1.00928e+006	-15229.6	-0.864503
11	127.997	-2654.72	1.03292e+006	-15586.3	-0.864502
12	139.166	-2660.23	1.04246e+006	-15730.3	-0.864505
13	150.335	-2665.26	1.03849e+006	-15670.3	-0.864499
14	161.504	-2669.83	1.0215e+006	-15413.9	-0.864498
15	172.673	-2673.97	991947	-14968.1	-0.864506
16	183.842	-2677.67	950268	-14339.1	-0.864501
17	195.011	-2680.97	908053	-13702.1	-0.864501
18	206.18	-2683.88	857173	-12934.4	-0.864505
19	217.349	-2686.39	795356	-12001.6	-0.864505
20	228.518	-2688.53	723060	-10910.7	-0.864506
21	239.687	-2690.29	640875	-9670.53	-0.864503
22	250.856	-2691.69	549328	-8289.13	-0.864504
23	262.025	-2692.72	446666	-6740.01	-0.864505
24	273.194	-2693.4	332966	-5024.32	-0.864504
25	284.363	-2693.72	209018	-3154	-0.864505
26	295.532	-2693.68	3.7368e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00185218

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	32.6148	-2571.78	3.40624e+007	0	0
2	53.2638	-2590.48	233304	-449.929	-0.110495
3	73.9129	-2607.96	438980	-1679.81	-0.219248
4	94.5619	-2624.31	618193	-3501.68	-0.324542
5	115.211	-2639.62	771979	-5722.52	-0.424714
6	135.86	-2653.95	901274	-8151.4	-0.518187
7	156.509	-2667.37	1.00695e+006	-10606.3	-0.60348
8	177.158	-2679.93	1.0898e+006	-12920.6	-0.679263
9	197.807	-2691.68	1.16568e+006	-15144.2	-0.744329
10	218.456	-2702.64	1.23176e+006	-17149.3	-0.797655
11	239.105	-2712.87	1.27744e+006	-18694	-0.838404
12	259.754	-2722.39	1.30331e+006	-19699	-0.865936
13	280.403	-2731.22	1.30999e+006	-20117.2	-0.879808
14	301.052	-2739.39	1.30121e+006	-19982.3	-0.879805
15	321.701	-2746.93	1.27415e+006	-19258.2	-0.865934
16	342.35	-2753.84	1.22922e+006	-17988.4	-0.838406
17	362.999	-2760.15	1.16676e+006	-16244.5	-0.797663

18	383.649	-2765.87	1.09633e+006	-14243.2	-0.744328
19	404.298	-2771.01	1.01768e+006	-12065.6	-0.679266
20	424.947	-2775.59	922376	-9715.57	-0.603486
21	445.596	-2779.61	810533	-7330.71	-0.518187
22	466.245	-2783.08	682666	-5060.46	-0.424714
23	486.894	-2786.01	574342	-3253.28	-0.32454
24	507.543	-2788.41	449784	-1721.15	-0.219248
25	528.192	-2790.27	308883	-595.686	-0.110496
26	548.841	-2791.61	4.01345e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.087337
Factor of Safety, standard deviation: 0.093006
Factor of Safety, minimum: 0.000796
Factor of Safety, maximum: 1.163960
Probability of Failure: 99.980% (= 9906 failed surfaces / 9908 valid surfaces), 92 invalid surfaces
Reliability index: -9.81294 (assuming normal distribution)
Reliability index: -3.23553 (assuming lognormal distribution)
* best fit = Beta

Method: gle/morgenstern-price
Factor of Safety, mean: 0.071281
Factor of Safety, standard deviation: 0.085690
Factor of Safety, minimum: 0.000392
Factor of Safety, maximum: 1.186350
Probability of Failure: 99.980% (= 9992 failed surfaces / 9994 valid surfaces), 6 invalid surfaces
Reliability index: -10.83814 (assuming normal distribution)
Reliability index: -3.26594 (assuming lognormal distribution)
* best fit = Beta

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
2087	-6000
2087	0
0	0

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 103PC Site 13		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	4/01/2013		File Name: RR0705_103_13_1g.slim

External Boundary

X	Y
2087	-6000
2087	-3093
2006	-3092
1925	-3091
1843	-3089
1762	-3085
1681	-3081
1598	-3070
1515	-3055
1432	-3033
1349	-3012
1266	-2989
1183	-2969
1094	-2947
1006	-2924
918	-2904
829	-2878
741	-2849
653	-2822
559	-2795
466	-2764
373	-2727
280	-2687
186	-2646
93	-2601
0	-2556
0	-6000

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_103_14_0g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 103PC Site 14
Author: Jason R. Patton
Company: Oregon State University
Date Created: 4/01/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364838232
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 103PC Site 14		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	4/01/2013		File Name: RR0705_103_14_0g.slim

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Global Minimums

Method: spencer

FS: 1.154250
Center: 954.769, -2322.293
Radius: 635.590
Left Slip Surface Endpoint: 501.450, -2767.800
Right Slip Surface Endpoint: 873.421, -2952.656
Left Slope Intercept: 501.450 -0.000
Right Slope Intercept: 873.421 -0.000
Resisting Moment=1.77931e+007 kN-m
Driving Moment=1.54153e+007 kN-m
Resisting Horizontal Force=24948.1 kN
Driving Horizontal Force=21614.2 kN
Total Slice Area=1.07362e+006 m2

Method: gle/morgenstern-price

FS: 1.152690
Center: 955.959, -2320.293
Radius: 638.061
Left Slip Surface Endpoint: 500.932, -2767.588
Right Slip Surface Endpoint: 874.438, -2953.125
Left Slope Intercept: 500.932 -0.000
Right Slope Intercept: 874.438 -0.000
Resisting Moment=1.79812e+007 kN-m
Driving Moment=1.55994e+007 kN-m
Resisting Horizontal Force=25138 kN

Driving Horizontal Force=21808.1 kN
Total Slice Area=1.07814e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2034
Number of Invalid Surfaces: 435

Error Codes:

Error Code -108 reported for 434 surfaces
Error Code -112 reported for 1 surface

Method: gle/morgenstern-price

Number of Valid Surfaces: 2469
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.15425

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	14.8788	425650	basement	5.551	27.1	5.38082	6.21081	28585.1	28583.8	1.2588
2	14.8788	428474	basement	5.551	27.1	20.2182	23.3368	28764.7	28730	34.6942
3	14.8788	431043	basement	5.551	27.1	32.603	37.632	28929.8	28867.1	62.6692
4	14.8788	433420	basement	5.551	27.1	43.742	50.4892	29083.6	28995.8	87.8395
5	14.8788	435620	basement	5.551	27.1	53.7807	62.0764	29227.3	29116.9	110.43
6	14.8788	437655	basement	5.551	27.1	62.74	72.4177	29361.4	29230.8	130.624
7	14.8788	439524	basement	5.551	27.1	70.753	81.6666	29486.7	29337.9	148.775

8	14.8788	441182	basement	5.551	27.1	76.199	87.9527	29599.8	29438.7	161.071
9	14.8788	442693	basement	5.551	27.1	79.9683	92.3034	29703.1	29533.5	169.552
10	14.8788	444072	basement	5.551	27.1	82.6708	95.4228	29798.3	29622.7	175.606
11	14.8788	445327	basement	5.551	27.1	84.3193	97.3256	29885.7	29706.4	179.297
12	14.8788	446463	basement	5.551	27.1	84.9112	98.0088	29965.5	29784.9	180.631
13	14.8788	447490	basement	5.551	27.1	84.5772	97.6232	30038.3	29858.4	179.861
14	14.8788	448408	basement	5.551	27.1	83.3306	96.1844	30104.2	29927	177.161
15	14.8788	449220	basement	5.551	27.1	81.0645	93.5687	30163.1	29991.1	171.973
16	14.8788	449929	basement	5.551	27.1	77.7811	89.7788	30215.3	30050.7	164.565
17	14.8788	450537	basement	5.551	27.1	73.4806	84.815	30260.7	30105.8	154.941
18	14.8788	451073	basement	5.551	27.1	68.3004	78.8357	30300	30156.8	143.175
19	14.8788	451544	basement	5.551	27.1	63.388	73.1656	30335.6	30203.5	132.138
20	14.8788	451921	basement	5.551	27.1	57.5011	66.3706	30365.1	30246.3	118.797
21	14.8788	452207	basement	5.551	27.1	50.6084	58.4148	30388.3	30285	103.297
22	14.8788	452403	basement	5.551	27.1	42.7004	49.2869	30405.3	30319.8	85.509
23	14.8788	452519	basement	5.551	27.1	33.7494	38.9552	30416.1	30350.8	65.3466
24	14.8788	452571	basement	5.551	27.1	24.5227	28.3053	30422.5	30378.1	44.4064
25	14.8788	452538	basement	5.551	27.1	14.3868	16.606	30423.1	30401.5	21.6491

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.15269

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	14.9402	427379	basement	5.551	27.1	9.92833	11.4443	28593.4	28581.9	11.5256
2	14.9402	430227	basement	5.551	27.1	22.5735	26.0203	28768.6	28728.6	40.031
3	14.9402	432817	basement	5.551	27.1	33.3998	38.4996	28930.7	28866.3	64.3515
4	14.9402	435213	basement	5.551	27.1	43.3424	49.9603	29082.3	28995.5	86.8132
5	14.9402	437430	basement	5.551	27.1	52.4853	60.4993	29224.4	29117	107.399
6	14.9402	439481	basement	5.551	27.1	60.8498	70.1409	29357.6	29231.4	126.182
7	14.9402	441366	basement	5.551	27.1	68.5479	79.0145	29482.5	29338.9	143.574
8	14.9402	443037	basement	5.551	27.1	74.0583	85.3663	29596.1	29440.1	155.965
9	14.9402	444559	basement	5.551	27.1	78.139	90.07	29700.5	29535.3	165.164
10	14.9402	445949	basement	5.551	27.1	81.3224	93.7395	29797.1	29624.7	172.388
11	14.9402	447214	basement	5.551	27.1	83.5741	96.335	29886.2	29708.8	177.38
12	14.9402	448358	basement	5.551	27.1	84.8339	97.7872	29967.8	29787.5	180.268
13	14.9402	449393	basement	5.551	27.1	85.1792	98.1852	30042.3	29861.3	181.011
14	14.9402	450318	basement	5.551	27.1	84.5878	97.5035	30110	29930.3	179.663
15	14.9402	451136	basement	5.551	27.1	82.8885	95.5447	30170.4	29994.5	175.883
16	14.9402	451850	basement	5.551	27.1	80.0318	92.2519	30223.7	30054.3	169.409
17	14.9402	452463	basement	5.551	27.1	75.9709	87.5709	30269.9	30109.7	160.239
18	14.9402	453004	basement	5.551	27.1	70.853	81.6716	30309.5	30160.8	148.737

19	14.9402	453478	basement	5.551	27.1	65.8375	75.8902	30345.2	30207.7	137.459
20	14.9402	453858	basement	5.551	27.1	59.566	68.6611	30373.9	30250.6	123.32
21	14.9402	454145	basement	5.551	27.1	52.0088	59.95	30395.8	30289.5	106.258
22	14.9402	454342	basement	5.551	27.1	43.1473	49.7355	30410.7	30324.4	86.3368
23	14.9402	454460	basement	5.551	27.1	33.1533	38.2155	30419.3	30355.5	63.8274
24	14.9402	454512	basement	5.551	27.1	22.5971	26.0475	30422.9	30382.8	40.0926
25	14.9402	454478	basement	5.551	27.1	10.8134	12.4645	30419.9	30406.4	13.4671

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.15425

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	501.45	-2767.8	3.94527e+007	0	0
2	516.329	-2782.45	244492	258.024	0.0604669
3	531.208	-2796.18	444260	468.849	0.060467
4	546.087	-2809.07	616834	650.975	0.060467
5	560.966	-2821.19	768152	810.668	0.060467
6	575.844	-2832.58	899492	949.278	0.060467
7	590.723	-2843.3	1.01195e+006	1067.96	0.060467
8	605.602	-2853.38	1.09101e+006	1151.4	0.0604672
9	620.481	-2862.87	1.13803e+006	1201.02	0.0604671
10	635.36	-2871.79	1.16849e+006	1233.17	0.0604673
11	650.239	-2880.18	1.18303e+006	1248.51	0.060467
12	665.117	-2888.05	1.18222e+006	1247.65	0.0604668
13	679.996	-2895.42	1.16736e+006	1231.97	0.0604669
14	694.875	-2902.32	1.1403e+006	1203.41	0.0604668
15	709.754	-2908.76	1.09926e+006	1160.1	0.0604669
16	724.633	-2914.76	1.04462e+006	1102.44	0.0604671
17	739.512	-2920.32	976697	1030.76	0.0604672
18	754.39	-2925.47	895791	945.371	0.0604669
19	769.269	-2930.21	821141	866.59	0.060467
20	784.148	-2934.55	734924	775.6	0.0604669
21	799.027	-2938.51	636546	671.777	0.0604669
22	813.906	-2942.08	526204	555.328	0.0604669
23	828.785	-2945.27	404076	426.441	0.060467
24	843.663	-2948.1	278598	294.018	0.060467
25	858.542	-2950.56	144952	152.975	0.060467
26	873.421	-2952.66	4.48986e+007	0	0

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 103PC Site 14		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	4/01/2013		File Name: RR0705_103_14_0g.slim

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.15269

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	500.932	-2767.59	3.94466e+007	0	0
2	515.872	-2782.29	245464	40.752	0.00951226
3	530.813	-2796.08	446727	147.162	0.0188745
4	545.753	-2809.02	619926	302.294	0.0279391
5	560.693	-2821.18	771771	492.502	0.036563
6	575.633	-2832.62	903551	703.503	0.0446104
7	590.574	-2843.38	1.01637e+006	921.614	0.0519541
8	605.514	-2853.5	1.0959e+006	1118.53	0.0584789
9	620.454	-2863.03	1.14302e+006	1278.38	0.0640809
10	635.394	-2871.98	1.17352e+006	1406.53	0.0686722
11	650.334	-2880.4	1.18803e+006	1496.68	0.0721812
12	665.275	-2888.29	1.18713e+006	1544.66	0.0745516
13	680.215	-2895.69	1.17217e+006	1549.62	0.0757455
14	695.155	-2902.62	1.14491e+006	1513.59	0.0757459
15	710.095	-2909.08	1.10362e+006	1435.99	0.0745511
16	725.036	-2915.1	1.04866e+006	1321.1	0.0721811
17	739.976	-2920.69	980355	1175.02	0.0686727
18	754.916	-2925.85	899009	1005.47	0.0640807
19	769.856	-2930.61	824644	841.669	0.0584786
20	784.796	-2934.97	737956	669.158	0.0519542
21	799.737	-2938.93	639055	497.567	0.0446104
22	814.677	-2942.52	528138	337.029	0.0365631
23	829.617	-2945.72	405388	197.679	0.0279391
24	844.557	-2948.55	279940	92.2185	0.0188745
25	859.497	-2951.02	145640	24.1791	0.00951222
26	874.438	-2953.13	4.49129e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.161789
Factor of Safety, standard deviation: 0.190197
Factor of Safety, minimum: 0.613745
Factor of Safety, maximum: 1.819830
Probability of Failure: 20.150% (= 2015 failed surfaces / 10000 valid surfaces)
Reliability index: 0.85064 (assuming normal distribution)

Reliability index: 0.84079 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 1.161129
Factor of Safety, standard deviation: 0.191001
Factor of Safety, minimum: 0.615449
Factor of Safety, maximum: 1.818970
Probability of Failure: 20.450% (= 2045 failed surfaces / 10000 valid surfaces)
Reliability index: 0.84360 (assuming normal distribution)
Reliability index: 0.83258 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
1515	-6000
1515	0
0	0

External Boundary

X	Y
1515	-6000
1515	-3092
1429	-3092
1343	-3090
1256	-3086
1170	-3071
1084	-3045
998	-3009
911	-2970
833	-2934
755	-2896
676	-2854
598	-2812
519	-2775
441	-2743

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 103PC Site 14		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 4/01/2013		File Name: RR0705_103_14_0g.slim

353	-2707
265	-2673
176	-2644
88	-2618
0	-2597
0	-6000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 103PC Site 14		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	4/01/2013		File Name: RR0705_103_14_1g.slim

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_103_14_1g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 103PC Site 14
Author: Jason R. Patton
Company: Oregon State University
Date Created: 4/01/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364838404
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.001921
Center: 950.233, -2743.763
Radius: 245.518
Left Slip Surface Endpoint: 759.277, -2898.083
Right Slip Surface Endpoint: 953.950, -2989.253
Left Slope Intercept: 759.277 -0.000
Right Slope Intercept: 953.950 -0.000
Resisting Moment=35740.9 kN-m
Driving Moment=1.86075e+007 kN-m
Resisting Horizontal Force=152.002 kN

Driving Horizontal Force=79135.4 kN
Total Slice Area=576635 m2

Method: gle/morgenstern-price

FS: 0.001346
Center: 1272.542, -2153.602
Radius: 929.267
Left Slip Surface Endpoint: 640.662, -2834.972
Right Slip Surface Endpoint: 1233.295, -3082.040
Left Slope Intercept: 640.662 -0.000
Right Slope Intercept: 1233.295 -0.000
Resisting Moment=411437 kN-m
Driving Moment=3.05698e+008 kN-m
Resisting Horizontal Force=446.147 kN
Driving Horizontal Force=331488 kN
Total Slice Area=1.77791e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1460
Number of Invalid Surfaces: 88

Error Codes:

Error Code -108 reported for 75 surfaces
Error Code -112 reported for 13 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1532
Number of Invalid Surfaces: 16

Error Codes:

Error Code -108 reported for 10 surfaces
Error Code -112 reported for 6 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This

screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.00192078

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	7.78692	232926	basement	5.551	27.1	259.353	0.49816	29930.3	29940.2	-9.89464
2	7.78692	233844	basement	5.551	27.1	295.765	0.5681	30099.3	30109	-9.69081
3	7.78692	234665	basement	5.551	27.1	332.152	0.63799	30247.8	30257.4	-9.56955
4	7.78692	235401	basement	5.551	27.1	367.981	0.70681	30378.5	30388	-9.50896
5	7.78692	236064	basement	5.551	27.1	402.805	0.7737	30493.5	30502.9	-9.3533
6	7.78692	236660	basement	5.551	27.1	436.187	0.83782	30594.4	30603.6	-9.18283
7	7.78692	237195	basement	5.551	27.1	467.711	0.89837	30682.6	30691.6	-9.03549
8	7.78692	237675	basement	5.551	27.1	496.913	0.95446	30758.8	30767.8	-9.00706
9	7.78692	238103	basement	5.551	27.1	523.293	1.00513	30824.3	30833.2	-8.88185
10	7.78692	238485	basement	5.551	27.1	556.201	1.06834	30880	30888.8	-8.79161
11	7.78692	238828	basement	5.551	27.1	588.553	1.13048	30928.6	30937.2	-8.58745
12	7.78692	239129	basement	5.551	27.1	608.982	1.16972	30968.5	30977	-8.50512
13	7.78692	239390	basement	5.551	27.1	624.423	1.19938	30999.7	31008.2	-8.48527
14	7.78692	239612	basement	5.551	27.1	633.649	1.2171	31022.8	31031.3	-8.53911
15	7.78692	239797	basement	5.551	27.1	634.997	1.21969	31037.9	31046.4	-8.5057
16	7.78692	239946	basement	5.551	27.1	626.136	1.20267	31045.5	31053.9	-8.42742
17	7.78692	240060	basement	5.551	27.1	603.656	1.15949	31045.5	31054.1	-8.60062
18	7.78692	240140	basement	5.551	27.1	562.35	1.08015	31038.4	31047.1	-8.73757
19	7.78692	240187	basement	5.551	27.1	493.836	0.94855	31024.1	31033.1	-9.03362
20	7.78692	240203	basement	5.551	27.1	399.588	0.76752	31003.2	31012.5	-9.31587
21	7.78692	240190	basement	5.551	27.1	248.102	0.47655	30976.6	30986.4	-9.84991
22	7.78692	240146	basement	5.551	27.1	0	0	30940.4	30953.9	-13.4506
23	7.78692	240071	basement	5.551	27.1	0	0	30877.7	30914.7	-36.955
24	7.78692	239966	basement	5.551	27.1	0	0	30807.3	30869.1	-61.8433
25	7.78692	239830	basement	5.551	27.1	0	0	30696.1	30817	-120.92

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00134589

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	23.7053	695356	basement	5.551	27.1	147.806	0.19893	29366.5	29377	-10.482
2	23.7053	701406	basement	5.551	27.1	392.432	0.52817	29702.7	29712.5	-9.80921

3	23.7053	706965	basement	5.551	27.1	614.174	0.82661	30005.5	30014.7	-9.21832
4	23.7053	712059	basement	5.551	27.1	801.224	1.07836	30276	30284.7	-8.73205
5	23.7053	716721	basement	5.551	27.1	957.448	1.28862	30516.4	30524.8	-8.36049
6	23.7053	721066	basement	5.551	27.1	1130.52	1.52156	30739.5	30747.3	-7.84556
7	23.7053	725075	basement	5.551	27.1	1224.06	1.64745	30941.4	30949	-7.63627
8	23.7053	728723	basement	5.551	27.1	1266.57	1.70466	31118	31125.5	-7.50883
9	23.7053	732059	basement	5.551	27.1	1318.36	1.77437	31274.5	31281.9	-7.35422
10	23.7053	735116	basement	5.551	27.1	1288.35	1.73398	31413.9	31421.4	-7.49298
11	23.7053	737859	basement	5.551	27.1	1200.3	1.61547	31531.4	31539.1	-7.73928
12	23.7053	740308	basement	5.551	27.1	1091.63	1.46922	31628.7	31636.7	-8.00378
13	23.7053	742497	basement	5.551	27.1	939.386	1.26431	31709.4	31717.8	-8.42372
14	23.7053	744408	basement	5.551	27.1	728.611	0.98063	31770.8	31779.7	-8.92984
15	23.7053	746046	basement	5.551	27.1	481.822	0.64848	31813.1	31822.7	-9.57736
16	23.7053	747459	basement	5.551	27.1	334.73	0.45051	31842.1	31852	-9.94321
17	23.7053	748667	basement	5.551	27.1	66.2758	0.0892	31859	31869.7	-10.6639
18	23.7053	749621	basement	5.551	27.1	0	0	31826.8	31869.8	-43.0449
19	23.7053	750343	basement	5.551	27.1	0	0	31798.5	31854.6	-56.1253
20	23.7053	751081	basement	5.551	27.1	0	0	31820.2	31853.6	-33.4476
21	23.7053	751670	basement	5.551	27.1	0	0	31795.7	31846.7	-51.0431
22	23.7053	752022	basement	5.551	27.1	0	0	31762.6	31823.3	-60.6733
23	23.7053	752230	basement	5.551	27.1	0	0	31753.9	31794.5	-40.5878
24	23.7053	752496	basement	5.551	27.1	0	0	31753.6	31784.3	-30.7226
25	23.7053	752554	basement	5.551	27.1	0	0	31734.1	31760.8	-26.6673

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.00192078

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	759.277	-2898.08	4.32543e+007	0	0
2	767.063	-2907.25	160250	-1142.08	-0.408332
3	774.85	-2915.58	297072	-2117.21	-0.408336
4	782.637	-2923.18	413472	-2946.78	-0.408335
5	790.424	-2930.15	511720	-3646.98	-0.408335
6	798.211	-2936.55	593579	-4230.38	-0.408335
7	805.998	-2942.45	660449	-4706.96	-0.408335
8	813.785	-2947.87	713464	-5084.79	-0.408335
9	821.572	-2952.87	753555	-5370.52	-0.408335
10	829.359	-2957.47	781500	-5569.68	-0.408335

11	837.146	-2961.69	801127	-5709.56	-0.408335
12	844.933	-2965.55	812627	-5791.52	-0.408335
13	852.72	-2969.09	813689	-5799.09	-0.408335
14	860.507	-2972.3	804723	-5735.19	-0.408335
15	868.293	-2975.2	786087	-5602.37	-0.408335
16	876.08	-2977.82	758097	-5402.89	-0.408335
17	883.867	-2980.14	721040	-5138.78	-0.408334
18	891.654	-2982.19	675178	-4811.94	-0.408336
19	899.441	-2983.97	620769	-4424.17	-0.408335
20	907.228	-2985.49	558076	-3977.36	-0.408335
21	915.015	-2986.74	488964	-3484.8	-0.408335
22	922.802	-2987.74	413696	-2948.37	-0.408334
23	930.589	-2988.49	331239	-2360.71	-0.408335
24	938.376	-2988.99	240554	-1714.4	-0.408333
25	946.163	-2989.25	141684	-1009.77	-0.408335
26	953.95	-2989.25	4.60185e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00134589

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	640.662	-2834.97	4.13909e+007	0	0
2	664.367	-2856.21	249969	-815.714	-0.18697
3	688.072	-2876.05	466146	-3018.33	-0.370989
4	711.778	-2894.6	650117	-6231.21	-0.549149
5	735.483	-2911.96	801044	-10047.7	-0.718638
6	759.188	-2928.2	925755	-14167.8	-0.876789
7	782.894	-2943.4	1.04571e+006	-18638	-1.02109
8	806.599	-2957.61	1.1369e+006	-22808	-1.14929
9	830.304	-2970.89	1.20046e+006	-26390.4	-1.25936
10	854.01	-2983.28	1.25319e+006	-29523.6	-1.34957
11	877.715	-2994.82	1.28255e+006	-31759	-1.41849
12	901.42	-3005.54	1.28747e+006	-32927.8	-1.46505
13	925.126	-3015.48	1.27424e+006	-33111.6	-1.48852
14	948.831	-3024.66	1.24195e+006	-32272.5	-1.48852
15	972.536	-3033.11	1.18763e+006	-30374.2	-1.46505
16	996.242	-3040.84	1.11187e+006	-27532.7	-1.4185
17	1019.95	-3047.88	1.034e+006	-24359.7	-1.34956
18	1043.65	-3054.24	937302	-20605.2	-1.25936
19	1067.36	-3059.93	817586	-16402.1	-1.14929
20	1091.06	-3064.98	700073	-12477.6	-1.02109

21	1114.77	-3069.38	621135	-9505.85	-0.876786
22	1138.47	-3073.15	520305	-6526.33	-0.718639
23	1162.18	-3076.29	397597	-3810.87	-0.549149
24	1185.88	-3078.82	317682	-2057.01	-0.370988
25	1209.59	-3080.73	248973	-812.463	-0.18697
26	1233.29	-3082.04	4.89197e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.084351
Factor of Safety, standard deviation: 0.096272
Factor of Safety, minimum: 0.000547
Factor of Safety, maximum: 1.288630
Probability of Failure: 99.960% (= 9986 failed surfaces / 9990 valid surfaces), 10 invalid surfaces
Reliability index: -9.51105 (assuming normal distribution)
Reliability index: -3.16425 (assuming lognormal distribution)
* best fit = Beta

Method: gle/morgenstern-price
Factor of Safety, mean: 0.065207
Factor of Safety, standard deviation: 0.084150
Factor of Safety, minimum: 0.000293
Factor of Safety, maximum: 1.211670
Probability of Failure: 99.970% (= 9971 failed surfaces / 9974 valid surfaces), 26 invalid surfaces
Reliability index: -11.10865 (assuming normal distribution)
Reliability index: -3.25247 (assuming lognormal distribution)
* best fit = Beta

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
1515	-6000
1515	0
0	0

External Boundary

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 103PC Site 14		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 4/01/2013		File Name: RR0705_103_14_1g.slim

X	Y
1515	-6000
1515	-3092
1429	-3092
1343	-3090
1256	-3086
1170	-3071
1084	-3045
998	-3009
911	-2970
833	-2934
755	-2896
676	-2854
598	-2812
519	-2775
441	-2743
353	-2707
265	-2673
176	-2644
88	-2618
0	-2597
0	-6000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 103PC Site 15		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	4/01/2013		File Name: RR0705_103_15_0g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_103_15_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 103PC Site 15
Author: Jason R. Patton
Company: Oregon State University
Date Created: 4/01/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364838678
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 103PC Site 15		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	4/01/2013		File Name: RR0705_103_15_0g.sli

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Global Minimums

Method: spencer

FS: 1.636090
Center: 1905.853, -1917.263
Radius: 1039.473
Left Slip Surface Endpoint: 1337.583, -2787.649
Right Slip Surface Endpoint: 1820.491, -2953.225
Left Slope Intercept: 1337.583 -0.000
Right Slope Intercept: 1820.491 -0.000
Resisting Moment=3.49431e+007 kN-m
Driving Moment=2.13577e+007 kN-m
Resisting Horizontal Force=31680.5 kN
Driving Horizontal Force=19363.5 kN
Total Slice Area=1.39701e+006 m2

Method: gle/morgenstern-price

FS: 1.637870
Center: 1907.166, -1913.894
Radius: 1043.181
Left Slip Surface Endpoint: 1337.019, -2787.483
Right Slip Surface Endpoint: 1821.768, -2953.573
Left Slope Intercept: 1337.019 -0.000
Right Slope Intercept: 1821.768 -0.000
Resisting Moment=3.53114e+007 kN-m
Driving Moment=2.15593e+007 kN-m
Resisting Horizontal Force=31872.9 kN

Driving Horizontal Force=19459.9 kN
Total Slice Area=1.40242e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2294
Number of Invalid Surfaces: 616

Error Codes:

Error Code -108 reported for 616 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2905
Number of Invalid Surfaces: 5

Error Codes:

Error Code -108 reported for 5 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.63609

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	19.3164	556208	basement	5.551	27.1	6.03629	9.87591	28784.6	28776.2	8.43625
2	19.3164	559282	basement	5.551	27.1	15.5082	25.3728	28938.7	28900	38.6794
3	19.3164	562142	basement	5.551	27.1	23.9294	39.1506	29083.5	29017.8	65.6724
4	19.3164	564798	basement	5.551	27.1	30.9985	50.7163	29218.2	29130	88.2098
5	19.3164	567289	basement	5.551	27.1	37.3582	61.1213	29345.2	29236.6	108.622
6	19.3164	569623	basement	5.551	27.1	43.016	70.3781	29464.7	29338	126.664
7	19.3164	571797	basement	5.551	27.1	47.9612	78.4688	29576.7	29434.2	142.466

8	19.3164	573788	basement	5.551	27.1	51.7231	84.6236	29679.9	29525.4	154.494
9	19.3164	575627	basement	5.551	27.1	54.6313	89.3817	29775.5	29611.7	163.803
10	19.3164	577324	basement	5.551	27.1	56.8516	93.0143	29864.2	29693.3	170.948
11	19.3164	578884	basement	5.551	27.1	58.3879	95.5279	29946.2	29770.3	175.873
12	19.3164	580300	basement	5.551	27.1	59.1567	96.7857	30021.1	29842.8	178.293
13	19.3164	581570	basement	5.551	27.1	58.9928	96.5176	30088.6	29910.9	177.738
14	19.3164	582712	basement	5.551	27.1	58.1403	95.1227	30149.7	29974.7	174.995
15	19.3164	583727	basement	5.551	27.1	56.6076	92.6152	30204.3	30034.2	170.115
16	19.3164	584617	basement	5.551	27.1	54.3951	88.9952	30252.6	30089.5	163.095
17	19.3164	585385	basement	5.551	27.1	51.5021	84.2621	30294.6	30140.8	153.781
18	19.3164	586033	basement	5.551	27.1	47.9274	78.4136	30330.3	30188	142.324
19	19.3164	586562	basement	5.551	27.1	43.669	71.4464	30359.9	30231.2	128.737
20	19.3164	586973	basement	5.551	27.1	38.724	63.3559	30383.4	30270.4	112.994
21	19.3164	587290	basement	5.551	27.1	33.2779	54.4456	30401.3	30305.8	95.5468
22	19.3164	587540	basement	5.551	27.1	27.9851	45.7862	30416	30337.3	78.6594
23	19.3164	587677	basement	5.551	27.1	22.0704	36.1092	30424.8	30365	59.7666
24	19.3164	587701	basement	5.551	27.1	15.4627	25.2984	30427.5	30388.9	38.6109
25	19.3164	587617	basement	5.551	27.1	8.12884	13.2995	30424.2	30409.1	15.1154

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.63787

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	19.39	558300	basement	5.551	27.1	7.36971	12.0706	28787.4	28774.7	12.7431
2	19.39	561395	basement	5.551	27.1	16.211	26.5515	28939.9	28898.9	41.0299
3	19.39	564278	basement	5.551	27.1	24.0316	39.3606	29083.2	29017.1	66.1024
4	19.39	566952	basement	5.551	27.1	30.7049	50.2906	29217.1	29129.7	87.4028
5	19.39	569461	basement	5.551	27.1	36.7679	60.2211	29343.5	29236.7	106.828
6	19.39	571811	basement	5.551	27.1	42.2308	69.1685	29462.7	29338.4	124.293
7	19.39	574001	basement	5.551	27.1	47.086	77.1208	29574.7	29434.9	139.844
8	19.39	576006	basement	5.551	27.1	50.8703	83.3189	29678.4	29526.4	151.963
9	19.39	577857	basement	5.551	27.1	53.8781	88.2454	29774.6	29613	161.62
10	19.39	579566	basement	5.551	27.1	56.2634	92.1521	29864.1	29694.9	169.229
11	19.39	581137	basement	5.551	27.1	58.0144	95.0201	29947	29772.1	174.891
12	19.39	582562	basement	5.551	27.1	59.0498	96.7159	30023	29844.9	178.122
13	19.39	583840	basement	5.551	27.1	59.1471	96.8753	30091.6	29913.2	178.415
14	19.39	584989	basement	5.551	27.1	58.5452	95.8895	30153.7	29977.1	176.553
15	19.39	586010	basement	5.551	27.1	57.2345	93.7426	30209.1	30036.8	172.336
16	19.39	586906	basement	5.551	27.1	55.1964	90.4046	30258.1	30092.3	165.808
17	19.39	587679	basement	5.551	27.1	52.4137	85.8468	30300.6	30143.7	156.914
18	19.39	588330	basement	5.551	27.1	48.8699	80.0426	30336.6	30191	145.603

19	19.39	588861	basement	5.551	27.1	44.5507	72.9683	30366.1	30234.4	131.733
20	19.39	589274	basement	5.551	27.1	39.4442	64.6044	30389.1	30273.7	115.424
21	19.39	589595	basement	5.551	27.1	33.814	55.3829	30406.6	30309.2	97.3789
22	19.39	589846	basement	5.551	27.1	28.2349	46.2451	30420.3	30340.8	79.4986
23	19.39	589983	basement	5.551	27.1	21.9096	35.8851	30427.8	30368.5	59.3247
24	19.39	590006	basement	5.551	27.1	14.7952	24.2326	30429	30392.5	36.5022
25	19.39	589921	basement	5.551	27.1	6.97576	11.4254	30424.2	30412.7	11.4625

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.63609

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	1337.58	-2787.65	4.00206e+007	0	0
2	1356.9	-2799.96	190192	119.568	0.0360201
3	1376.22	-2811.68	364580	229.201	0.0360202
4	1395.53	-2822.84	504961	317.454	0.0360202
5	1414.85	-2833.46	630425	396.33	0.0360202
6	1434.16	-2843.55	741310	466.04	0.0360202
7	1453.48	-2853.14	837923	526.778	0.0360202
8	1472.8	-2862.23	914717	575.056	0.0360202
9	1492.11	-2870.85	970762	610.289	0.0360201
10	1511.43	-2879	1.01325e+006	637.001	0.0360202
11	1530.75	-2886.7	1.04241e+006	655.33	0.03602
12	1550.06	-2893.95	1.05843e+006	665.404	0.0360202
13	1569.38	-2900.77	1.05569e+006	663.678	0.03602
14	1588.7	-2907.17	1.0395e+006	653.5	0.03602
15	1608.01	-2913.15	1.01067e+006	635.38	0.0360203
16	1627.33	-2918.73	969366	609.412	0.0360202
17	1646.64	-2923.9	915719	575.686	0.0360202
18	1665.96	-2928.68	849862	534.283	0.0360202
19	1685.28	-2933.06	771916	485.281	0.0360202
20	1704.59	-2937.07	681996	428.751	0.0360202
21	1723.91	-2940.69	580206	364.758	0.0360201
22	1743.23	-2943.94	482298	303.207	0.0360202
23	1762.54	-2946.81	376987	237.001	0.0360202
24	1781.86	-2949.31	260157	163.553	0.0360202
25	1801.18	-2951.45	131883	82.9112	0.0360203
26	1820.49	-2953.22	4.49159e+007	0	0

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 103PC Site 15		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	4/01/2013		File Name: RR0705_103_15_0g.sli

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.63787

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	1337.02	-2787.48	4.00158e+007	0	0
2	1356.41	-2799.84	190798	21.5311	0.00646569
3	1375.8	-2811.6	365937	81.9388	0.0128294
4	1395.19	-2822.8	506919	168.019	0.0189908
5	1414.58	-2833.45	632728	274.452	0.0248526
6	1433.97	-2843.58	743900	393.693	0.0303226
7	1453.36	-2853.19	840748	518.196	0.0353143
8	1472.75	-2862.32	917756	636.696	0.0397491
9	1492.14	-2870.96	973884	740.36	0.043557
10	1511.53	-2879.14	1.01641e+006	828.052	0.0466779
11	1530.92	-2886.86	1.04554e+006	895.31	0.0490631
12	1550.31	-2894.14	1.0615e+006	938.824	0.0506742
13	1569.7	-2900.98	1.05853e+006	951.2	0.0514862
14	1589.09	-2907.4	1.04215e+006	936.48	0.0514862
15	1608.48	-2913.4	1.01309e+006	896.004	0.0506739
16	1627.87	-2918.99	971486	831.894	0.049063
17	1647.26	-2924.18	917494	747.47	0.0466781
18	1666.65	-2928.97	851240	647.125	0.0435571
19	1686.04	-2933.37	772846	536.164	0.0397491
20	1705.43	-2937.38	682427	420.615	0.0353143
21	1724.82	-2941.01	580089	307	0.0303226
22	1744.21	-2944.27	482597	209.332	0.0248527
23	1763.6	-2947.15	376723	124.865	0.0189907
24	1782.99	-2949.66	259287	58.0581	0.0128294
25	1802.38	-2951.8	130365	14.7113	0.00646566
26	1821.77	-2953.57	4.49265e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.647874
Factor of Safety, standard deviation: 0.269942
Factor of Safety, minimum: 0.832526
Factor of Safety, maximum: 2.606350
Probability of Failure: 0.420% (= 42 failed surfaces / 10000 valid surfaces)
Reliability index: 2.40005 (assuming normal distribution)

Reliability index: 2.98807 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 1.648666
Factor of Safety, standard deviation: 0.269096
Factor of Safety, minimum: 0.833494
Factor of Safety, maximum: 2.603730
Probability of Failure: 0.410% (= 41 failed surfaces / 10000 valid surfaces)
Reliability index: 2.41053 (assuming normal distribution)
Reliability index: 3.00230 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
3318	-6000
3318	0
0	0

External Boundary

X	Y
3318	-6000
3318	-3030
3229	-3039
3139	-3042
3050	-3045
2961	-3048
2871	-3051
2782	-3055
2693	-3059
2605	-3062
2517	-3061
2430	-3054
2342	-3044
2255	-3032
2167	-3020

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 103PC Site 15		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 4/01/2013		File Name: RR0705_103_15_0g.sli

2079	-3007
1992	-2993
1904	-2976
1816	-2952
1728	-2923
1640	-2891
1552	-2859
1464	-2828
1376	-2799
1288	-2773
1200	-2750
1112	-2726
1024	-2705
936	-2692
848	-2669
763	-2645
678	-2625
594	-2606
509	-2588
424	-2572
339	-2552
254	-2534
170	-2523
85	-2518
0	-2521
0	-6000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 103PC Site 15		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	4/01/2013		File Name: RR0705_103_15_1g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_103_15_1g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 103PC Site 15
Author: Jason R. Patton
Company: Oregon State University
Date Created: 4/01/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364838810
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.011491
Center: 2122.892, -923.187
Radius: 2037.856
Left Slip Surface Endpoint: 1242.735, -2761.169
Right Slip Surface Endpoint: 1724.464, -2921.714
Left Slope Intercept: 1242.735 -0.000
Right Slope Intercept: 1724.464 -0.000
Resisting Moment=3.8075e+006 kN-m
Driving Moment=3.31338e+008 kN-m
Resisting Horizontal Force=1814.54 kN

Driving Horizontal Force=157905 kN
Total Slice Area=1.37417e+006 m2

Method: gle/morgenstern-price

FS: 0.010783
Center: 2396.611, -316.235
Radius: 2703.541
Left Slip Surface Endpoint: 1242.735, -2761.169
Right Slip Surface Endpoint: 1886.350, -2971.186
Left Slope Intercept: 1242.735 -0.000
Right Slope Intercept: 1886.350 -0.000
Resisting Moment=6.63347e+006 kN-m
Driving Moment=6.15201e+008 kN-m
Resisting Horizontal Force=2382.62 kN
Driving Horizontal Force=220969 kN
Total Slice Area=1.85431e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 816
Number of Invalid Surfaces: 27

Error Codes:

Error Code -108 reported for 25 surfaces
Error Code -112 reported for 2 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 842
Number of Invalid Surfaces: 1

Error Codes:

Error Code -108 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with

many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.0114913

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	19.2691	549138	basement	5.551	27.1	90.3074	1.03775	28510.4	28519.3	-8.87063
2	19.2691	551346	basement	5.551	27.1	145.619	1.67335	28666.9	28674.5	-7.55845
3	19.2691	553465	basement	5.551	27.1	194.264	2.23235	28814.7	28821.2	-6.50375
4	19.2691	555459	basement	5.551	27.1	236.817	2.72134	28948.4	28954	-5.56636
5	19.2691	557376	basement	5.551	27.1	279.719	3.21433	29075.4	29079.9	-4.52531
6	19.2691	559222	basement	5.551	27.1	321.267	3.69177	29196.2	29199.8	-3.64966
7	19.2691	560997	basement	5.551	27.1	360.729	4.14525	29310.8	29313.6	-2.77642
8	19.2691	562661	basement	5.551	27.1	386.36	4.43978	29413.2	29415.4	-2.2337
9	19.2691	564227	basement	5.551	27.1	411.694	4.7309	29505.3	29506.9	-1.59267
10	19.2691	565725	basement	5.551	27.1	434.532	4.99333	29591.5	29592.6	-1.09072
11	19.2691	567155	basement	5.551	27.1	454.676	5.22482	29671.9	29672.6	-0.66067
12	19.2691	568513	basement	5.551	27.1	468.01	5.37804	29745.6	29745.9	-0.312198
13	19.2691	569769	basement	5.551	27.1	471.907	5.42282	29808.1	29808.4	-0.270653
14	19.2691	570955	basement	5.551	27.1	473.553	5.44174	29864.3	29864.5	-0.220809
15	19.2691	572076	basement	5.551	27.1	470.918	5.41146	29914.8	29915.1	-0.301764
16	19.2691	573133	basement	5.551	27.1	463.624	5.32764	29959.7	29960.2	-0.489523
17	19.2691	574116	basement	5.551	27.1	446.037	5.12554	29997.4	29998.3	-0.856518
18	19.2691	575023	basement	5.551	27.1	422.869	4.85932	30027.7	30029.1	-1.39249
19	19.2691	575868	basement	5.551	27.1	393.406	4.52075	30052.6	30054.6	-2.03228
20	19.2691	576651	basement	5.551	27.1	356.847	4.10064	30071.9	30074.8	-2.85074
21	19.2691	577372	basement	5.551	27.1	312.462	3.59059	30085.9	30089.7	-3.82306
22	19.2691	578033	basement	5.551	27.1	259.409	2.98095	30094.4	30099.5	-5.07396
23	19.2691	578633	basement	5.551	27.1	196.724	2.26061	30097.6	30104	-6.42898
24	19.2691	579173	basement	5.551	27.1	123.289	1.41675	30095.4	30103.5	-8.11263
25	19.2691	579653	basement	5.551	27.1	19.6827	0.22618	30087.3	30097.8	-10.4591

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.0107826

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	25.7446	734146	basement	5.551	27.1	68.6532	0.74026	28534.2	28543.6	-9.4269
2	25.7446	738011	basement	5.551	27.1	152.667	1.64615	28738.3	28745.9	-7.64788
3	25.7446	741657	basement	5.551	27.1	224.147	2.41689	28924.1	28930.2	-6.13286

4	25.7446	745136	basement	5.551	27.1	290.05	3.12749	29097.4	29102.1	-4.73227
5	25.7446	748485	basement	5.551	27.1	352.806	3.80417	29262.3	29265.8	-3.46894
6	25.7446	751665	basement	5.551	27.1	402.427	4.33921	29414.1	29416.5	-2.36493
7	25.7446	754636	basement	5.551	27.1	440.91	4.75415	29548.6	29550.2	-1.55931
8	25.7446	757482	basement	5.551	27.1	475.295	5.12491	29674.9	29675.7	-0.833948
9	25.7446	760197	basement	5.551	27.1	501.527	5.40777	29792.3	29792.6	-0.281113
10	25.7446	762729	basement	5.551	27.1	513.133	5.53291	29894.8	29894.8	-0.041545
11	25.7446	765125	basement	5.551	27.1	520.48	5.61212	29987.8	29987.7	0.0883341
12	25.7446	767403	basement	5.551	27.1	522.101	5.62961	30073.1	30072.9	0.181199
13	25.7446	769542	basement	5.551	27.1	511.593	5.5163	30148.3	30148.4	-0.0570127
14	25.7446	771544	basement	5.551	27.1	495.596	5.34381	30213.6	30214	-0.375545
15	25.7446	773429	basement	5.551	27.1	473.593	5.10657	30271.4	30272.3	-0.902762
16	25.7446	775201	basement	5.551	27.1	445.456	4.80318	30321.7	30323.2	-1.45942
17	25.7446	776859	basement	5.551	27.1	411.047	4.43215	30364.7	30366.9	-2.23918
18	25.7446	778405	basement	5.551	27.1	370.138	3.99105	30400.3	30403.3	-3.02217
19	25.7446	779840	basement	5.551	27.1	324.035	3.49394	30428.8	30432.8	-4.01111
20	25.7446	781245	basement	5.551	27.1	289.583	3.12246	30459.3	30464	-4.74701
21	25.7446	782585	basement	5.551	27.1	246.797	2.66111	30487.5	30493.2	-5.68466
22	25.7446	783817	basement	5.551	27.1	196.304	2.11667	30508.7	30515.4	-6.74164
23	25.7446	784996	basement	5.551	27.1	152.984	1.64957	30529.3	30536.9	-7.60417
24	25.7446	786215	basement	5.551	27.1	121.494	1.31002	30559.4	30567.7	-8.25571
25	25.7446	787335	basement	5.551	27.1	80.3174	0.86603	30583.4	30592.5	-9.14203

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.0114913

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	1242.74	-2761.17	3.92639e+007	0	0
2	1262	-2770.27	115374	-290.613	-0.144321
3	1281.27	-2779.13	225223	-567.306	-0.14432
4	1300.54	-2787.75	317255	-799.122	-0.14432
5	1319.81	-2796.13	396866	-999.653	-0.14432
6	1339.08	-2804.28	470486	-1185.09	-0.14432
7	1358.35	-2812.19	538043	-1355.26	-0.14432
8	1377.62	-2819.87	597892	-1506.01	-0.14432
9	1396.89	-2827.33	634201	-1597.47	-0.14432
10	1416.16	-2834.57	664093	-1672.76	-0.14432
11	1435.43	-2841.58	687532	-1731.8	-0.14432

12	1454.7	-2848.38	704487	-1774.51	-0.14432
13	1473.97	-2854.96	708367	-1784.28	-0.14432
14	1493.23	-2861.33	699512	-1761.98	-0.14432
15	1512.5	-2867.48	684027	-1722.97	-0.14432
16	1531.77	-2873.43	661918	-1667.28	-0.14432
17	1551.04	-2879.16	633200	-1594.95	-0.14432
18	1570.31	-2884.69	591798	-1490.66	-0.14432
19	1589.58	-2890.02	543488	-1368.97	-0.14432
20	1608.85	-2895.14	488639	-1230.82	-0.144321
21	1628.12	-2900.07	427313	-1076.34	-0.14432
22	1647.39	-2904.79	359584	-905.744	-0.14432
23	1666.66	-2909.32	285544	-719.246	-0.14432
24	1685.93	-2913.64	205299	-517.12	-0.14432
25	1705.19	-2917.78	118976	-299.685	-0.14432
26	1724.46	-2921.71	4.39625e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.0107826

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	1242.74	-2761.17	3.92639e+007	0	0
2	1268.48	-2773.15	150004	-58.667	-0.0224085
3	1294.22	-2784.81	286822	-222.586	-0.0444639
4	1319.97	-2796.15	397103	-456.168	-0.0658179
5	1345.71	-2807.17	499571	-751.014	-0.0861337
6	1371.46	-2817.87	594085	-1089.67	-0.105092
7	1397.2	-2828.27	659667	-1409.14	-0.122392
8	1422.95	-2838.36	712321	-1712.7	-0.137761
9	1448.69	-2848.15	756411	-1992.94	-0.150959
10	1474.44	-2857.64	784994	-2216.45	-0.161776
11	1500.18	-2866.83	794671	-2358.41	-0.170041
12	1525.93	-2875.74	795436	-2438.2	-0.175625
13	1551.67	-2884.35	787262	-2451.82	-0.178439
14	1577.42	-2892.68	761655	-2372.07	-0.178439
15	1603.16	-2900.72	726879	-2228.06	-0.175625
16	1628.9	-2908.48	683041	-2027.12	-0.170041
17	1654.65	-2915.97	630146	-1779.23	-0.161775
18	1680.39	-2923.18	568205	-1497.07	-0.150959
19	1706.14	-2930.12	497239	-1195.56	-0.137762
20	1731.88	-2936.78	421236	-899.82	-0.122392
21	1757.63	-2943.18	358680	-657.888	-0.105091

22	1783.37	-2949.31	287416	-432.078	-0.0861338
23	1809.12	-2955.17	207499	-238.362	-0.0658178
24	1834.86	-2960.77	151516	-117.583	-0.044464
25	1860.61	-2966.11	99085.7	-38.7529	-0.0224087
26	1886.35	-2971.19	4.54639e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.074248
Factor of Safety, standard deviation: 0.097189
Factor of Safety, minimum: 0.000765
Factor of Safety, maximum: 1.295470
Probability of Failure: 99.930% (= 9989 failed surfaces / 9996 valid surfaces), 4 invalid surfaces
Reliability index: -9.52531 (assuming normal distribution)
Reliability index: -3.10223 (assuming lognormal distribution)
* best fit = Beta

Method: gle/morgenstern-price
Factor of Safety, mean: 0.081182
Factor of Safety, standard deviation: 0.097330
Factor of Safety, minimum: 0.000751
Factor of Safety, maximum: 1.276890
Probability of Failure: 99.930% (= 9988 failed surfaces / 9995 valid surfaces), 5 invalid surfaces
Reliability index: -9.44024 (assuming normal distribution)
Reliability index: -3.13228 (assuming lognormal distribution)
* best fit = Beta

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
3318	-6000
3318	0
0	0

External Boundary

X	Y

3318	-6000
3318	-3030
3229	-3039
3139	-3042
3050	-3045
2961	-3048
2871	-3051
2782	-3055
2693	-3059
2605	-3062
2517	-3061
2430	-3054
2342	-3044
2255	-3032
2167	-3020
2079	-3007
1992	-2993
1904	-2976
1816	-2952
1728	-2923
1640	-2891
1552	-2859
1464	-2828
1376	-2799
1288	-2773
1200	-2750
1112	-2726
1024	-2705
936	-2692
848	-2669
763	-2645
678	-2625
594	-2606
509	-2588
424	-2572
339	-2552
254	-2534
170	-2523
85	-2518
0	-2521

rocscience	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 103PC Site 15		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
SLIDEINTERPRET 6.020	Date: 4/01/2013		File Name: RR0705_103_15_1g.sli

0 -6000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 104PC Site 06		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_104_06_0g.slim

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_104_06_0g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 104PC Site 06
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/31/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364795999
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 104PC Site 06		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_104_06_0g.slim

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Global Minimums

Method: spencer

FS: 1.190310
Center: 1352.534, -2034.987
Radius: 1384.575
Left Slip Surface Endpoint: 501.292, -3126.975
Right Slip Surface Endpoint: 1066.876, -3389.775
Left Slope Intercept: 501.292 0.000
Right Slope Intercept: 1066.876 0.000
Resisting Moment=6.11896e+007 kN-m
Driving Moment=5.14066e+007 kN-m
Resisting Horizontal Force=39898.8 kN
Driving Horizontal Force=33519.8 kN
Total Slice Area=1.85769e+006 m2

Method: gle/morgenstern-price

FS: 1.191700
Center: 1355.729, -2030.359
Radius: 1390.248
Left Slip Surface Endpoint: 501.126, -3126.919
Right Slip Surface Endpoint: 1069.135, -3390.746
Left Slope Intercept: 501.126 0.000
Right Slope Intercept: 1069.135 0.000
Resisting Moment=6.19389e+007 kN-m
Driving Moment=5.19751e+007 kN-m
Resisting Horizontal Force=40192.2 kN

Driving Horizontal Force=33726.7 kN
Total Slice Area=1.86598e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2042
Number of Invalid Surfaces: 276

Error Codes:

Error Code -108 reported for 276 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2318
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.19031

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	22.6234	731272	basement	5.551	27.1	8.25671	9.82804	32305.1	32296.8	8.32165
2	22.6234	736337	basement	5.551	27.1	25.4813	30.3307	32519.3	32470.9	48.4019
3	22.6234	740909	basement	5.551	27.1	38.1147	45.3683	32715.6	32637.8	77.7551
4	22.6234	745206	basement	5.551	27.1	48.7632	58.0433	32900.3	32797.7	102.562
5	22.6234	749271	basement	5.551	27.1	58.3719	69.4806	33075.9	32951	124.917
6	22.6234	753093	basement	5.551	27.1	66.8774	79.6048	33242.6	33097.8	144.765
7	22.6234	756626	basement	5.551	27.1	73.1771	87.1034	33397.9	33238.5	159.408
8	22.6234	759944	basement	5.551	27.1	78.1979	93.0798	33544.3	33373.2	171.087
9	22.6234	763061	basement	5.551	27.1	82.1839	97.8243	33682.5	33502.2	180.313
10	22.6234	765975	basement	5.551	27.1	85.1336	101.335	33812.7	33625.5	187.202
11	22.6234	768666	basement	5.551	27.1	86.514	102.979	33933.8	33743.4	190.418

12	22.6234	771166	basement	5.551	27.1	86.6945	103.193	34046.9	33856.1	190.779
13	22.6234	773486	basement	5.551	27.1	85.8476	102.185	34152.4	33963.5	188.859
14	22.6234	775635	basement	5.551	27.1	83.9706	99.951	34250.4	34066	184.42
15	22.6234	777647	basement	5.551	27.1	81.6075	97.1382	34342.5	34163.5	178.962
16	22.6234	779499	basement	5.551	27.1	78.447	93.3762	34427.9	34256.2	171.676
17	22.6234	781186	basement	5.551	27.1	74.2757	88.4111	34506.2	34344.3	161.883
18	22.6234	782714	basement	5.551	27.1	69.086	82.2337	34577.5	34427.7	149.841
19	22.6234	784095	basement	5.551	27.1	63.0538	75.0536	34642.4	34506.6	135.844
20	22.6234	785325	basement	5.551	27.1	56.1112	66.7897	34700.8	34581.1	119.659
21	22.6234	786402	basement	5.551	27.1	48.1523	57.3162	34752.3	34651.2	101.109
22	22.6234	787334	basement	5.551	27.1	39.1029	46.5446	34797	34717	80.0464
23	22.6234	788213	basement	5.551	27.1	30.3956	36.1802	34838.4	34778.5	59.8596
24	22.6234	788984	basement	5.551	27.1	21.7419	25.8796	34875.6	34835.9	39.6763
25	22.6234	789610	basement	5.551	27.1	12.081	14.3801	34906.3	34889.1	17.2388

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.1917

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	22.7204	734405	basement	5.551	27.1	11.5452	13.7584	32312.6	32296.5	16.0652
2	22.7204	739513	basement	5.551	27.1	26.8625	32.0121	32523.1	32471.4	51.6663
3	22.7204	744123	basement	5.551	27.1	38.1081	45.4134	32716.8	32638.9	77.9162
4	22.7204	748456	basement	5.551	27.1	47.9462	57.1375	32900.3	32799.5	100.81
5	22.7204	752554	basement	5.551	27.1	56.9517	67.8694	33075.2	32953.4	121.769
6	22.7204	756406	basement	5.551	27.1	65.0544	77.5253	33241.5	33100.8	140.704
7	22.7204	759968	basement	5.551	27.1	71.2221	84.8754	33397.1	33242.1	155.025
8	22.7204	763313	basement	5.551	27.1	76.3237	90.955	33544.2	33377.4	166.836
9	22.7204	766455	basement	5.551	27.1	80.5496	95.991	33683.5	33506.8	176.747
10	22.7204	769393	basement	5.551	27.1	83.8986	99.982	33815.2	33630.6	184.587
11	22.7204	772104	basement	5.551	27.1	85.7726	102.215	33937.9	33749	188.9
12	22.7204	774624	basement	5.551	27.1	86.4904	103.071	34052.7	33862.1	190.564
13	22.7204	776962	basement	5.551	27.1	86.1922	102.715	34159.8	33970	189.835
14	22.7204	779129	basement	5.551	27.1	84.8061	101.063	34259.5	34072.8	186.654
15	22.7204	781159	basement	5.551	27.1	82.8968	98.7881	34352.9	34170.7	182.211
16	22.7204	783025	basement	5.551	27.1	80.1056	95.4618	34439.5	34263.8	175.716
17	22.7204	784726	basement	5.551	27.1	76.172	90.7742	34518.7	34352.2	166.546
18	22.7204	786266	basement	5.551	27.1	71.0564	84.6779	34590.5	34435.9	154.649
19	22.7204	787658	basement	5.551	27.1	64.9335	77.3812	34655.5	34515.1	140.389
20	22.7204	788897	basement	5.551	27.1	57.6882	68.747	34713.4	34589.9	123.49
21	22.7204	789982	basement	5.551	27.1	49.2091	58.6425	34764	34660.2	103.784
22	22.7204	790924	basement	5.551	27.1	39.5242	47.101	34807.5	34726.3	81.1736

23	22.7204	791818	basement	5.551	27.1	30.3632	36.1838	34847.9	34788	59.9137
24	22.7204	792593	basement	5.551	27.1	20.7671	24.7482	34883.1	34845.6	37.5004
25	22.7204	793224	basement	5.551	27.1	9.98716	11.9017	34911.4	34899	12.4059

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.19031

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	501.292	-3126.97	5.03566e+007	0	0
2	523.916	-3144.24	311644	278.946	0.0512842
3	546.539	-3160.79	557002	498.561	0.0512843
4	569.162	-3176.64	745176	666.992	0.0512843
5	591.786	-3191.84	913273	817.451	0.0512842
6	614.409	-3206.41	1.06179e+006	950.384	0.0512841
7	637.032	-3220.36	1.17533e+006	1052.01	0.0512841
8	659.656	-3233.72	1.26031e+006	1128.08	0.0512844
9	682.279	-3246.52	1.32679e+006	1187.58	0.0512842
10	704.903	-3258.76	1.37512e+006	1230.84	0.0512842
11	727.526	-3270.47	1.39946e+006	1252.62	0.0512839
12	750.149	-3281.66	1.40027e+006	1253.36	0.0512846
13	772.773	-3292.34	1.38379e+006	1238.6	0.0512842
14	795.396	-3302.52	1.35027e+006	1208.6	0.0512843
15	818.019	-3312.23	1.30542e+006	1168.45	0.0512841
16	840.643	-3321.46	1.25094e+006	1119.69	0.0512842
17	863.266	-3330.23	1.18022e+006	1056.39	0.0512842
18	885.889	-3338.56	1.09346e+006	978.736	0.0512844
19	908.513	-3346.43	992306	888.192	0.0512842
20	931.136	-3353.88	878406	786.243	0.0512843
21	953.759	-3360.89	749050	670.459	0.0512842
22	976.383	-3367.49	604399	540.985	0.0512842
23	999.006	-3373.67	454622	406.923	0.0512843
24	1021.63	-3379.44	317685	284.354	0.0512844
25	1044.25	-3384.81	166102	148.674	0.0512841
26	1066.88	-3389.77	5.91764e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.1917

Slice	X coordinate	Y coordinate - Bottom	Interslice Normal Force	Interslice Shear Force	Interslice Force Angle

	[m]	[m]	[kN]	[kN]	[degrees]
1	501.126	-3126.92	5.03548e+007	0	0
2	523.846	-3144.25	312904	51.0304	0.00934416
3	546.567	-3160.87	559307	180.992	0.0185409
4	569.287	-3176.79	748171	358.383	0.0274454
5	592.007	-3192.05	916867	574.755	0.0359169
6	614.728	-3206.67	1.0659e+006	815.239	0.0438219
7	637.448	-3220.68	1.1794e+006	1050.55	0.0510362
8	660.169	-3234.1	1.26462e+006	1267.92	0.0574453
9	682.889	-3246.94	1.33126e+006	1462.6	0.0629485
10	705.609	-3259.23	1.37968e+006	1624.41	0.067459
11	728.33	-3270.99	1.4036e+006	1737.01	0.0709057
12	751.05	-3282.22	1.4043e+006	1794.94	0.0732339
13	773.771	-3292.94	1.38763e+006	1802.05	0.0744073
14	796.491	-3303.17	1.35384e+006	1758.17	0.0744074
15	819.211	-3312.91	1.30929e+006	1673.5	0.0732339
16	841.932	-3322.18	1.25444e+006	1552.42	0.0709058
17	864.652	-3330.99	1.18328e+006	1393.17	0.0674589
18	887.372	-3339.34	1.096e+006	1204.13	0.0629485
19	910.093	-3347.25	994541	997.136	0.0574453
20	932.813	-3354.72	879985	783.845	0.0510361
21	955.534	-3361.76	749897	573.551	0.0438221
22	978.254	-3368.38	604444	378.907	0.0359169
23	1000.97	-3374.58	457078	218.946	0.0274454
24	1023.69	-3380.37	319383	103.353	0.018541
25	1046.42	-3385.76	166980	27.2321	0.00934414
26	1069.14	-3390.75	5.92104e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.198075
Factor of Safety, standard deviation: 0.196969
Factor of Safety, minimum: 0.617578
Factor of Safety, maximum: 1.903200
Probability of Failure: 15.910% (= 1591 failed surfaces / 10000 valid surfaces)
Reliability index: 1.00561 (assuming normal distribution)
Reliability index: 1.02493 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price

Factor of Safety, mean: 1.199500
Factor of Safety, standard deviation: 0.197265
Factor of Safety, minimum: 0.618639
Factor of Safety, maximum: 1.901890
Probability of Failure: 15.740% (= 1574 failed surfaces / 10000 valid surfaces)
Reliability index: 1.01133 (assuming normal distribution)
Reliability index: 1.03184 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
1946	-6000
1946	0
0	0

External Boundary

X	Y
1946	-6000
1946	-3474
1863	-3476
1780	-3476
1697	-3477
1613	-3477
1530	-3477
1447	-3476
1364	-3472
1271	-3458
1179	-3433
1086	-3398
993	-3358
901	-3314
808	-3269
716	-3223
623	-3178
534	-3138

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 104PC Site 06		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 3/31/2013		File Name: RR0705_104_06_0g.slim

445	-3108
356	-3089
267	-3076
178	-3071
89	-3067
0	-3058
0	-6000

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_104_06_1g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 104PC Site 06
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/31/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364796111
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.001989
Center: 1044.951, -3151.819
Radius: 230.503
Left Slip Surface Endpoint: 865.944, -3297.037
Right Slip Surface Endpoint: 1049.448, -3382.279
Left Slope Intercept: 865.944 0.000
Right Slope Intercept: 1049.448 0.000
Resisting Moment=30400.4 kN-m
Driving Moment=1.52861e+007 kN-m
Resisting Horizontal Force=137.57 kN

Driving Horizontal Force=69173.6 kN
Total Slice Area=616022 m2

Method: gle/morgenstern-price

FS: 0.002318
Center: 1263.701, -2202.716
Radius: 1189.109
Left Slip Surface Endpoint: 525.930, -3135.280
Right Slip Surface Endpoint: 1005.876, -3363.538
Left Slope Intercept: 525.930 0.000
Right Slope Intercept: 1005.876 0.000
Resisting Moment=722991 kN-m
Driving Moment=3.11885e+008 kN-m
Resisting Horizontal Force=610.354 kN
Driving Horizontal Force=263295 kN
Total Slice Area=1.57021e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1325
Number of Invalid Surfaces: 104

Error Codes:

Error Code -108 reported for 96 surfaces
Error Code -112 reported for 8 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1401
Number of Invalid Surfaces: 28

Error Codes:

Error Code -108 reported for 17 surfaces
Error Code -111 reported for 2 surfaces
Error Code -112 reported for 9 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.00198876

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	7.34015	249697	basement	5.551	27.1	281.401	0.55964	34034.2	34044	-9.79164
2	7.34015	250509	basement	5.551	27.1	314.216	0.6249	34193	34202.7	-9.66569
3	7.34015	251236	basement	5.551	27.1	346.955	0.69001	34332.7	34342.1	-9.43869
4	7.34015	251888	basement	5.551	27.1	379.09	0.75392	34455.5	34464.9	-9.40876
5	7.34015	252475	basement	5.551	27.1	410.799	0.81698	34563.6	34572.8	-9.20427
6	7.34015	253003	basement	5.551	27.1	443.186	0.88139	34658.8	34667.9	-9.1224
7	7.34015	253478	basement	5.551	27.1	471.696	0.93809	34742.2	34751.2	-9.04685
8	7.34015	253904	basement	5.551	27.1	497.898	0.9902	34814.4	34823.4	-9.01247
9	7.34015	254284	basement	5.551	27.1	521.285	1.03671	34876.5	34885.3	-8.82752
10	7.34015	254622	basement	5.551	27.1	541.247	1.07641	34928.9	34937.7	-8.78231
11	7.34015	254920	basement	5.551	27.1	557.066	1.10787	34972.4	34981.1	-8.73265
12	7.34015	255179	basement	5.551	27.1	567.816	1.12925	35007.3	35015.9	-8.58305
13	7.34015	255403	basement	5.551	27.1	572.326	1.13822	35034.1	35042.7	-8.63653
14	7.34015	255592	basement	5.551	27.1	569.038	1.13168	35053.1	35061.8	-8.67101
15	7.34015	255749	basement	5.551	27.1	555.804	1.10536	35064.7	35073.4	-8.70223
16	7.34015	255873	basement	5.551	27.1	529.601	1.05325	35069.1	35077.9	-8.79525
17	7.34015	255966	basement	5.551	27.1	485.966	0.96647	35066.5	35075.4	-8.89377
18	7.34015	256033	basement	5.551	27.1	480.883	0.95636	35058.5	35067.5	-9.01986
19	7.34015	256080	basement	5.551	27.1	436.126	0.86735	35047.9	35057	-9.07898
20	7.34015	256100	basement	5.551	27.1	323.061	0.64249	35030.7	35040.3	-9.62903
21	7.34015	256091	basement	5.551	27.1	138.574	0.27559	35007	35017.3	-10.2757
22	7.34015	256054	basement	5.551	27.1	0	0	34966.3	34988	-21.6944
23	7.34015	255990	basement	5.551	27.1	0	0	34908.1	34952.4	-44.2757
24	7.34015	255898	basement	5.551	27.1	0	0	34842.6	34910.7	-68.1117
25	7.34015	255779	basement	5.551	27.1	0	0	34740.1	34862.9	-122.823

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00231813

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]

1	19.1979	621847	basement	5.551	27.1	156.471	0.36272	32420.8	32431	-10.1634
2	19.1979	625385	basement	5.551	27.1	373.788	0.86649	32669.3	32678.4	-9.1303
3	19.1979	628721	basement	5.551	27.1	575.11	1.33318	32898.9	32907.1	-8.20965
4	19.1979	631881	basement	5.551	27.1	758.555	1.75843	33113.4	33120.8	-7.39659
5	19.1979	634873	basement	5.551	27.1	919.823	2.13227	33313.4	33320.1	-6.71611
6	19.1979	637671	basement	5.551	27.1	1008.58	2.33801	33494.5	33500.7	-6.24263
7	19.1979	640275	basement	5.551	27.1	1085.88	2.5172	33656.3	33662.2	-5.87666
8	19.1979	642728	basement	5.551	27.1	1134.27	2.62938	33805.1	33810.8	-5.72663
9	19.1979	645035	basement	5.551	27.1	1151.01	2.66818	33941.2	33946.9	-5.66249
10	19.1979	647202	basement	5.551	27.1	1133.01	2.62646	34065.1	34070.8	-5.69608
11	19.1979	649211	basement	5.551	27.1	1050.62	2.43548	34174	34180.1	-6.07468
12	19.1979	651074	basement	5.551	27.1	967.461	2.2427	34269.5	34276	-6.52191
13	19.1979	652808	basement	5.551	27.1	861.095	1.99613	34353.8	34360.7	-6.93625
14	19.1979	654415	basement	5.551	27.1	736.063	1.70629	34427.1	34434.6	-7.51187
15	19.1979	655900	basement	5.551	27.1	611.389	1.41728	34490	34498.1	-8.07386
16	19.1979	657288	basement	5.551	27.1	502.094	1.16392	34546.3	34554.8	-8.54767
17	19.1979	658567	basement	5.551	27.1	361.805	0.83871	34593.3	34602.5	-9.15409
18	19.1979	659729	basement	5.551	27.1	225.915	0.5237	34630.5	34640.4	-9.87044
19	19.1979	660778	basement	5.551	27.1	101.271	0.23476	34658	34668.4	-10.3552
20	19.1979	661717	basement	5.551	27.1	0.664329	0.00154	34676.2	34687.1	-10.8536
21	19.1979	662555	basement	5.551	27.1	0	0	34675.8	34697.6	-21.763
22	19.1979	663287	basement	5.551	27.1	0	0	34670.7	34699.2	-28.4995
23	19.1979	663912	basement	5.551	27.1	0	0	34661.7	34691.6	-29.8728
24	19.1979	664433	basement	5.551	27.1	0	0	34648.6	34675	-26.4278
25	19.1979	664872	basement	5.551	27.1	0	0	34635	34652.8	-17.8399

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.00198876

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	865.944	-3297.04	5.59828e+007	0	0
2	873.284	-3305.64	171424	-1161.08	-0.388067
3	880.624	-3313.46	317492	-2150.44	-0.38807
4	887.964	-3320.6	441504	-2990.39	-0.388069
5	895.304	-3327.14	545949	-3697.81	-0.388069
6	902.645	-3333.15	633079	-4287.96	-0.388069
7	909.985	-3338.68	705206	-4776.49	-0.388069
8	917.325	-3343.77	762496	-5164.53	-0.388069

9	924.665	-3348.45	805973	-5459	-0.388069
10	932.005	-3352.75	836487	-5665.68	-0.388069
11	939.345	-3356.71	854757	-5789.43	-0.388069
12	946.685	-3360.33	861391	-5834.36	-0.388069
13	954.026	-3363.63	856913	-5804.03	-0.388069
14	961.366	-3366.63	841778	-5701.52	-0.388069
15	968.706	-3369.35	816382	-5529.5	-0.388069
16	976.046	-3371.78	781078	-5290.39	-0.388069
17	983.386	-3373.95	736186	-4986.33	-0.388069
18	990.726	-3375.85	682004	-4619.34	-0.388069
19	998.067	-3377.5	627024	-4246.95	-0.388069
20	1005.41	-3378.91	566968	-3840.18	-0.388069
21	1012.75	-3380.06	498457	-3376.14	-0.388069
22	1020.09	-3380.98	421886	-2857.51	-0.388069
23	1027.43	-3381.66	337141	-2283.52	-0.388069
24	1034.77	-3382.1	243718	-1650.74	-0.388067
25	1042.11	-3382.3	141662	-959.503	-0.388069
26	1049.45	-3382.28	5.8915e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00231813

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	525.93	-3135.28	5.06244e+007	0	0
2	545.127	-3150.15	232243	-492.442	-0.121488
3	564.325	-3164.41	418004	-1758.67	-0.241059
4	583.523	-3178.08	586790	-3654.46	-0.356827
5	602.721	-3191.19	738925	-6022.44	-0.466966
6	621.919	-3203.76	874757	-8698.66	-0.569735
7	641.117	-3215.82	974447	-11285.2	-0.66352
8	660.315	-3227.37	1.05717e+006	-13780.7	-0.746835
9	679.512	-3238.43	1.12452e+006	-16063	-0.818375
10	698.71	-3249.03	1.17689e+006	-18015.6	-0.877004
11	717.908	-3259.17	1.21365e+006	-19527.4	-0.921799
12	737.106	-3268.87	1.2271e+006	-20392.3	-0.95207
13	756.304	-3278.14	1.22652e+006	-20709.2	-0.96732
14	775.502	-3286.99	1.21217e+006	-20466.9	-0.967319
15	794.7	-3295.43	1.18429e+006	-19680.8	-0.952067
16	813.897	-3303.47	1.14614e+006	-18441.3	-0.921805
17	833.095	-3311.12	1.1018e+006	-16866.1	-0.877002
18	852.293	-3318.39	1.0444e+006	-14918.5	-0.818373

19	871.491	-3325.28	973945	-12695.8	-0.746833
20	890.689	-3331.81	890367	-10311.4	-0.663517
21	909.887	-3337.97	795184	-7907.39	-0.569736
22	929.084	-3343.77	687776	-5605.55	-0.466965
23	948.282	-3349.23	566223	-3526.38	-0.356828
24	967.48	-3354.34	430575	-1811.56	-0.241059
25	986.678	-3359.11	280873	-595.557	-0.121489
26	1005.88	-3363.54	5.82639e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.089353
Factor of Safety, standard deviation: 0.098421
Factor of Safety, minimum: 0.000668
Factor of Safety, maximum: 1.428440
Probability of Failure: 99.969% (= 9723 failed surfaces / 9726 valid surfaces), 274 invalid surfaces
Reliability index: -9.25257 (assuming normal distribution)
Reliability index: -3.15528 (assuming lognormal distribution)
* best fit = Beta

Method: gle/morgenstern-price
Factor of Safety, mean: 0.032214
Factor of Safety, standard deviation: 0.071353
Factor of Safety, minimum: 0.000128
Factor of Safety, maximum: 1.239610
Probability of Failure: 99.990% (= 9996 failed surfaces / 9997 valid surfaces), 3 invalid surfaces
Reliability index: -13.56332 (assuming normal distribution)
Reliability index: -3.24415 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
1946	-6000
1946	0
0	0

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 104PC Site 06		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 3/31/2013		File Name: RR0705_104_06_1g.slim

External Boundary

X	Y
1946	-6000
1946	-3474
1863	-3476
1780	-3476
1697	-3477
1613	-3477
1530	-3477
1447	-3476
1364	-3472
1271	-3458
1179	-3433
1086	-3398
993	-3358
901	-3314
808	-3269
716	-3223
623	-3178
534	-3138
445	-3108
356	-3089
267	-3076
178	-3071
89	-3067
0	-3058
0	-6000

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_104_07_0g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 104PC Site 07
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/31/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364796346
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 104PC Site 07		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_104_07_0g.slim

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Global Minimums

Method: spencer

FS: 1.142060
Center: 1604.482, -1811.302
Radius: 893.135
Left Slip Surface Endpoint: 969.655, -2439.541
Right Slip Surface Endpoint: 1495.890, -2697.810
Left Slope Intercept: 969.655 -0.000
Right Slope Intercept: 1495.890 -0.000
Resisting Moment=4.81694e+007 kN-m
Driving Moment=4.21778e+007 kN-m
Resisting Horizontal Force=48290.6 kN
Driving Horizontal Force=42283.9 kN
Total Slice Area=1.37113e+006 m2

Method: gle/morgenstern-price

FS: 1.144390
Center: 1823.240, -1294.389
Radius: 1441.093
Left Slip Surface Endpoint: 921.166, -2418.227
Right Slip Surface Endpoint: 1495.890, -2697.810
Left Slope Intercept: 921.166 -0.000
Right Slope Intercept: 1495.890 -0.000
Resisting Moment=6.4802e+007 kN-m
Driving Moment=5.66259e+007 kN-m
Resisting Horizontal Force=40258.5 kN

Driving Horizontal Force=35179.1 kN
Total Slice Area=1.48545e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2749
Number of Invalid Surfaces: 200

Error Codes:

Error Code -108 reported for 152 surfaces
Error Code -112 reported for 48 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2948
Number of Invalid Surfaces: 1

Error Codes:

Error Code -108 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.14206

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	21.0494	531813	basement	5.551	27.1	6.95799	7.94644	25237.9	25233.3	4.6432
2	21.0494	537376	basement	5.551	27.1	26.7426	30.5416	25487.4	25438.6	48.8139
3	21.0494	542464	basement	5.551	27.1	43.9117	50.1498	25718.2	25631.1	87.149
4	21.0494	547166	basement	5.551	27.1	59.2735	67.6939	25933.3	25811.9	121.403

5	21.0494	551514	basement	5.551	27.1	73.0681	83.4481	26134	25981.7	152.269
6	21.0494	555528	basement	5.551	27.1	85.3929	97.5238	26321.2	26141.5	179.72
7	21.0494	559174	basement	5.551	27.1	95.3917	108.943	26493.8	26291.8	201.98
8	21.0494	562511	basement	5.551	27.1	103.28	117.952	26652.7	26433.1	219.628
9	21.0494	565574	basement	5.551	27.1	109.663	125.242	26799.8	26565.9	233.888
10	21.0494	568374	basement	5.551	27.1	114.559	130.833	26935.5	26690.7	244.83
11	21.0494	570919	basement	5.551	27.1	117.94	134.694	27060.2	26807.8	252.382
12	21.0494	573217	basement	5.551	27.1	119.662	136.661	27173.8	26917.6	256.206
13	21.0494	575286	basement	5.551	27.1	119.929	136.966	27277.1	27020.3	256.773
14	21.0494	577135	basement	5.551	27.1	118.749	135.619	27370.4	27116.2	254.173
15	21.0494	578758	basement	5.551	27.1	116.112	132.607	27453.8	27205.5	248.31
16	21.0494	580147	basement	5.551	27.1	111.403	127.229	27526.3	27288.5	237.753
17	21.0494	581333	basement	5.551	27.1	105.143	120.08	27589.1	27365.3	223.756
18	21.0494	582323	basement	5.551	27.1	97.4213	111.261	27642.6	27436	206.571
19	21.0494	583131	basement	5.551	27.1	88.1149	100.633	27686.7	27500.9	185.78
20	21.0494	583833	basement	5.551	27.1	78.7355	89.9207	27724.8	27560	164.845
21	21.0494	584371	basement	5.551	27.1	68.6858	78.4433	27755.9	27613.5	142.407
22	21.0494	584729	basement	5.551	27.1	57.1737	65.2958	27778.2	27661.4	116.786
23	21.0494	584911	basement	5.551	27.1	44.1111	50.3775	27791.5	27703.9	87.6036
24	21.0494	584997	basement	5.551	27.1	30.3236	34.6314	27797.9	27741	56.8885
25	21.0494	584967	basement	5.551	27.1	17.0397	19.4604	27800	27772.9	27.128

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.14439

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	22.989	575255	basement	5.551	27.1	10.3671	11.864	25013.2	25000.8	12.3583
2	22.989	580425	basement	5.551	27.1	23.6062	27.0147	25225.1	25183.2	41.8966
3	22.989	585332	basement	5.551	27.1	35.9468	41.1372	25427.6	25358.1	69.5069
4	22.989	589965	basement	5.551	27.1	47.2616	54.0857	25620.7	25525.9	94.824
5	22.989	594286	basement	5.551	27.1	56.6894	64.8748	25802.8	25686.9	115.899
6	22.989	598368	basement	5.551	27.1	65.1155	74.5175	25976.1	25841.3	134.773
7	22.989	602226	basement	5.551	27.1	72.69	83.1857	26141.2	25989.4	151.759
8	22.989	605844	basement	5.551	27.1	79.3398	90.7957	26298	26131.5	166.545
9	22.989	609184	basement	5.551	27.1	83.93	96.0487	26444.4	26267.6	176.845
10	22.989	612316	basement	5.551	27.1	87.4048	100.025	26582.7	26398	184.669
11	22.989	615252	basement	5.551	27.1	89.9204	102.904	26713.2	26522.9	190.284
12	22.989	617993	basement	5.551	27.1	91.4377	104.64	26836.1	26642.4	193.686
13	22.989	620536	basement	5.551	27.1	91.6978	104.938	26950.9	26756.7	194.196
14	22.989	622897	basement	5.551	27.1	90.8487	103.966	27058.2	26865.9	192.271
15	22.989	625081	basement	5.551	27.1	88.8822	101.716	27158	26970	187.955

16	22.989	627076	basement	5.551	27.1	85.6937	98.067	27250.1	27069.3	180.824
17	22.989	628870	basement	5.551	27.1	80.5994	92.2371	27333.3	27163.9	169.356
18	22.989	630498	basement	5.551	27.1	74.194	84.9069	27408.8	27253.7	155.089
19	22.989	631964	basement	5.551	27.1	66.507	76.1099	27476.9	27339	137.898
20	22.989	633318	basement	5.551	27.1	57.9475	66.3145	27538.6	27419.8	118.754
21	22.989	634597	basement	5.551	27.1	49.9327	57.1425	27597	27496.2	100.769
22	22.989	635721	basement	5.551	27.1	40.7368	46.6188	27648.5	27568.2	80.2638
23	22.989	636694	basement	5.551	27.1	30.266	34.6361	27692.8	27635.9	56.8829
24	22.989	637585	basement	5.551	27.1	19.5797	22.4068	27732.4	27699.4	32.9815
25	22.989	638422	basement	5.551	27.1	9.66355	11.0589	27769.6	27758.8	10.7686

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.14206

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	969.655	-2439.54	3.06495e+007	0	0
2	990.704	-2460.12	286330	425.913	0.0852268
3	1011.75	-2479.41	531987	791.324	0.0852267
4	1032.8	-2497.5	744130	1106.88	0.0852264
5	1053.85	-2514.51	930426	1384	0.0852269
6	1074.9	-2530.49	1.09224e+006	1624.69	0.0852265
7	1095.95	-2545.53	1.22484e+006	1821.93	0.0852265
8	1117	-2559.67	1.32307e+006	1968.05	0.0852267
9	1138.05	-2572.96	1.39973e+006	2082.08	0.0852267
10	1159.1	-2585.46	1.4556e+006	2165.18	0.0852264
11	1180.15	-2597.2	1.49134e+006	2218.35	0.0852267
12	1201.2	-2608.2	1.50451e+006	2237.94	0.0852267
13	1222.25	-2618.51	1.49872e+006	2229.32	0.0852264
14	1243.3	-2628.15	1.47445e+006	2193.23	0.0852269
15	1264.35	-2637.13	1.43217e+006	2130.33	0.0852265
16	1285.4	-2645.49	1.36553e+006	2031.21	0.0852267
17	1306.45	-2653.24	1.2791e+006	1902.64	0.0852265
18	1327.49	-2660.4	1.17567e+006	1748.8	0.085227
19	1348.54	-2666.98	1.05556e+006	1570.13	0.0852266
20	1369.59	-2673	929311	1382.34	0.0852268
21	1390.64	-2678.46	801928	1192.86	0.0852268
22	1411.69	-2683.38	658812	979.975	0.0852267
23	1432.74	-2687.77	500175	744.005	0.0852268

24	1453.79	-2691.63	328930	489.28	0.0852268
25	1474.84	-2694.98	171861	255.641	0.0852267
26	1495.89	-2697.81	3.74826e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.14439

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	921.166	-2418.23	3.01163e+007	0	0
2	944.155	-2436.3	199584	41.874	0.012021
3	967.144	-2453.63	383041	159.462	0.0238525
4	990.133	-2470.26	550753	339.394	0.0353077
5	1013.12	-2486.22	690436	556.803	0.0462062
6	1036.11	-2501.52	808319	795.344	0.0563761
7	1059.1	-2516.21	911233	1044.21	0.065657
8	1082.09	-2530.29	999446	1289.12	0.073902
9	1105.08	-2543.79	1.05954e+006	1497.56	0.0809821
10	1128.07	-2556.72	1.09939e+006	1665.21	0.086784
11	1151.06	-2569.11	1.12504e+006	1791.13	0.0912182
12	1174.04	-2580.97	1.13671e+006	1869.13	0.0942133
13	1197.03	-2592.32	1.13206e+006	1891.31	0.0957228
14	1220.02	-2603.16	1.11288e+006	1859.27	0.095723
15	1243.01	-2613.51	1.08021e+006	1776.23	0.0942135
16	1266	-2623.39	1.03421e+006	1646.52	0.091218
17	1288.99	-2632.79	966717	1464.26	0.0867843
18	1311.98	-2641.74	884354	1249.94	0.0809814
19	1334.97	-2650.24	788998	1017.68	0.0739023
20	1357.96	-2658.3	680783	780.127	0.0656567
21	1380.95	-2665.93	583720	574.349	0.0563759
22	1403.93	-2673.13	477901	385.404	0.0462063
23	1426.92	-2679.91	359812	221.73	0.0353079
24	1449.91	-2686.29	229564	95.5685	0.0238525
25	1472.9	-2692.25	119055	24.9784	0.012021
26	1495.89	-2697.81	3.74826e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.152039
Factor of Safety, standard deviation: 0.193148
Factor of Safety, minimum: 0.604789

Factor of Safety, maximum: 1.819280
Probability of Failure: 22.300% (= 2230 failed surfaces / 10000 valid surfaces)
Reliability index: 0.78716 (assuming normal distribution)
Reliability index: 0.76682 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 1.151933
Factor of Safety, standard deviation: 0.189859
Factor of Safety, minimum: 0.609207
Factor of Safety, maximum: 1.822790
Probability of Failure: 21.870% (= 2187 failed surfaces / 10000 valid surfaces)
Reliability index: 0.80024 (assuming normal distribution)
Reliability index: 0.78209 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
5144	-6000
5144	0
0	0

External Boundary

X	Y
5144	-6000
5144	-3485
5052	-3484
4960	-3483
4868	-3481
4776	-3478
4684	-3476
4592	-3473
4500	-3470
4408	-3467
4316	-3463
4227	-3460
4138	-3457

4049	-3454
3960	-3450
3871	-3442
3782	-3430
3693	-3411
3604	-3385
3515	-3357
3426	-3329
3337	-3299
3248	-3271
3159	-3247
3070	-3225
2980	-3202
2890	-3179
2801	-3153
2711	-3127
2622	-3102
2532	-3076
2442	-3046
2353	-3015
2263	-2984
2173	-2956
2084	-2926
1994	-2893
1905	-2859
1815	-2824
1724	-2788
1633	-2753
1543	-2718
1452	-2679
1361	-2635
1270	-2587
1180	-2541
1089	-2495
998	-2452
907	-2412
817	-2374
726	-2340
635	-2309
544	-2279

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 104PC Site 07		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 3/31/2013		File Name: RR0705_104_07_0g.slim

454	-2245
363	-2209
272	-2175
182	-2148
91	-2124
0	-2093
0	-6000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 104PC Site 07		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_104_07_1g.slim

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_104_07_1g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 104PC Site 07
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/31/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364796450
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.001961
Center: 1799.088, -1337.626
Radius: 1390.562
Left Slip Surface Endpoint: 927.156, -2420.860
Right Slip Surface Endpoint: 1480.426, -2691.183
Left Slope Intercept: 927.156 -0.000
Right Slope Intercept: 1480.426 -0.000
Resisting Moment=962556 kN-m
Driving Moment=4.90737e+008 kN-m
Resisting Horizontal Force=695.511 kN

Driving Horizontal Force=354591 kN
Total Slice Area=1.42835e+006 m2

Method: gle/morgenstern-price

FS: 0.001818
Center: 1757.438, -1407.585
Radius: 1307.760
Left Slip Surface Endpoint: 934.857, -2424.245
Right Slip Surface Endpoint: 1452.934, -2679.400
Left Slope Intercept: 934.857 -0.000
Right Slope Intercept: 1452.934 -0.000
Resisting Moment=761290 kN-m
Driving Moment=4.18848e+008 kN-m
Resisting Horizontal Force=587.681 kN
Driving Horizontal Force=323332 kN
Total Slice Area=1.33448e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1394
Number of Invalid Surfaces: 31

Error Codes:

Error Code -108 reported for 22 surfaces
Error Code -112 reported for 9 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1402
Number of Invalid Surfaces: 23

Error Codes:

Error Code -108 reported for 11 surfaces
Error Code -111 reported for 1 surface
Error Code -112 reported for 11 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.00196145

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	22.1308	554295	basement	5.551	27.1	490.841	0.96276	25077.1	25086.1	-8.97913
2	22.1308	559104	basement	5.551	27.1	592.342	1.16185	25370.6	25379.2	-8.56217
3	22.1308	563668	basement	5.551	27.1	690.459	1.3543	25646	25654.2	-8.22972
4	22.1308	567970	basement	5.551	27.1	745.795	1.46284	25900	25908	-8.02867
5	22.1308	571987	basement	5.551	27.1	812.215	1.59312	26129.7	26137.4	-7.70802
6	22.1308	575787	basement	5.551	27.1	881.45	1.72892	26343.1	26350.6	-7.50485
7	22.1308	579379	basement	5.551	27.1	944.424	1.85244	26541	26548.2	-7.16702
8	22.1308	582749	basement	5.551	27.1	960.998	1.88495	26721.1	26728.3	-7.21987
9	22.1308	585861	basement	5.551	27.1	976.104	1.91458	26878.4	26885.5	-7.07119
10	22.1308	588780	basement	5.551	27.1	997.344	1.95624	27021.3	27028.3	-7.0443
11	22.1308	591517	basement	5.551	27.1	1008.12	1.97738	27150.4	27157.4	-6.96153
12	22.1308	594075	basement	5.551	27.1	1000.71	1.96285	27266.1	27273.1	-7.03546
13	22.1308	596449	basement	5.551	27.1	979.469	1.92118	27367.3	27374.4	-7.08185
14	22.1308	598653	basement	5.551	27.1	948.319	1.86008	27455.8	27463.1	-7.27446
15	22.1308	600693	basement	5.551	27.1	901.435	1.76812	27532.1	27539.5	-7.39159
16	22.1308	602568	basement	5.551	27.1	816.172	1.60088	27595.5	27603.3	-7.75947
17	22.1308	604252	basement	5.551	27.1	701.869	1.37668	27642.9	27651.1	-8.17815
18	22.1308	605777	basement	5.551	27.1	582.151	1.14186	27678.1	27686.7	-8.60003
19	22.1308	607151	basement	5.551	27.1	436.412	0.856	27702	27711.2	-9.18105
20	22.1308	608387	basement	5.551	27.1	315.007	0.61787	27716.2	27725.8	-9.5773
21	22.1308	609567	basement	5.551	27.1	220.556	0.43261	27731.1	27741.1	-9.99868
22	22.1308	610626	basement	5.551	27.1	20.286	0.03979	27737.8	27748.6	-10.8129
23	22.1308	611545	basement	5.551	27.1	0	0	27703.3	27745.6	-42.2924
24	22.1308	612330	basement	5.551	27.1	0	0	27662.5	27733	-70.4609
25	22.1308	613085	basement	5.551	27.1	0	0	27499.5	27723.8	-224.305

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00181758

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]

1	20.7231	519627	basement	5.551	27.1	132.924	0.2416	25102.1	25112.5	-10.4222
2	20.7231	523871	basement	5.551	27.1	341.063	0.61991	25379.5	25389.2	-9.65306
3	20.7231	527901	basement	5.551	27.1	540.901	0.98313	25639.9	25648.8	-8.89892
4	20.7231	531690	basement	5.551	27.1	704.239	1.28001	25878.9	25887.2	-8.32054
5	20.7231	535238	basement	5.551	27.1	852.111	1.54878	26096.2	26104	-7.81608
6	20.7231	538597	basement	5.551	27.1	980.325	1.78182	26298.4	26305.8	-7.41581
7	20.7231	541773	basement	5.551	27.1	1085.67	1.9733	26486	26493	-6.99239
8	20.7231	544761	basement	5.551	27.1	1140.86	2.0736	26657.7	26664.5	-6.77299
9	20.7231	547520	basement	5.551	27.1	1157	2.10294	26807.7	26814.4	-6.72829
10	20.7231	550106	basement	5.551	27.1	1162.01	2.11204	26943.4	26950.2	-6.76145
11	20.7231	552532	basement	5.551	27.1	1141.59	2.07493	27066.4	27073.2	-6.81998
12	20.7231	554803	basement	5.551	27.1	1095.54	1.99124	27176.9	27183.8	-6.90711
13	20.7231	556914	basement	5.551	27.1	1018.92	1.85197	27274.1	27281.3	-7.22754
14	20.7231	558873	basement	5.551	27.1	931.112	1.69237	27358.8	27366.4	-7.57481
15	20.7231	560688	basement	5.551	27.1	828.684	1.5062	27432.1	27440	-7.86419
16	20.7231	562363	basement	5.551	27.1	715.858	1.30113	27494.2	27502.5	-8.27569
17	20.7231	563887	basement	5.551	27.1	567.452	1.03139	27543.4	27552.3	-8.85751
18	20.7231	565251	basement	5.551	27.1	434.908	0.79048	27578.5	27587.8	-9.28022
19	20.7231	566482	basement	5.551	27.1	312.779	0.5685	27603.1	27612.8	-9.71471
20	20.7231	567584	basement	5.551	27.1	199.892	0.36332	27617.4	27627.5	-10.0932
21	20.7231	568569	basement	5.551	27.1	129.926	0.23615	27623.1	27633.5	-10.4323
22	20.7231	569507	basement	5.551	27.1	93.0083	0.16905	27629.7	27640.3	-10.5507
23	20.7231	570339	basement	5.551	27.1	35.7288	0.06494	27628.9	27639.6	-10.7349
24	20.7231	571050	basement	5.551	27.1	0	0	27617.7	27629.2	-11.4563
25	20.7231	571641	basement	5.551	27.1	0	0	27595	27609.3	-14.3392

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.00196145

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	927.156	-2420.86	3.01819e+007	0	0
2	949.287	-2438.31	190417	-3512.06	-1.05665
3	971.418	-2455.04	368426	-6795.26	-1.05665
4	993.549	-2471.1	533917	-9847.59	-1.05665
5	1015.68	-2486.51	672315	-12400.2	-1.05665
6	1037.81	-2501.29	794003	-14644.6	-1.05664
7	1059.94	-2515.47	902534	-16646.4	-1.05665
8	1082.07	-2529.07	997871	-18404.8	-1.05665

9	1104.2	-2542.12	1.06741e+006	-19687.4	-1.05665
10	1126.33	-2554.61	1.11769e+006	-20614.7	-1.05664
11	1148.46	-2566.59	1.15439e+006	-21291.7	-1.05665
12	1170.59	-2578.05	1.17757e+006	-21719.1	-1.05664
13	1192.73	-2589.02	1.18546e+006	-21864.6	-1.05664
14	1214.86	-2599.5	1.17856e+006	-21737.5	-1.05665
15	1236.99	-2609.52	1.15831e+006	-21363.8	-1.05664
16	1259.12	-2619.07	1.1248e+006	-20745.9	-1.05665
17	1281.25	-2628.17	1.07347e+006	-19799.2	-1.05665
18	1303.38	-2636.83	1.00455e+006	-18528	-1.05665
19	1325.51	-2645.06	922762	-17019.5	-1.05665
20	1347.64	-2652.87	828349	-15278.1	-1.05665
21	1369.77	-2660.26	731521	-13492.2	-1.05665
22	1391.9	-2667.24	637910	-11765.6	-1.05664
23	1414.03	-2673.81	532820	-9827.36	-1.05665
24	1436.16	-2679.99	414029	-7636.37	-1.05665
25	1458.3	-2685.78	290887	-5365.13	-1.05665
26	1480.43	-2691.18	3.72987e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00181758

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	934.857	-2424.24	3.02664e+007	0	0
2	955.58	-2440.67	184311	-368.853	-0.114663
3	976.303	-2456.43	355717	-1412.54	-0.227518
4	997.027	-2471.55	514215	-3022.57	-0.336782
5	1017.75	-2486.06	643395	-4949.24	-0.440732
6	1038.47	-2499.98	758687	-7120.61	-0.53773
7	1059.2	-2513.34	861026	-9411.43	-0.626246
8	1079.92	-2526.16	950569	-11695	-0.704883
9	1100.64	-2538.45	1.01779e+006	-13721.7	-0.772407
10	1121.37	-2550.23	1.06482e+006	-15384.2	-0.827735
11	1142.09	-2561.53	1.09934e+006	-16694.6	-0.870028
12	1162.81	-2572.34	1.12157e+006	-17591.5	-0.898594
13	1183.53	-2582.69	1.13119e+006	-18026.6	-0.912986
14	1204.26	-2592.59	1.12639e+006	-17950.1	-0.912986
15	1224.98	-2602.04	1.10973e+006	-17405.7	-0.898589
16	1245.7	-2611.07	1.08132e+006	-16420.9	-0.870025
17	1266.43	-2619.67	1.04122e+006	-15043.4	-0.827744
18	1287.15	-2627.86	982188	-13241.7	-0.772406

19	1307.87	-2635.64	909808	-11193.5	-0.704883
20	1328.6	-2643.03	825509	-9023.22	-0.626246
21	1349.32	-2650.03	729178	-6843.66	-0.537731
22	1370.04	-2656.65	631223	-4855.61	-0.440732
23	1390.77	-2662.89	534890	-3144.09	-0.336781
24	1411.49	-2668.76	426500	-1693.61	-0.227517
25	1432.21	-2674.26	305812	-612.008	-0.114663
26	1452.93	-2679.4	3.69728e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.028281
Factor of Safety, standard deviation: 0.065100
Factor of Safety, minimum: 0.000153
Factor of Safety, maximum: 1.063840
Probability of Failure: 99.990% (= 9952 failed surfaces / 9953 valid surfaces), 47 invalid surfaces
Reliability index: -14.92666 (assuming normal distribution)
Reliability index: -3.30662 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 0.028435
Factor of Safety, standard deviation: 0.065979
Factor of Safety, minimum: 0.000151
Factor of Safety, maximum: 1.065760
Probability of Failure: 99.990% (= 9993 failed surfaces / 9994 valid surfaces), 6 invalid surfaces
Reliability index: -14.72537 (assuming normal distribution)
Reliability index: -3.29555 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
5144	-6000
5144	0
0	0

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 104PC Site 07		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 3/31/2013		File Name: RR0705_104_07_1g.slim

External Boundary

X	Y
5144	-6000
5144	-3485
5052	-3484
4960	-3483
4868	-3481
4776	-3478
4684	-3476
4592	-3473
4500	-3470
4408	-3467
4316	-3463
4227	-3460
4138	-3457
4049	-3454
3960	-3450
3871	-3442
3782	-3430
3693	-3411
3604	-3385
3515	-3357
3426	-3329
3337	-3299
3248	-3271
3159	-3247
3070	-3225
2980	-3202
2890	-3179
2801	-3153
2711	-3127
2622	-3102
2532	-3076
2442	-3046
2353	-3015
2263	-2984
2173	-2956
2084	-2926
1994	-2893
1905	-2859

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 104PC Site 07		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 3/31/2013		File Name: RR0705_104_07_1g.slim

1815	-2824
1724	-2788
1633	-2753
1543	-2718
1452	-2679
1361	-2635
1270	-2587
1180	-2541
1089	-2495
998	-2452
907	-2412
817	-2374
726	-2340
635	-2309
544	-2279
454	-2245
363	-2209
272	-2175
182	-2148
91	-2124
0	-2093
0	-6000

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_104_09_0g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 104PC Site 09
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/31/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364796658
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 104PC Site 09		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_104_09_0g.slim

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Global Minimums

Method: spencer

FS: 1.031520
Center: 992.037, -2144.697
Radius: 955.964
Left Slip Surface Endpoint: 293.796, -2797.634
Right Slip Surface Endpoint: 826.118, -3086.153
Left Slope Intercept: 293.796 0.000
Right Slope Intercept: 826.118 0.000
Resisting Moment=5.20347e+007 kN-m
Driving Moment=5.04449e+007 kN-m
Resisting Horizontal Force=47791.3 kN
Driving Horizontal Force=46331.1 kN
Total Slice Area=1.58597e+006 m2

Method: gle/morgenstern-price

FS: 1.033230
Center: 939.864, -2242.580
Radius: 838.812
Left Slip Surface Endpoint: 324.829, -2812.964
Right Slip Surface Endpoint: 787.943, -3067.520
Left Slope Intercept: 324.829 0.000
Right Slope Intercept: 787.943 0.000
Resisting Moment=3.52903e+007 kN-m
Driving Moment=3.41555e+007 kN-m
Resisting Horizontal Force=36805.4 kN

Driving Horizontal Force=35621.8 kN
Total Slice Area=1.37676e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2579
Number of Invalid Surfaces: 351

Error Codes:

Error Code -108 reported for 344 surfaces
Error Code -112 reported for 7 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2930
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.03152

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	21.2929	616673	basement	5.551	27.1	7.20034	7.42729	28932.9	28929.2	3.66986
2	21.2929	622655	basement	5.551	27.1	28.4954	29.3936	29195.9	29149.4	46.5482
3	21.2929	628152	basement	5.551	27.1	47.6031	49.1036	29441.4	29356.2	85.1535
4	21.2929	633222	basement	5.551	27.1	64.2468	66.2719	29669.6	29550.9	118.699
5	21.2929	637921	basement	5.551	27.1	79.2032	81.6997	29883.2	29734.4	148.794
6	21.2929	642276	basement	5.551	27.1	92.5369	95.4537	30083	29907.4	175.629
7	21.2929	646278	basement	5.551	27.1	103.856	107.13	30269.1	30070.6	198.476

8	21.2929	649964	basement	5.551	27.1	113.09	116.655	30441.7	30224.6	217.114
9	21.2929	653365	basement	5.551	27.1	120.708	124.513	30602.4	30369.9	232.48
10	21.2929	656492	basement	5.551	27.1	126.806	130.803	30751.8	30507	244.823
11	21.2929	659308	basement	5.551	27.1	130.532	134.646	30888.6	30636.3	252.296
12	21.2929	661861	basement	5.551	27.1	132.034	136.196	31013.5	30758.1	255.363
13	21.2929	664179	basement	5.551	27.1	131.947	136.106	31127.9	30872.8	255.13
14	21.2929	666265	basement	5.551	27.1	130.363	134.472	31232.5	30980.6	251.868
15	21.2929	668074	basement	5.551	27.1	126.241	130.22	31325.3	31081.7	243.607
16	21.2929	669658	basement	5.551	27.1	119.895	123.674	31407.2	31176.4	230.795
17	21.2929	671036	basement	5.551	27.1	111.939	115.467	31479.7	31264.8	214.855
18	21.2929	672234	basement	5.551	27.1	102.208	105.43	31542.5	31347.3	195.153
19	21.2929	673352	basement	5.551	27.1	93.08	96.0139	31600.6	31423.8	176.825
20	21.2929	674304	basement	5.551	27.1	83.3698	85.9976	31651.9	31494.7	157.176
21	21.2929	675071	basement	5.551	27.1	72.0898	74.3621	31694.4	31559.9	134.455
22	21.2929	675680	basement	5.551	27.1	59.1141	60.9774	31727.9	31619.6	108.289
23	21.2929	676214	basement	5.551	27.1	46.8139	48.2895	31757.4	31673.9	83.5415
24	21.2929	676586	basement	5.551	27.1	33.6372	34.6974	31779.9	31723	56.8883
25	21.2929	676787	basement	5.551	27.1	18.878	19.473	31794	31766.8	27.1713

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.03323

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	18.5246	539087	basement	5.551	27.1	11.6142	12.0002	29085.8	29073.2	12.5519
2	18.5246	543611	basement	5.551	27.1	26.9701	27.8663	29309.9	29266.3	43.6463
3	18.5246	547796	basement	5.551	27.1	41.0932	42.4587	29520.1	29447.9	72.1576
4	18.5246	551678	basement	5.551	27.1	54.1369	55.9359	29717.3	29618.9	98.3979
5	18.5246	555278	basement	5.551	27.1	66.1472	68.3453	29902.7	29780	122.665
6	18.5246	558600	basement	5.551	27.1	77.0077	79.5667	30076.6	29932	144.611
7	18.5246	561660	basement	5.551	27.1	86.366	89.2359	30238.9	30075.4	163.53
8	18.5246	564491	basement	5.551	27.1	94.6869	97.8333	30391.2	30210.8	180.364
9	18.5246	567106	basement	5.551	27.1	101.949	105.336	30533.7	30338.7	195.029
10	18.5246	569508	basement	5.551	27.1	108.24	111.837	30667.1	30459.4	207.722
11	18.5246	571673	basement	5.551	27.1	112.503	116.241	30789.7	30573.3	216.359
12	18.5246	573645	basement	5.551	27.1	115.156	118.983	30902.4	30680.7	221.695
13	18.5246	575439	basement	5.551	27.1	116.489	120.36	31006.2	30781.9	224.336
14	18.5246	577062	basement	5.551	27.1	116.436	120.305	31101.2	30877	224.246
15	18.5246	578489	basement	5.551	27.1	114.868	118.685	31187.4	30966.4	221.048
16	18.5246	579728	basement	5.551	27.1	110.437	114.107	31262.3	31050.2	212.104
17	18.5246	580811	basement	5.551	27.1	104.342	107.809	31328.4	31128.5	199.871
18	18.5246	581745	basement	5.551	27.1	96.5198	99.7272	31385.7	31201.7	183.994

19	18.5246	582549	basement	5.551	27.1	86.7996	89.6839	31434.1	31269.7	164.417
20	18.5246	583297	basement	5.551	27.1	77.5115	80.0872	31478.4	31332.7	145.698
21	18.5246	583918	basement	5.551	27.1	67.2619	69.497	31515.9	31390.9	124.967
22	18.5246	584403	basement	5.551	27.1	55.2443	57.0801	31545	31444.3	100.688
23	18.5246	584755	basement	5.551	27.1	41.4353	42.8122	31565.8	31493	72.8497
24	18.5246	585032	basement	5.551	27.1	27.0933	27.9936	31581	31537.2	43.8225
25	18.5246	585227	basement	5.551	27.1	12.6346	13.0545	31591.4	31576.8	14.6416

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.03152

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	293.796	-2797.63	4.03078e+007	0	0
2	315.089	-2819.68	334181	450.724	0.0772772
3	336.381	-2840.39	630247	850.04	0.0772771
4	357.674	-2859.86	877974	1184.16	0.0772772
5	378.967	-2878.19	1.09486e+006	1476.69	0.0772775
6	400.26	-2895.48	1.28266e+006	1729.98	0.0772773
7	421.553	-2911.78	1.44041e+006	1942.74	0.0772771
8	442.846	-2927.17	1.56274e+006	2107.74	0.0772774
9	464.139	-2941.69	1.65982e+006	2238.66	0.0772769
10	485.432	-2955.39	1.73263e+006	2336.86	0.0772768
11	506.724	-2968.31	1.77616e+006	2395.58	0.0772771
12	528.017	-2980.49	1.78421e+006	2406.44	0.0772772
13	549.31	-2991.96	1.77021e+006	2387.56	0.0772773
14	570.603	-3002.75	1.73479e+006	2339.78	0.077277
15	591.896	-3012.89	1.67106e+006	2253.82	0.0772769
16	613.189	-3022.39	1.57422e+006	2123.22	0.0772773
17	634.482	-3031.28	1.45736e+006	1965.6	0.0772771
18	655.775	-3039.57	1.32089e+006	1781.54	0.0772772
19	677.067	-3047.28	1.18401e+006	1596.93	0.0772775
20	698.36	-3054.43	1.04947e+006	1415.47	0.0772775
21	719.653	-3061.03	896714	1209.44	0.0772774
22	740.946	-3067.1	726032	979.229	0.0772771
23	762.239	-3072.63	558529	753.312	0.0772772
24	783.532	-3077.65	389220	524.957	0.0772771
25	804.825	-3082.15	202973	273.758	0.0772771
26	826.118	-3086.15	4.90503e+007	0	0

rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 104PC Site 09		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
SLIDEINTERPRET 6.020	Date	3/31/2013		File Name: RR0705_104_09_0g.slim

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.03323

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	324.829	-2812.96	4.07507e+007	0	0
2	343.353	-2832.31	287935	61.7	0.0122776
3	361.878	-2850.48	537333	228.468	0.0243615
4	380.402	-2867.57	757547	476.792	0.0360613
5	398.927	-2883.67	950496	782.889	0.0471924
6	417.452	-2898.85	1.11757e+006	1123.09	0.0575788
7	435.976	-2913.18	1.25058e+006	1463.65	0.0670576
8	454.501	-2926.71	1.36047e+006	1792.23	0.0754792
9	473.025	-2939.48	1.44831e+006	2090.72	0.0827097
10	491.55	-2951.54	1.51499e+006	2343.69	0.0886365
11	510.074	-2962.92	1.5525e+006	2524.42	0.0931649
12	528.599	-2973.65	1.56288e+006	2624.75	0.0962243
13	547.123	-2983.77	1.55416e+006	2651.93	0.0977662
14	565.648	-2993.29	1.52692e+006	2605.46	0.0977666
15	584.173	-3002.24	1.48152e+006	2488.11	0.0962242
16	602.697	-3010.65	1.40121e+006	2278.43	0.0931654
17	621.222	-3018.51	1.30368e+006	2016.78	0.0886359
18	639.746	-3025.86	1.18929e+006	1716.81	0.0827098
19	658.271	-3032.71	1.05842e+006	1394.32	0.0754791
20	676.795	-3039.07	929673	1088.07	0.0670578
21	695.32	-3044.95	801544	805.509	0.0575792
22	713.845	-3050.37	658053	542.013	0.0471923
23	732.369	-3055.32	499450	314.348	0.0360613
24	750.894	-3059.83	327486	139.244	0.0243616
25	769.418	-3063.89	170894	36.6198	0.0122776
26	787.943	-3067.52	4.84598e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.040758
Factor of Safety, standard deviation: 0.173639
Factor of Safety, minimum: 0.542201
Factor of Safety, maximum: 1.650180
Probability of Failure: 42.380% (= 4238 failed surfaces / 10000 valid surfaces)
Reliability index: 0.23473 (assuming normal distribution)

Reliability index: 0.15826 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 1.040157
Factor of Safety, standard deviation: 0.171370
Factor of Safety, minimum: 0.542671
Factor of Safety, maximum: 1.649650
Probability of Failure: 42.200% (= 4220 failed surfaces / 10000 valid surfaces)
Reliability index: 0.23433 (assuming normal distribution)
Reliability index: 0.15875 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
2866	-6000
2866	0
0	0

External Boundary

X	Y
2866	-6000
2866	-3488
2774	-3488
2683	-3487
2591	-3482
2499	-3473
2408	-3464
2316	-3456
2224	-3449
2132	-3441
2052	-3428
1971	-3411
1891	-3395
1810	-3380
1730	-3367

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 104PC Site 09		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 3/31/2013		File Name: RR0705_104_09_0g.slim

1649	-3352
1569	-3337
1489	-3323
1408	-3309
1328	-3292
1248	-3270
1167	-3240
1084	-3206
1000	-3169
917	-3130
834	-3090
750	-3049
667	-3004
584	-2954
500	-2906
417	-2861
333	-2817
250	-2776
167	-2737
83	-2701
0	-2679
0	-6000

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_104_09_1g.slim
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 104PC Site 09
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/31/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364796821
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.000654
Center: 741.207, -2895.089
Radius: 150.048
Left Slip Surface Endpoint: 611.537, -2970.589
Right Slip Surface Endpoint: 742.857, -3045.128
Left Slope Intercept: 611.537 0.000
Right Slope Intercept: 742.857 0.000
Resisting Moment=4306.34 kN-m
Driving Moment=6.58781e+006 kN-m
Resisting Horizontal Force=31.1997 kN

Driving Horizontal Force=47729 kN
Total Slice Area=397069 m2

Method: gle/morgenstern-price

FS: 0.001008
Center: 1484.935, -1124.376
Radius: 2090.073
Left Slip Surface Endpoint: 142.902, -2726.672
Right Slip Surface Endpoint: 946.708, -3143.959
Left Slope Intercept: 142.902 0.000
Right Slope Intercept: 946.708 0.000
Resisting Moment=1.56231e+006 kN-m
Driving Moment=1.55041e+009 kN-m
Resisting Horizontal Force=761.895 kN
Driving Horizontal Force=756095 kN
Total Slice Area=2.38942e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1600
Number of Invalid Surfaces: 53

Error Codes:

Error Code -108 reported for 39 surfaces
Error Code -112 reported for 14 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1616
Number of Invalid Surfaces: 37

Error Codes:

Error Code -108 reported for 4 surfaces
Error Code -111 reported for 5 surfaces
Error Code -112 reported for 28 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.000653683

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	5.2528	161023	basement	5.551	27.1	478.887	0.31304	30671.3	30681.6	-10.266
2	5.2528	161585	basement	5.551	27.1	494.919	0.32352	30826.5	30836.8	-10.2755
3	5.2528	162068	basement	5.551	27.1	511.456	0.33433	30956.9	30967.1	-10.2111
4	5.2528	162489	basement	5.551	27.1	527.136	0.34458	31067.7	31077.9	-10.2437
5	5.2528	162857	basement	5.551	27.1	540.92	0.35359	31162.3	31172.5	-10.1683
6	5.2528	163182	basement	5.551	27.1	551.904	0.36077	31243.1	31253.3	-10.1687
7	5.2528	163470	basement	5.551	27.1	559.247	0.36557	31312.1	31322.3	-10.1526
8	5.2528	163723	basement	5.551	27.1	562.061	0.36741	31370.5	31380.6	-10.053
9	5.2528	163946	basement	5.551	27.1	559.354	0.36564	31419.4	31429.5	-10.0786
10	5.2528	164142	basement	5.551	27.1	549.976	0.35951	31459.6	31469.7	-10.1177
11	5.2528	164313	basement	5.551	27.1	565.932	0.36994	31492.4	31502.5	-10.0876
12	5.2528	164467	basement	5.551	27.1	594.478	0.3886	31521.5	31531.6	-10.1165
13	5.2528	164601	basement	5.551	27.1	573.52	0.3749	31544.5	31554.6	-10.0561
14	5.2528	164714	basement	5.551	27.1	540.782	0.3535	31560.9	31571.1	-10.2216
15	5.2528	164807	basement	5.551	27.1	493.083	0.32232	31571.2	31581.4	-10.1868
16	5.2528	164882	basement	5.551	27.1	425.879	0.27839	31575.3	31585.7	-10.3645
17	5.2528	164938	basement	5.551	27.1	332.623	0.21743	31573.9	31584.4	-10.5009
18	5.2528	164977	basement	5.551	27.1	203.264	0.13287	31566.9	31577.6	-10.6604
19	5.2528	164999	basement	5.551	27.1	20.9582	0.0137	31554.6	31565.5	-10.8739
20	5.2528	165004	basement	5.551	27.1	0	0	31517.6	31548.1	-30.503
21	5.2528	164994	basement	5.551	27.1	0	0	31472.6	31525.8	-53.1687
22	5.2528	164967	basement	5.551	27.1	0	0	31421.8	31498.4	-76.5843
23	5.2528	164925	basement	5.551	27.1	0	0	31365.1	31466.1	-101.044
24	5.2528	164867	basement	5.551	27.1	0	0	31302.6	31429	-126.445
25	5.2528	164794	basement	5.551	27.1	0	0	31182.5	31387	-204.492

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00100767

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]

1	32.1522	908484	basement	5.551	27.1	226.175	0.22791	28309.8	28320.2	-10.417
2	32.1522	919055	basement	5.551	27.1	588.883	0.5934	28754	28763.7	-9.70862
3	32.1522	929036	basement	5.551	27.1	932.21	0.93936	29165.4	29174.4	-9.01077
4	32.1522	938486	basement	5.551	27.1	1234.49	1.24396	29548.4	29556.8	-8.36998
5	32.1522	947358	basement	5.551	27.1	1494.72	1.50618	29897.8	29905.7	-7.86859
6	32.1522	955761	basement	5.551	27.1	1720.37	1.73357	30223	30230.4	-7.43553
7	32.1522	963622	basement	5.551	27.1	1843.63	1.85777	30516.4	30523.6	-7.20606
8	32.1522	970985	basement	5.551	27.1	1950.79	1.96575	30781.4	30788.5	-7.10859
9	32.1522	977924	basement	5.551	27.1	1987.24	2.00248	31024.3	31031.3	-6.99941
10	32.1522	984384	basement	5.551	27.1	1956.26	1.97126	31239.6	31246.6	-7.04416
11	32.1522	990444	basement	5.551	27.1	1898.8	1.91336	31433.9	31440.9	-7.02313
12	32.1522	996060	basement	5.551	27.1	1705.53	1.71861	31602.4	31609.9	-7.51643
13	32.1522	1.00121e+006	basement	5.551	27.1	1523.7	1.53539	31743.6	31751.4	-7.80101
14	32.1522	1.006e+006	basement	5.551	27.1	1289.48	1.29937	31865.5	31873.9	-8.3923
15	32.1522	1.01032e+006	basement	5.551	27.1	963.262	0.97065	31958.6	31967.6	-9.04477
16	32.1522	1.01425e+006	basement	5.551	27.1	694.404	0.69973	32030.5	32039.9	-9.38912
17	32.1522	1.01793e+006	basement	5.551	27.1	582.681	0.58715	32093.1	32102.7	-9.60133
18	32.1522	1.02155e+006	basement	5.551	27.1	424.683	0.42794	32160.9	32170.9	-9.95347
19	32.1522	1.02486e+006	basement	5.551	27.1	233.013	0.2348	32214.2	32224.5	-10.3345
20	32.1522	1.02805e+006	basement	5.551	27.1	206.834	0.20842	32268.3	32278.8	-10.548
21	32.1522	1.03106e+006	basement	5.551	27.1	58.9677	0.05942	32317.6	32328.3	-10.7161
22	32.1522	1.03377e+006	basement	5.551	27.1	0	0	32344	32362.8	-18.849
23	32.1522	1.03622e+006	basement	5.551	27.1	0	0	32355.2	32384.5	-29.3282
24	32.1522	1.03838e+006	basement	5.551	27.1	0	0	32355.9	32391.8	-35.8622
25	32.1522	1.04028e+006	basement	5.551	27.1	0	0	32350.4	32387	-36.5846

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.000653683

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	611.537	-2970.59	4.54456e+007	0	0
2	616.79	-2978.96	159162	-1524.08	-0.548628
3	622.043	-2986.27	287032	-2748.5	-0.548624
4	627.296	-2992.75	390457	-3738.86	-0.548625
5	632.549	-2998.57	473877	-4537.66	-0.548625
6	637.801	-3003.82	540367	-5174.35	-0.548626
7	643.054	-3008.58	592160	-5670.29	-0.548625
8	648.307	-3012.92	630937	-6041.61	-0.548626

9	653.56	-3016.88	658005	-6300.79	-0.548624
10	658.813	-3020.49	674397	-6457.76	-0.548625
11	664.065	-3023.79	680952	-6520.53	-0.548625
12	669.318	-3026.79	682614	-6536.44	-0.548625
13	674.571	-3029.53	681103	-6521.97	-0.548625
14	679.824	-3032.01	671525	-6430.26	-0.548625
15	685.077	-3034.24	654290	-6265.22	-0.548625
16	690.329	-3036.25	629753	-6030.27	-0.548625
17	695.582	-3038.03	598230	-5728.42	-0.548626
18	700.835	-3039.6	560006	-5362.4	-0.548625
19	706.088	-3040.97	515353	-4934.82	-0.548625
20	711.341	-3042.13	464545	-4448.3	-0.548625
21	716.593	-3043.1	407347	-3900.59	-0.548624
22	721.846	-3043.88	343825	-3292.34	-0.548626
23	727.099	-3044.47	274073	-2624.41	-0.548624
24	732.352	-3044.88	198160	-1897.5	-0.548624
25	737.605	-3045.09	116138	-1112.09	-0.548624
26	742.857	-3045.13	4.77549e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00100767

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	142.902	-2726.67	3.82889e+007	0	0
2	175.055	-2753.06	349916	-1005.67	-0.164669
3	207.207	-2778.41	652046	-3718.46	-0.32674
4	239.359	-2802.75	933540	-7880.52	-0.483653
5	271.511	-2826.14	1.17926e+006	-13027.6	-0.632936
6	303.664	-2848.62	1.396e+006	-18816.2	-0.772223
7	335.816	-2870.21	1.58852e+006	-24935.7	-0.899323
8	367.968	-2890.95	1.73405e+006	-30638.7	-1.01225
9	400.12	-2910.88	1.85731e+006	-35960.2	-1.10919
10	432.273	-2930.01	1.95047e+006	-40469.9	-1.18865
11	464.425	-2948.37	2.01268e+006	-43894.3	-1.24936
12	496.577	-2965.99	2.05298e+006	-46243.4	-1.29037
13	528.729	-2982.89	2.04725e+006	-46853.4	-1.31104
14	560.881	-2999.08	2.0166e+006	-46151.8	-1.31104
15	593.034	-3014.59	1.95587e+006	-44056.1	-1.29037
16	625.186	-3029.43	1.852e+006	-40389.9	-1.24935
17	657.338	-3043.62	1.72549e+006	-35801.8	-1.18865
18	689.49	-3057.16	1.61652e+006	-31298.2	-1.10919

19	721.643	-3070.09	1.50312e+006	-26558.3	-1.01224
20	753.795	-3082.4	1.37406e+006	-21569.3	-0.899326
21	785.947	-3094.1	1.26976e+006	-17114.6	-0.772221
22	818.099	-3105.22	1.14418e+006	-12640	-0.632933
23	850.252	-3115.75	999078	-8433.76	-0.483653
24	882.404	-3125.72	833530	-4753.42	-0.32674
25	914.556	-3135.12	644317	-1851.79	-0.16467
26	946.708	-3143.96	5.09051e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.076979
Factor of Safety, standard deviation: 0.092133
Factor of Safety, minimum: 0.000305
Factor of Safety, maximum: 0.996805
Probability of Failure: 100.000% (= 9794 failed surfaces / 9794 valid surfaces), 206 invalid surfaces
Reliability index: -10.01839 (assuming normal distribution)
Reliability index: -3.19115 (assuming lognormal distribution)
* best fit = Beta

Method: gle/morgenstern-price
Factor of Safety, mean: 0.021650
Factor of Safety, standard deviation: 0.058151
Factor of Safety, minimum: 0.000085
Factor of Safety, maximum: 0.835228
Probability of Failure: 100.000% (= 9995 failed surfaces / 9995 valid surfaces), 5 invalid surfaces
Reliability index: -16.82438 (assuming normal distribution)
Reliability index: -3.36674 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
2866	-6000
2866	0
0	0

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 104PC Site 09		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 3/31/2013		File Name: RR0705_104_09_1g.slim

External Boundary

X	Y
2866	-6000
2866	-3488
2774	-3488
2683	-3487
2591	-3482
2499	-3473
2408	-3464
2316	-3456
2224	-3449
2132	-3441
2052	-3428
1971	-3411
1891	-3395
1810	-3380
1730	-3367
1649	-3352
1569	-3337
1489	-3323
1408	-3309
1328	-3292
1248	-3270
1167	-3240
1084	-3206
1000	-3169
917	-3130
834	-3090
750	-3049
667	-3004
584	-2954
500	-2906
417	-2861
333	-2817
250	-2776
167	-2737
83	-2701
0	-2679
0	-6000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 00		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	4/01/2013		File Name: RR0705_108_0_0g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_108_0_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 108PC Site 00
Author: Jason R. Patton
Company: Oregon State University
Date Created: 4/01/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364839012
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 00		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	4/01/2013		File Name: RR0705_108_0_0g.sli

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Global Minimums

Method: spencer

FS: 1.316140
Center: 1561.485, -642.979
Radius: 2177.576
Left Slip Surface Endpoint: 282.979, -2405.722
Right Slip Surface Endpoint: 1223.476, -2794.162
Left Slope Intercept: 282.979 -0.000
Right Slope Intercept: 1223.476 -0.000
Resisting Moment=2.58528e+008 kN-m
Driving Moment=1.96429e+008 kN-m
Resisting Horizontal Force=109319 kN
Driving Horizontal Force=83060.2 kN
Total Slice Area=2.48617e+006 m2

Method: gle/morgenstern-price

FS: 1.316850
Center: 1561.485, -642.979
Radius: 2177.576
Left Slip Surface Endpoint: 282.979, -2405.722
Right Slip Surface Endpoint: 1223.476, -2794.162
Left Slope Intercept: 282.979 -0.000
Right Slope Intercept: 1223.476 -0.000
Resisting Moment=2.58667e+008 kN-m
Driving Moment=1.96429e+008 kN-m
Resisting Horizontal Force=109335 kN

Driving Horizontal Force=83027.7 kN
Total Slice Area=2.48617e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2575
Number of Invalid Surfaces: 107

Error Codes:

Error Code -108 reported for 106 surfaces
Error Code -112 reported for 1 surface

Method: gle/morgenstern-price

Number of Valid Surfaces: 2682
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.31614

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	37.6199	938937	basement	5.551	27.1	10.2216	13.453	24931.8	24916.3	15.4829
2	37.6199	951899	basement	5.551	27.1	34.8881	45.9176	25264	25185.1	78.8677
3	37.6199	963832	basement	5.551	27.1	54.4438	71.6556	25571.3	25442.1	129.199
4	37.6199	974990	basement	5.551	27.1	71.9224	94.66	25861.9	25687.7	174.168
5	37.6199	985167	basement	5.551	27.1	84.5678	111.303	26129.2	25922.5	206.738
6	37.6199	994716	basement	5.551	27.1	95.0621	125.115	26380.2	26146.7	233.539
7	37.6199	1.00372e+006	basement	5.551	27.1	104.278	137.245	26618.2	26360.8	257.416

8	37.6199	1.01214e+006	basement	5.551	27.1	112.033	147.451	26842.3	26565	277.329
9	37.6199	1.01991e+006	basement	5.551	27.1	117.339	154.434	27050.7	26759.7	290.986
10	37.6199	1.0271e+006	basement	5.551	27.1	120.538	158.645	27244.4	26945.2	299.195
11	37.6199	1.03381e+006	basement	5.551	27.1	122.36	161.043	27425.5	27121.6	303.938
12	37.6199	1.04002e+006	basement	5.551	27.1	122.848	161.685	27594.5	27289.3	305.206
13	37.6199	1.04586e+006	basement	5.551	27.1	122.319	160.989	27752.2	27448.4	303.759
14	37.6199	1.05133e+006	basement	5.551	27.1	121.777	160.275	27901.6	27599.2	302.381
15	37.6199	1.05638e+006	basement	5.551	27.1	119.879	157.777	28039.1	27741.8	297.347
16	37.6199	1.06106e+006	basement	5.551	27.1	117.576	154.746	28167.9	27876.3	291.602
17	37.6199	1.06529e+006	basement	5.551	27.1	113.844	149.834	28284.9	28003	281.855
18	37.6199	1.06911e+006	basement	5.551	27.1	108.864	143.28	28391	28122	268.998
19	37.6199	1.07247e+006	basement	5.551	27.1	102.403	134.777	28485.8	28233.3	252.486
20	37.6199	1.07529e+006	basement	5.551	27.1	93.4498	122.993	28566.6	28337.2	229.385
21	37.6199	1.07765e+006	basement	5.551	27.1	82.6819	108.821	28635.6	28433.7	201.911
22	37.6199	1.0794e+006	basement	5.551	27.1	68.807	90.5597	28689.1	28522.9	166.235
23	37.6199	1.08069e+006	basement	5.551	27.1	52.3363	68.8819	28728.6	28604.9	123.672
24	37.6199	1.08172e+006	basement	5.551	27.1	35.3501	46.5257	28759.8	28679.8	79.9999
25	37.6199	1.08243e+006	basement	5.551	27.1	18.0981	23.8196	28783.5	28747.7	35.8161

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.31685

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	37.6199	938937	basement	5.551	27.1	15.1373	19.9335	24944.4	24916.3	28.0584
2	37.6199	951899	basement	5.551	27.1	36.9791	48.6959	25269.5	25185.1	84.3678
3	37.6199	963832	basement	5.551	27.1	54.7473	72.094	25572.2	25442.1	130.091
4	37.6199	974990	basement	5.551	27.1	70.6245	93.0019	25858.7	25687.7	171.004
5	37.6199	985167	basement	5.551	27.1	82.3177	108.4	26123.5	25922.5	201.019
6	37.6199	994716	basement	5.551	27.1	92.3112	121.56	26373.3	26146.7	226.597
7	37.6199	1.00372e+006	basement	5.551	27.1	101.299	133.396	26610.5	26360.8	249.696
8	37.6199	1.01214e+006	basement	5.551	27.1	109.11	143.681	26835	26565	270.002
9	37.6199	1.01991e+006	basement	5.551	27.1	114.772	151.137	27044.2	26759.7	284.542
10	37.6199	1.0271e+006	basement	5.551	27.1	118.503	156.051	27239.3	26945.2	294.137
11	37.6199	1.03381e+006	basement	5.551	27.1	120.971	159.301	27422.1	27121.6	300.536
12	37.6199	1.04002e+006	basement	5.551	27.1	122.22	160.945	27593	27289.3	303.737
13	37.6199	1.04586e+006	basement	5.551	27.1	122.296	161.045	27752.4	27448.4	304.006
14	37.6199	1.05133e+006	basement	5.551	27.1	122.54	161.367	27903.6	27599.2	304.37
15	37.6199	1.05638e+006	basement	5.551	27.1	121.283	159.711	28042.9	27741.8	301.102
16	37.6199	1.06106e+006	basement	5.551	27.1	119.614	157.514	28173.2	27876.3	296.891
17	37.6199	1.06529e+006	basement	5.551	27.1	116.375	153.248	28291.7	28003	288.697
18	37.6199	1.06911e+006	basement	5.551	27.1	111.703	147.096	28398.6	28122	276.642

19	37.6199	1.07247e+006	basement	5.551	27.1	105.302	138.667	28493.5	28233.3	260.17
20	37.6199	1.07529e+006	basement	5.551	27.1	96.0588	126.495	28573.5	28337.2	236.334
21	37.6199	1.07765e+006	basement	5.551	27.1	84.5928	111.396	28640.5	28433.7	206.822
22	37.6199	1.0794e+006	basement	5.551	27.1	69.4828	91.4984	28691	28522.9	168.051
23	37.6199	1.08069e+006	basement	5.551	27.1	51.5623	67.8998	28726.7	28604.9	121.849
24	37.6199	1.08172e+006	basement	5.551	27.1	33.1934	43.7107	28754.3	28679.8	74.5101
25	37.6199	1.08243e+006	basement	5.551	27.1	14.0191	18.4611	28773	28747.7	25.3271

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.31614

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	282.979	-2405.72	2.98056e+007	0	0
2	320.599	-2432.4	376443	733.858	0.111695
3	358.219	-2457.91	673862	1313.66	0.111695
4	395.839	-2482.3	938253	1829.08	0.111695
5	433.459	-2505.61	1.13975e+006	2221.89	0.111695
6	471.078	-2527.88	1.29837e+006	2531.12	0.111696
7	508.698	-2549.15	1.43627e+006	2799.94	0.111695
8	546.318	-2569.45	1.5537e+006	3028.87	0.111695
9	583.938	-2588.81	1.64103e+006	3199.11	0.111695
10	621.558	-2607.25	1.69238e+006	3299.22	0.111695
11	659.178	-2624.82	1.72119e+006	3355.38	0.111695
12	696.798	-2641.52	1.73217e+006	3376.77	0.111695
13	734.418	-2657.38	1.7202e+006	3353.44	0.111695
14	772.037	-2672.42	1.7149e+006	3343.11	0.111695
15	809.657	-2686.65	1.68696e+006	3288.65	0.111695
16	847.277	-2700.1	1.65315e+006	3222.73	0.111695
17	884.897	-2712.78	1.60052e+006	3120.13	0.111695
18	922.517	-2724.7	1.5292e+006	2981.11	0.111696
19	960.137	-2735.88	1.4376e+006	2802.53	0.111695
20	997.757	-2746.32	1.31527e+006	2564.05	0.111695
21	1035.38	-2756.05	1.16214e+006	2265.54	0.111695
22	1073	-2765.06	975746	1902.17	0.111695
23	1110.62	-2773.37	745627	1453.56	0.111695
24	1148.24	-2780.98	499319	973.398	0.111695
25	1185.86	-2787.91	259799	506.466	0.111695
26	1223.48	-2794.16	4.02078e+007	0	0

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 00		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	4/01/2013		File Name: RR0705_108_0_0g.sli

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.31685

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	282.979	-2405.72	2.98056e+007	0	0
2	320.599	-2432.4	376596	126.276	0.0192118
3	358.219	-2457.91	674075	448.48	0.0381204
4	395.839	-2482.3	938475	924.262	0.056428
5	433.459	-2505.61	1.13995e+006	1469.22	0.0738454
6	471.078	-2527.88	1.29853e+006	2041.96	0.0900985
7	508.698	-2549.15	1.43638e+006	2630.57	0.104931
8	546.318	-2569.45	1.55377e+006	3202.91	0.118108
9	583.938	-2588.81	1.64107e+006	3706.94	0.129423
10	621.558	-2607.25	1.6924e+006	4096.8	0.138696
11	659.178	-2624.82	1.72119e+006	4379.38	0.145783
12	696.798	-2641.52	1.73216e+006	4552.02	0.15057
13	734.418	-2657.38	1.72019e+006	4593	0.152982
14	772.037	-2672.42	1.7149e+006	4578.87	0.152982
15	809.657	-2686.65	1.68696e+006	4433.24	0.15057
16	847.277	-2700.1	1.65315e+006	4206.25	0.145782
17	884.897	-2712.78	1.60051e+006	3874.36	0.138696
18	922.517	-2724.7	1.52918e+006	3454.2	0.129423
19	960.137	-2735.88	1.43755e+006	2963.33	0.118108
20	997.757	-2746.32	1.31519e+006	2408.63	0.104931
21	1035.38	-2756.05	1.16203e+006	1827.32	0.0900989
22	1073	-2765.06	975611	1257.42	0.0738458
23	1110.62	-2773.37	745482	734.191	0.056428
24	1148.24	-2780.98	499188	332.123	0.0381204
25	1185.86	-2787.91	259711	87.0832	0.0192117
26	1223.48	-2794.16	4.02078e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.325004
Factor of Safety, standard deviation: 0.222211
Factor of Safety, minimum: 0.701563
Factor of Safety, maximum: 2.095650
Probability of Failure: 6.780% (= 678 failed surfaces / 10000 valid surfaces)
Reliability index: 1.46260 (assuming normal distribution)

Reliability index: 1.60647 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 1.325039
Factor of Safety, standard deviation: 0.222217
Factor of Safety, minimum: 0.701580
Factor of Safety, maximum: 2.095710
Probability of Failure: 6.780% (= 678 failed surfaces / 10000 valid surfaces)
Reliability index: 1.46271 (assuming normal distribution)
Reliability index: 1.60662 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-5000
2430	-5000
2430	0
0	0

External Boundary

X	Y
2430	-5000
2430	-2907
2341	-2907
2252	-2906
2163	-2903
2075	-2899
1986	-2898
1897	-2897
1808	-2896
1719	-2893
1630	-2885
1549	-2875
1468	-2861
1386	-2844
1305	-2822

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 108PC Site 00		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 4/01/2013		File Name: RR0705_108_0_0g.sli

1223	-2794
1142	-2761
1060	-2725
979	-2692
897	-2660
816	-2628
734	-2594
653	-2558
571	-2521
490	-2486
408	-2450
326	-2419
245	-2394
163	-2381
82	-2377
0	-2371
0	-5000

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_108_0_1g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 108PC Site 00
Author: Jason R. Patton
Company: Oregon State University
Date Created: 4/01/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 00		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	4/01/2013		File Name: RR0705_108_0_1g.sli

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364839114
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.003418
Center: 2181.289, 908.851
Radius: 3814.315
Left Slip Surface Endpoint: 306.740, -2413.056
Right Slip Surface Endpoint: 1143.171, -2761.477
Left Slope Intercept: 306.740 -0.000
Right Slope Intercept: 1143.171 -0.000
Resisting Moment=5.04531e+006 kN-m
Driving Moment=1.47624e+009 kN-m
Resisting Horizontal Force=1294.83 kN

Driving Horizontal Force=378862 kN
Total Slice Area=2.18037e+006 m2

Method: gle/morgenstern-price

FS: 0.003277
Center: 2181.289, 908.851
Radius: 3814.315
Left Slip Surface Endpoint: 306.740, -2413.056
Right Slip Surface Endpoint: 1143.171, -2761.477
Left Slope Intercept: 306.740 -0.000
Right Slope Intercept: 1143.171 -0.000
Resisting Moment=4.83813e+006 kN-m
Driving Moment=1.47624e+009 kN-m
Resisting Horizontal Force=1242.99 kN
Driving Horizontal Force=379270 kN
Total Slice Area=2.18037e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1011
Number of Invalid Surfaces: 40

Error Codes:

Error Code -108 reported for 38 surfaces
Error Code -112 reported for 2 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1042
Number of Invalid Surfaces: 9

Error Codes:

Error Code -108 reported for 6 surfaces
Error Code -112 reported for 3 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This

screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.00341768

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	33.4572	835519	basement	5.551	27.1	214.874	0.73437	25004.1	25013.5	-9.42372
2	33.4572	843031	basement	5.551	27.1	289.893	0.99076	25292.7	25301.6	-8.86798
3	33.4572	850240	basement	5.551	27.1	378.186	1.29252	25564	25572.3	-8.30408
4	33.4572	857042	basement	5.551	27.1	410.659	1.4035	25808.4	25816.5	-8.1422
5	33.4572	863419	basement	5.551	27.1	454.557	1.55353	26024.7	26032.5	-7.78454
6	33.4572	869582	basement	5.551	27.1	496.989	1.69855	26230.8	26238.3	-7.54838
7	33.4572	875561	basement	5.551	27.1	536.864	1.83483	26428.8	26436.1	-7.28339
8	33.4572	881330	basement	5.551	27.1	567.874	1.94081	26616.7	26623.8	-7.08733
9	33.4572	886818	basement	5.551	27.1	574.653	1.96398	26788	26795	-6.97776
10	33.4572	892049	basement	5.551	27.1	581.345	1.98685	26945	26952	-6.99277
11	33.4572	897085	basement	5.551	27.1	584.774	1.99857	27092.6	27099.5	-6.89057
12	33.4572	901948	basement	5.551	27.1	582.22	1.98984	27232.8	27239.8	-6.99377
13	33.4572	906619	basement	5.551	27.1	575.94	1.96838	27363.8	27370.8	-7.02928
14	33.4572	911219	basement	5.551	27.1	589.154	2.01354	27495.9	27502.8	-6.92059
15	33.4572	915679	basement	5.551	27.1	581.851	1.98858	27622.9	27629.9	-6.9889
16	33.4572	919982	basement	5.551	27.1	583.767	1.99513	27743.6	27750.6	-6.96605
17	33.4572	924177	basement	5.551	27.1	577.655	1.97424	27861.9	27868.9	-6.9986
18	33.4572	928188	basement	5.551	27.1	560.731	1.9164	27971.2	27978.3	-7.11567
19	33.4572	932033	basement	5.551	27.1	538.269	1.83963	28073.1	28080.3	-7.22123
20	33.4572	935699	basement	5.551	27.1	503.257	1.71997	28166.3	28173.8	-7.51196
21	33.4572	939137	basement	5.551	27.1	434.514	1.48503	28246.5	28254.4	-7.93747
22	33.4572	942331	basement	5.551	27.1	358.281	1.22449	28312.3	28320.8	-8.49161
23	33.4572	945320	basement	5.551	27.1	248.745	0.85013	28367	28376.2	-9.19248
24	33.4572	947981	basement	5.551	27.1	98.7102	0.33736	28400	28410.2	-10.1669
25	33.4572	950440	basement	5.551	27.1	0	0	28378.5	28433.3	-54.7535

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00327734

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	33.4572	835519	basement	5.551	27.1	129.63	0.42484	25003.5	25013.5	-10.0241
2	33.4572	843031	basement	5.551	27.1	289.714	0.94949	25292.7	25301.6	-8.94672

3	33.4572	850240	basement	5.551	27.1	436.787	1.4315	25564.3	25572.3	-8.04018
4	33.4572	857042	basement	5.551	27.1	518.06	1.69786	25808.9	25816.5	-7.58513
5	33.4572	863419	basement	5.551	27.1	586.482	1.9221	26025.4	26032.5	-7.06467
6	33.4572	869582	basement	5.551	27.1	645.664	2.11606	26231.6	26238.3	-6.74459
7	33.4572	875561	basement	5.551	27.1	694.341	2.27559	26429.7	26436.1	-6.42192
8	33.4572	881330	basement	5.551	27.1	722.403	2.36756	26617.5	26623.8	-6.27596
9	33.4572	886818	basement	5.551	27.1	704.147	2.30773	26788.7	26795	-6.29857
10	33.4572	892049	basement	5.551	27.1	686.261	2.24911	26945.5	26952	-6.50161
11	33.4572	897085	basement	5.551	27.1	662.562	2.17144	27092.9	27099.5	-6.56175
12	33.4572	901948	basement	5.551	27.1	626.798	2.05423	27232.9	27239.8	-6.8562
13	33.4572	906619	basement	5.551	27.1	588.95	1.93019	27363.7	27370.8	-7.08453
14	33.4572	911219	basement	5.551	27.1	586.836	1.92326	27495.7	27502.8	-7.11471
15	33.4572	915679	basement	5.551	27.1	540.371	1.77098	27622.5	27629.9	-7.43426
16	33.4572	919982	basement	5.551	27.1	519.192	1.70157	27743	27750.6	-7.55272
17	33.4572	924177	basement	5.551	27.1	481.049	1.57656	27861.1	27868.9	-7.78357
18	33.4572	928188	basement	5.551	27.1	434.136	1.42281	27970.2	27978.3	-8.07211
19	33.4572	932033	basement	5.551	27.1	389.661	1.27705	28072	28080.3	-8.32193
20	33.4572	935699	basement	5.551	27.1	340.239	1.11508	28165.1	28173.8	-8.70111
21	33.4572	939137	basement	5.551	27.1	268.111	0.87869	28245.3	28254.4	-9.10189
22	33.4572	942331	basement	5.551	27.1	213.585	0.69999	28311.3	28320.8	-9.51707
23	33.4572	945320	basement	5.551	27.1	152.178	0.49874	28366.3	28376.2	-9.87809
24	33.4572	947981	basement	5.551	27.1	85.3711	0.27979	28399.9	28410.2	-10.2815
25	33.4572	950440	basement	5.551	27.1	33.4112	0.1095	28422.6	28433.3	-10.6634

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.00341768

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	306.74	-2413.06	2.99876e+007	0	0
2	340.197	-2431.71	182234	-1496.19	-0.470403
3	373.655	-2449.94	325615	-2673.39	-0.470404
4	407.112	-2467.73	462257	-3795.26	-0.470404
5	440.569	-2485.1	541705	-4447.55	-0.470404
6	474.026	-2502.05	610853	-5015.27	-0.470403
7	507.484	-2518.59	673817	-5532.22	-0.470403
8	540.941	-2534.73	730169	-5994.89	-0.470404
9	574.398	-2550.47	775217	-6364.75	-0.470404
10	607.855	-2565.81	795458	-6530.93	-0.470404

11	641.313	-2580.77	805184	-6610.78	-0.470403
12	674.77	-2595.35	808064	-6634.43	-0.470404
13	708.227	-2609.54	802274	-6586.89	-0.470404
14	741.684	-2623.36	791651	-6499.68	-0.470404
15	775.142	-2636.81	790584	-6490.92	-0.470404
16	808.599	-2649.9	778987	-6395.7	-0.470404
17	842.056	-2662.63	770372	-6324.97	-0.470404
18	875.513	-2674.99	755184	-6200.27	-0.470404
19	908.971	-2687.01	731058	-6002.18	-0.470403
20	942.428	-2698.67	699210	-5740.71	-0.470404
21	975.885	-2709.99	656842	-5392.85	-0.470403
22	1009.34	-2720.96	589747	-4841.99	-0.470404
23	1042.8	-2731.59	510473	-4191.13	-0.470404
24	1076.26	-2741.89	406430	-3336.91	-0.470405
25	1109.71	-2751.85	276647	-2271.35	-0.470404
26	1143.17	-2761.48	3.92726e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00327734

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	306.74	-2413.06	2.99876e+007	0	0
2	340.197	-2431.71	184169	-411.165	-0.127915
3	373.655	-2449.94	327808	-1452.15	-0.253812
4	407.112	-2467.73	463581	-3039.86	-0.375703
5	440.569	-2485.1	541188	-4644.16	-0.491667
6	474.026	-2502.05	608032	-6366.18	-0.599873
7	507.484	-2518.59	668384	-8150.11	-0.698616
8	540.941	-2534.73	721980	-9909.21	-0.786338
9	574.398	-2550.47	764358	-11495.9	-0.86166
10	607.855	-2565.81	782448	-12611.2	-0.923392
11	641.313	-2580.77	790534	-13392.5	-0.97056
12	674.77	-2595.35	792332	-13863.7	-1.00242
13	708.227	-2609.54	786138	-13975.7	-1.01848
14	741.684	-2623.36	775755	-13791.2	-1.01848
15	775.142	-2636.81	775253	-13564.9	-1.00242
16	808.599	-2649.9	765018	-12960.2	-0.970557
17	842.056	-2662.63	758242	-12221	-0.923387
18	875.513	-2674.99	745544	-11212.9	-0.861657
19	908.971	-2687.01	724508	-9943.92	-0.786339
20	942.428	-2698.67	696184	-8489.1	-0.698616

21	975.885	-2709.99	657605	-6885.22	-0.599873
22	1009.34	-2720.96	594310	-5100.02	-0.491667
23	1042.8	-2731.59	518322	-3398.82	-0.375703
24	1076.26	-2741.89	416481	-1844.96	-0.253812
25	1109.71	-2751.85	287058	-640.871	-0.127915
26	1143.17	-2761.48	3.92726e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.044987
Factor of Safety, standard deviation: 0.081485
Factor of Safety, minimum: 0.000349
Factor of Safety, maximum: 1.162870
Probability of Failure: 99.970% (= 9979 failed surfaces / 9982 valid surfaces), 18 invalid surfaces
Reliability index: -11.72018 (assuming normal distribution)
Reliability index: -3.17483 (assuming lognormal distribution)
* best fit = Beta

Method: gle/morgenstern-price
Factor of Safety, mean: 0.046027
Factor of Safety, standard deviation: 0.083304
Factor of Safety, minimum: 0.000365
Factor of Safety, maximum: 1.162700
Probability of Failure: 99.970% (= 9995 failed surfaces / 9998 valid surfaces), 2 invalid surfaces
Reliability index: -11.45175 (assuming normal distribution)
Reliability index: -3.15668 (assuming lognormal distribution)
* best fit = Beta

List Of Coordinates

Water Table

X	Y
0	0
0	-5000
2430	-5000
2430	0
0	0

External Boundary

	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 108PC Site 00		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
SLIDEINTERPRET 6.020	Date: 4/01/2013		File Name: RR0705_108_0_1g.sli

X	Y
2430	-5000
2430	-2907
2341	-2907
2252	-2906
2163	-2903
2075	-2899
1986	-2898
1897	-2897
1808	-2896
1719	-2893
1630	-2885
1549	-2875
1468	-2861
1386	-2844
1305	-2822
1223	-2794
1142	-2761
1060	-2725
979	-2692
897	-2660
816	-2628
734	-2594
653	-2558
571	-2521
490	-2486
408	-2450
326	-2419
245	-2394
163	-2381
82	-2377
0	-2371
0	-5000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 01		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	4/01/2013		File Name: RR0705_108_01_0g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_108_01_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 108PC Site 01
Author: Jason R. Patton
Company: Oregon State University
Date Created: 4/01/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364839927
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 01		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	4/01/2013		File Name: RR0705_108_01_0g.sli

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Global Minimums

Method: spencer

FS: 0.967574
Center: 745.186, -2113.504
Radius: 563.743
Left Slip Surface Endpoint: 321.498, -2485.384
Right Slip Surface Endpoint: 615.037, -2662.018
Left Slope Intercept: 321.498 -0.000
Right Slope Intercept: 615.037 -0.000
Resisting Moment=1.0038e+007 kN-m
Driving Moment=1.03744e+007 kN-m
Resisting Horizontal Force=15190.1 kN
Driving Horizontal Force=15699.1 kN
Total Slice Area=761586 m2

Method: gle/morgenstern-price

FS: 0.967285
Center: 745.323, -2111.694
Radius: 565.535
Left Slip Surface Endpoint: 320.389, -2484.872
Right Slip Surface Endpoint: 615.037, -2662.018
Left Slope Intercept: 320.389 -0.000
Right Slope Intercept: 615.037 -0.000
Resisting Moment=1.01691e+007 kN-m
Driving Moment=1.0513e+007 kN-m
Resisting Horizontal Force=15345.2 kN

Driving Horizontal Force=15864.2 kN
Total Slice Area=764412 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2198
Number of Invalid Surfaces: 456

Error Codes:

Error Code -108 reported for 455 surfaces
Error Code -112 reported for 1 surface

Method: gle/morgenstern-price

Number of Valid Surfaces: 2654
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.967574

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	11.7415	301609	basement	5.551	27.1	4.95622	4.79551	25664.8	25666.2	-1.43895
2	11.7415	303601	basement	5.551	27.1	19.3099	18.6838	25821.5	25795.8	25.6609
3	11.7415	305456	basement	5.551	27.1	32.7709	31.7083	25968.9	25917.8	51.1245
4	11.7415	307175	basement	5.551	27.1	45.7202	44.2377	26108.5	26032.9	75.5783
5	11.7415	308669	basement	5.551	27.1	54.8835	53.1038	26234.5	26141.6	92.9304
6	11.7415	310027	basement	5.551	27.1	61.0177	59.0391	26348.9	26244.4	104.537
7	11.7415	311285	basement	5.551	27.1	66.1452	64.0004	26455.9	26341.7	114.247

8	11.7415	312449	basement	5.551	27.1	70.2832	68.0042	26555.9	26433.8	122.076
9	11.7415	313525	basement	5.551	27.1	73.4467	71.0651	26649.1	26521.1	128.013
10	11.7415	314518	basement	5.551	27.1	75.6493	73.1963	26736	26603.8	132.161
11	11.7415	315432	basement	5.551	27.1	76.8953	74.4019	26816.6	26682.1	134.507
12	11.7415	316272	basement	5.551	27.1	77.2508	74.7459	26891.4	26756.2	135.212
13	11.7415	317041	basement	5.551	27.1	76.7458	74.2572	26960.6	26826.3	134.298
14	11.7415	317741	basement	5.551	27.1	75.3194	72.8771	27024.3	26892.7	131.557
15	11.7415	318375	basement	5.551	27.1	72.9768	70.6105	27082.5	26955.4	127.095
16	11.7415	318945	basement	5.551	27.1	69.7215	67.4607	27135.5	27014.5	120.994
17	11.7415	319452	basement	5.551	27.1	65.5554	63.4297	27183.3	27070.2	113.13
18	11.7415	319900	basement	5.551	27.1	60.3564	58.3993	27225.9	27122.6	103.254
19	11.7415	320329	basement	5.551	27.1	55.0173	53.2333	27265	27171.8	93.2155
20	11.7415	320723	basement	5.551	27.1	50.4215	48.7865	27302.3	27217.9	84.4376
21	11.7415	321061	basement	5.551	27.1	44.9591	43.5013	27335	27260.9	74.1493
22	11.7415	321346	basement	5.551	27.1	38.625	37.3725	27363.1	27300.9	62.1775
23	11.7415	321577	basement	5.551	27.1	31.4116	30.393	27386.6	27338	48.5598
24	11.7415	321757	basement	5.551	27.1	23.3109	22.555	27405.5	27372.3	33.2359
25	11.7415	321886	basement	5.551	27.1	14.3097	13.8457	27420	27403.7	16.2568

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.967285

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	11.7859	302690	basement	5.551	27.1	9.75438	9.43527	25668.8	25661.2	7.56836
2	11.7859	304696	basement	5.551	27.1	21.9834	21.2642	25821.9	25791.2	30.7027
3	11.7859	306564	basement	5.551	27.1	33.5988	32.4996	25966.2	25913.6	52.616
4	11.7859	308299	basement	5.551	27.1	44.7894	43.3241	26102.8	26029	73.8374
5	11.7859	309810	basement	5.551	27.1	52.994	51.2603	26227.4	26138.1	89.3263
6	11.7859	311177	basement	5.551	27.1	58.7412	56.8195	26341.4	26241.2	100.198
7	11.7859	312444	basement	5.551	27.1	63.7666	61.6805	26448.5	26338.8	109.683
8	11.7859	313616	basement	5.551	27.1	68.0581	65.8316	26549	26431.2	117.782
9	11.7859	314699	basement	5.551	27.1	71.5938	69.2516	26643.2	26518.7	124.485
10	11.7859	315698	basement	5.551	27.1	74.3421	71.91	26731.4	26601.6	129.755
11	11.7859	316617	basement	5.551	27.1	76.2556	73.7609	26813.5	26680.2	133.287
12	11.7859	317463	basement	5.551	27.1	77.3283	74.7985	26889.9	26754.5	135.381
13	11.7859	318237	basement	5.551	27.1	77.5702	75.0325	26960.7	26824.9	135.792
14	11.7859	318941	basement	5.551	27.1	76.8461	74.3321	27025.8	26891.4	134.392
15	11.7859	319579	basement	5.551	27.1	75.1039	72.6469	27085.4	26954.3	131.056
16	11.7859	320151	basement	5.551	27.1	72.2937	69.9286	27139.3	27013.6	125.734
17	11.7859	320662	basement	5.551	27.1	68.3684	66.1317	27187.8	27069.4	118.393
18	11.7859	321112	basement	5.551	27.1	63.1785	61.1116	27230.5	27122	108.5

19	11.7859	321541	basement	5.551	27.1	57.59	55.7059	27269.3	27171.3	98.0063
20	11.7859	321937	basement	5.551	27.1	52.6672	50.9442	27306.1	27217.4	88.72
21	11.7859	322277	basement	5.551	27.1	46.6031	45.0785	27337.8	27260.6	77.179
22	11.7859	322562	basement	5.551	27.1	39.3824	38.094	27364.3	27300.7	63.5837
23	11.7859	322794	basement	5.551	27.1	30.9986	29.9845	27385.6	27337.9	47.7034
24	11.7859	322975	basement	5.551	27.1	21.4551	20.7532	27401.9	27372.2	29.7348
25	11.7859	323103	basement	5.551	27.1	10.765	10.4129	27413.2	27403.7	9.52655

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.967574

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	321.498	-2485.38	3.18122e+007	0	0
2	333.24	-2498.35	193830	201.178	0.0594678
3	344.981	-2510.55	369340	383.342	0.0594679
4	356.723	-2522.04	527986	548.002	0.0594678
5	368.464	-2532.89	648707	673.3	0.0594679
6	380.206	-2543.15	718260	745.49	0.0594679
7	391.947	-2552.85	773738	803.07	0.0594678
8	403.689	-2562.04	815906	846.837	0.0594678
9	415.431	-2570.74	845433	877.484	0.0594679
10	427.172	-2578.99	862904	895.617	0.0594679
11	438.914	-2586.79	868835	901.773	0.0594679
12	450.655	-2594.19	863977	896.73	0.0594678
13	462.397	-2601.19	849447	881.65	0.0594679
14	474.138	-2607.81	824619	855.881	0.0594679
15	485.88	-2614.07	789821	819.764	0.0594679
16	497.621	-2619.98	745351	773.607	0.0594678
17	509.363	-2625.55	691477	717.691	0.0594679
18	521.104	-2630.8	628444	652.268	0.0594678
19	532.846	-2635.73	560411	581.656	0.0594678
20	544.587	-2640.35	504825	523.963	0.0594679
21	556.329	-2644.67	440821	457.533	0.0594679
22	568.07	-2648.7	368566	382.538	0.0594678
23	579.812	-2652.45	288212	299.138	0.0594678
24	591.553	-2655.91	199900	207.478	0.0594678
25	603.295	-2659.1	103760	107.694	0.0594681
26	615.037	-2662.02	3.64946e+007	0	0

rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 01		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
SLIDEINTERPRET 6.020	Date	4/01/2013		File Name: RR0705_108_01_0g.sli

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.967285

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	320.389	-2484.87	3.17991e+007	0	0
2	332.175	-2497.88	194401	33.3987	0.00984359
3	343.961	-2510.11	370395	126.267	0.019532
4	355.746	-2521.65	529449	267.168	0.0289123
5	367.532	-2532.53	655166	432.656	0.0378368
6	379.318	-2542.82	724809	583.993	0.0461643
7	391.104	-2552.56	780326	732.226	0.053764
8	402.89	-2561.77	822490	868.713	0.0605157
9	414.676	-2570.5	851971	986.056	0.0663131
10	426.462	-2578.77	869356	1078.27	0.0710644
11	438.248	-2586.6	875162	1140.93	0.0746952
12	450.034	-2594.02	870072	1171.55	0.0771486
13	461.82	-2601.04	855346	1170.17	0.0783844
14	473.606	-2607.68	830282	1135.88	0.0783843
15	485.391	-2613.96	795210	1070.74	0.077148
16	497.177	-2619.88	750426	978.318	0.0746955
17	508.963	-2625.47	696200	863.506	0.0710647
18	520.749	-2630.73	632777	732.365	0.0663131
19	532.535	-2635.67	563653	595.33	0.0605157
20	544.321	-2640.3	507696	476.401	0.053764
21	556.107	-2644.64	443285	357.164	0.0461644
22	567.893	-2648.68	370591	244.729	0.0378367
23	579.679	-2652.43	289768	146.221	0.0289123
24	591.465	-2655.9	200961	68.507	0.019532
25	603.251	-2659.09	104301	17.9192	0.00984357
26	615.037	-2662.02	3.64946e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.974167
Factor of Safety, standard deviation: 0.156670
Factor of Safety, minimum: 0.515428
Factor of Safety, maximum: 1.515210
Probability of Failure: 57.970% (= 5797 failed surfaces / 10000 valid surfaces)
Reliability index: -0.16489 (assuming normal distribution)

Reliability index: -0.24368 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 0.973999
Factor of Safety, standard deviation: 0.156631
Factor of Safety, minimum: 0.518268
Factor of Safety, maximum: 1.515070
Probability of Failure: 58.130% (= 5813 failed surfaces / 10000 valid surfaces)
Reliability index: -0.16600 (assuming normal distribution)
Reliability index: -0.24477 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
2068	-6000
2068	0
0	0

External Boundary

X	Y
2068	-6000
2068	-2868
1975	-2872
1883	-2874
1791	-2876
1699	-2877
1606	-2876
1514	-2875
1422	-2872
1329	-2865
1237	-2854
1145	-2836
1052	-2809
958	-2780
865	-2754

782	-2733
698	-2702
615	-2662
531	-2614
448	-2560
364	-2505
273	-2463
182	-2433
91	-2425
0	-2430
0	-6000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 01		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	4/01/2013		File Name: RR0705_108_01_1g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_108_01_1g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 108PC Site 01
Author: Jason R. Patton
Company: Oregon State University
Date Created: 4/01/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364840681
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.000545
Center: 677.721, -2216.843
Radius: 432.534
Left Slip Surface Endpoint: 349.161, -2498.151
Right Slip Surface Endpoint: 568.280, -2635.303
Left Slope Intercept: 349.161 -0.000
Right Slope Intercept: 568.280 -0.000
Resisting Moment=19578.6 kN-m
Driving Moment=3.59293e+007 kN-m
Resisting Horizontal Force=47.6765 kN

Driving Horizontal Force=87492.8 kN
Total Slice Area=565835 m2

Method: gle/morgenstern-price

FS: 0.000547
Center: 680.823, -2173.562
Radius: 475.259
Left Slip Surface Endpoint: 322.608, -2485.896
Right Slip Surface Endpoint: 568.280, -2635.303
Left Slope Intercept: 322.608 -0.000
Right Slope Intercept: 568.280 -0.000
Resisting Moment=29910.5 kN-m
Driving Moment=5.46619e+007 kN-m
Resisting Horizontal Force=66.6211 kN
Driving Horizontal Force=121751 kN
Total Slice Area=633350 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1567
Number of Invalid Surfaces: 81

Error Codes:

Error Code -108 reported for 68 surfaces
Error Code -111 reported for 3 surfaces
Error Code -112 reported for 10 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1623
Number of Invalid Surfaces: 25

Error Codes:

Error Code -108 reported for 15 surfaces
Error Code -112 reported for 10 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.000544919

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	8.76477	226118	basement	5.551	27.1	436.01	0.23759	25818.5	25828.8	-10.3456
2	8.76477	227258	basement	5.551	27.1	474.401	0.25851	26005.3	26015.6	-10.3357
3	8.76477	228262	basement	5.551	27.1	443.277	0.24155	26158.3	26168.7	-10.3633
4	8.76477	229174	basement	5.551	27.1	480.842	0.26202	26291.6	26302	-10.3838
5	8.76477	230022	basement	5.551	27.1	514.774	0.28051	26412.7	26423	-10.2789
6	8.76477	230809	basement	5.551	27.1	544.576	0.29675	26522.5	26532.7	-10.2398
7	8.76477	231540	basement	5.551	27.1	569.754	0.31047	26621.6	26631.9	-10.2679
8	8.76477	232218	basement	5.551	27.1	589.794	0.32139	26710.8	26721.1	-10.2527
9	8.76477	232847	basement	5.551	27.1	604.126	0.3292	26790.8	26801.1	-10.2526
10	8.76477	233430	basement	5.551	27.1	612.164	0.33358	26862	26872.2	-10.1796
11	8.76477	233967	basement	5.551	27.1	613.21	0.33415	26924.9	26935	-10.1494
12	8.76477	234463	basement	5.551	27.1	609.834	0.33231	26979.9	26990.1	-10.2153
13	8.76477	234920	basement	5.551	27.1	596.896	0.32526	27027.8	27037.9	-10.1441
14	8.76477	235339	basement	5.551	27.1	573.333	0.31242	27068.3	27078.6	-10.3149
15	8.76477	235720	basement	5.551	27.1	539.144	0.29379	27101.9	27112.2	-10.2845
16	8.76477	236066	basement	5.551	27.1	492.991	0.26864	27128.8	27139.1	-10.3062
17	8.76477	236377	basement	5.551	27.1	433.33	0.23613	27149.1	27159.5	-10.3884
18	8.76477	236654	basement	5.551	27.1	358.292	0.19524	27163.3	27173.7	-10.4462
19	8.76477	236900	basement	5.551	27.1	265.636	0.14475	27171.2	27181.7	-10.4908
20	8.76477	237113	basement	5.551	27.1	152.683	0.0832	27173.2	27183.9	-10.6823
21	8.76477	237298	basement	5.551	27.1	52.3564	0.02853	27169.8	27180.6	-10.7954
22	8.76477	237475	basement	5.551	27.1	24.8844	0.01356	27168.5	27179.3	-10.7967
23	8.76477	237633	basement	5.551	27.1	0	0	27150.1	27175.6	-25.507
24	8.76477	237763	basement	5.551	27.1	0	0	27122.1	27166.5	-44.4259
25	8.76477	237864	basement	5.551	27.1	0	0	27036.6	27152.1	-115.5

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.000547191

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]

1	9.8269	252344	basement	5.551	27.1	115.06	0.06296	25701	25711.8	-10.7557
2	9.8269	253751	basement	5.551	27.1	294.559	0.16118	25906.9	25917.4	-10.5301
3	9.8269	255061	basement	5.551	27.1	469.927	0.25714	26096.6	26106.9	-10.3319
4	9.8269	256283	basement	5.551	27.1	637.693	0.34894	26271.4	26281.6	-10.1772
5	9.8269	257392	basement	5.551	27.1	725.158	0.3968	26423.1	26433.3	-10.1514
6	9.8269	258355	basement	5.551	27.1	788.244	0.43132	26542.2	26552.2	-10.0175
7	9.8269	259246	basement	5.551	27.1	844.111	0.46189	26648.8	26658.7	-9.91757
8	9.8269	260072	basement	5.551	27.1	879.693	0.48136	26744.2	26754.2	-9.95404
9	9.8269	260835	basement	5.551	27.1	894.66	0.48955	26829.4	26839.3	-9.91198
10	9.8269	261541	basement	5.551	27.1	889.306	0.48662	26904.6	26914.6	-9.95172
11	9.8269	262190	basement	5.551	27.1	864.488	0.47304	26970.6	26980.5	-9.91125
12	9.8269	262787	basement	5.551	27.1	821.687	0.44962	27027.7	27037.7	-9.99836
13	9.8269	263333	basement	5.551	27.1	763.993	0.41805	27076.3	27086.3	-10.0476
14	9.8269	263832	basement	5.551	27.1	696.082	0.38089	27117.2	27127.3	-10.1388
15	9.8269	264285	basement	5.551	27.1	614.74	0.33638	27150.4	27160.6	-10.2062
16	9.8269	264694	basement	5.551	27.1	526.16	0.28791	27176.2	27186.4	-10.2471
17	9.8269	265059	basement	5.551	27.1	433.889	0.23742	27194.6	27205	-10.4294
18	9.8269	265381	basement	5.551	27.1	341.636	0.18694	27206	27216.5	-10.4736
19	9.8269	265664	basement	5.551	27.1	253.038	0.13846	27210.5	27221.1	-10.5702
20	9.8269	265906	basement	5.551	27.1	171.567	0.09388	27208.5	27219.1	-10.6066
21	9.8269	266110	basement	5.551	27.1	100.312	0.05489	27199.9	27210.6	-10.692
22	9.8269	266289	basement	5.551	27.1	96.1821	0.05263	27189	27199.7	-10.7106
23	9.8269	266460	basement	5.551	27.1	73.9961	0.04049	27180.1	27190.8	-10.7474
24	9.8269	266596	basement	5.551	27.1	51.4446	0.02815	27165.2	27176.1	-10.8516
25	9.8269	266696	basement	5.551	27.1	41.9049	0.02293	27144.6	27155.4	-10.784

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.000544919

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	349.161	-2498.15	3.21399e+007	0	0
2	357.926	-2508.08	151104	-1328.44	-0.503706
3	366.691	-2517.42	275963	-2426.14	-0.503705
4	375.455	-2526.23	358429	-3151.14	-0.503705
5	384.22	-2534.56	429231	-3773.6	-0.503705
6	392.985	-2542.44	489075	-4299.72	-0.503705
7	401.75	-2549.9	538565	-4734.81	-0.503705
8	410.514	-2556.97	578224	-5083.47	-0.503704

9	419.279	-2563.68	608509	-5349.72	-0.503704
10	428.044	-2570.04	629822	-5537.09	-0.503704
11	436.809	-2576.07	642519	-5648.73	-0.503705
12	445.573	-2581.8	646922	-5687.43	-0.503704
13	454.338	-2587.23	644006	-5661.79	-0.503704
14	463.103	-2592.38	633616	-5570.45	-0.503704
15	471.868	-2597.25	615730	-5413.21	-0.503705
16	480.633	-2601.87	590571	-5192.02	-0.503704
17	489.397	-2606.23	558346	-4908.71	-0.503704
18	498.162	-2610.35	519250	-4565	-0.503704
19	506.927	-2614.23	473470	-4162.53	-0.503705
20	515.692	-2617.88	421188	-3702.89	-0.503705
21	524.456	-2621.31	362581	-3187.64	-0.503704
22	533.221	-2624.53	302454	-2659.03	-0.503704
23	541.986	-2627.53	250024	-2198.09	-0.503704
24	550.751	-2630.32	191430	-1682.97	-0.503707
25	559.515	-2632.91	126663	-1113.56	-0.503704
26	568.28	-2635.3	3.57658e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.000547191

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	322.608	-2485.9	3.18253e+007	0	0
2	332.435	-2496.82	164642	-163.958	-0.0570577
3	342.262	-2507.1	314888	-622.217	-0.113216
4	352.088	-2516.79	451752	-1321.36	-0.167588
5	361.915	-2525.94	576088	-2205.17	-0.219318
6	371.742	-2534.59	650036	-3035.87	-0.267587
7	381.569	-2542.77	701983	-3818.19	-0.311637
8	391.396	-2550.53	742863	-4547.96	-0.350772
9	401.223	-2557.87	773210	-5187.24	-0.384375
10	411.05	-2564.83	793500	-5704.8	-0.411916
11	420.877	-2571.43	804159	-6076.81	-0.43296
12	430.704	-2577.68	805565	-6287.34	-0.447178
13	440.531	-2583.6	798060	-6328.57	-0.454343
14	450.357	-2589.2	782201	-6202.8	-0.454342
15	460.184	-2594.5	758814	-5922.45	-0.447177
16	470.011	-2599.51	727329	-5496.23	-0.432961
17	479.838	-2604.23	687949	-4945.95	-0.411916
18	489.665	-2608.68	640847	-4299.25	-0.384374

19	499.492	-2612.87	586165	-3588.62	-0.350772
20	509.319	-2616.8	524023	-2850.24	-0.311637
21	519.146	-2620.47	454514	-2122.73	-0.267588
22	528.973	-2623.91	377709	-1445.81	-0.219318
23	538.8	-2627.1	310180	-907.27	-0.167588
24	548.626	-2630.06	239939	-474.119	-0.113216
25	558.453	-2632.8	162747	-162.071	-0.0570578
26	568.28	-2635.3	3.57658e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.016300
Factor of Safety, standard deviation: 0.051504
Factor of Safety, minimum: 0.000057
Factor of Safety, maximum: 0.963162
Probability of Failure: 100.000% (= 9803 failed surfaces / 9803 valid surfaces), 197 invalid surfaces
Reliability index: -19.09955 (assuming normal distribution)
Reliability index: -3.43324 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 0.015243
Factor of Safety, standard deviation: 0.050814
Factor of Safety, minimum: 0.000041
Factor of Safety, maximum: 0.953365
Probability of Failure: 100.000% (= 9988 failed surfaces / 9988 valid surfaces), 12 invalid surfaces
Reliability index: -19.37968 (assuming normal distribution)
Reliability index: -3.43866 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
2068	-6000
2068	0
0	0

rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 01		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	4/01/2013		File Name: RR0705_108_01_1g.sli

SLIDEINTERPRET 6.020

External Boundary

X	Y
2068	-6000
2068	-2868
1975	-2872
1883	-2874
1791	-2876
1699	-2877
1606	-2876
1514	-2875
1422	-2872
1329	-2865
1237	-2854
1145	-2836
1052	-2809
958	-2780
865	-2754
782	-2733
698	-2702
615	-2662
531	-2614
448	-2560
364	-2505
273	-2463
182	-2433
91	-2425
0	-2430
0	-6000

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_108_02_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 108PC Site 02
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/31/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364840899
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 02		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_108_02_0g.sli

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Global Minimums

Method: spencer

FS: 1.064170
Center: 1223.141, -1684.308
Radius: 805.540
Left Slip Surface Endpoint: 638.002, -2237.938
Right Slip Surface Endpoint: 1091.965, -2479.095
Left Slope Intercept: 638.002 0.000
Right Slope Intercept: 1091.965 0.000
Resisting Moment=3.3047e+007 kN-m
Driving Moment=3.10542e+007 kN-m
Resisting Horizontal Force=36169.1 kN
Driving Horizontal Force=33988.1 kN
Total Slice Area=1.08516e+006 m2

Method: gle/morgenstern-price

FS: 1.065680
Center: 1666.901, -934.532
Radius: 1674.058
Left Slip Surface Endpoint: 591.758, -2217.707
Right Slip Surface Endpoint: 1235.364, -2552.013
Left Slope Intercept: 591.758 0.000
Right Slope Intercept: 1235.364 0.000
Resisting Moment=9.31471e+007 kN-m
Driving Moment=8.74059e+007 kN-m
Resisting Horizontal Force=49171 kN

Driving Horizontal Force=46140.3 kN
Total Slice Area=1.55414e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2578
Number of Invalid Surfaces: 264

Error Codes:

Error Code -108 reported for 261 surfaces
Error Code -112 reported for 3 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2842
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.06417

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	18.1585	420846	basement	5.551	27.1	6.64885	7.07551	23149.4	23146.5	2.94912
2	18.1585	425207	basement	5.551	27.1	25.9112	27.5739	23375	23332	43.0234
3	18.1585	429172	basement	5.551	27.1	41.995	44.6898	23582.7	23506.2	76.4963
4	18.1585	432843	basement	5.551	27.1	56.3938	60.0126	23776.5	23670.1	106.437
5	18.1585	436246	basement	5.551	27.1	69.3924	73.8453	23957.9	23824.5	133.407
6	18.1585	439394	basement	5.551	27.1	81.1447	86.3518	24127.8	23969.9	157.929
7	18.1585	442227	basement	5.551	27.1	90.1783	95.965	24283.8	24107.1	176.669

8	18.1585	444814	basement	5.551	27.1	96.7891	103	24426.9	24236.4	190.463
9	18.1585	447194	basement	5.551	27.1	102.017	108.563	24559.7	24358.4	201.313
10	18.1585	449378	basement	5.551	27.1	105.88	112.674	24682.7	24473.4	209.309
11	18.1585	451376	basement	5.551	27.1	108.392	115.347	24796.2	24581.7	214.537
12	18.1585	453195	basement	5.551	27.1	109.565	116.596	24900.6	24683.6	217.04
13	18.1585	454843	basement	5.551	27.1	109.41	116.431	24996.2	24779.5	216.663
14	18.1585	456326	basement	5.551	27.1	107.936	114.862	25083.1	24869.4	213.67
15	18.1585	457654	basement	5.551	27.1	105.119	111.865	25161.5	24953.8	207.693
16	18.1585	458845	basement	5.551	27.1	101.377	107.882	25232.6	25032.6	199.951
17	18.1585	459890	basement	5.551	27.1	96.4794	102.671	25295.9	25106.1	189.809
18	18.1585	460791	basement	5.551	27.1	90.2782	96.0713	25351.3	25174.5	176.845
19	18.1585	461551	basement	5.551	27.1	82.7328	88.0418	25399	25237.8	161.198
20	18.1585	462201	basement	5.551	27.1	74.2089	78.9709	25439.7	25296.2	143.468
21	18.1585	462735	basement	5.551	27.1	65.1398	69.3198	25474.5	25349.8	124.684
22	18.1585	463137	basement	5.551	27.1	54.7572	58.271	25501.8	25398.8	103.023
23	18.1585	463409	basement	5.551	27.1	43.0468	45.8091	25521.8	25443.1	78.6571
24	18.1585	463572	basement	5.551	27.1	29.9726	31.8959	25534.3	25482.9	51.4323
25	18.1585	463658	basement	5.551	27.1	16.983	18.0728	25542.6	25518.1	24.5137

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.06568

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	25.7442	591574	basement	5.551	27.1	12.3781	13.1911	22966.2	22951.2	14.9751
2	25.7442	598431	basement	5.551	27.1	29.3339	31.2605	23214.9	23164.7	50.1982
3	25.7442	604943	basement	5.551	27.1	45.2836	48.2578	23453.1	23369.6	83.4762
4	25.7442	610968	basement	5.551	27.1	58.3541	62.1868	23677.2	23566.6	110.641
5	25.7442	616631	basement	5.551	27.1	69.4892	74.0533	23889.6	23755.8	133.822
6	25.7442	621995	basement	5.551	27.1	79.7689	85.0081	24092.8	23937.5	155.332
7	25.7442	626922	basement	5.551	27.1	87.5573	93.3081	24283.7	24112.2	171.492
8	25.7442	631502	basement	5.551	27.1	92.6754	98.7623	24462.1	24280	182.135
9	25.7442	635818	basement	5.551	27.1	96.7156	103.068	24631.7	24441.1	190.552
10	25.7442	639878	basement	5.551	27.1	99.6462	106.191	24792.5	24595.8	196.673
11	25.7442	643690	basement	5.551	27.1	101.425	108.087	24944.6	24744.3	200.331
12	25.7442	647262	basement	5.551	27.1	102.008	108.708	25088.3	24886.7	201.568
13	25.7442	650623	basement	5.551	27.1	101.409	108.07	25223.5	25023.2	200.349
14	25.7442	653780	basement	5.551	27.1	100.145	106.722	25351.7	25154	197.713
15	25.7442	656714	basement	5.551	27.1	97.5474	103.954	25471.5	25279.2	192.326
16	25.7442	659469	basement	5.551	27.1	93.6584	99.8099	25583.2	25399	184.172
17	25.7442	662067	basement	5.551	27.1	89.6616	95.5506	25689.3	25513.4	175.907
18	25.7442	664459	basement	5.551	27.1	84.3029	89.8399	25787.4	25622.6	164.772

19	25.7442	666690	basement	5.551	27.1	77.647	82.7469	25877.6	25726.8	150.807
20	25.7442	668816	basement	5.551	27.1	71.4623	76.1559	25963.8	25825.9	137.95
21	25.7442	670749	basement	5.551	27.1	64.0185	68.2232	26042.5	25920	122.515
22	25.7442	672463	basement	5.551	27.1	54.8384	58.4402	26112.8	26009.4	103.353
23	25.7442	673896	basement	5.551	27.1	42.3911	45.1754	26171.5	26094	77.4533
24	25.7442	675136	basement	5.551	27.1	28.1471	29.9958	26221.7	26173.9	47.7933
25	25.7442	676193	basement	5.551	27.1	12.3998	13.2142	26264.2	26249.2	15.0028

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.06417

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	638.002	-2237.94	2.57931e+007	0	0
2	656.161	-2256.52	246601	363.222	0.0843917
3	674.319	-2273.96	450331	663.3	0.0843918
4	692.478	-2290.35	624903	920.429	0.0843918
5	710.636	-2305.78	778663	1146.91	0.0843922
6	728.795	-2320.32	912761	1344.42	0.0843918
7	746.953	-2334.03	1.0194e+006	1501.5	0.0843923
8	765.112	-2346.96	1.09006e+006	1605.57	0.084392
9	783.27	-2359.15	1.1434e+006	1684.14	0.0843922
10	801.429	-2370.64	1.18009e+006	1738.17	0.0843916
11	819.587	-2381.47	1.2007e+006	1768.52	0.0843913
12	837.746	-2391.67	1.20575e+006	1775.97	0.0843919
13	855.904	-2401.27	1.19571e+006	1761.18	0.0843918
14	874.063	-2410.28	1.171e+006	1724.79	0.0843921
15	892.221	-2418.74	1.132e+006	1667.34	0.0843918
16	910.38	-2426.65	1.08192e+006	1593.57	0.0843914
17	928.538	-2434.04	1.02092e+006	1503.73	0.0843918
18	946.697	-2440.93	946608	1394.27	0.0843916
19	964.855	-2447.32	859236	1265.58	0.0843916
20	983.014	-2453.22	760298	1119.85	0.0843914
21	1001.17	-2458.66	658876	970.469	0.0843918
22	1019.33	-2463.64	545131	802.932	0.0843918
23	1037.49	-2468.16	419245	617.512	0.0843917
24	1055.65	-2472.24	281386	414.457	0.0843916
25	1073.81	-2475.88	143929	211.995	0.0843917
26	1091.96	-2479.1	3.16515e+007	0	0

rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 02		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
SLIDEINTERPRET 6.020	Date	3/31/2013		File Name: RR0705_108_02_0g.sli

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.06568

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	591.758	-2217.71	2.53288e+007	0	0
2	617.502	-2238.84	227214	65.8173	0.0165969
3	643.247	-2259.15	438503	252.039	0.032932
4	668.991	-2278.65	622576	529.695	0.0487479
5	694.735	-2297.38	765265	852.069	0.0637948
6	720.479	-2315.39	892405	1212.32	0.0778355
7	746.224	-2332.68	996527	1576.63	0.090649
8	771.968	-2349.3	1.055e+006	1878.76	0.102033
9	797.712	-2365.26	1.0981e+006	2142.85	0.111808
10	823.456	-2380.59	1.12602e+006	2354.77	0.119819
11	849.201	-2395.3	1.13893e+006	2503.47	0.125941
12	874.945	-2409.41	1.13701e+006	2581.32	0.130077
13	900.689	-2422.95	1.12042e+006	2584.4	0.13216
14	926.433	-2435.92	1.09713e+006	2530.69	0.132161
15	952.177	-2448.35	1.05965e+006	2405.7	0.130077
16	977.922	-2460.24	1.00803e+006	2215.73	0.12594
17	1003.67	-2471.6	956593	2000.46	0.119819
18	1029.41	-2482.46	893361	1743.32	0.111808
19	1055.15	-2492.81	816535	1454.09	0.102033
20	1080.9	-2502.67	745244	1179.07	0.0906491
21	1106.64	-2512.06	666389	905.284	0.0778358
22	1132.39	-2520.96	574520	639.688	0.0637948
23	1158.13	-2529.41	454567	386.75	0.0487478
24	1183.88	-2537.39	313998	180.478	0.0329321
25	1209.62	-2544.92	160511	46.4954	0.0165969
26	1235.36	-2552.01	3.35408e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.073378
Factor of Safety, standard deviation: 0.178719
Factor of Safety, minimum: 0.548075
Factor of Safety, maximum: 1.712580
Probability of Failure: 35.290% (= 3529 failed surfaces / 10000 valid surfaces)
Reliability index: 0.41057 (assuming normal distribution)

Reliability index: 0.34552 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 1.072428
Factor of Safety, standard deviation: 0.176977
Factor of Safety, minimum: 0.548349
Factor of Safety, maximum: 1.711370
Probability of Failure: 34.970% (= 3497 failed surfaces / 10000 valid surfaces)
Reliability index: 0.40925 (assuming normal distribution)
Reliability index: 0.34463 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
2128	-6000
2128	0
0	0

External Boundary

X	Y
2127	-6000
2127	-2790
2039	-2789
1951	-2773
1862	-2748
1774	-2718
1685	-2689
1596	-2667
1507	-2646
1415	-2621
1324	-2590
1233	-2551
1141	-2503
1061	-2464
981	-2422

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 108PC Site 02		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 3/31/2013		File Name: RR0705_108_02_0g.sli

901	-2378
821	-2333
741	-2288
661	-2248
581	-2213
498	-2179
415	-2151
332	-2123
249	-2087
166	-2070
83	-2061
0	-2063
0	-6000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 02		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_108_02_1g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_108_02_1g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 108PC Site 02
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/31/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364841019
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.001238
Center: 1353.610, -1452.642
Radius: 1053.064
Left Slip Surface Endpoint: 666.765, -2250.882
Right Slip Surface Endpoint: 1062.190, -2464.580
Left Slope Intercept: 666.765 0.000
Right Slope Intercept: 1062.190 0.000
Resisting Moment=232689 kN-m
Driving Moment=1.87993e+008 kN-m
Resisting Horizontal Force=223.789 kN

Driving Horizontal Force=180803 kN
Total Slice Area=939580 m2

Method: gle/morgenstern-price

FS: 0.001169
Center: 1660.965, -993.801
Radius: 1615.949
Left Slip Surface Endpoint: 620.661, -2230.352
Right Slip Surface Endpoint: 1239.714, -2553.877
Left Slope Intercept: 620.661 0.000
Right Slope Intercept: 1239.714 0.000
Resisting Moment=803209 kN-m
Driving Moment=6.86887e+008 kN-m
Resisting Horizontal Force=502.884 kN
Driving Horizontal Force=430056 kN
Total Slice Area=1.49864e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1484
Number of Invalid Surfaces: 56

Error Codes:

Error Code -108 reported for 46 surfaces
Error Code -112 reported for 10 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1522
Number of Invalid Surfaces: 18

Error Codes:

Error Code -108 reported for 6 surfaces
Error Code -112 reported for 12 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This

screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.00123775

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	15.817	368030	basement	5.551	27.1	336.199	0.41613	23285.9	23296	-10.0537
2	15.817	370619	basement	5.551	27.1	407.199	0.50401	23503.1	23513	-9.8684
3	15.817	373081	basement	5.551	27.1	475.427	0.58846	23707	23716.7	-9.6801
4	15.817	375421	basement	5.551	27.1	540.594	0.66912	23898.2	23907.7	-9.52613
5	15.817	377641	basement	5.551	27.1	583.882	0.7227	24076.4	24085.8	-9.39493
6	15.817	379685	basement	5.551	27.1	585.643	0.72488	24231.7	24241.1	-9.44539
7	15.817	381602	basement	5.551	27.1	617.524	0.76434	24372	24381.3	-9.32884
8	15.817	383414	basement	5.551	27.1	643.434	0.79641	24501.5	24510.8	-9.27845
9	15.817	385126	basement	5.551	27.1	662.872	0.82047	24620.5	24629.8	-9.25942
10	15.817	386742	basement	5.551	27.1	675.298	0.83585	24729.5	24738.7	-9.18774
11	15.817	388263	basement	5.551	27.1	680.113	0.84181	24828.6	24837.9	-9.25593
12	15.817	389693	basement	5.551	27.1	676.663	0.83754	24918.3	24927.5	-9.1947
13	15.817	391035	basement	5.551	27.1	664.205	0.82212	24998.7	25008	-9.29332
14	15.817	392291	basement	5.551	27.1	641.931	0.79455	25070.2	25079.5	-9.31816
15	15.817	393464	basement	5.551	27.1	612.41	0.75801	25132.9	25142.3	-9.38633
16	15.817	394566	basement	5.551	27.1	586.475	0.72591	25189.2	25198.6	-9.42886
17	15.817	395594	basement	5.551	27.1	535.359	0.66264	25238.1	25247.6	-9.52782
18	15.817	396544	basement	5.551	27.1	470.475	0.58233	25278.8	25288.5	-9.65575
19	15.817	397417	basement	5.551	27.1	390.313	0.48311	25311.5	25321.5	-9.96034
20	15.817	398216	basement	5.551	27.1	299.285	0.37044	25336.5	25346.7	-10.1622
21	15.817	398962	basement	5.551	27.1	233.108	0.28853	25357.8	25368	-10.2365
22	15.817	399650	basement	5.551	27.1	112.567	0.13933	25373.7	25384.3	-10.5844
23	15.817	400266	basement	5.551	27.1	0	0	25377.5	25393.1	-15.5502
24	15.817	400813	basement	5.551	27.1	0	0	25354.8	25394.7	-39.9217
25	15.817	401291	basement	5.551	27.1	0	0	25246.8	25389.1	-142.298

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00116935

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	24.7621	572119	basement	5.551	27.1	216.77	0.25348	23143.6	23153.9	-10.2952
2	24.7621	578481	basement	5.551	27.1	576.85	0.67454	23494.8	23504.3	-9.50083

3	24.7621	584375	basement	5.551	27.1	867.576	1.0145	23807.2	23816	-8.84241
4	24.7621	589931	basement	5.551	27.1	1138.94	1.33182	24094.9	24103.1	-8.24526
5	24.7621	595200	basement	5.551	27.1	1362.34	1.59305	24363.3	24371	-7.71171
6	24.7621	600063	basement	5.551	27.1	1429.12	1.67114	24597.9	24605.5	-7.55682
7	24.7621	604584	basement	5.551	27.1	1507.77	1.76311	24806	24813.4	-7.36907
8	24.7621	608853	basement	5.551	27.1	1536.73	1.79698	24997.2	25004.5	-7.29456
9	24.7621	612876	basement	5.551	27.1	1515.25	1.77186	25172	25179.3	-7.33133
10	24.7621	616663	basement	5.551	27.1	1444.33	1.68893	25330.9	25338.4	-7.53523
11	24.7621	620221	basement	5.551	27.1	1326.87	1.55157	25474.4	25482.2	-7.78386
12	24.7621	623566	basement	5.551	27.1	1201.3	1.40474	25604.3	25612.4	-8.13179
13	24.7621	626725	basement	5.551	27.1	1032.27	1.20709	25723.1	25731.6	-8.4652
14	24.7621	629676	basement	5.551	27.1	820.003	0.95887	25828.2	25837.1	-8.94366
15	24.7621	632431	basement	5.551	27.1	636.217	0.74396	25920.6	25930	-9.44706
16	24.7621	635048	basement	5.551	27.1	466.122	0.54506	26007	26016.8	-9.78242
17	24.7621	637484	basement	5.551	27.1	237.807	0.27808	26081.8	26092.1	-10.2882
18	24.7621	639730	basement	5.551	27.1	51.1652	0.05983	26144.3	26155	-10.7243
19	24.7621	641875	basement	5.551	27.1	0	0	26200.5	26215.3	-14.7706
20	24.7621	643876	basement	5.551	27.1	0	0	26226.7	26267.9	-41.1696
21	24.7621	645696	basement	5.551	27.1	0	0	26249	26308.4	-59.3947
22	24.7621	647281	basement	5.551	27.1	0	0	26247.8	26330.6	-82.7512
23	24.7621	648630	basement	5.551	27.1	0	0	26253.1	26334.2	-81.1293
24	24.7621	649808	basement	5.551	27.1	0	0	26255.9	26326.4	-70.5139
25	24.7621	650829	basement	5.551	27.1	0	0	26256.8	26308.7	-51.8654

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.00123775

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	666.765	-2250.88	2.60923e+007	0	0
2	682.582	-2264.22	125252	-1623.65	-0.742687
3	698.399	-2277.05	241342	-3128.55	-0.742692
4	714.216	-2289.37	348340	-4515.57	-0.74269
5	730.033	-2301.23	446309	-5785.56	-0.742691
6	745.85	-2312.63	528272	-6848.05	-0.74269
7	761.667	-2323.59	585124	-7585.04	-0.742691
8	777.484	-2334.13	632699	-8201.76	-0.742691
9	793.301	-2344.27	671073	-8699.21	-0.742691
10	809.118	-2354.01	700323	-9078.37	-0.74269

11	824.935	-2363.38	720524	-9340.25	-0.742691
12	840.752	-2372.38	731756	-9485.86	-0.742692
13	856.569	-2381.02	734099	-9516.22	-0.742691
14	872.386	-2389.32	727634	-9432.42	-0.742692
15	888.203	-2397.28	712449	-9235.57	-0.742691
16	904.02	-2404.91	689537	-8938.56	-0.742691
17	919.837	-2412.22	661949	-8580.93	-0.742691
18	935.654	-2419.21	625993	-8114.83	-0.742691
19	951.471	-2425.9	581777	-7541.65	-0.742691
20	967.288	-2432.28	529416	-6862.89	-0.742691
21	983.105	-2438.38	470311	-6096.7	-0.742691
22	998.922	-2444.18	411653	-5336.31	-0.742691
23	1014.74	-2449.69	345360	-4476.94	-0.74269
24	1030.56	-2454.93	271351	-3517.55	-0.742689
25	1046.37	-2459.89	188719	-2446.39	-0.742691
26	1062.19	-2464.58	3.12819e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00116935

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	620.661	-2230.35	2.56185e+007	0	0
2	645.423	-2250.77	222585	-986.094	-0.25383
3	670.185	-2270.38	418584	-3679.56	-0.503645
4	694.947	-2289.22	578034	-7521.48	-0.745501
5	719.709	-2307.32	723066	-12312.8	-0.975572
6	744.471	-2324.71	848760	-17634.3	-1.19024
7	769.233	-2341.43	929365	-22487.7	-1.38611
8	793.996	-2357.49	995344	-27108.7	-1.56009
9	818.758	-2372.92	1.04702e+006	-31247.8	-1.70946
10	843.52	-2387.74	1.08472e+006	-34692.6	-1.83187
11	868.282	-2401.97	1.10879e+006	-37274.5	-1.9254
12	893.044	-2415.63	1.11956e+006	-38872.4	-1.98858
13	917.806	-2428.72	1.12216e+006	-39587	-2.02041
14	942.568	-2441.28	1.11438e+006	-39312.7	-2.02042
15	967.33	-2453.31	1.09413e+006	-37989.3	-1.98857
16	992.092	-2464.82	1.06792e+006	-35900.4	-1.92539
17	1016.85	-2475.83	1.03748e+006	-33181.7	-1.83187
18	1041.62	-2486.35	994849	-29690.9	-1.70946
19	1066.38	-2496.38	944605	-25726.8	-1.56009
20	1091.14	-2505.95	898972	-21752.3	-1.38611

21	1115.9	-2515.05	838864	-17428.7	-1.19024
22	1140.67	-2523.7	764260	-13014.3	-0.975574
23	1165.43	-2531.89	653139	-8498.77	-0.745502
24	1190.19	-2539.65	526548	-4628.62	-0.503646
25	1214.95	-2546.98	384761	-1704.56	-0.253829
26	1239.71	-2553.88	3.35898e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.023183
Factor of Safety, standard deviation: 0.060722
Factor of Safety, minimum: 0.000106
Factor of Safety, maximum: 0.841182
Probability of Failure: 100.000% (= 9694 failed surfaces / 9694 valid surfaces), 306 invalid surfaces
Reliability index: -16.08667 (assuming normal distribution)
Reliability index: -3.33952 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 0.022762
Factor of Safety, standard deviation: 0.060486
Factor of Safety, minimum: 0.000108
Factor of Safety, maximum: 0.823561
Probability of Failure: 100.000% (= 9994 failed surfaces / 9994 valid surfaces), 6 invalid surfaces
Reliability index: -16.15656 (assuming normal distribution)
Reliability index: -3.34069 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
2128	-6000
2128	0
0	0

External Boundary

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 108PC Site 02		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 3/31/2013		File Name: RR0705_108_02_1g.sli

X	Y
2127	-6000
2127	-2790
2039	-2789
1951	-2773
1862	-2748
1774	-2718
1685	-2689
1596	-2667
1507	-2646
1415	-2621
1324	-2590
1233	-2551
1141	-2503
1061	-2464
981	-2422
901	-2378
821	-2333
741	-2288
661	-2248
581	-2213
498	-2179
415	-2151
332	-2123
249	-2087
166	-2070
83	-2061
0	-2063
0	-6000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 03		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_108_03_0g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_108_03_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 108PC Site 03
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/31/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364841282
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 03		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_108_03_0g.sli

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Global Minimums

Method: spencer

FS: 1.794920
Center: 1185.840, -2403.099
Radius: 423.939
Left Slip Surface Endpoint: 915.546, -2729.694
Right Slip Surface Endpoint: 1212.301, -2826.211
Left Slope Intercept: 915.546 -0.000
Right Slope Intercept: 1212.301 -0.000
Resisting Moment=8.15847e+006 kN-m
Driving Moment=4.5453e+006 kN-m
Resisting Horizontal Force=18086.8 kN
Driving Horizontal Force=10076.6 kN
Total Slice Area=830597 m2

Method: gle/morgenstern-price

FS: 1.790080
Center: 1184.222, -2408.238
Radius: 418.154
Left Slip Surface Endpoint: 917.402, -2730.200
Right Slip Surface Endpoint: 1209.807, -2825.609
Left Slope Intercept: 917.402 -0.000
Right Slope Intercept: 1209.807 -0.000
Resisting Moment=7.82223e+006 kN-m
Driving Moment=4.36976e+006 kN-m
Resisting Horizontal Force=17619.5 kN

Driving Horizontal Force=9842.84 kN
Total Slice Area=818317 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1871
Number of Invalid Surfaces: 840

Error Codes:

Error Code -108 reported for 840 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2711
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.79492

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	11.8702	334527	basement	5.551	27.1	4.23779	7.6065	28168.6	28164.6	4.03146
2	11.8702	336034	basement	5.551	27.1	12.3383	22.1462	28291.2	28258.7	32.4646
3	11.8702	337393	basement	5.551	27.1	19.2933	34.63	28403.1	28346.2	56.8685
4	11.8702	338633	basement	5.551	27.1	25.2983	45.4084	28505.5	28427.6	77.8747
5	11.8702	339767	basement	5.551	27.1	30.6487	55.012	28599.8	28503.2	96.6336
6	11.8702	340802	basement	5.551	27.1	35.3619	63.4718	28686.5	28573.3	113.232
7	11.8702	341743	basement	5.551	27.1	39.453	70.815	28765.9	28638.4	127.544
8	11.8702	342595	basement	5.551	27.1	42.9351	77.0651	28838.3	28698.6	139.731
9	11.8702	343363	basement	5.551	27.1	45.8194	82.2421	28904	28754.2	149.827
10	11.8702	344036	basement	5.551	27.1	48.0149	86.1829	28962.9	28805.3	157.568
11	11.8702	344616	basement	5.551	27.1	49.1542	88.2279	29013.7	28852.1	161.585

12	11.8702	345121	basement	5.551	27.1	49.6991	89.2059	29058.3	28894.8	163.496
13	11.8702	345552	basement	5.551	27.1	49.6639	89.1428	29096.9	28933.5	163.421
14	11.8702	345912	basement	5.551	27.1	49.0519	88.0442	29129.5	28968.3	161.249
15	11.8702	346201	basement	5.551	27.1	47.8647	85.9133	29156.3	28999.3	157.023
16	11.8702	346423	basement	5.551	27.1	46.1026	82.7504	29177.4	29026.6	150.827
17	11.8702	346580	basement	5.551	27.1	43.7583	78.5427	29192.8	29050.2	142.596
18	11.8702	346685	basement	5.551	27.1	41.1525	73.8654	29203.7	29070.2	133.52
19	11.8702	346727	basement	5.551	27.1	38.0707	68.3339	29209.4	29086.7	122.688
20	11.8702	346705	basement	5.551	27.1	34.4067	61.7572	29209.5	29099.7	109.849
21	11.8702	346620	basement	5.551	27.1	30.1529	54.122	29204.1	29109.2	94.9202
22	11.8702	346471	basement	5.551	27.1	25.3005	45.4123	29193.2	29115.3	77.8999
23	11.8702	346259	basement	5.551	27.1	19.8384	35.6084	29176.7	29117.9	58.7605
24	11.8702	345985	basement	5.551	27.1	13.706	24.6012	29154.4	29117.1	37.3029
25	11.8702	345691	basement	5.551	27.1	7.57978	13.6051	29128.6	29112.9	15.7335

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.79008

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	11.6962	329675	basement	5.551	27.1	6.1878	11.0767	28180	28169.2	10.819
2	11.6962	331138	basement	5.551	27.1	13.2854	23.7819	28297.7	28262.1	35.5918
3	11.6962	332458	basement	5.551	27.1	19.3477	34.6339	28405.2	28348.4	56.8073
4	11.6962	333663	basement	5.551	27.1	24.7695	44.3393	28504.4	28428.7	75.7212
5	11.6962	334766	basement	5.551	27.1	29.6771	53.1243	28596.2	28503.3	92.8933
6	11.6962	335773	basement	5.551	27.1	34.0856	61.0159	28680.9	28572.5	108.437
7	11.6962	336689	basement	5.551	27.1	38.0041	68.0304	28758.8	28636.8	122.033
8	11.6962	337519	basement	5.551	27.1	41.4358	74.1734	28830.3	28696.2	134.135
9	11.6962	338266	basement	5.551	27.1	44.3786	79.4412	28895.5	28751.1	144.413
10	11.6962	338922	basement	5.551	27.1	46.7399	83.6681	28954.2	28801.6	152.644
11	11.6962	339487	basement	5.551	27.1	48.1198	86.1383	29005.3	28847.9	157.409
12	11.6962	339979	basement	5.551	27.1	48.9533	87.6303	29050.4	28890	160.447
13	11.6962	340400	basement	5.551	27.1	49.2279	88.1218	29089.6	28928.3	161.306
14	11.6962	340751	basement	5.551	27.1	48.9236	87.5771	29123	28962.7	160.294
15	11.6962	341035	basement	5.551	27.1	48.0195	85.9588	29150.5	28993.3	157.185
16	11.6962	341252	basement	5.551	27.1	46.4944	83.2287	29172.2	29020.3	151.86
17	11.6962	341406	basement	5.551	27.1	44.3136	79.3249	29187.9	29043.7	144.232
18	11.6962	341510	basement	5.551	27.1	41.7776	74.7852	29198.9	29063.6	135.324
19	11.6962	341553	basement	5.551	27.1	38.7056	69.2862	29204.5	29080	124.469
20	11.6962	341534	basement	5.551	27.1	34.9475	62.5589	29204.3	29092.9	111.402
21	11.6962	341453	basement	5.551	27.1	30.4881	54.5762	29198.2	29102.4	95.7624
22	11.6962	341311	basement	5.551	27.1	25.3148	45.3155	29186.2	29108.5	77.7348

23	11.6962	341108	basement	5.551	27.1	19.4175	34.7588	29168.3	29111.3	57.005
24	11.6962	340844	basement	5.551	27.1	12.7888	22.8929	29144.5	29110.6	33.9351
25	11.6962	340548	basement	5.551	27.1	6.13814	10.9878	29117.3	29106.6	10.6592

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.79492

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	915.546	-2729.69	3.83738e+007	0	0
2	927.416	-2739.17	175658	119.365	0.0389342
3	939.286	-2747.97	327882	222.806	0.0389343
4	951.156	-2756.15	453604	308.238	0.0389343
5	963.027	-2763.76	563528	382.935	0.0389343
6	974.897	-2770.83	658510	447.478	0.0389343
7	986.767	-2777.39	739284	502.366	0.0389342
8	998.637	-2783.47	806482	548.029	0.0389342
9	1010.51	-2789.08	860654	584.84	0.0389342
10	1022.38	-2794.26	902279	613.126	0.0389342
11	1034.25	-2799.01	920848	625.744	0.0389342
12	1046.12	-2803.35	927017	629.936	0.0389342
13	1057.99	-2807.3	921713	626.332	0.0389342
14	1069.86	-2810.86	905220	615.124	0.0389342
15	1081.73	-2814.05	877787	596.483	0.0389342
16	1093.6	-2816.88	839633	570.556	0.0389342
17	1105.47	-2819.35	790947	537.473	0.0389343
18	1117.34	-2821.47	736044	500.164	0.0389342
19	1129.21	-2823.24	674550	458.378	0.0389343
20	1141.08	-2824.67	602970	409.736	0.0389342
21	1152.95	-2825.76	521401	354.308	0.0389342
22	1164.82	-2826.52	429922	292.145	0.0389342
23	1176.69	-2826.94	328594	223.289	0.0389341
24	1188.56	-2827.03	217460	147.771	0.0389343
25	1200.43	-2826.79	100216	68.0996	0.0389341
26	1212.3	-2826.21	4.11355e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.79008

Slice	X coordinate	Y coordinate - Bottom	Interslice Normal Force	Interslice Shear Force	Interslice Force Angle

	[m]	[m]	[kN]	[kN]	[degrees]
1	917.402	-2730.2	3.83881e+007	0	0
2	929.098	-2739.55	173513	17.451	0.0057625
3	940.794	-2748.23	321878	64.2349	0.0114341
4	952.49	-2756.31	446104	131.781	0.0169254
5	964.187	-2763.82	554743	214.456	0.0221498
6	975.883	-2770.8	648644	305.947	0.0270248
7	987.579	-2777.27	728536	400.199	0.0314737
8	999.275	-2783.27	795048	491.581	0.0354262
9	1010.97	-2788.81	848724	575.042	0.03882
10	1022.67	-2793.92	890039	646.244	0.0416016
11	1034.36	-2798.62	908367	693.249	0.0437271
12	1046.06	-2802.91	914754	721.049	0.045163
13	1057.76	-2806.81	909843	728.669	0.0458867
14	1069.45	-2810.33	893914	715.912	0.0458867
15	1081.15	-2813.49	867212	683.574	0.045163
16	1092.85	-2816.29	829952	633.404	0.0437271
17	1104.54	-2818.73	782323	568.033	0.0416016
18	1116.24	-2820.83	727915	493.189	0.03882
19	1127.93	-2822.59	667681	412.829	0.0354261
20	1139.63	-2824.01	597517	328.228	0.0314737
21	1151.33	-2825.1	517522	244.101	0.0270249
22	1163.02	-2825.85	427776	165.373	0.0221499
23	1174.72	-2826.28	328341	96.9934	0.0169254
24	1186.41	-2826.39	219263	43.7568	0.0114341
25	1198.11	-2826.16	100570	10.1147	0.00576245
26	1209.81	-2825.61	4.11179e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.806783
Factor of Safety, standard deviation: 0.294696
Factor of Safety, minimum: 0.907674
Factor of Safety, maximum: 2.858960
Probability of Failure: 0.040% (= 4 failed surfaces / 10000 valid surfaces)
Reliability index: 2.73768 (assuming normal distribution)
Reliability index: 3.56971 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price

Factor of Safety, mean: 1.804841
Factor of Safety, standard deviation: 0.295512
Factor of Safety, minimum: 0.904767
Factor of Safety, maximum: 2.859750
Probability of Failure: 0.040% (= 4 failed surfaces / 10000 valid surfaces)
Reliability index: 2.72355 (assuming normal distribution)
Reliability index: 3.54897 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
1797	-6000
1797	0
0	0

External Boundary

X	Y
1797	-6000
1797	-2851
1712	-2854
1627	-2857
1541	-2859
1456	-2859
1371	-2855
1286	-2844
1199	-2823
1111	-2794
1023	-2763
935	-2735
847	-2711
758	-2691
668	-2670
579	-2645
489	-2616
399	-2587

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 108PC Site 03		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 3/31/2013		File Name: RR0705_108_03_0g.sli

310	-2562
232	-2549
155	-2531
77	-2514
0	-2491
0	-6000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 03		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	3/31/2013		File Name: RR0705_108_03_1g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_108_03_1g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 108PC Site 03
Author: Jason R. Patton
Company: Oregon State University
Date Created: 3/31/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364841467
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.020165
Center: 1589.074, -890.981
Radius: 1971.006
Left Slip Surface Endpoint: 815.918, -2704.015
Right Slip Surface Endpoint: 1199.054, -2823.013
Left Slope Intercept: 815.918 -0.000
Right Slope Intercept: 1199.054 -0.000
Resisting Moment=3.45815e+006 kN-m
Driving Moment=1.71493e+008 kN-m
Resisting Horizontal Force=1698.14 kN

Driving Horizontal Force=84212.1 kN
Total Slice Area=1.06154e+006 m2

Method: gle/morgenstern-price

FS: 0.011797
Center: 1192.625, -1004.372
Radius: 1804.912
Left Slip Surface Endpoint: 269.257, -2555.210
Right Slip Surface Endpoint: 1156.265, -2808.917
Left Slope Intercept: 269.257 -0.000
Right Slope Intercept: 1156.265 -0.000
Resisting Moment=1.79122e+007 kN-m
Driving Moment=1.51832e+009 kN-m
Resisting Horizontal Force=9813.87 kN
Driving Horizontal Force=831871 kN
Total Slice Area=2.41594e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 807
Number of Invalid Surfaces: 36

Error Codes:

Error Code -108 reported for 36 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 835
Number of Invalid Surfaces: 8

Error Codes:

Error Code -112 reported for 8 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 03		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
SLIDEINTERPRET 6.020	Date	3/31/2013		File Name: RR0705_108_03_1g.sli

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.020165

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	15.3254	427473	basement	5.551	27.1	80.058	1.61437	27900.9	27908.6	-7.70959
2	15.3254	428733	basement	5.551	27.1	121.091	2.44181	28015	28021.1	-6.101
3	15.3254	429926	basement	5.551	27.1	148.518	2.99487	28119.1	28124.1	-5.00809
4	15.3254	431050	basement	5.551	27.1	177.531	3.57992	28213.2	28217	-3.82842
5	15.3254	432138	basement	5.551	27.1	205.863	4.15122	28303.3	28306.1	-2.76134
6	15.3254	433190	basement	5.551	27.1	233.217	4.70282	28389.7	28391.3	-1.63947
7	15.3254	434207	basement	5.551	27.1	259.532	5.23347	28472.1	28472.8	-0.656045
8	15.3254	435187	basement	5.551	27.1	282.356	5.6937	28550.4	28550.1	0.326637
9	15.3254	436092	basement	5.551	27.1	291.155	5.87113	28616.9	28616.3	0.625152
10	15.3254	436945	basement	5.551	27.1	301.875	6.08731	28676.5	28675.5	1.02784
11	15.3254	437764	basement	5.551	27.1	310.675	6.26477	28732.4	28731	1.38174
12	15.3254	438549	basement	5.551	27.1	317.429	6.40097	28784.5	28782.8	1.69708
13	15.3254	439300	basement	5.551	27.1	322	6.49313	28832.9	28831.1	1.8464
14	15.3254	440013	basement	5.551	27.1	319.193	6.43653	28876.6	28874.8	1.75279
15	15.3254	440659	basement	5.551	27.1	306.013	6.17075	28909.9	28908.7	1.23038
16	15.3254	441267	basement	5.551	27.1	292.454	5.89733	28938.7	28938	0.695709
17	15.3254	441842	basement	5.551	27.1	275.451	5.55446	28963.8	28963.8	-0.00135467
18	15.3254	442384	basement	5.551	27.1	254.746	5.13695	28985.3	28986.1	-0.785406
19	15.3254	442895	basement	5.551	27.1	230.055	4.63905	29003.2	29005	-1.80693
20	15.3254	443382	basement	5.551	27.1	207.894	4.19219	29019.3	29022	-2.71694
21	15.3254	443857	basement	5.551	27.1	183.641	3.70313	29035.7	29039.3	-3.59828
22	15.3254	444302	basement	5.551	27.1	153.463	3.09459	29048.7	29053.5	-4.83136
23	15.3254	444716	basement	5.551	27.1	118.338	2.38629	29058.1	29064.3	-6.23165
24	15.3254	445098	basement	5.551	27.1	77.8259	1.56936	29063.9	29071.7	-7.7879
25	15.3254	445450	basement	5.551	27.1	24.55	0.49505	29065.9	29075.8	-9.90835

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.0117973

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	35.4803	939012	basement	5.551	27.1	224.76	2.65156	26535.5	26541.3	-5.75443
2	35.4803	948859	basement	5.551	27.1	561.569	6.625	26951.4	26949.3	2.13666
3	35.4803	957615	basement	5.551	27.1	837.867	9.88457	27298.3	27289.8	8.46545
4	35.4803	965780	basement	5.551	27.1	1075.14	12.6838	27615.9	27601.9	14.0056

5	35.4803	973188	basement	5.551	27.1	1230.71	14.5191	27889.4	27871.8	17.614
6	35.4803	980004	basement	5.551	27.1	1369.66	16.1583	28132.6	28112	20.6457
7	35.4803	986305	basement	5.551	27.1	1466.73	17.3034	28351.4	28328.4	23.0352
8	35.4803	992107	basement	5.551	27.1	1520.08	17.9328	28545.8	28521.6	24.178
9	35.4803	997432	basement	5.551	27.1	1563.76	18.4482	28718.3	28693	25.2923
10	35.4803	1.00248e+006	basement	5.551	27.1	1656.25	19.5393	28885.8	28858.5	27.2846
11	35.4803	1.00715e+006	basement	5.551	27.1	1628.89	19.2165	29035.4	29008.7	26.7412
12	35.4803	1.01146e+006	basement	5.551	27.1	1714.13	20.2221	29174	29145.4	28.6344
13	35.4803	1.01554e+006	basement	5.551	27.1	1705.42	20.1194	29308.2	29279.7	28.4979
14	35.4803	1.0192e+006	basement	5.551	27.1	1627.55	19.2007	29421.2	29394.5	26.6731
15	35.4803	1.02247e+006	basement	5.551	27.1	1545.51	18.2328	29517.2	29492.4	24.8248
16	35.4803	1.02533e+006	basement	5.551	27.1	1407.57	16.6055	29593.5	29572	21.52
17	35.4803	1.02768e+006	basement	5.551	27.1	1065.48	12.5698	29638.9	29625.2	13.6589
18	35.4803	1.02938e+006	basement	5.551	27.1	770.657	9.09167	29646.9	29640.1	6.77633
19	35.4803	1.03065e+006	basement	5.551	27.1	474.359	5.59616	29634	29634	0.00878443
20	35.4803	1.03129e+006	basement	5.551	27.1	0	0	29574.4	29591.6	-17.1702
21	35.4803	1.03144e+006	basement	5.551	27.1	0	0	29472.3	29523	-50.6715
22	35.4803	1.03111e+006	basement	5.551	27.1	0	0	29347.2	29430.3	-83.1488
23	35.4803	1.03022e+006	basement	5.551	27.1	0	0	29217.1	29306	-88.8854
24	35.4803	1.02894e+006	basement	5.551	27.1	0	0	29089.6	29163.1	-73.5491
25	35.4803	1.02737e+006	basement	5.551	27.1	0	0	28966.4	29010.9	-44.4701

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.020165

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	815.918	-2704.02	3.76552e+007	0	0
2	831.244	-2710.47	83516.5	-210.126	-0.144155
3	846.569	-2716.78	163563	-411.522	-0.144155
4	861.894	-2722.94	220156	-553.91	-0.144155
5	877.22	-2728.95	272453	-685.489	-0.144155
6	892.545	-2734.81	320996	-807.622	-0.144155
7	907.871	-2740.53	365753	-920.23	-0.144155
8	923.196	-2746.1	406695	-1023.24	-0.144155
9	938.522	-2751.53	439309	-1105.29	-0.144154
10	953.847	-2756.82	452937	-1139.58	-0.144155
11	969.172	-2761.97	462546	-1163.76	-0.144155
12	984.498	-2766.97	468123	-1177.79	-0.144155

13	999.823	-2771.84	469662	-1181.66	-0.144155
14	1015.15	-2776.58	467158	-1175.36	-0.144155
15	1030.47	-2781.17	453399	-1140.75	-0.144156
16	1045.8	-2785.64	427961	-1076.74	-0.144155
17	1061.12	-2789.96	398408	-1002.39	-0.144155
18	1076.45	-2794.16	364758	-917.727	-0.144155
19	1091.78	-2798.22	327033	-822.812	-0.144155
20	1107.1	-2802.15	285260	-717.712	-0.144155
21	1122.43	-2805.95	246892	-621.178	-0.144155
22	1137.75	-2809.62	207106	-521.076	-0.144155
23	1153.08	-2813.16	163410	-411.137	-0.144155
24	1168.4	-2816.57	115845	-291.464	-0.144155
25	1183.73	-2819.86	64458.2	-162.176	-0.144155
26	1199.05	-2823.01	4.10424e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.0117973

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	269.257	-2555.21	3.36248e+007	0	0
2	304.738	-2575.79	387999	-2109.22	-0.311465
3	340.218	-2595.32	661788	-7138.41	-0.618
4	375.698	-2613.82	894806	-14287.2	-0.914753
5	411.178	-2631.35	1.08971e+006	-22769.9	-1.19704
6	446.659	-2647.92	1.23476e+006	-31479.4	-1.4604
7	482.139	-2663.56	1.35513e+006	-40235.4	-1.70068
8	517.619	-2678.31	1.45143e+006	-48506.5	-1.9141
9	553.1	-2692.18	1.52436e+006	-55824.5	-2.09733
10	588.58	-2705.21	1.58455e+006	-62186.6	-2.24745
11	624.06	-2717.39	1.64948e+006	-68042.3	-2.36216
12	659.541	-2728.76	1.69334e+006	-72145.1	-2.43962
13	695.021	-2739.33	1.74822e+006	-75677.1	-2.47868
14	730.501	-2749.12	1.79316e+006	-77622.2	-2.47867
15	765.982	-2758.13	1.82057e+006	-77565.8	-2.43962
16	801.462	-2766.39	1.83498e+006	-75694.3	-2.36215
17	836.942	-2773.89	1.83112e+006	-71863.4	-2.24745
18	872.423	-2780.65	1.78001e+006	-65186.7	-2.09732
19	907.903	-2786.68	1.69953e+006	-56798.2	-1.91411
20	943.383	-2791.99	1.59208e+006	-47270.7	-1.70068
21	978.863	-2796.58	1.43756e+006	-36649.6	-1.4604
22	1014.34	-2800.46	1.25628e+006	-26250.4	-1.19704

23	1049.82	-2803.63	1.02174e+006	-16314	-0.914757
24	1085.3	-2806.09	750783	-8098.37	-0.618001
25	1120.78	-2807.85	458067	-2490.12	-0.311465
26	1156.27	-2808.92	4.06336e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.088840
Factor of Safety, standard deviation: 0.109010
Factor of Safety, minimum: 0.000934
Factor of Safety, maximum: 1.264590
Probability of Failure: 99.860% (= 9971 failed surfaces / 9985 valid surfaces), 15 invalid surfaces
Reliability index: -8.35849 (assuming normal distribution)
Reliability index: -3.00519 (assuming lognormal distribution)
* best fit = Beta

Method: gle/morgenstern-price
Factor of Safety, mean: 0.114272
Factor of Safety, standard deviation: 0.103683
Factor of Safety, minimum: 0.002700
Factor of Safety, maximum: 1.323340
Probability of Failure: 99.840% (= 9984 failed surfaces / 10000 valid surfaces)
Reliability index: -8.54263 (assuming normal distribution)
Reliability index: -3.18643 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
1797	-6000
1797	0
0	0

External Boundary

X	Y
1797	-6000

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 108PC Site 03		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 3/31/2013		File Name: RR0705_108_03_1g.sli

1797	-2851
1712	-2854
1627	-2857
1541	-2859
1456	-2859
1371	-2855
1286	-2844
1199	-2823
1111	-2794
1023	-2763
935	-2735
847	-2711
758	-2691
668	-2670
579	-2645
489	-2616
399	-2587
310	-2562
232	-2549
155	-2531
77	-2514
0	-2491
0	-6000

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_108_04_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 108PC Site 04
Author: Jason R. Patton
Company: Oregon State University
Date Created: 4/01/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364841748
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 04		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	4/01/2013		File Name: RR0705_108_04_0g.sli

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Global Minimums

Method: spencer

FS: 1.425240
Center: 1022.191, -1437.055
Radius: 1200.655
Left Slip Surface Endpoint: 332.437, -2419.812
Right Slip Surface Endpoint: 863.501, -2627.177
Left Slope Intercept: 332.437 -0.000
Right Slope Intercept: 863.501 -0.000
Resisting Moment=4.72323e+007 kN-m
Driving Moment=3.31399e+007 kN-m
Resisting Horizontal Force=36471.4 kN
Driving Horizontal Force=25589.7 kN
Total Slice Area=1.3532e+006 m2

Method: gle/morgenstern-price

FS: 1.426420
Center: 1024.615, -1432.127
Radius: 1206.282
Left Slip Surface Endpoint: 331.771, -2419.590
Right Slip Surface Endpoint: 865.440, -2627.861
Left Slope Intercept: 331.771 -0.000
Right Slope Intercept: 865.440 -0.000
Resisting Moment=4.79006e+007 kN-m
Driving Moment=3.3581e+007 kN-m
Resisting Horizontal Force=36793 kN

Driving Horizontal Force=25794 kN
Total Slice Area=1.36003e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2531
Number of Invalid Surfaces: 388

Error Codes:

Error Code -108 reported for 386 surfaces
Error Code -112 reported for 2 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2919
Number of Invalid Surfaces: 0

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.42524

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	21.2426	531491	basement	5.551	27.1	6.70565	9.55716	25006.9	24999.1	7.8432
2	21.2426	535458	basement	5.551	27.1	18.643	26.5707	25186.9	25145.8	41.1114
3	21.2426	539152	basement	5.551	27.1	29.1316	41.5195	25356.2	25285.9	70.2989
4	21.2426	542604	basement	5.551	27.1	38.0671	54.2548	25514.8	25419.6	95.204
5	21.2426	545855	basement	5.551	27.1	46.1444	65.7668	25664.9	25547.3	117.618
6	21.2426	548912	basement	5.551	27.1	53.3716	76.0673	25806.8	25669	137.777
7	21.2426	551750	basement	5.551	27.1	59.5339	84.8501	25939.9	25785	154.941

8	21.2426	554342	basement	5.551	27.1	63.7494	90.8582	26062.1	25895.4	166.743
9	21.2426	556756	basement	5.551	27.1	67.0312	95.5356	26176.4	26000.6	175.824
10	21.2426	558999	basement	5.551	27.1	69.4675	99.0079	26283.1	26100.5	182.602
11	21.2426	561070	basement	5.551	27.1	71.061	101.279	26382.3	26195.3	187.034
12	21.2426	562928	basement	5.551	27.1	71.1055	101.342	26472.3	26285.1	187.233
13	21.2426	564616	basement	5.551	27.1	70.0215	99.7975	26554.4	26370.2	184.162
14	21.2426	566150	basement	5.551	27.1	68.0916	97.0469	26629.3	26450.5	178.773
15	21.2426	567542	basement	5.551	27.1	65.3171	93.0925	26697.2	26526.1	171.117
16	21.2426	568874	basement	5.551	27.1	62.9853	89.7691	26761.9	26597.3	164.554
17	21.2426	570078	basement	5.551	27.1	60.3453	86.0065	26821.1	26663.9	157.247
18	21.2426	571140	basement	5.551	27.1	56.8831	81.0721	26873.8	26726.2	147.59
19	21.2426	572056	basement	5.551	27.1	52.5971	74.9635	26919.8	26784.2	135.626
20	21.2426	572811	basement	5.551	27.1	47.154	67.2057	26958.4	26837.9	120.454
21	21.2426	573424	basement	5.551	27.1	40.7408	58.0654	26990	26887.4	102.593
22	21.2426	573900	basement	5.551	27.1	33.4856	47.725	27015.1	26932.7	82.4199
23	21.2426	574253	basement	5.551	27.1	25.3773	36.1688	27033.8	26974	59.8131
24	21.2426	574561	basement	5.551	27.1	17.7647	25.3189	27049.8	27011.2	38.6045
25	21.2426	574757	basement	5.551	27.1	9.86425	14.0589	27061	27044.3	16.674

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.42642

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	21.3468	534058	basement	5.551	27.1	8.75618	12.49	25010.7	24997.2	13.5169
2	21.3468	538064	basement	5.551	27.1	19.7489	28.1702	25188.7	25144.5	44.2454
3	21.3468	541794	basement	5.551	27.1	29.3604	41.8803	25356.3	25285.3	70.9671
4	21.3468	545278	basement	5.551	27.1	37.7079	53.7873	25513.9	25419.6	94.3027
5	21.3468	548559	basement	5.551	27.1	45.3418	64.6765	25663.3	25547.8	115.543
6	21.3468	551645	basement	5.551	27.1	52.2744	74.5653	25805	25670.1	134.863
7	21.3468	554510	basement	5.551	27.1	58.3065	83.1695	25938.3	25786.6	151.704
8	21.3468	557126	basement	5.551	27.1	62.5682	89.2485	26061.1	25897.6	163.527
9	21.3468	559562	basement	5.551	27.1	66.0101	94.1581	26176.3	26003.2	173.104
10	21.3468	561826	basement	5.551	27.1	68.699	97.9936	26284.2	26103.5	180.661
11	21.3468	563915	basement	5.551	27.1	70.6448	100.769	26384.8	26198.7	186.121
12	21.3468	565789	basement	5.551	27.1	71.087	101.4	26476.3	26289	187.292
13	21.3468	567493	basement	5.551	27.1	70.3802	100.392	26559.7	26374.4	185.347
14	21.3468	569039	basement	5.551	27.1	68.8006	98.1385	26636	26455.1	180.886
15	21.3468	570446	basement	5.551	27.1	66.2791	94.5419	26705	26531.1	173.882
16	21.3468	571792	basement	5.551	27.1	64.1888	91.5602	26770.5	26602.5	168.05
17	21.3468	573007	basement	5.551	27.1	61.7301	88.053	26830.7	26669.4	161.262
18	21.3468	574077	basement	5.551	27.1	58.3434	83.2222	26883.7	26732	151.747

19	21.3468	575001	basement	5.551	27.1	53.9992	77.0255	26929.8	26790.2	139.641
20	21.3468	575761	basement	5.551	27.1	48.3215	68.9268	26968	26844.1	123.854
21	21.3468	576378	basement	5.551	27.1	41.5355	59.2471	26998.7	26893.8	104.896
22	21.3468	576857	basement	5.551	27.1	33.7488	48.14	27022.5	26939.3	83.2291
23	21.3468	577216	basement	5.551	27.1	25.1257	35.8398	27039.9	26980.7	59.2002
24	21.3468	577531	basement	5.551	27.1	17.0419	24.3089	27054.7	27018	36.7092
25	21.3468	577727	basement	5.551	27.1	8.33223	11.8853	27063.7	27051.3	12.3905

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.42524

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	332.437	-2419.81	3.01558e+007	0	0
2	353.68	-2434.38	187507	181.528	0.0554688
3	374.922	-2448.3	357689	346.285	0.055469
4	396.165	-2461.59	496824	480.984	0.055469
5	417.407	-2474.27	621804	601.978	0.0554689
6	438.65	-2486.37	732914	709.546	0.055469
7	459.893	-2497.9	830418	803.942	0.055469
8	481.135	-2508.89	897513	868.897	0.055469
9	502.378	-2519.35	947242	917.041	0.055469
10	523.62	-2529.3	983887	952.517	0.055469
11	544.863	-2538.75	1.00764e+006	975.514	0.055469
12	566.105	-2547.71	1.01241e+006	980.127	0.0554688
13	587.348	-2556.2	996184	964.422	0.055469
14	608.591	-2564.22	967475	936.628	0.0554689
15	629.833	-2571.79	926429	896.891	0.055469
16	651.076	-2578.92	884387	856.189	0.0554689
17	672.318	-2585.6	845421	818.466	0.055469
18	693.561	-2591.86	794691	769.353	0.0554689
19	714.803	-2597.7	732310	708.961	0.0554689
20	736.046	-2603.11	655560	634.658	0.0554689
21	757.288	-2608.12	563530	545.563	0.055469
22	778.531	-2612.73	460119	445.448	0.0554689
23	799.774	-2616.93	345418	334.404	0.0554688
24	821.016	-2620.74	230933	223.57	0.055469
25	842.259	-2624.15	120915	117.059	0.0554686
26	863.501	-2627.18	3.55456e+007	0	0

rocscience	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 04		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
SLIDEINTERPRET 6.020	Date	4/01/2013		File Name: RR0705_108_04_0g.sli

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.42642

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	331.771	-2419.59	3.01502e+007	0	0
2	353.117	-2434.23	188339	32.0126	0.00973875
3	374.464	-2448.21	359687	121.31	0.0193239
4	395.811	-2461.56	499399	249.319	0.0286042
5	417.158	-2474.29	624883	408.261	0.0374336
6	438.504	-2486.45	736430	587.035	0.0456725
7	459.851	-2498.03	834305	774.536	0.0531911
8	481.198	-2509.07	901644	942.169	0.059871
9	502.545	-2519.58	951514	1089.53	0.0656064
10	523.891	-2529.58	988238	1212.66	0.0703072
11	545.238	-2539.07	1.01201e+006	1305.28	0.0738995
12	566.585	-2548.07	1.0164e+006	1353.99	0.0763261
13	587.932	-2556.59	999995	1353.49	0.0775496
14	609.278	-2564.65	971039	1314.29	0.0775491
15	630.625	-2572.25	929682	1238.47	0.0763262
16	651.972	-2579.41	888370	1145.81	0.0738994
17	673.319	-2586.12	849097	1041.93	0.0703078
18	694.666	-2592.41	797995	913.745	0.0656066
19	716.012	-2598.27	735179	768.222	0.0598709
20	737.359	-2603.71	657519	610.415	0.0531912
21	758.706	-2608.74	564892	450.296	0.0456725
22	780.053	-2613.36	460823	301.074	0.0374336
23	801.399	-2617.58	345407	172.441	0.0286043
24	822.746	-2621.4	232344	78.3616	0.0193239
25	844.093	-2624.82	121645	20.6763	0.0097387
26	865.44	-2627.86	3.55641e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.434279
Factor of Safety, standard deviation: 0.235276
Factor of Safety, minimum: 0.738681
Factor of Safety, maximum: 2.260070
Probability of Failure: 2.730% (= 273 failed surfaces / 10000 valid surfaces)
Reliability index: 1.84583 (assuming normal distribution)

Reliability index: 2.13185 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 1.435473
Factor of Safety, standard deviation: 0.235533
Factor of Safety, minimum: 0.739567
Factor of Safety, maximum: 2.261960
Probability of Failure: 2.680% (= 268 failed surfaces / 10000 valid surfaces)
Reliability index: 1.84889 (assuming normal distribution)
Reliability index: 2.13637 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
2337	-6000
2337	0
0	0

External Boundary

X	Y
2337	-6000
2337	-2903
2253	-2901
2169	-2900
2085	-2898
2001	-2894
1916	-2888
1832	-2879
1747	-2867
1662	-2852
1577	-2834
1492	-2816
1407	-2793
1321	-2769
1236	-2745

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 108PC Site 04		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 4/01/2013		File Name: RR0705_108_04_0g.sli

1151	-2721
1067	-2696
982	-2670
897	-2639
812	-2609
727	-2575
642	-2542
557	-2505
464	-2467
372	-2433
279	-2402
186	-2371
93	-2340
0	-2310
0	-6000

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_108_04_1g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 108PC Site 04
Author: Jason R. Patton
Company: Oregon State University
Date Created: 4/01/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364841858
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.005875
Center: 1787.193, 635.359
Radius: 3401.791
Left Slip Surface Endpoint: 211.501, -2379.500
Right Slip Surface Endpoint: 980.057, -2669.292
Left Slope Intercept: 211.501 -0.000
Right Slope Intercept: 980.057 -0.000
Resisting Moment=6.81946e+006 kN-m
Driving Moment=1.16085e+009 kN-m
Resisting Horizontal Force=1956.19 kN

Driving Horizontal Force=332995 kN
Total Slice Area=1.95375e+006 m2

Method: gle/morgenstern-price

FS: 0.003168
Center: 739.986, -1754.064
Radius: 826.538
Left Slip Surface Endpoint: 192.300, -2373.100
Right Slip Surface Endpoint: 741.004, -2580.602
Left Slope Intercept: 192.300 -0.000
Right Slope Intercept: 741.004 -0.000
Resisting Moment=1.33984e+006 kN-m
Driving Moment=4.22894e+008 kN-m
Resisting Horizontal Force=1646.24 kN
Driving Horizontal Force=519601 kN
Total Slice Area=1.3802e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1154
Number of Invalid Surfaces: 35

Error Codes:

Error Code -108 reported for 29 surfaces
Error Code -112 reported for 6 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1174
Number of Invalid Surfaces: 15

Error Codes:

Error Code -108 reported for 2 surfaces
Error Code -112 reported for 13 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This

screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.00587454

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	30.7423	756454	basement	5.551	27.1	124.798	0.73313	24625.9	24635.3	-9.44126
2	30.7423	762350	basement	5.551	27.1	208.583	1.22533	24874.5	24882.9	-8.41229
3	30.7423	768056	basement	5.551	27.1	290.213	1.70487	25112.9	25120.4	-7.50688
4	30.7423	773574	basement	5.551	27.1	369.539	2.17087	25341.2	25347.8	-6.60963
5	30.7423	778907	basement	5.551	27.1	446.396	2.62237	25559.6	25565.3	-5.7368
6	30.7423	784000	basement	5.551	27.1	505.268	2.96822	25762.6	25767.6	-5.02188
7	30.7423	788784	basement	5.551	27.1	554.345	3.25652	25943.9	25948.4	-4.49205
8	30.7423	793385	basement	5.551	27.1	601.598	3.53411	26115.3	26119.2	-3.90717
9	30.7423	797747	basement	5.551	27.1	626.262	3.679	26271.1	26274.8	-3.69599
10	30.7423	801799	basement	5.551	27.1	638.547	3.75117	26404.8	26408.3	-3.51677
11	30.7423	805674	basement	5.551	27.1	647.195	3.80197	26528.8	26532.2	-3.40812
12	30.7423	809340	basement	5.551	27.1	636.123	3.73693	26639.7	26643.3	-3.56328
13	30.7423	812742	basement	5.551	27.1	611.478	3.59215	26732.7	26736.5	-3.81435
14	30.7423	815975	basement	5.551	27.1	580.331	3.40918	26816.3	26820.5	-4.18931
15	30.7423	819168	basement	5.551	27.1	576.75	3.38814	26902.9	26907.1	-4.18907
16	30.7423	822324	basement	5.551	27.1	560.109	3.29038	26992.3	26996.7	-4.39998
17	30.7423	825319	basement	5.551	27.1	533.107	3.13176	27072.8	27077.5	-4.70507
18	30.7423	828113	basement	5.551	27.1	487.546	2.86411	27140.7	27145.9	-5.22155
19	30.7423	830731	basement	5.551	27.1	433.103	2.54428	27198.3	27204.2	-5.85622
20	30.7423	833220	basement	5.551	27.1	382.798	2.24876	27250.2	27256.6	-6.41976
21	30.7423	835741	basement	5.551	27.1	351.018	2.06207	27311.2	27318	-6.7778
22	30.7423	838145	basement	5.551	27.1	299.647	1.76029	27367.1	27374.5	-7.44179
23	30.7423	840381	basement	5.551	27.1	228.437	1.34196	27413.1	27421.3	-8.19197
24	30.7423	842423	basement	5.551	27.1	138.63	0.81439	27446.8	27456.1	-9.30674
25	30.7423	844311	basement	5.551	27.1	0	0	27463.7	27482.5	-18.848

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00316827

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	21.9481	539298	basement	5.551	27.1	136.829	0.43351	24620.4	24630.3	-9.94919
2	21.9481	544719	basement	5.551	27.1	376.903	1.19413	24980	24988.5	-8.51847

3	21.9481	549714	basement	5.551	27.1	613.322	1.94317	25307.6	25314.7	-7.06916
4	21.9481	554315	basement	5.551	27.1	840.812	2.66392	25605.6	25611.3	-5.6707
5	21.9481	558549	basement	5.551	27.1	1054.4	3.34063	25876	25880.3	-4.29067
6	21.9481	562438	basement	5.551	27.1	1249.6	3.95908	26120.4	26123.5	-3.12736
7	21.9481	566003	basement	5.551	27.1	1422.51	4.5069	26340.3	26342.3	-2.03632
8	21.9481	569260	basement	5.551	27.1	1569.93	4.97397	26536.9	26538.1	-1.15888
9	21.9481	572192	basement	5.551	27.1	1644.68	5.21078	26707	26707.6	-0.629418
10	21.9481	574781	basement	5.551	27.1	1700.73	5.38836	26847.6	26848	-0.364116
11	21.9481	577100	basement	5.551	27.1	1733.93	5.49357	26967.8	26967.9	-0.11092
12	21.9481	579160	basement	5.551	27.1	1736.38	5.50133	27068.3	27068.4	-0.0664426
13	21.9481	580949	basement	5.551	27.1	1655.55	5.24522	27147	27147.6	-0.586154
14	21.9481	582420	basement	5.551	27.1	1542.78	4.88793	27197.3	27198.6	-1.32715
15	21.9481	583647	basement	5.551	27.1	1432.7	4.53919	27228.9	27230.9	-2.01322
16	21.9481	584645	basement	5.551	27.1	1299.88	4.11836	27243.1	27245.9	-2.7963
17	21.9481	585413	basement	5.551	27.1	1119.6	3.54721	27239.5	27243.5	-3.96958
18	21.9481	585908	basement	5.551	27.1	888.943	2.81641	27212.3	27217.6	-5.3416
19	21.9481	586173	basement	5.551	27.1	685.289	2.17118	27167.2	27173.8	-6.59035
20	21.9481	586226	basement	5.551	27.1	468.969	1.48582	27106	27114	-7.95273
21	21.9481	586085	basement	5.551	27.1	314.989	0.99797	27031.7	27040.6	-8.92311
22	21.9481	585831	basement	5.551	27.1	185.297	0.58707	26954.1	26963.8	-9.68313
23	21.9481	585386	basement	5.551	27.1	0	0	26861.3	26873.6	-12.3174
24	21.9481	584737	basement	5.551	27.1	0	0	26747.9	26768	-20.1366
25	21.9481	583877	basement	5.551	27.1	0	0	26623.2	26646.3	-23.1163

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.00587454

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	211.501	-2379.5	2.91594e+007	0	0
2	242.243	-2395.37	137763	-614.086	-0.255397
3	272.985	-2410.84	269457	-1201.12	-0.255398
4	303.728	-2425.93	394739	-1759.57	-0.255397
5	334.47	-2440.64	513281	-2287.98	-0.255398
6	365.212	-2454.97	624775	-2784.97	-0.255397
7	395.954	-2468.93	707192	-3152.35	-0.255398
8	426.697	-2482.53	775303	-3455.96	-0.255398
9	457.439	-2495.76	834973	-3721.94	-0.255398
10	488.181	-2508.64	862052	-3842.64	-0.255397

11	518.924	-2521.17	873250	-3892.56	-0.255397
12	549.666	-2533.35	874861	-3899.74	-0.255397
13	580.408	-2545.18	850709	-3792.08	-0.255397
14	611.15	-2556.68	811384	-3616.79	-0.255397
15	641.893	-2567.84	761828	-3395.89	-0.255397
16	672.635	-2578.66	739635	-3296.96	-0.255397
17	703.377	-2589.16	707919	-3155.59	-0.255398
18	734.119	-2599.33	664322	-2961.25	-0.255397
19	764.862	-2609.18	603662	-2690.86	-0.255398
20	795.604	-2618.71	533204	-2376.79	-0.255398
21	826.346	-2627.91	470945	-2099.27	-0.255398
22	857.088	-2636.81	419834	-1871.43	-0.255397
23	887.831	-2645.39	359541	-1602.68	-0.255398
24	918.573	-2653.67	283334	-1262.98	-0.255398
25	949.315	-2661.63	195183	-870.04	-0.255398
26	980.057	-2669.29	3.66944e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00316827

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	192.3	-2373.1	2.90028e+007	0	0
2	214.249	-2391.85	282546	-672.773	-0.136427
3	236.197	-2409.32	540044	-2551.53	-0.270702
4	258.145	-2425.63	773195	-5407.51	-0.400704
5	280.093	-2440.84	982647	-8993.64	-0.524383
6	302.041	-2455.04	1.16902e+006	-13054.3	-0.639788
7	323.989	-2468.29	1.3329e+006	-17334.6	-0.7451
8	345.937	-2480.63	1.47489e+006	-21590	-0.838657
9	367.886	-2492.11	1.59556e+006	-25594	-0.918989
10	389.834	-2502.77	1.67973e+006	-28874.7	-0.984822
11	411.782	-2512.65	1.73991e+006	-31437.5	-1.03513
12	433.73	-2521.77	1.7803e+006	-33223.5	-1.06911
13	455.678	-2530.17	1.80143e+006	-34156.4	-1.08624
14	477.626	-2537.86	1.7909e+006	-33956.7	-1.08624
15	499.575	-2544.87	1.75408e+006	-32734.1	-1.06911
16	521.523	-2551.21	1.69923e+006	-30702.4	-1.03513
17	543.471	-2556.9	1.62673e+006	-27963.6	-0.984821
18	565.419	-2561.96	1.53143e+006	-24565.2	-0.918985
19	587.367	-2566.39	1.41028e+006	-20644.2	-0.838657
20	609.315	-2570.21	1.27219e+006	-16545	-0.745097

21	631.263	-2573.42	1.11736e+006	-12477.4	-0.639787
22	653.212	-2576.03	958839	-8775.74	-0.524383
23	675.16	-2578.06	796164	-5568.15	-0.400704
24	697.108	-2579.49	616908	-2914.68	-0.270701
25	719.056	-2580.34	418510	-996.519	-0.136427
26	741.004	-2580.6	3.42965e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.053305
Factor of Safety, standard deviation: 0.084704
Factor of Safety, minimum: 0.000371
Factor of Safety, maximum: 1.029070
Probability of Failure: 99.980% (= 9996 failed surfaces / 9998 valid surfaces), 2 invalid surfaces
Reliability index: -11.17648 (assuming normal distribution)
Reliability index: -3.17312 (assuming lognormal distribution)
* best fit = Beta

Method: gle/morgenstern-price
Factor of Safety, mean: 0.106348
Factor of Safety, standard deviation: 0.088832
Factor of Safety, minimum: 0.000985
Factor of Safety, maximum: 1.100190
Probability of Failure: 99.980% (= 9998 failed surfaces / 10000 valid surfaces)
Reliability index: -10.06007 (assuming normal distribution)
Reliability index: -3.44415 (assuming lognormal distribution)
* best fit = Beta

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
2337	-6000
2337	0
0	0

External Boundary

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 108PC Site 04		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 4/01/2013		File Name: RR0705_108_04_1g.sli

X	Y
2337	-6000
2337	-2903
2253	-2901
2169	-2900
2085	-2898
2001	-2894
1916	-2888
1832	-2879
1747	-2867
1662	-2852
1577	-2834
1492	-2816
1407	-2793
1321	-2769
1236	-2745
1151	-2721
1067	-2696
982	-2670
897	-2639
812	-2609
727	-2575
642	-2542
557	-2505
464	-2467
372	-2433
279	-2402
186	-2371
93	-2340
0	-2310
0	-6000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 05		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	4/01/2013		File Name: RR0705_108_05_0g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_108_05_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 108PC Site 05
Author: Jason R. Patton
Company: Oregon State University
Date Created: 4/01/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 05		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	4/01/2013		File Name: RR0705_108_05_0g.sli

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364842063
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 05		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	4/01/2013		File Name: RR0705_108_05_0g.sli

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Global Minimums

Method: spencer

FS: 1.408730
Center: 1326.448, -1342.739
Radius: 1499.487
Left Slip Surface Endpoint: 464.984, -2570.070
Right Slip Surface Endpoint: 1128.195, -2829.062
Left Slope Intercept: 464.984 0.000
Right Slope Intercept: 1128.195 0.000
Resisting Moment=9.15767e+007 kN-m
Driving Moment=6.50064e+007 kN-m
Resisting Horizontal Force=56644.8 kN
Driving Horizontal Force=40209.8 kN
Total Slice Area=1.81076e+006 m2

Method: gle/morgenstern-price

FS: 1.409790
Center: 1326.482, -1344.120
Radius: 1498.122
Left Slip Surface Endpoint: 465.684, -2570.251
Right Slip Surface Endpoint: 1128.195, -2829.062
Left Slope Intercept: 465.684 0.000
Right Slope Intercept: 1128.195 0.000
Resisting Moment=9.12575e+007 kN-m
Driving Moment=6.47314e+007 kN-m
Resisting Horizontal Force=56465.6 kN

Driving Horizontal Force=40052.6 kN
Total Slice Area=1.80888e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2358
Number of Invalid Surfaces: 389

Error Codes:

Error Code -108 reported for 385 surfaces
Error Code -112 reported for 4 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2710
Number of Invalid Surfaces: 37

Error Codes:

Error Code -108 reported for 37 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.40873

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	26.5285	705565	basement	5.551	27.1	8.57474	12.0795	26578.2	26565.4	12.7971
2	26.5285	711752	basement	5.551	27.1	24.2275	34.13	26804.5	26748.7	55.8283
3	26.5285	717498	basement	5.551	27.1	37.0136	52.1422	27014.7	26923.6	91.0902
4	26.5285	722899	basement	5.551	27.1	48.7009	68.6064	27213.9	27090.7	123.17

5	26.5285	727847	basement	5.551	27.1	57.7559	81.3625	27398.2	27250	148.179
6	26.5285	732464	basement	5.551	27.1	65.1546	91.7853	27570.6	27402	168.553
7	26.5285	736790	basement	5.551	27.1	71.4657	100.676	27732.8	27546.9	185.898
8	26.5285	740833	basement	5.551	27.1	76.6975	108.046	27885.2	27684.9	200.295
9	26.5285	744601	basement	5.551	27.1	80.8586	113.908	28027.9	27816.2	211.732
10	26.5285	748111	basement	5.551	27.1	83.9927	118.323	28161.3	27940.9	220.421
11	26.5285	751383	basement	5.551	27.1	86.3629	121.662	28286.3	28059.4	226.864
12	26.5285	754403	basement	5.551	27.1	87.718	123.571	28402.3	28171.6	230.656
13	26.5285	757184	basement	5.551	27.1	88.0786	124.079	28509.5	28277.8	231.654
14	26.5285	759736	basement	5.551	27.1	87.5881	123.388	28608.4	28378.1	230.287
15	26.5285	762050	basement	5.551	27.1	86.0697	121.249	28698.7	28472.6	226.128
16	26.5285	764103	basement	5.551	27.1	83.2857	117.327	28779.9	28561.5	218.382
17	26.5285	765900	basement	5.551	27.1	78.9832	111.266	28851.3	28644.7	206.607
18	26.5285	767473	basement	5.551	27.1	73.6285	103.723	28914.3	28722.5	191.844
19	26.5285	768830	basement	5.551	27.1	67.2413	94.7249	28969.2	28794.9	174.259
20	26.5285	769982	basement	5.551	27.1	59.9788	84.4939	29016.2	28862	154.226
21	26.5285	770920	basement	5.551	27.1	51.6792	72.802	29055.2	28923.8	131.424
22	26.5285	771655	basement	5.551	27.1	42.2839	59.5666	29086	28980.4	105.587
23	26.5285	772277	basement	5.551	27.1	32.9534	46.4225	29111.8	29032	79.8498
24	26.5285	772718	basement	5.551	27.1	23.1533	32.6167	29131.3	29078.4	52.929
25	26.5285	772954	basement	5.551	27.1	12.278	17.2964	29142.8	29119.9	22.9256

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.40979

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	26.5005	704864	basement	5.551	27.1	11.5262	16.2495	26588.1	26567.2	20.9363
2	26.5005	711032	basement	5.551	27.1	25.2637	35.6165	26809	26750.3	58.7463
3	26.5005	716768	basement	5.551	27.1	37.027	52.2003	27016.3	26925.1	91.1888
4	26.5005	722158	basement	5.551	27.1	47.7878	67.3707	27212.8	27092	120.803
5	26.5005	727094	basement	5.551	27.1	56.1801	79.2022	27395.2	27251.3	143.87
6	26.5005	731703	basement	5.551	27.1	63.2557	89.1773	27566.6	27403.1	163.46
7	26.5005	736021	basement	5.551	27.1	69.4262	97.8763	27728.3	27547.9	180.411
8	26.5005	740057	basement	5.551	27.1	74.6878	105.294	27880.7	27685.8	194.888
9	26.5005	743819	basement	5.551	27.1	79.0295	111.415	28023.8	27816.9	206.924
10	26.5005	747323	basement	5.551	27.1	82.4555	116.245	28157.9	27941.6	216.337
11	26.5005	750590	basement	5.551	27.1	85.2198	120.142	28283.9	28060	223.903
12	26.5005	753605	basement	5.551	27.1	87.0413	122.71	28401.1	28172.1	228.981
13	26.5005	756382	basement	5.551	27.1	87.8847	123.899	28509.5	28278.2	231.324
14	26.5005	758930	basement	5.551	27.1	87.8925	123.91	28609.8	28378.5	231.261
15	26.5005	761241	basement	5.551	27.1	86.8406	122.427	28701.3	28472.9	228.421

16	26.5005	763290	basement	5.551	27.1	84.4757	119.093	28783.6	28561.7	221.867
17	26.5005	765085	basement	5.551	27.1	80.434	113.395	28855.7	28644.9	210.764
18	26.5005	766657	basement	5.551	27.1	75.1949	106.009	28918.9	28722.6	196.344
19	26.5005	768012	basement	5.551	27.1	68.7568	96.9327	28973.6	28795	178.57
20	26.5005	769164	basement	5.551	27.1	61.2651	86.3709	29020	28862	157.969
21	26.5005	770101	basement	5.551	27.1	52.5383	74.068	29057.7	28923.8	133.944
22	26.5005	770836	basement	5.551	27.1	42.583	60.0331	29086.9	28980.5	106.443
23	26.5005	771458	basement	5.551	27.1	32.6358	46.0096	29111.1	29032	79.0506
24	26.5005	771900	basement	5.551	27.1	21.9518	30.9474	29128.1	29078.4	49.6613
25	26.5005	772137	basement	5.551	27.1	10.0327	14.144	29136.7	29119.9	16.7686

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.40873

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	464.984	-2570.07	3.40171e+007	0	0
2	491.513	-2588.27	281061	330.502	0.0673746
3	518.041	-2605.65	492234	578.823	0.0673747
4	544.569	-2622.24	684551	804.971	0.0673747
5	571.098	-2638.08	842804	991.062	0.0673747
6	597.626	-2653.19	964093	1133.69	0.0673749
7	624.155	-2667.6	1.06719e+006	1254.92	0.0673747
8	650.683	-2681.32	1.15238e+006	1355.1	0.0673749
9	677.212	-2694.39	1.21992e+006	1434.51	0.0673744
10	703.74	-2706.81	1.27003e+006	1493.45	0.0673751
11	730.269	-2718.61	1.30715e+006	1537.09	0.0673746
12	756.797	-2729.81	1.3289e+006	1562.66	0.0673744
13	783.326	-2740.41	1.3339e+006	1568.55	0.0673748
14	809.854	-2750.43	1.32585e+006	1559.08	0.0673746
15	836.382	-2759.88	1.30182e+006	1530.83	0.067375
16	862.911	-2768.78	1.26124e+006	1483.11	0.0673749
17	889.439	-2777.13	1.19426e+006	1404.34	0.0673745
18	915.968	-2784.95	1.1113e+006	1306.79	0.0673747
19	942.496	-2792.24	1.01251e+006	1190.62	0.0673746
20	969.025	-2799	900518	1058.93	0.0673748
21	995.553	-2805.26	773960	910.107	0.0673746
22	1022.08	-2811.01	631981	743.153	0.0673747
23	1048.61	-2816.26	484042	569.19	0.0673747

24	1075.14	-2821.02	337475	396.841	0.0673748
25	1101.67	-2825.28	175994	206.953	0.0673746
26	1128.2	-2829.06	4.12185e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.40979

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	465.684	-2570.25	3.40219e+007	0	0
2	492.184	-2588.43	279135	56.907	0.0116808
3	518.685	-2605.8	490213	198.303	0.0231775
4	545.185	-2622.38	682432	408.639	0.0343086
5	571.686	-2638.2	839830	658.116	0.0448987
6	598.186	-2653.3	961061	918.874	0.0547807
7	624.687	-2667.7	1.06412e+006	1184.9	0.063799
8	651.187	-2681.41	1.14929e+006	1440.44	0.0718105
9	677.688	-2694.47	1.21682e+006	1671.19	0.0786904
10	704.188	-2706.88	1.26697e+006	1864.73	0.084328
11	730.689	-2718.67	1.30422e+006	2017.64	0.088637
12	757.189	-2729.86	1.32603e+006	2118.74	0.0915475
13	783.69	-2740.45	1.33112e+006	2160.96	0.0930147
14	810.19	-2750.47	1.32322e+006	2148.13	0.0930145
15	836.69	-2759.91	1.29932e+006	2076.06	0.0915474
16	863.191	-2768.81	1.25876e+006	1947.31	0.0886369
17	889.691	-2777.15	1.19194e+006	1754.31	0.0843285
18	916.192	-2784.96	1.10916e+006	1523.32	0.07869
19	942.692	-2792.25	1.01056e+006	1266.57	0.0718108
20	969.193	-2799.01	898800	1000.81	0.0637986
21	995.693	-2805.27	772465	738.556	0.0547806
22	1022.19	-2811.01	630731	494.26	0.0448987
23	1048.69	-2816.26	483142	289.305	0.0343087
24	1075.19	-2821.02	336842	136.261	0.0231776
25	1101.69	-2825.28	175659	35.8116	0.0116809
26	1128.2	-2829.06	4.12185e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.417700
Factor of Safety, standard deviation: 0.234544
Factor of Safety, minimum: 0.720718

Factor of Safety, maximum: 2.241630
Probability of Failure: 3.310% (= 331 failed surfaces / 10000 valid surfaces)
Reliability index: 1.78090 (assuming normal distribution)
Reliability index: 2.04191 (assuming lognormal distribution)
* best fit = Gamma

Method: gle/morgenstern-price
Factor of Safety, mean: 1.418763
Factor of Safety, standard deviation: 0.234720
Factor of Safety, minimum: 0.721207
Factor of Safety, maximum: 2.243270
Probability of Failure: 3.260% (= 326 failed surfaces / 10000 valid surfaces)
Reliability index: 1.78410 (assuming normal distribution)
Reliability index: 2.04647 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
2018	-6000
2018	0
0	0

External Boundary

X	Y
2018	-6000
2018	-2943
1929	-2940
1840	-2936
1751	-2931
1662	-2925
1573	-2919
1483	-2910
1394	-2896
1305	-2880
1216	-2857
1128	-2829
1039	-2796

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 108PC Site 05		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 4/01/2013		File Name: RR0705_108_05_0g.sli

950	-2760
862	-2724
786	-2694
711	-2664
635	-2633
559	-2602
484	-2575
403	-2554
322	-2542
242	-2534
161	-2526
81	-2519
0	-2511
0	-6000

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 05		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	4/01/2013		File Name: RR0705_108_05_1g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_108_05_1g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 108PC Site 05
Author: Jason R. Patton
Company: Oregon State University
Date Created: 4/01/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364842182
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table

Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: spencer

FS: 0.005281
Center: 1884.689, 176.616
Radius: 3099.381
Left Slip Surface Endpoint: 433.027, -2561.785
Right Slip Surface Endpoint: 1127.797, -2828.925
Left Slope Intercept: 433.027 0.000
Right Slope Intercept: 1127.797 0.000
Resisting Moment=4.95556e+006 kN-m
Driving Moment=9.38447e+008 kN-m
Resisting Horizontal Force=1561.35 kN

Driving Horizontal Force=295678 kN
Total Slice Area=1.88377e+006 m2

Method: gle/morgenstern-price

FS: 0.005285
Center: 1885.229, 181.545
Radius: 3104.292
Left Slip Surface Endpoint: 431.759, -2561.456
Right Slip Surface Endpoint: 1127.797, -2828.925
Left Slope Intercept: 431.759 0.000
Right Slope Intercept: 1127.797 0.000
Resisting Moment=5.00293e+006 kN-m
Driving Moment=9.46558e+008 kN-m
Resisting Horizontal Force=1574.24 kN
Driving Horizontal Force=297847 kN
Total Slice Area=1.88712e+006 m2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 1023
Number of Invalid Surfaces: 52

Error Codes:

Error Code -108 reported for 48 surfaces
Error Code -112 reported for 4 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1070
Number of Invalid Surfaces: 5

Error Codes:

Error Code -112 reported for 5 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with

many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.0052806

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	27.7908	735953	basement	5.551	27.1	172.477	0.91078	26510.7	26519.7	-9.01956
2	27.7908	741178	basement	5.551	27.1	278.819	1.47233	26773.2	26781.2	-7.97471
3	27.7908	745968	basement	5.551	27.1	332.419	1.75537	26997.5	27005	-7.45132
4	27.7908	750453	basement	5.551	27.1	396.688	2.09475	27197.4	27204.2	-6.77257
5	27.7908	754765	basement	5.551	27.1	447.534	2.36325	27385.9	27392.1	-6.23577
6	27.7908	758772	basement	5.551	27.1	476.48	2.5161	27549.4	27555.3	-5.93475
7	27.7908	762602	basement	5.551	27.1	507.387	2.67931	27701.2	27706.8	-5.62323
8	27.7908	766288	basement	5.551	27.1	533.756	2.81855	27844.3	27849.7	-5.38675
9	27.7908	769830	basement	5.551	27.1	555.293	2.93228	27978.9	27984	-5.0669
10	27.7908	773230	basement	5.551	27.1	571.677	3.0188	28105.1	28110	-4.89951
11	27.7908	776508	basement	5.551	27.1	588.189	3.10599	28224.7	28229.5	-4.78147
12	27.7908	779665	basement	5.551	27.1	597.796	3.15672	28337.8	28342.5	-4.68715
13	27.7908	782687	basement	5.551	27.1	602.235	3.18016	28442.9	28447.5	-4.60265
14	27.7908	785589	basement	5.551	27.1	603.492	3.1868	28541.6	28546.2	-4.63027
15	27.7908	788364	basement	5.551	27.1	596.991	3.15247	28632.8	28637.5	-4.65525
16	27.7908	790997	basement	5.551	27.1	577.578	3.04996	28715.1	28720	-4.88692
17	27.7908	793452	basement	5.551	27.1	544.05	2.87291	28784.8	28790	-5.23107
18	27.7908	795772	basement	5.551	27.1	503.882	2.6608	28846.1	28851.7	-5.63765
19	27.7908	797965	basement	5.551	27.1	455.255	2.40402	28899.8	28906	-6.19807
20	27.7908	800046	basement	5.551	27.1	399.102	2.1075	28947.4	28954.2	-6.773
21	27.7908	802005	basement	5.551	27.1	330.661	1.74609	28987.8	28995.3	-7.45806
22	27.7908	803841	basement	5.551	27.1	254.662	1.34477	29021	29029.3	-8.25344
23	27.7908	805649	basement	5.551	27.1	196.538	1.03784	29056.9	29065.7	-8.80885
24	27.7908	807381	basement	5.551	27.1	116.439	0.61487	29090	29099.7	-9.70596
25	27.7908	808991	basement	5.551	27.1	0	0	29104.3	29126.4	-22.0789

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00528539

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	27.8415	737206	basement	5.551	27.1	95.2721	0.50355	26506.6	26516.5	-9.86405
2	27.8415	742449	basement	5.551	27.1	227.919	1.20464	26770.1	26778.5	-8.44391
3	27.8415	747270	basement	5.551	27.1	321.486	1.69918	26996.6	27004.2	-7.55529

4	27.8415	751769	basement	5.551	27.1	397.916	2.10314	27196.8	27203.6	-6.75383
5	27.8415	756097	basement	5.551	27.1	463.294	2.44869	27385.9	27392	-6.05148
6	27.8415	760120	basement	5.551	27.1	502.158	2.6541	27550.1	27555.8	-5.67296
7	27.8415	763962	basement	5.551	27.1	535.542	2.83055	27702.1	27707.4	-5.31974
8	27.8415	767658	basement	5.551	27.1	562.119	2.97102	27845.3	27850.4	-5.06359
9	27.8415	771210	basement	5.551	27.1	581.698	3.0745	27980	27984.8	-4.81288
10	27.8415	774620	basement	5.551	27.1	594.174	3.14044	28106.2	28110.9	-4.70521
11	27.8415	777907	basement	5.551	27.1	604.758	3.19638	28225.7	28230.3	-4.60727
12	27.8415	781072	basement	5.551	27.1	607.819	3.21256	28338.8	28343.4	-4.59445
13	27.8415	784102	basement	5.551	27.1	604.678	3.19596	28443.8	28448.4	-4.61714
14	27.8415	787012	basement	5.551	27.1	598.088	3.16113	28542.4	28547	-4.61342
15	27.8415	789794	basement	5.551	27.1	584.07	3.08704	28633.6	28638.4	-4.83398
16	27.8415	792434	basement	5.551	27.1	558.842	2.9537	28715.8	28720.9	-5.08383
17	27.8415	794896	basement	5.551	27.1	521.572	2.75671	28785.4	28790.9	-5.46377
18	27.8415	797222	basement	5.551	27.1	480.275	2.53844	28846.7	28852.5	-5.83144
19	27.8415	799420	basement	5.551	27.1	433.697	2.29226	28900.4	28906.7	-6.34566
20	27.8415	801506	basement	5.551	27.1	383.309	2.02594	28948	28954.9	-6.93522
21	27.8415	803468	basement	5.551	27.1	325.779	1.72187	28988.4	28995.9	-7.52788
22	27.8415	805308	basement	5.551	27.1	263.14	1.3908	29021.6	29029.7	-8.08923
23	27.8415	807119	basement	5.551	27.1	211.854	1.11973	29057.3	29066	-8.65911
24	27.8415	808855	basement	5.551	27.1	153.045	0.8089	29090.6	29099.8	-9.22897
25	27.8415	810468	basement	5.551	27.1	85.4279	0.45152	29116.5	29126.4	-9.93485

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.0052806

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	433.027	-2561.78	3.37981e+007	0	0
2	460.818	-2576.34	193737	-898.06	-0.26559
3	488.609	-2590.53	370033	-1715.27	-0.26559
4	516.399	-2604.38	478440	-2217.79	-0.26559
5	544.19	-2617.88	579592	-2686.68	-0.265591
6	571.981	-2631.04	656685	-3044.04	-0.265591
7	599.772	-2643.87	706664	-3275.72	-0.265591
8	627.563	-2656.37	748101	-3467.79	-0.26559
9	655.353	-2668.54	780853	-3619.61	-0.26559
10	683.144	-2680.38	804790	-3730.58	-0.265591
11	710.935	-2691.91	819800	-3800.15	-0.26559

12	738.726	-2703.13	831772	-3855.65	-0.265591
13	766.517	-2714.03	834741	-3869.41	-0.26559
14	794.307	-2724.63	829817	-3846.59	-0.265591
15	822.098	-2734.92	818594	-3794.56	-0.26559
16	849.889	-2744.92	798222	-3700.13	-0.265591
17	877.68	-2754.61	762406	-3534.1	-0.26559
18	905.471	-2764.01	712439	-3302.48	-0.26559
19	933.261	-2773.12	653135	-3027.58	-0.26559
20	961.052	-2781.94	585956	-2716.17	-0.26559
21	988.843	-2790.47	511715	-2372.03	-0.26559
22	1016.63	-2798.72	428335	-1985.53	-0.26559
23	1044.42	-2806.69	341101	-1581.16	-0.26559
24	1072.22	-2814.38	266470	-1235.21	-0.26559
25	1100.01	-2821.79	183250	-849.447	-0.26559
26	1127.8	-2828.92	4.12145e+007	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00528539

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	431.759	-2561.46	3.37894e+007	0	0
2	459.6	-2576.03	195368	-109.597	-0.0321416
3	487.442	-2590.25	375921	-418.44	-0.0637763
4	515.283	-2604.11	484647	-798.543	-0.094405
5	543.125	-2617.63	585872	-1263.3	-0.123545
6	570.966	-2630.81	664067	-1747.06	-0.150736
7	598.808	-2643.65	713597	-2186.42	-0.17555
8	626.649	-2656.17	754518	-2602.12	-0.197596
9	654.491	-2668.35	786728	-2973.13	-0.216526
10	682.332	-2680.21	810141	-3280.98	-0.23204
11	710.174	-2691.76	824678	-3510.5	-0.243896
12	738.015	-2702.99	836110	-3676.04	-0.251905
13	765.857	-2713.91	838806	-3746.98	-0.255941
14	793.698	-2724.52	833641	-3723.91	-0.255941
15	821.54	-2734.82	822398	-3615.75	-0.251905
16	849.382	-2744.83	802126	-3414.5	-0.243896
17	877.223	-2754.53	766685	-3104.99	-0.23204
18	905.065	-2763.94	716939	-2709.39	-0.216526
19	932.906	-2773.06	657853	-2268.75	-0.197596
20	960.748	-2781.89	590786	-1810.14	-0.175551
21	988.589	-2790.44	516570	-1359.02	-0.150736

22	1016.43	-2798.69	432981	-933.623	-0.123545
23	1044.27	-2806.67	345110	-568.63	-0.0944049
24	1072.11	-2814.36	269879	-300.403	-0.0637761
25	1099.96	-2821.78	185629	-104.134	-0.0321417
26	1127.8	-2828.92	4.12145e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 0.048544
Factor of Safety, standard deviation: 0.085326
Factor of Safety, minimum: 0.000319
Factor of Safety, maximum: 1.258700
Probability of Failure: 99.940% (= 9988 failed surfaces / 9994 valid surfaces), 6 invalid surfaces
Reliability index: -11.15089 (assuming normal distribution)
Reliability index: -3.14256 (assuming lognormal distribution)
* best fit = Beta

Method: gle/morgenstern-price
Factor of Safety, mean: 0.054491
Factor of Safety, standard deviation: 0.087526
Factor of Safety, minimum: 0.000281
Factor of Safety, maximum: 1.262840
Probability of Failure: 99.940% (= 9990 failed surfaces / 9996 valid surfaces), 4 invalid surfaces
Reliability index: -10.80263 (assuming normal distribution)
Reliability index: -3.14118 (assuming lognormal distribution)
* best fit = Beta

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
2018	-6000
2018	0
0	0

External Boundary

X	Y

2018	-6000
2018	-2943
1929	-2940
1840	-2936
1751	-2931
1662	-2925
1573	-2919
1483	-2910
1394	-2896
1305	-2880
1216	-2857
1128	-2829
1039	-2796
950	-2760
862	-2724
786	-2694
711	-2664
635	-2633
559	-2602
484	-2575
403	-2554
322	-2542
242	-2534
161	-2526
81	-2519
0	-2511
0	-6000

rocscience SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 05		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	4/01/2013		File Name: RR0705_108_08_0g.sli

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_108_08_0g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 108PC Site 05
Author: Jason R. Patton
Company: Oregon State University
Date Created: 4/01/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364842371
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	
B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Global Minimums

Method: gle/morgenstern-price

FS: 1.211490
Center: 2033.568, -1114.762
Radius: 1448.215
Left Slip Surface Endpoint: 1151.260, -2263.178
Right Slip Surface Endpoint: 1749.754, -2534.895
Left Slope Intercept: 1151.260 0.000
Right Slope Intercept: 1749.754 0.000
Resisting Moment=7.21104e+007 kN-m
Driving Moment=5.95221e+007 kN-m
Resisting Horizontal Force=45071 kN
Driving Horizontal Force=37203 kN
Total Slice Area=1.45238e+006 m2

Valid / Invalid Surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2998
Number of Invalid Surfaces: 0

Slice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.21149

				Base	Base	Shear	Shear	Base	Pore	Effective

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 108PC Site 05		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 4/01/2013		File Name: RR0705_108_08_0g.sli

Number	[m]	[kN]	Material	Cohesion [kPa]	Friction Angle [degrees]	Stress [kPa]	Strength [kPa]	Normal Stress [kPa]	Pressure [kPa]	Normal Stress [kPa]
1	23.9398	560998	basement	5.551	27.1	12.375	14.9922	23421.9	23403.4	18.4765
2	23.9398	566547	basement	5.551	27.1	27.6626	33.513	23639.6	23585	54.6009
3	23.9398	571654	basement	5.551	27.1	39.8957	48.3333	23842.5	23758.8	83.6602
4	23.9398	576490	basement	5.551	27.1	51.2655	62.1076	24035.9	23925.4	110.529
5	23.9398	581057	basement	5.551	27.1	61.8474	74.9275	24220.5	24084.9	135.605
6	23.9398	585224	basement	5.551	27.1	69.8752	84.6531	24392.3	24237.7	154.612
7	23.9398	589095	basement	5.551	27.1	75.9206	91.977	24552.9	24384	168.878
8	23.9398	592734	basement	5.551	27.1	81.0715	98.2173	24705	24523.9	181.12
9	23.9398	596135	basement	5.551	27.1	85.3461	103.396	24849	24657.8	191.202
10	23.9398	599250	basement	5.551	27.1	87.73	106.284	24982.6	24785.7	196.855
11	23.9398	602143	basement	5.551	27.1	88.7956	107.575	25107.3	24907.9	199.378
12	23.9398	604830	basement	5.551	27.1	88.822	107.607	25223.9	25024.5	199.429
13	23.9398	607339	basement	5.551	27.1	87.7803	106.345	25332.6	25135.7	196.929
14	23.9398	609713	basement	5.551	27.1	86.7734	105.125	25436.1	25241.5	194.568
15	23.9398	611899	basement	5.551	27.1	84.8206	102.759	25532.1	25342.1	189.983
16	23.9398	613897	basement	5.551	27.1	81.7058	98.9858	25620.3	25437.7	182.576
17	23.9398	615744	basement	5.551	27.1	77.5807	93.9882	25701.1	25528.3	172.77
18	23.9398	617449	basement	5.551	27.1	73.1751	88.6509	25776.3	25613.9	162.43
19	23.9398	618976	basement	5.551	27.1	67.5447	81.8297	25843.9	25694.8	149.115
20	23.9398	620331	basement	5.551	27.1	60.639	73.4636	25903.7	25771	132.728
21	23.9398	621537	basement	5.551	27.1	52.7818	63.9446	25956.7	25842.6	114.093
22	23.9398	622586	basement	5.551	27.1	43.9279	53.2182	26002.7	25909.6	93.1203
23	23.9398	623468	basement	5.551	27.1	33.7876	40.9334	26041.2	25972	69.1728
24	23.9398	624192	basement	5.551	27.1	22.4299	27.1736	26072.3	26030.1	42.2203
25	23.9398	624791	basement	5.551	27.1	10.4696	12.6839	26097.6	26083.7	13.9489

Interslice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.21149

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	1151.26	-2263.18	2.63782e+007	0	0
2	1175.2	-2281.18	250543	60.3692	0.0138056
3	1199.14	-2298.42	426864	204.086	0.0273934
4	1223.08	-2314.94	588105	416.213	0.0405493
5	1247.02	-2330.77	734554	680.323	0.0530657
6	1270.96	-2345.92	855439	966.66	0.0647451

7	1294.9	-2360.43	934859	1230.31	0.0754034
8	1318.84	-2374.32	999845	1481.08	0.0848727
9	1342.78	-2387.61	1.05061e+006	1705.37	0.0930035
10	1366.72	-2400.31	1.07879e+006	1876.59	0.0996678
11	1390.66	-2412.45	1.08546e+006	1984.66	0.10476
12	1414.6	-2424.04	1.0783e+006	2036.3	0.108199
13	1438.54	-2435.09	1.05746e+006	2028.96	0.109934
14	1462.48	-2445.62	1.03511e+006	1986.08	0.109934
15	1486.42	-2455.64	1.00397e+006	1895.95	0.1082
16	1510.36	-2465.16	959759	1754.83	0.10476
17	1534.3	-2474.19	902607	1570.11	0.0996675
18	1558.24	-2482.75	845666	1372.7	0.0930034
19	1582.18	-2490.83	776538	1150.29	0.0848725
20	1606.12	-2498.46	694944	914.574	0.0754035
21	1630.06	-2505.63	602427	680.753	0.0647452
22	1654	-2512.35	503057	465.917	0.0530657
23	1677.93	-2518.63	391591	277.136	0.0405492
24	1701.87	-2524.48	268129	128.194	0.0273934
25	1725.81	-2529.9	137232	33.0665	0.0138056
26	1749.75	-2534.89	3.30923e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: gle/morgenstern-price
Factor of Safety, mean: 1.219390
Factor of Safety, standard deviation: 0.200707
Factor of Safety, minimum: 0.629236
Factor of Safety, maximum: 1.953610
Probability of Failure: 13.620% (= 1362 failed surfaces / 10000 valid surfaces)
Reliability index: 1.09308 (assuming normal distribution)
Reliability index: 1.13142 (assuming lognormal distribution)
* best fit = Gamma

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
4284	-6000

4284	0
0	0

External Boundary

X	Y
4284	-6000
4284	-3156
4207	-3200
4130	-3242
4053	-3268
3975	-3271
3905	-3261
3834	-3246
3764	-3228
3693	-3207
3612	-3186
3531	-3163
3450	-3144
3369	-3123
3288	-3106
3204	-3087
3121	-3066
3038	-3041
2955	-3012
2872	-2981
2789	-2950
2705	-2918
2622	-2885
2539	-2849
2447	-2813
2356	-2777
2264	-2742
2172	-2707
2081	-2673
1989	-2636
1897	-2598
1806	-2559
1715	-2520
1625	-2480

SLIDEINTERPRET 6.020	Project: Sumatra Submarine Slide		
	Analysis Description: RR0705 108PC Site 05		
	Drawn By: Jason R. Patton	Scale:	Company: Oregon State University
	Date: 4/01/2013		File Name: RR0705_108_08_0g.sli

1535	-2439
1445	-2396
1354	-2350
1264	-2307
1174	-2270
1084	-2243
993	-2222
903	-2204
813	-2189
723	-2168
632	-2148
542	-2128
452	-2095
361	-2053
271	-2016
181	-1986
90	-1952
0	-1908
0	-6000

Slide Analysis Information

Sumatra Submarine Slide

Project Summary

File Name: RR0705_108_08_1g.sli
Slide Modeler Version: 6.02
Project Title: Sumatra Submarine Slide
Analysis: RR0705 108PC Site 05
Author: Jason R. Patton
Company: Oregon State University
Date Created: 4/01/2013
Comments:

http://earthjay.com
http://activetectonics.coas.oregonstate.edu/

General Settings

Units of Measurement: Metric Units
Time Units: days
Permeability Units: meters/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 10.3 kN/m3
Advanced Groundwater Method: Excess Pore Pressure

Random Numbers

Random Seed: 1364842468
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Auto Refine Search
Divisions along slope: 10
Circles per division: 10
Number of iterations: 10
Divisions to use in next iteration: 50%
Composite Surfaces: Disabled
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 1
Seismic Load Coefficient (Vertical): 1

Material Properties

Property	basement
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [kN/m3]	7.35
Saturated Unit Weight [kN/m3]	15.9
Cohesion [kPa]	5.551
Friction Angle [deg]	27.1
Water Surface	Water Table
Hu Value	1
Material Weight Causes Excess Pore Pressure	

B_bar value	1

Probabilistic Analysis Input

General Settings

Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Latin-Hypercube
Number of Samples: 10000
Analysis Type: Global Minimum

Variables

Material	Property	Distribution	Mean	Min	Max	Standard Deviation
basement	Cohesion	Normal	5.551	0.551	10.551	2.6
basement	Phi	Normal	27.1	14.8	39.4	4.1
basement	Unit Weight	Normal	7.35	5.82	8.88	0.51

Seismic Coefficient	Property	Distribution	Mean	Min	Max	Standard Deviation
Horizontal Seismic Coefficient		Normal	1	0	2	0.5
Vertical Seismic Coefficient		Normal	1	0	2	0.5

Seismic Coefficient Correlation: 0.5

Global Minimums

Method: gle/morgenstern-price

FS: 0.002666
Center: 2443.685, -376.887
Radius: 2263.739
Left Slip Surface Endpoint: 1254.401, -2303.054
Right Slip Surface Endpoint: 1716.573, -2520.674
Left Slope Intercept: 1254.401 0.000
Right Slope Intercept: 1716.573 0.000
Resisting Moment=580140 kN-m
Driving Moment=2.17596e+008 kN-m
Resisting Horizontal Force=250.164 kN
Driving Horizontal Force=93830.3 kN
Total Slice Area=1.11962e+006 m2

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 05		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	4/01/2013		File Name: RR0705_108_08_1g.sli

Valid / Invalid Surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 1450
Number of Invalid Surfaces: 0

Slice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00266613

Slice Number	Width [m]	Weight [kN]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	18.4869	439787	basement	5.551	27.1	91.0196	0.24267	23796.3	23806.7	-10.3655
2	18.4869	442174	basement	5.551	27.1	182.654	0.48698	23951.7	23961.6	-9.86541
3	18.4869	444474	basement	5.551	27.1	262.512	0.69989	24098.1	24107.6	-9.46302
4	18.4869	446704	basement	5.551	27.1	331.36	0.88345	24238.4	24247.5	-9.10782
5	18.4869	448866	basement	5.551	27.1	387.674	1.03359	24372.5	24381.3	-8.81091
6	18.4869	450952	basement	5.551	27.1	407.591	1.08669	24498.9	24507.6	-8.70104
7	18.4869	452933	basement	5.551	27.1	405.509	1.08114	24613.3	24622.1	-8.75487
8	18.4869	454845	basement	5.551	27.1	400.239	1.06709	24721.4	24730.2	-8.81274
9	18.4869	456693	basement	5.551	27.1	381.778	1.01787	24823.7	24832.5	-8.80947
10	18.4869	458478	basement	5.551	27.1	351.236	0.93644	24920.3	24929.3	-8.9955
11	18.4869	460214	basement	5.551	27.1	351.269	0.93653	25013.5	25022.5	-9.03384
12	18.4869	461926	basement	5.551	27.1	332.504	0.8865	25106.9	25116	-9.08397
13	18.4869	463581	basement	5.551	27.1	289.029	0.77059	25195.2	25204.5	-9.3054
14	18.4869	465176	basement	5.551	27.1	239.336	0.6381	25278.2	25287.8	-9.6398
15	18.4869	466711	basement	5.551	27.1	185.947	0.49576	25355.8	25365.7	-9.88293
16	18.4869	468203	basement	5.551	27.1	173.536	0.46267	25430.7	25440.7	-9.95081
17	18.4869	469665	basement	5.551	27.1	134.337	0.35816	25504.6	25514.8	-10.2157
18	18.4869	471071	basement	5.551	27.1	88.6791	0.23643	25573.5	25583.9	-10.4249
19	18.4869	472420	basement	5.551	27.1	47.7846	0.1274	25637.3	25647.9	-10.5723
20	18.4869	473714	basement	5.551	27.1	13.9828	0.03728	25696.3	25707.1	-10.8008
21	18.4869	474962	basement	5.551	27.1	5.4461	0.01452	25752	25762.8	-10.8371
22	18.4869	476168	basement	5.551	27.1	0	0	25802.6	25815.4	-12.8314
23	18.4869	477319	basement	5.551	27.1	0	0	25849.5	25863.2	-13.7053
24	18.4869	478417	basement	5.551	27.1	0	0	25894.1	25906.2	-12.1141
25	18.4869	479462	basement	5.551	27.1	12.0699	0.03218	25933.8	25944.6	-10.7845

SLIDEINTERPRET 6.020	Project	Sumatra Submarine Slide		
	Analysis Description	RR0705 108PC Site 05		
	Drawn By	Jason R. Patton	Scale	Company: Oregon State University
	Date	4/01/2013		File Name: RR0705_108_08_1g.sli

Interslice Data

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.00266613

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	1254.4	-2303.05	2.73159e+007	0	0
2	1272.89	-2314.35	73575.1	-218.076	-0.169824
3	1291.37	-2325.4	126923	-746.467	-0.336967
4	1309.86	-2336.21	175155	-1524.85	-0.498788
5	1328.35	-2346.8	218277	-2486.82	-0.65274
6	1346.84	-2357.15	256316	-3562.91	-0.796386
7	1365.32	-2367.28	281896	-4563.55	-0.927467
8	1383.81	-2377.18	297700	-5424.62	-1.04391
9	1402.3	-2386.87	308452	-6158.99	-1.1439
10	1420.78	-2396.34	314206	-6723.42	-1.22584
11	1439.27	-2405.6	315003	-7084.87	-1.28845
12	1457.76	-2414.65	319245	-7416.05	-1.33074
13	1476.24	-2423.49	322470	-7611	-1.35206
14	1494.73	-2432.12	320957	-7575.28	-1.35205
15	1513.22	-2440.56	314694	-7310.34	-1.33074
16	1531.7	-2448.8	303648	-6829.47	-1.28845
17	1550.19	-2456.84	295880	-6331.29	-1.22584
18	1568.68	-2464.68	285122	-5693.14	-1.14389
19	1587.16	-2472.33	269535	-4911.4	-1.04391
20	1605.65	-2479.79	249004	-4031.07	-0.927468
21	1624.14	-2487.07	223390	-3105.22	-0.796385
22	1642.63	-2494.15	197421	-2249.21	-0.65274
23	1661.11	-2501.06	166298	-1447.74	-0.498787
24	1679.6	-2507.78	129666	-762.596	-0.336966
25	1698.09	-2514.31	87484.6	-259.304	-0.169824
26	1716.57	-2520.67	3.27221e+007	0	0

Probabilistic Analysis Results (Global Minimum)

Method: gle/morgenstern-price
Factor of Safety, mean: 0.044361
Factor of Safety, standard deviation: 0.084289
Factor of Safety, minimum: 0.000197
Factor of Safety, maximum: 1.452360

Probability of Failure: 99.970% (= 9994 failed surfaces / 9997 valid surfaces), 3 invalid surfaces
Reliability index: -11.33770 (assuming normal distribution)
Reliability index: -3.13819 (assuming lognormal distribution)
* best fit = Beta

List Of Coordinates

Water Table

X	Y
0	0
0	-6000
4284	-6000
4284	0
0	0

External Boundary

X	Y
4284	-6000
4284	-3156
4207	-3200
4130	-3242
4053	-3268
3975	-3271
3905	-3261
3834	-3246
3764	-3228
3693	-3207
3612	-3186
3531	-3163
3450	-3144
3369	-3123
3288	-3106
3204	-3087
3121	-3066
3038	-3041
2955	-3012
2872	-2981
2789	-2950
2705	-2918

2622	-2885
2539	-2849
2447	-2813
2356	-2777
2264	-2742
2172	-2707
2081	-2673
1989	-2636
1897	-2598
1806	-2559
1715	-2520
1625	-2480
1535	-2439
1445	-2396
1354	-2350
1264	-2307
1174	-2270
1084	-2243
993	-2222
903	-2204
813	-2189
723	-2168
632	-2148
542	-2128
452	-2095
361	-2053
271	-2016
181	-1986
90	-1952
0	-1908
0	-6000