TECHNICAL MEMORANDUM

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TO: Michael Jaworski – Phelps Dodge Tyrone, Inc. **DATE:** May 11, 2007

FROM: Thomas Wythes, P.E., R.G., and Eugene Muller, P.E. – Golder Associates Inc. **OUR REF.:** 053-2550

RE: **TYRONE RECLAMATION**
4C STOCKPILE STABILITY ANALYSIS, DP-1341, CONDITION 78

1.0 INTRODUCTION

Golder Associates Inc. (Golder) is performing slope stability studies of waste rock and leached ore stockpiles at Phelps Dodge Tyrone, Inc.'s (PDTI) Tyrone Mine to address the supplemental stability analysis requirements of Condition 78 of the New Mexico Environment Department's Discharge Permit (DP)-1341. The purpose of this technical memorandum is to document foundation conditions and evaluate the stability of the reclaimed configuration of the 4C Leached Ore Stockpile. A preliminary regrading plan for the reclaimed stockpile configuration has been produced by Montgomery Watson Harza Inc. (MWH), (2006). This stability analysis is based on the preliminary MWH regrading plan.

Reclamation of the 4C Stockpile will include regrading slopes to overall slopes of 3.5H:1V. These slopes bound the perimeter of the mine area on the south and southwest sides of the stockpile, extend into the partially backfilled San Salvador Pit on the east side of the stockpile and lie within the interior portions of the mine area that drain into the pregnant leach solution (PLS) ponds and open pits. Figure 1 illustrates the proposed grading plan and includes sections illustrating the current and future configuration of the stockpile, with foundation materials identified. A total of three cross sections are shown on Figure 1. At the location of the sections, the stockpile has been determined to have the highest continuous slopes and/or potentially unfavorable foundation slopes. The selection criteria for the individual stability sections are discussed below.

2.0 METHOD

2.1 Overall Approach

Golder performed stability evaluations through a two-dimensional, limit equilibrium analysis with the computer program SLIDE (Rocscience, 2000) and application of Bishop's Method of Slices (Bishop, 1955) using effective stress parameters.

The following conditions were considered in the analyses:

- base-case (expected) conditions;
- the impact of long-term weathering and decrepitation of the leached ore and waste rock and the potential for a resulting reduction in material strength; and
- the impact of weathering and decrepitation at the interface between the stockpiles and the foundation, and the potential for a resulting reduction of shear strength.

Base-case stability analyses represent the predicted stability of the stockpile based on measured strength properties. Golder conducted sensitivity studies to determine the range in material strength required to maintain stable conditions and to indirectly evaluate the effects of decrepitation and weathering of the waste rock, leached ore, and the foundation-stockpile interface.

2.2 Evaluation of Weathering and Decrepitation

EnviroGroup Limited (2005a and 2005b) investigated the long-term effects of weathering and decrepitation on the strength of waste rock and leached ore at PDTI as a part of the supplemental materials characterization requirements of Condition 80 of DP-1341. The EnviroGroup studies supplement previous material characterization studies by Greystone and Daniel B. Stephens & Associates, Inc., which are referenced in EnviroGroup's reports (2005a and 2005b). The results of the material characterization studies indicate that sulfide oxidation is occurring in the stockpiles, but at generally low rates due to the low sulfide concentrations. There is a weak correlation between the age of the stockpile materials and the sulfide concentration, suggesting that sulfide is being consumed over time.

Based on Golder's sampling and testing, there is no clear relationship between grain size, mineralogy, or clay content (or other factors that may influence shear strength) with the age of the stockpile. The variability of these factors is overwhelmingly attributable to variability in the lithology and hydrothermal alteration of the ore and overburden, and the mechanical segregation of the materials as they were originally placed in the stockpile, rather than to post-placement weathering.

The geochemical characterization studies do not provide a direct means to assess the potential long-term strength reductions for the stockpile materials that may be attributable to weathering and chemical decrepitation. However, Condition 78 states that the stability analyses should account for changes in the chemical and physical properties of the stockpile materials from the time of deposition to present day and to a specified time after closure. To address this requirement, we have performed back-analyses to determine the minimum

leached ore shear strength that results in a minimally acceptable factor of safety of 1.0 under pseudostatic loading, and qualitatively assessed the potential that long-term decrepitation could reduce the stockpile shear strength to levels that could lead to instability.

The possible presence of a weak zone at the stockpile-foundation interface is postulated as a result of low pH pregnant leach solutions or acidic leachate seeping along the base of the stockpile causing chemical alteration (decrepitation) of the soil and stockpile materials. To assess the potential that a weak layer at the stockpile-foundation interface will impact the stockpile stability, Golder completed back-analyses of the required interface shear strength that results in a computed factor of safety of 1.0 under pseudostatic loading, and qualitatively assessed the potential that long-term decrepitation could reduce the interface shear strength to levels that would result in instability.

2.3 Liquefaction Potential

The 4C stockpile, in both its current and regraded configuration, lies on a foundation of granodiorite. The bedrock foundation and the stockpile, due to its rock-fill composition, are not susceptible to liquefaction and a liquefaction potential analysis has not been performed.

3.0 DEVELOPMENT OF THE STABILITY MODEL

3.1 Modeling Input and Assumptions

Golder developed two-dimensional stability models for critical and representative stability cross sections. Cross sections were selected based on the slope height, foundation conditions, and the topography underlying the stockpile. Stability cross sections with pertinent geological information are shown on Figure 1. The geological base is from the PDTI mine area geology map.

The stability sections show the pre-mine topographic surface and the projected post-regrade (final or finished) surface. Existing outslopes are generally 33 to 36 degrees (1.5H:1V), while the regraded slopes will be approximately 16 degrees (3.5H:1V) overall.

3.2 Geometry

Stability cross sections are shown on Figure 1. Section A-A' illustrates foundation conditions on the west side of the 4C Stockpile. This section is composed of an upper slope segment that is 200 feet high and a lower slope that is 150 feet high separated by a 250-foot-wide bench. The upper slope segment overlies a bedrock surface that slopes back under the stockpile. The stability of the upper segment was evaluated for circular failure through the stockpile material. The lower segment overlies a northwest sloping bedrock surface and

modes of failure involving sliding along the stockpile interface were evaluated. The influence of a weak stockpile-foundation interface, and the effect of stockpile strength reduction due to decrepitation were evaluated through back-analyses.

Section B-B' represents the northern slope of the stockpile, which drains toward the 4C Leach Stockpile in the interior mine area. At this location, the stockpile outslope overlies an inward, southward sloping bedrock foundation. This section was evaluated for base-case and decrepitated ore conditions in circular failure mode.

Section C-C' represents the southern stockpile slope. This section was selected for analysis of circular failure because it represents the maximum toe to crest height (approximately 100 feet) on the stockpile outslope. The foundation slopes inward beneath the stockpile; therefore, block sliding and weak interface analyses were not performed. Analyses were limited to base-case and decrepitated ore conditions.

3.3 Geology

Based on the PDTI geology map, the bedrock consists mainly of Tertiary Granodiorite-Quartz-Diorite with lesser Granodiorite-Tonalite-Dacite. There are no occurrences of soil or alluvium within the stockpile foundation.

3.4 Groundwater Conditions

Exploration and testing of materials in the 4C Stockpile has been limited to surface test pits. Information regarding moisture and groundwater conditions in the 4C Stockpile have been estimated on the basis of geophysical exploration, drilling, and laboratory testing conducted on other leached ore stockpiles at Tyrone. The composition of the 4C leach stockpile (Section 3.5.1) is similar to the other leach stockpiles; Golder therefore expects moisture conditions to be similar to conditions indicated by testing at other Leach Stockpiles.

Information concerning moisture conditions in the leached ore stockpiles is available from downhole geophysical logging in sonic drillholes completed in 3A and 1A Stockpiles. The 3A Stockpile was under active leaching at the time of geophysical logging. Logging results (EnviroGroup, 2005a) indicate a volumetric moisture content between 3 and 19 percent, and averaging approximately 12 percent. This represents an average gravimetric moisture content of approximately 6 percent. Applying a dry unit weight of 120 pounds per cubic foot (pcf) and specific gravity of soil solids of 2.765 (the average from available laboratory testing), saturated conditions would occur at a gravimetric moisture content of 16 percent. As such, geophysical logging indicated the 3A Stockpile was generally unsaturated, even while under leach. Similar conditions are expected to occur in the 4C Leach Stockpile.

Moisture content testing (American Society for Testing and Materials D2216) of rotosonic drillhole samples collected in October 2005 (Golder, 2006) from the 1A Stockpile indicated gravimetric moisture contents ranging from 4.3 to 22.5 percent, and averaging 10.1 percent. Stockpile material properties are expected to vary; however, we believe that unsaturated conditions are indicated within the leached ore stockpiles. The potential for saturation to occur will be lower under post-closure conditions when leaching is terminated and surface water management measures are applied.

Elevated groundwater levels and local groundwater mounds in the stockpiles that would impact stability are not expected because of the drainage capacity of the leached ore stockpiles. In particular, the ore stockpiles have previously been leached at rates that exceed 100-year storm rainfall amounts on a daily basis. Saturation and instability did not occur under these conditions. The potential for elevated groundwater levels will be further reduced upon cessation of leaching operations and following reclamation cover placement and implementation of surface water management.

These data and conclusions are consistent with EnviroGroup (2005a and 2005b) findings, which indicate that the stockpiles are drained, that moisture content correlates with the grain size of the materials, and that sands and gravels have low moisture content and zones with higher clay content have higher retained moisture.

Based on geophysical exploration, drilling, laboratory testing and the operational history of the leach stockpiles at Tyrone, unsaturated conditions are indicated. Although available data suggest the stockpiles are drained, basal zones of saturation are incorporated into the stability models to provide a conservative estimate of stockpile stability. The incorporation of a saturated zone at the base of the stockpiles is considered conservative because of the resulting reduction in effective stress used in shear-strength calculations. Available data indicate that following the cessation of leaching operations, the stockpile will be drained.

3.5 Material Properties

Materials considered in the stability analysis include leached ore and decrepitated or weathered ore. In its current configuration, the stockpile is composed entirely of leached ore. Strength data for the leached ore have been determined through a number of geotechnical investigations, *in situ* testing, and laboratory testing programs. To evaluate the effect of weathering and decrepitation of the ore, the strength required for minimally acceptable stability conditions has been back-analyzed. Analyses have been performed using effective stress strength parameters and the effect of pore pressures was modeled by defining a static water table condition.

3.5.1 Leached Ore Stockpile Material

The compositional models (EnviroGroup, 2005a and 2005b) provide information regarding the type of materials present in the 4C Stockpile. The dominant material placed during the period from 1973 to 1986 was leached cap material. Between 1992 and 1996, the dominant materials included leached cap, chalcocite/pyrite ore and chalcopyrite/pyrite ore. Based on test-pit and drill-hole sample observations about the mine area, the general composition of the stockpiles is clayey gravel with sand containing 10 to 50 percent cobbles and boulders. Test pit TYTP01-5, which was excavated on the north limit of the 4C Stockpile in 2001, encountered strongly cemented clayey gravel with sand and 10 percent cobbles and boulders to 24 inches in diameter. Rock fragments were characterized as weak (R2 on the International Society of Rock Mechanics (ISRM) scale).

Golder has completed nine shear-strength tests of Tyrone stockpile materials. Samples were derived from surface test pits as well as from the interior of the stockpile when the stockpiles were being re-mined. Shear-strength testing included large-scale (6-inch box) direct shear and triaxial shear testing.

Direct shear tests were performed on remolded samples that were nominally compacted with a light tamp and allowed to consolidate at each applied load increment. Fragments larger than 1.5 inches were removed from the direct shear samples. Tests were performed under saturated conditions.

Triaxial tests were performed on remolded samples on the minus ¾-inch fraction under consolidated (C), undrained (U) conditions with pore pressure measurements. Strength tests were completed on four leached ore samples. Results of triaxial and direct shear tests are reported in the *Tyrone Supplemental Stability Evaluation Interim Report* (Golder, 2006).

Because fine material was used in the direct shear and triaxial testing, the shear strengths used in the stability analysis are not influenced by the coarse fraction of the leached ore. This is conservative because coarse material with interlocking particles generally has a higher shear strength than fine material.

The laboratory-derived friction angles (ϕ) of the leached and unleached materials are similar and are within a range of 29.0 to 36.9 degrees. The cohesion ranges from 0.4 to11.9 pounds per square inch (psi). The laboratory strengths were measured on the stockpile matrix. The results of geochemical testing associated with Condition 80 (EnviroGroup, 2005b) and comparisons of the geotechnical properties and weathering/leaching history completed for Condition 78 indicate that decrepitation does not result in the formation of additional clay fraction or more plastic clay minerals. The strength of the stockpile matrix is considered to represent the strength of the decrepitated stockpile material. We have applied the shear

strength at large displacement rather than peak strength when both are reported. However, the stockpile materials generally do not exhibit brittle behavior, and the peak and large displacement strengths are close in value. The average friction angle measured in the leached ore samples was 35.6 degrees and the apparent cohesion averaged 0.95 psi. Observations of the interiors of re-mined leached ore stockpiles indicate that they are cemented with sulfate minerals and have a true cohesion. However, cohesion has been ignored in these stability analyses, and a friction angle of 35.5 degrees was applied to represent the shear strength of leached ore in all base-case analyses.

The friction angle of the ore was varied in the stability analyses to yield a factor of safety of 1.0 under seismic loading to evaluate the potential impact of a decrease in leached ore strength due to long-term weathering and decrepitation.

Geophysical data (EnviroGroup, 2005a) indicate leached ore density from 100 to 150 pcf. The leached ore is assumed to have a moist unit weight of 120 pcf and a saturated unit weight of 133 pcf., which represent typical values for gravelly soils. The unit weight does not have a strong impact on the results of the stability analyses.

3.5.2 Granodiorite

Granodiorite underlies the entire foundation of 4C Stockpile. Call & Nicholas, Inc. (1982) used uniaxial compression and Brazilian disk tests to estimate the intact strength of mine area granitic rocks for pit-slope stability studies. Minimum reported estimates for intact bedrock cohesion and internal friction angle are 669 pounds per square inch (psi) and 43.41 degrees, respectively. Strength testing along fractures resulted in a strength of 26 to 28 degrees and an apparent cohesion of 13 to 16 psi. Applying the intact strength listed above (669 psi), a fracture strength of 26 degrees and 16 psi cohesion, and assuming that failure surfaces involve 50 percent intact material with the remainder following preexisting fractures, a strength of 35.6 degrees and 340 psi cohesion is estimated. For these stability analyses, we have applied a rock-mass cohesion of 20 psi and an internal friction angle of 35 degrees to represent the strength of the bedrock.

Wyllie and Mah (2004) report cohesion ranging from 20 to 600 psi and internal friction angles of 35 to 37 degrees for jointed porphyry, kaolinized granite, and weathered granite. General rock-strength characteristics reported by Wyllie and Mah (2004) indicate that an internal friction angle of 35 to 45 degrees is applicable to rock masses and fill containing angular, interlocking particles. For soft rock, or hard rock with discontinuities, a cohesion of 200 to 400 psi is indicated. The rock strength applied to the granodiorite at Tyrone is below the range of strengths reported for similar rocks and is considered conservative.

3.5.3 Basal Interface

Interface strength testing has not been completed at the 4C Stockpile. A triaxial test was recently completed on basal interface material from Borehole TSGT-04 (265 to 268 feet) at the base of the 2A Leach Stockpile. The 2A Leach basal interface sample yielded an effective friction angle of 38.0 degrees indicating that a weak interface was not present in that location and is not ubiquitous at the base of the leach stockpiles. Laboratory data are contained in Attachment 1.

The defined stockpile-foundation interface zone in Sections A-A', B-B', and C-C' was assigned the same strength that has been applied to the leached ore (35.5 degrees) for base-case stability analyses. To evaluate the potential risk posed by a weak interface along the lower slope segment at Section A-A', Golder back-calculated the shear strength required to maintain a minimally acceptable safety factor of 1.0 under seismic loading conditions.

3.5.4 Summary of Material Properties

Material strength parameters applied in the stability models are summarized in Table 1, below. The leached ore, waste rock, and recent alluvium (Qal) are assumed to have a moist unit weight of 120 pcf and saturated unit weight of 133 pcf.

TABLE 1
MATERIAL STRENGTH MATRIX, 2A/2B STOCKPILE

Material	Unit Weight moist/sat (pcf)	Cohesion (c, psi)	Friction Angle (ϕ, Degrees)
Leached Ore (base case)	120/133	0	35.5
Decrepitated Ore	120/133	0	Solve for FOS=1.0
Weathered Interface (basal ore/waste)	120/133	0	Solve for FOS=1.0
Granodiorite/Granitoid Rock	160/160	20	35.0

Notes:
pcf = pounds per cubic foot
c = consolidated
psi = pounds per square inch
FOS = factor of safety

3.6 Seismic Loading

Based on the Tyrone seismic hazard analysis prepared by URS Corporation (2005), the peak ground acceleration for a 2,500-year return period at bedrock sites is between 0.08 and 0.09g and results from a magnitude 6.7 earthquake. For sites underlain by local soils and Gila Conglomerate, magnification of bedrock acceleration was predicted to result in a peak

acceleration of 0.18g at the ground surface. Hynes and Franklin (1984) discuss the selection of pseudostatic coefficients for use in dam design and recommend the use of one-half the peak acceleration with a 20-percent reduction of the shear strength and a target factor of safety of 1.0. Bray et al. (1993) provide recommendations for seismic design of landfills and note that "the normalized fundamental periods of many solid waste landfills are greater than two, and that for these cases, the maximum horizontal equivalent acceleration value used to represent the seismic loading will be less than one-half of the bedrock maximum horizontal acceleration." Jansen (1985) states that an acceleration of 0.4 to 0.7 times peak ground acceleration is typically suitable for computing the sustained effect of an earthquake on embankment stability.

The 4C Stockpile lies on a foundation of granitic bedrock. For bedrock sites, the unmagnified acceleration of 0.8g to 0.9g could be applied; however, in a manner consistent with previously completed analyses, a pseudostatic coefficient equal to 0.66 times the amplified peak ground acceleration (i.e., 0.12g) and a seismic event with a 2,500-year return period were assumed. Golder believes this approach to be conservative.

4.0 CALCULATIONS

Searches for critical failure surfaces in circular and block failure modes were completed using SLIDE. Stability analyses were performed for existing base-case conditions under static and pseudostatic loading. In the block failure analyses, failure surface searches were configured to incorporate all foundation layers. In circular failure analyses, failure surface search limits were set to eliminate thin, infinite slope type failure mechanisms.

Base-case analyses incorporate shear strengths measured or estimated based on current conditions and available test results. Stability model shear strengths are conservative in that they are based on testing of the fine fraction of the leached ore and do not include the influence of the oversize fragments, which would increase the shear strength. The factor of safety for the base-case condition was computed for static and pseudostatic loading conditions.

The potential for decrepitation to reduce the long-term stockpile and stockpile-foundation interface shear strength to levels that could lead to instability was assessed qualitatively. The shear strength that would be required to result in instability of the decrepitated ore stockpile was evaluated through back-analyses using a circular failure surface search method. The strength of the ore was varied until a factor of safety of 1.0 resulted. To evaluate the effect of a weak stockpile-foundation interface, a 10-foot-thick basal ore interface zone was defined in the stability model, and the strength parameters were varied until a factor of safety of 1.0 resulted. The effect of a weakened interface was evaluated for circular and block failure modes. The reported factors of safety are based on Bishop's (1955) Method of Slices.

5.0 RESULTS

Results of the stability analyses of the 4C Stockpile are presented in Table 2. SLIDE computer output is provided in Attachment 2. The computer output includes a graphical representation of the failure surface with the minimum factor of safety for each analysis, and the corresponding text output file. Each graphic representation and text output file is labeled with the analysis number indicated on Table 2.

5.1 Section A-A'

Section A-A' represents the westward facing outslope of the 4C Stockpile. For the regraded upper slope under base-case conditions in circular failure mode, the minimum factor of safety is 2.6 under static loading and 1.8 under pseudostatic loading. For the slope at the stockpile toe in block failure mode searches that encompass the stockpile-foundation interface, the minimum factors of safety are 2.3 and 1.6 under static and pseudostatic conditions, respectively.

For evaluation of the potential for a weak interface to impact stability of the lower slope, input of a basal interface zone internal friction angle (ϕ) of 19.0 degrees resulted in a factor of safety of 1.0 for block failure mode under pseudostatic loading. In this analysis, the internal friction angle of the leached ore was assumed to be 35.5 degrees.

To simulate the impact of long-term decrepitation of the stockpile material, input of a leached ore internal friction angle of 22 degrees resulted in a factor of safety of 1.0 in circular failure mode under pseudostatic loading for the upper portion of the slope. A back-analysis for the lower slope segment applying reduced strengths for the leach ore and the foundation interface resulted in a factor of safety of 1.0 with an applied shear strength of 25 degrees.

5.2 Section B-B'

Section B-B' represents the northward slope of the 4C Stockpile. The minimum calculated factor of safety for the base-case condition is approximately 2.7 under static conditions and 1.8 under seismic loading conditions in circular failure modes.

The back-calculated stockpile shear strength (including the basal interface zone and leached ore) that yielded a factor of safety of 1.0 under pseudostatic loading in Section B-B' was a friction angle of 22 degrees in the circular failure model. Because of the inward slope of the foundation, block failure analyses were not performed at Section B-B'.

5.3 Section C-C'

The bedrock foundation at Section C-C' also slopes inward, so again, only circular slope failures were considered. For base-case conditions, the factors of safety are 2.5 and 1.7 under static and pseudostatic loading conditions, respectively. In evaluation of the effects of ore decrepitation, input of a leached ore internal friction angle of 23 degrees resulted in a factor of safety of 1.0 in circular failure mode under pseudostatic loading.

TABLE 2
STABILITY ANALYSIS SUMMARY 4C STOCKPILE

Section	Static FOS	Pseudostatic FOS (0.12g)	Failure Mode	Comments
A-A'	2.3 (A-1)	1.6 (A-2)	Block	Base Case (Lower Slope)
A-A'	2.6 (A-3)	1.8 (A-4)	Circular	Base Case (Upper Slope)
A-A'	NA	1.0 (A-5)	Block	Weak Interface Evaluation, Back-Analyzed ϕ = 19º (Lower Slope)
A-A'	NA	1.0 (A-6)	Circular	Weathered Ore Evaluation, Back-Analyzed ϕ = 22º (Upper Slope)
A-A'	NA	1.0 (A-7)	Block	Weathered Ore Evaluation, Back-Analyzed ϕ = 25º (Lower Slope)
B-B'	2.7 (B-1)	1.8 (B-2)	Circular	Base case
B-B'	NA	1.0 (B-3)	Circular	Weathered Ore Evaluation, Back-Analyzed ϕ = 22º
C-C'	2.5 (C-1)	1.7 (C-2)	Circular	Base case
C-C'	NA	1.0 (C-3)	Circular	Weathered Ore Evaluation, Back-Analyzed ϕ = 23º

Notes:
Analysis numbers in parentheses indicate the stability analysis output provided in Attachment 2.
FOS = Factor of Safety

6.0 SUMMARY AND CONCLUSIONS

6.1 Summary

The base-case strength properties used in these stability analyses are based primarily on recent and previously completed geotechnical testing. Base-case shear-strength properties used in stability analysis are conservative because they are based on testing of the fine fraction of the leached ore. The minimum factor of safety of 1.6 for base-case conditions

occurs at Section A-A' in block failure mode under pseudostatic loading conditions. This area overlies a relatively steep foundation outslope.

The long-term effects of weathering and decrepitation on the grain-size distribution and shear strength of the leached ore and basal stockpile-foundation interface cannot be assessed directly. Material characterization studies completed for Tyrone suggest that little loss of strength should be anticipated given the lithology of the ore, its current state of alteration, and the ambient conditions to which it is exposed. The laboratory-derived shear strengths were determined on the soil matrix component of the stockpile material. We consider the laboratory-measured values for the soil matrix component to be representative of the fully weathered (or decrepitated) condition of the leached ore. The effect of oversize fragments, which could enhance stability, has not been incorporated into the shear strength of the leached ore assumed for the stability analyses.

PDTI is planning to regrade the 4C Stockpile to overall slopes of at least 3.5H:1V. At that proposed slope angle, a leached ore friction angle of 22 to 25 degrees is required to reduce the factor of safety to 1.0 under pseudostatic loading, representing a low level of stability. The average leached ore friction angle determined from laboratory shear-strength testing is 35.6 degrees (Golder, 2006). A considerable change in the physical condition of the ore would be required before a factor of safety lower than 1.0 could develop. However, the material characterization studies do not predict a significant change in material properties over time.

Drill core observations and laboratory testing of stockpile-foundation interface material do not indicate the presence of a weak interface layer. A triaxial test of interface material from the 2A Stockpile indicated an internal friction angle of 38.4 degrees (Attachment 1). Back-analysis of the impact of a weak layer at the stockpile-foundation interface was completed by varying the strength of the basal stockpile-foundation interface zone to simulate a weak layer at the base of the stockpile.

At Section A-A' in the 4C stockpile where the foundation outslope is relatively steep, a reduction of the stockpile and interface shear strength to an internal friction angle of 25 degrees results in a factor of safety of 1.0 under pseudostatic loading conditions in block failure mode. A 25-degree friction angle represents a 30-percent reduction in the average measured shear strength of the leached ore. The material characterization studies (EnviroGroup, 2005a and 2005b) do not predict a significant change in material properties over time. Therefore, a long-term reduction in stability of the 4C Stockpiles due to basal interface weathering is not expected.

The stockpile is currently unsaturated. Golder expects moisture contents will be lower following closure as a result of the cessation of leaching, stockpile draindown, cover

placement, and implementation of surface water management measures. The development of groundwater mounds that could impact the stockpile's long-term stability is not expected. We also consider the potential for the initiation of flowslide related to stormwater runoff or infiltration near the stockpile crest will be further reduced as a result of cover placement and surface water management.

6.2 Conclusions

Stability evaluations incorporating base-case strength properties indicate that the 4C Stockpile will be stable at the proposed reclaimed configuration shown in the proposed preliminary MWH grading plan. Back-calculation of shear-strength reductions required to result in minimally acceptable safety factors suggest that the long term stability of the 4C Stockpile will not be impacted by weathering and decrepitation of the leached ore or the basal stockpile-foundation interface.

7.0 REFERENCES

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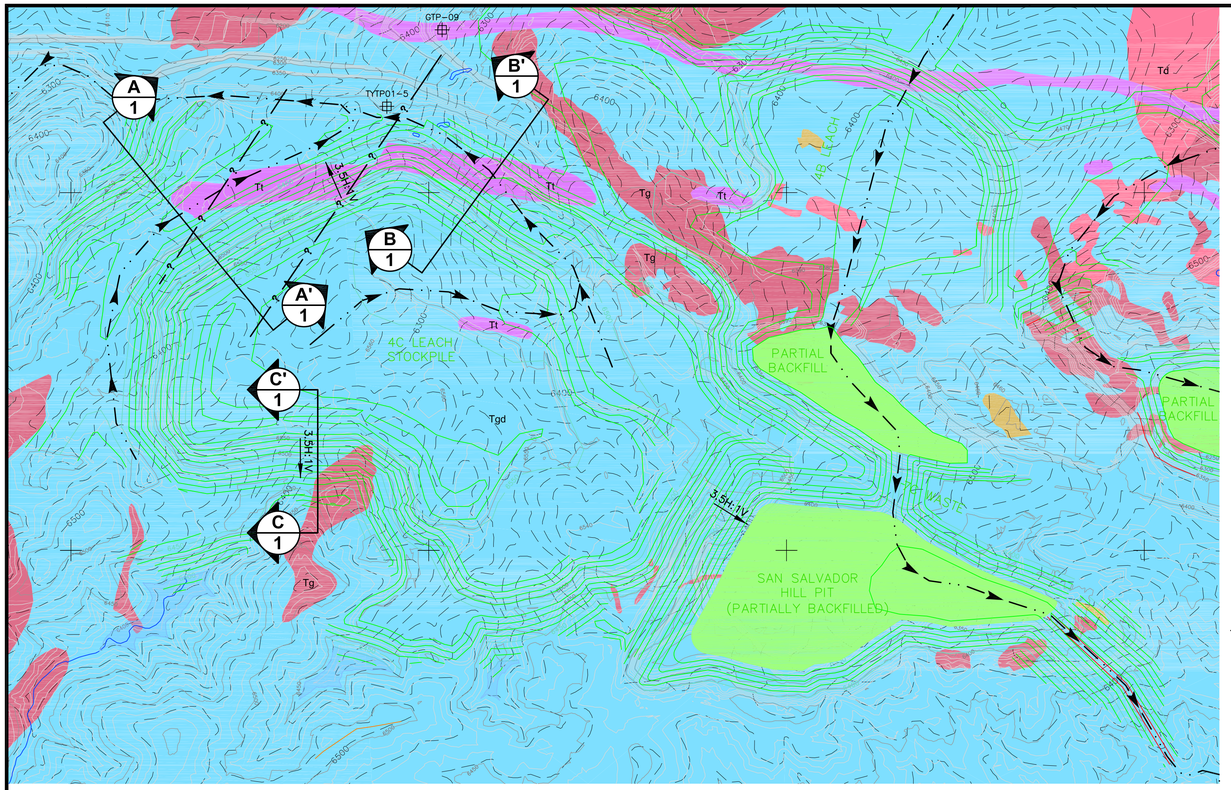
Attachments: Figure 1. Stability Plan And Sections
Geotechnical Data - Basal Interface Shear-Strength 2A Leach Stockpile
Slide Stability Output – 4C stockpile

FIGURE 1

STABILITY PLAN AND SECTIONS



4C LEACH STOCKPILE PLAN

400 0 400 800
SCALE FEET

GEOLOGIC LEGEND

Mine Dumps Alluvium (Qal) Colluvium	Quaternary
Upper Mangas Conglomerate Lower Mangas Conglomerate >(Qtg)	Upper Tertiary/ Quaternary
Latite & Basaltic Andesite (Tml) Wind Mountain Ash-flow Tuff (Twt) Volcanics and Volcaniclastics (Tv) Volcanic Rocks (undiff.) Tonalite-Dacite (Tt)	Tertiary
Igneous Breccia Granodiorite-Tonalite-Dacite (Tg) Diorite/Biotite Diorite (Td) Granodiorite-Quartz Diorite (Tgd)	Tertiary
Andesite\K volcanics Basal volcanics (K?) Colorado Shale \ Beartooth Quartzite	Cretaceous
Diabase Granitoid Rocks (P€g)	Precambrian

LEGEND

- STOCKPILE TEST PIT LOCATION
- EXISTING SURFACE CONTOURS
- PRE-MINE SURFACE CONTOURS
- POST REGRADE SURFACE CONTOURS
- INFERRED FAULT
- POST-REGRADE SURFACE DRAINAGE
- PARTIAL BACKFILL — PARTIAL BACKFILL

REFERENCES

1.) GEOLOGY FROM PDTI PROJECT GEOLOGY MAP.

2.) STOCKPILE GEOTECHNICAL INVESTIGATION REPORTED IN "SUPPLEMENTAL STABILITY STUDY OF WASTE ROCK PILES AND LEACH ORE STOCKPILES, INTERIM REPORT FOR DP1341, CONDITION 78, TYRONE MINE", GOLDER ASSOCIATES, JANUARY 2003.

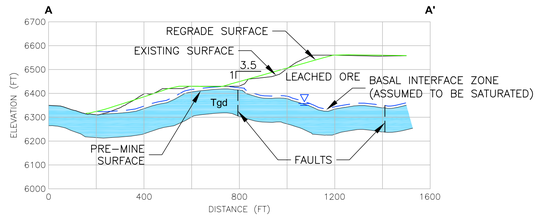
3.) PRE-1999 TOPOGRAPHIC BASE MAP PROVIDED BY PHELPS DODGE TYRONE, INC.

4.) POST REGRADE CONTOURS FROM TYRONE MINE REGRADE.DWG PROVIDED BY MONTGOMERY WATSON HARZA.

MATERIALS PROPERTIES
4C LEACHED ORE STOCKPILE

Material	Unit Weight moist/sat (pcf)	Cohesion (c, psi)	Friction Angle (ϕ,Degrees)
Leached Ore (base case)	120/133	0	35.5
Decrepitated Ore	120/133	0	Solve for FOS=1.0
Weathered Interface (basal ore/waste)	120/133	0	Solve for FOS=1.0
Granodiorite/Granitic Rocks	160/160	20	35

Notes:
FOS = factor of safety
pcf = pounds per cubic foot
psi = pounds per square inch



A/1 SECTION A-A'

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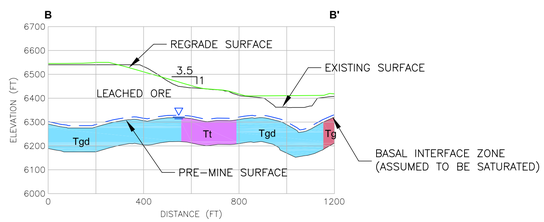
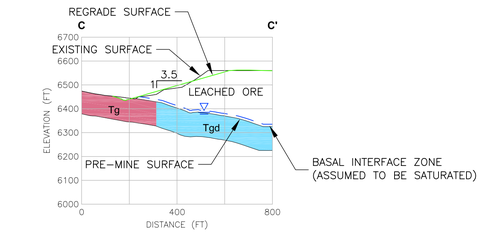
SCALE FEET



B/1 SECTION B-B'

300 0 300 600
SCALE FEET



C/1 SECTION C-C'

300 0 300 600
SCALE FEET

PROJECT
phelps dodge TYRONE Inc.
SUPPLEMENTAL STABILITY ANALYSIS
TYRONE MINE, NEW MEXICO

TITLE
4C LEACH STOCKPILE PLAN AND CROSS-SECTIONS

Golder Associates Tucson, Arizona

PROJECT No.		053-2550	FILE No.		05325500D006
DESIGN	GM	03/16/07	SCALE	AS SHOWN	REV. A
CADD	NIL	03/16/07	FIGURE		1
CHECK	GM	04/23/07			
REVIEW	TW	05/09/07			

Drawing File: 05325500D06.dwg May 11, 2007 - 10:02am

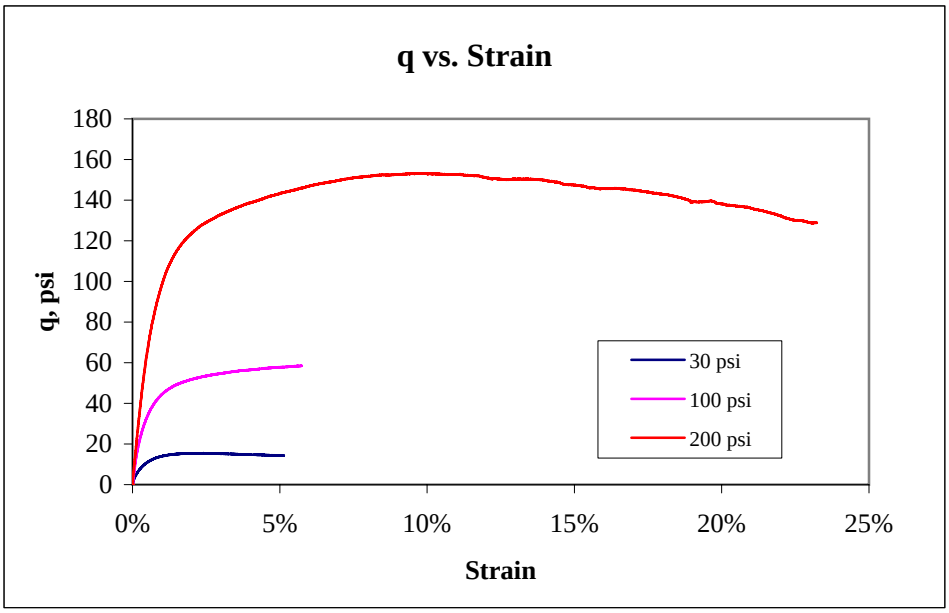
ATTACHMENT 1

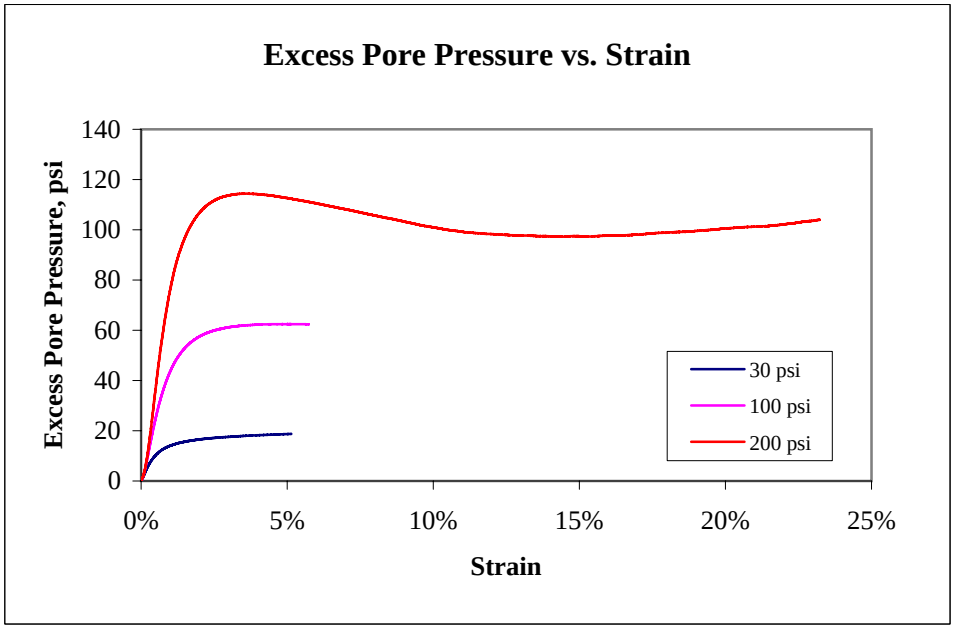
GEOTECHNICAL DATA
BASAL INTERFACE SHEAR-STRENGTH TESTING
BOREHOLE TSGT-04
AT 265 TO 268 FEET
2A LEACH STOCKPILE

Sample # =	TSTG-04		Sample # =	TSTG-04		Sample # =	TSTG-04	
Point # =	1		Point # =	2		Point # =	3	
	Initial			**Initial**			**Initial**	
Length =	14.67	cm	Length =	14.67	cm	Length =	14.67	cm
Diameter =	7.27	cm	Diameter =	7.27	cm	Diameter =	7.27	cm
Wet Weight =	1235.20	g	Wet Weight =	1235.20	g	Wet Weight =	1235.20	g
Area =	41.5	cm^2	Area =	41.5	cm^2	Area =	41.5	cm^2
Sample Area =	6.43	in^2	Sample Area =	6.43	in^2	Sample Area =	6.43	in^2
Volume =	608.9	cm^3	Volume =	608.9	cm^3	Volume =	608.9	cm^3
Moisture Content =	11.0%		Moisture Content =	11.0%		Moisture Content =	11.0%	
Specific Gravity =	-		Specific Gravity =	-		Specific Gravity =	-	
Dry Weight of Solids =	1112.79	g	Dry Weight of Solids =	1112.79	g	Dry Weight of Solids =	1112.79	g
Wet Unit Weight =	2.03	g/cm^3	Wet Unit Weight =	2.03	g/cm^3	Wet Unit Weight =	2.03	g/cm^3
Dry Unit Weight =	1.83	g/cm^3	Dry Unit Weight =	1.83	g/cm^3	Dry Unit Weight =	1.83	g/cm^3
Wet Unit Weight =	126.6	pcf	Wet Unit Weight =	126.6	pcf	Wet Unit Weight =	126.6	pcf
Dry Unit Weight =	114.0	pcf	Dry Unit Weight =	114.0	pcf	Dry Unit Weight =	114.0	pcf
Cell Pressure =	80	psi	Cell Pressure =	150	psi	Cell Pressure =	250	psi
Back Pressure =	50	psi	Back Pressure =	50	psi	Back Pressure =	50	psi
Confining Pressure =	30	psi	Confining Pressure =	100	psi	Confining Pressure =	200	psi

Notes: Material visually described as sand, reddish-brown, with clay and fine gravel.
Specimen remolded with a light to moderate tamp at visually estimated optimum moisture content.
Failure defined as maximum principal stress ratio.
The strain rate was 0.1mm/min, and t_{50} was 0.1 minutes.
Test was a staged trixial test.

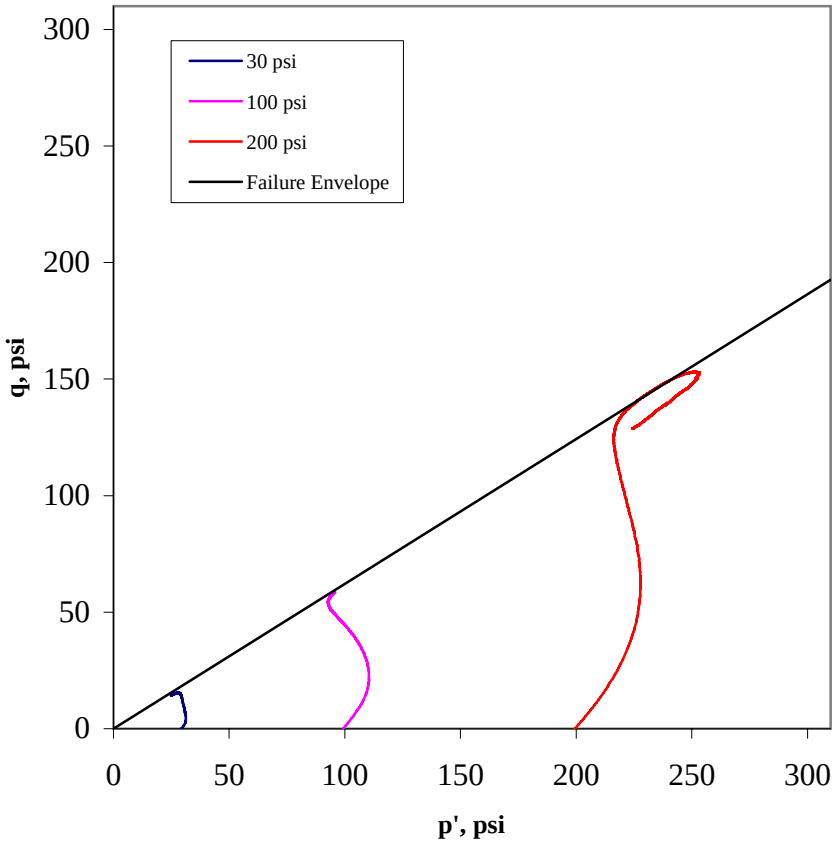
Golder Associates, Inc. **Denver, Colorado**	**Title:** **TRIAXIAL SHEAR TEST REPORT** **SAMPLE DATA AND CALCULATIONS**			
Job Short Title: **PD Tyrone/Stockpile Geotech**				
Sample Number: **TSTG-04 @ 265-268**	**Reviewed:** **JEO**	**Date:** **6/7/2006**	**Job Number:** **053-2550**	**Figure:** **1**





Golder Associates, Inc. **Denver, Colorado**		**Title:** **C-U TRIAXIAL SHEAR DATA** **q AND EXCESS PORE PRESSURE PLOTS**		
Job Short Title: **PD Tyrone/Stockpile Geotech**				
Sample Number: **TSTG-04 @ 265-268**	**Reviewed:** **JEO**	**Date:** **06/07/06**	**Job Number:** **053-2550**	**Figure:** **2**

Stress Path (p'-q) Plot

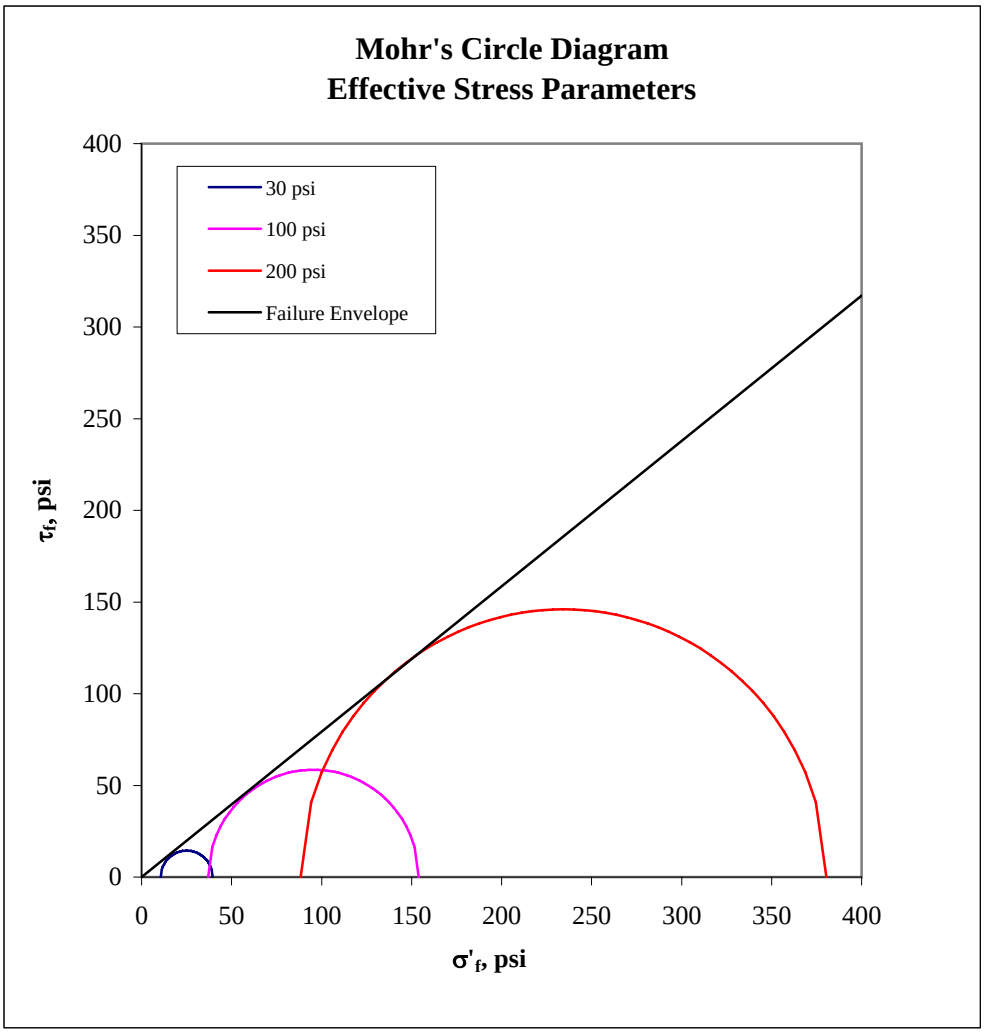


Stress Path Parameters

ψ' = 31.8 degrees

a' = 0.0 psi

Golder Associates, Inc. **Denver, Colorado**		**Title:** **C-U TRIAXIAL SHEAR DATA** **STRESS PATH PLOT**		
Job Short Title: PD Tyrone/Stockpile Geotech				
Sample Number: **TSTG-04 @ 265-268**	**Reviewed:** **JEO**	**Date:** **6/7/2006**	**Job Number:** **053-2550**	**Figure:** **3**



Effective Stress Shear Strength Parameters

ϕ' = 38.4 degrees
c' = 0.0 psi

Golder Associates, Inc. Denver, Colorado		**Title:** C-U TRIAXIAL SHEAR DATA MOHR'S CIRCLE DIAGRAM		
Job Short Title: PD Tyrone/Stockpile Geotech				
Sample Number: TSTG-04 @ 265-268	**Reviewed:** JEO	**Date:** 6/7/2006	**Job Number:** 053-2550	**Figure:** 4

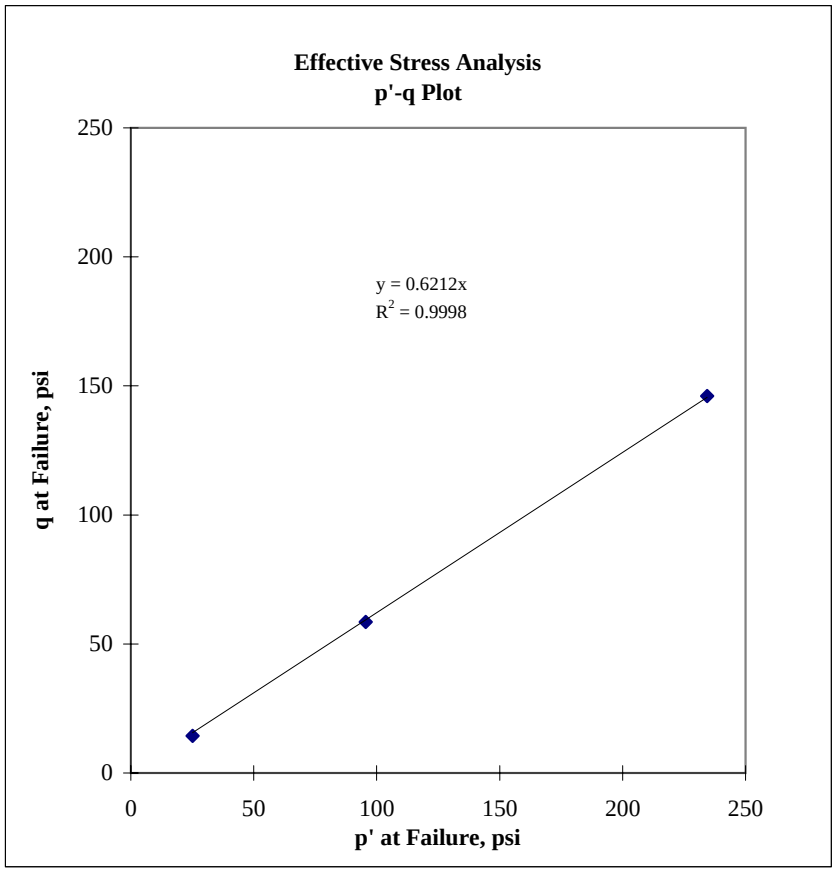
Consolidated-Undrained Triaxial Lab Data
From: GOLDER ASSOCIATES, INC.
Project: **PD Tyrone/Stockpile Geotech**
Project Number: **053-2550**

Sample Number	TSTG-04 @ 265-268
Effective Stress Analysis	

Point Number	p' (psi)	q (psi)
1	25.1	14.4
2	95.5	58.5
3	234.4	146.0

tan(ψ') = **0.6212**
a' = **0.0** **psi**

ϕ' = **38.4** **degrees**
c' = **0.0** **psi**



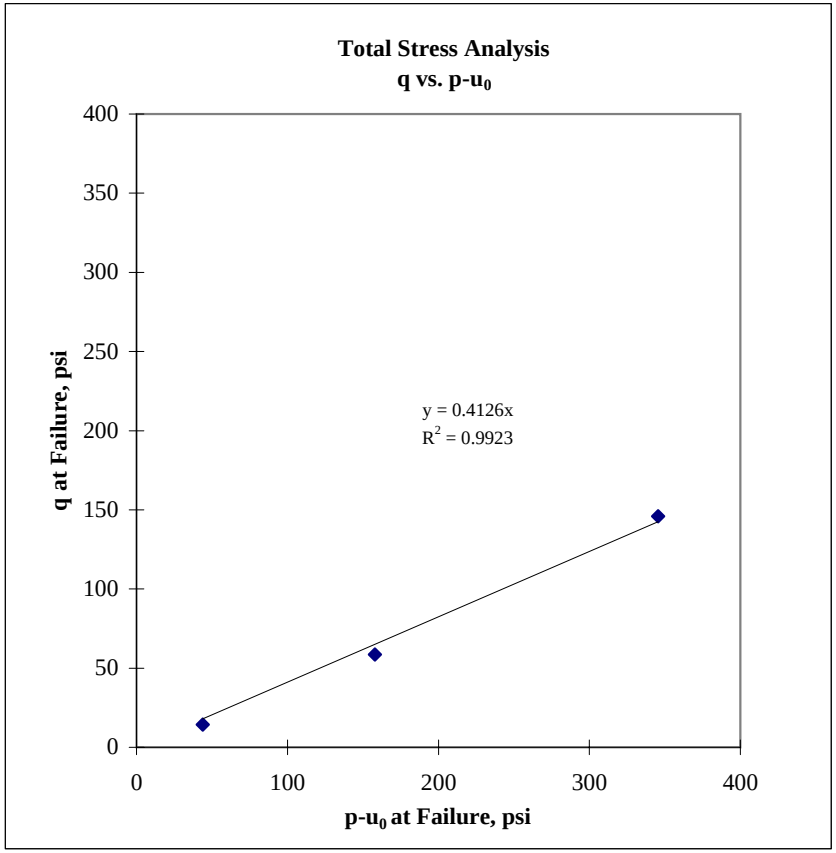
Consolidated-Undrained Triaxial Lab Data
From: GOLDER ASSOCIATES, INC.
Project: **PD Tyrone/Stockpile Geotech**
Project Number: **053-2550**

Sample Number	TSTG-04 @ 265-268
Total Stress Analysis	

Point Number	$p-u_o$ (psi)	q (psi)
1	43.8	14.4
2	157.8	58.5
3	345.5	146.0

$\tan(\psi)$ = 0.4126
a = 0.0 psi

ϕ = 24.4 degrees
c = 0.0 psi



Consolidated-Undrained Triaxial Lab Data
From: GOLDER ASSOCIATES, INC.
Project: **PD Tyrone/Stockpile Geotech**
Project Number: **053-2550**

Mohr-Coulomb Failure Criteria:

$$\tau_{ff} = c' + \sigma'_{ff} \tan(\phi')$$
$$\tau_{ff} = c + \sigma_{ff} \tan(\phi)$$

Where:
c', c = effective and total stress cohesion intercepts

ϕ', ϕ = effective and total stress friction angles

τ_{ff} = shear strength on the failure surface at failure

σ'_{ff}, σ_{ff} = effective and total normal stresses on the failure surface at failure

Stress Path Space:

$$q = \frac{\sigma_1 - \sigma_3}{2} \qquad p' = \frac{\sigma'_1 + \sigma'_3}{2} \qquad p = \frac{\sigma_1 + \sigma_3}{2}$$

Where:
q = maximum shear stress

p', p = mean effective and total stresses

σ'_1, σ_1 = effective and total axial stresses

σ'_3, σ_3 = effective and total confining stresses

Stress Path Failure Criteria:

$$q = a' + p' \tan(\psi')$$
$$q = a + (p - u_0) \tan(\psi)$$

Where:
a', a = intercepts of the q-axis in effective stress and total stress spaces

ψ', ψ = angles of the failure envelopes in effective stress and total stress spaces

q = maximum shear stress at failure

p' = mean effective stress at failure

$p-u_0$ = mean total stress at failure minus the initial pore pressure

The relationships between ψ and ϕ and a and c are as follows:

$$\tan(\psi) = \sin(\phi)$$
$$a = c \cos(\phi)$$

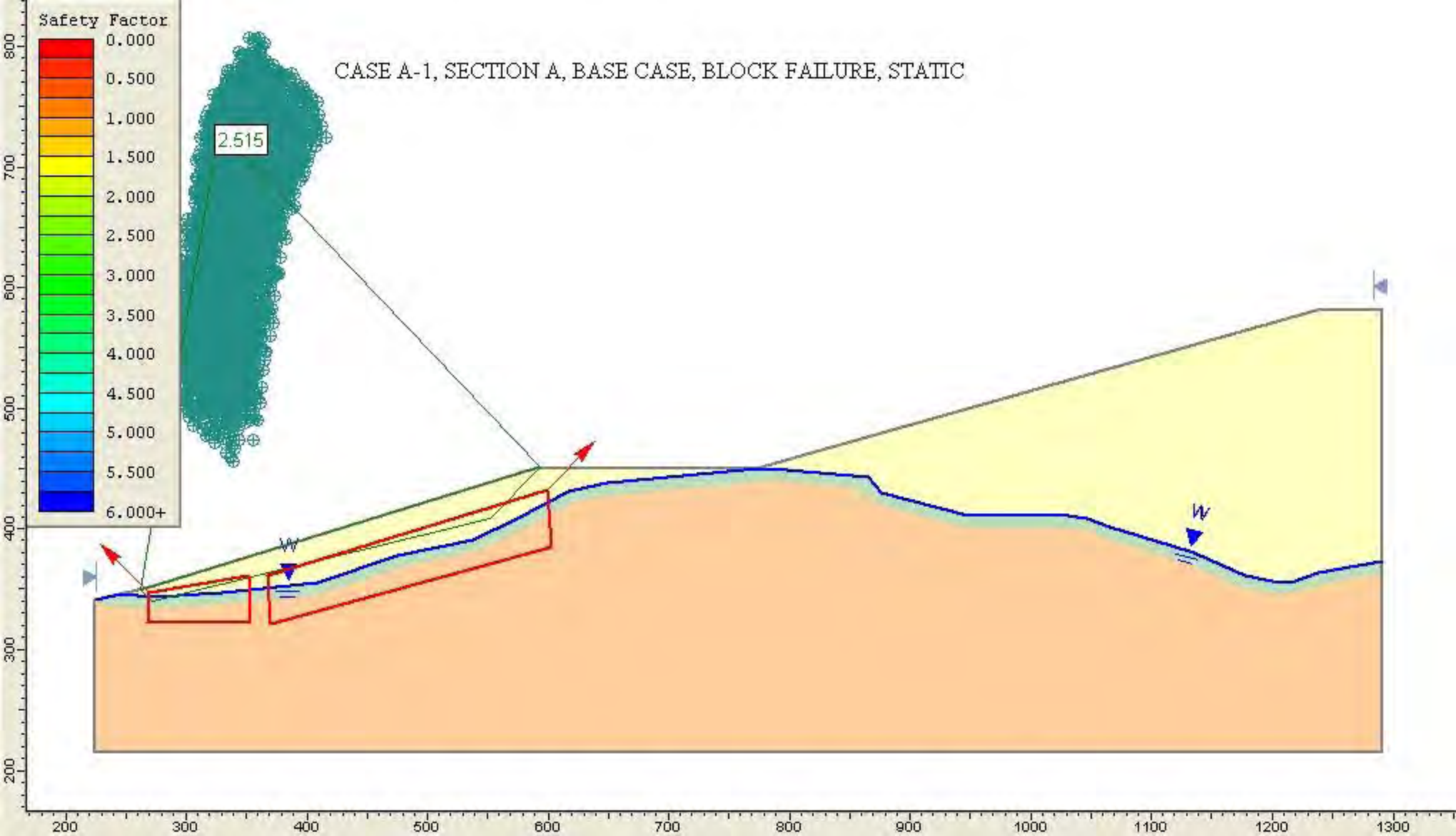
The relationships between ψ' and ϕ' and a' and c' are as follows:

$$\tan(\psi') = \sin(\phi')$$
$$a' = c' \cos(\phi')$$


PD TYRONE/STOCKPILE GEOTEC
053-2550
TSTG=4 @265-268
STAGED TRIAXIAL SHEAR TEST
Golder Associates, Inc.
Denver, Colorado

ATTACHMENT 2

SLIDE STABILITY OUTPUT
4C STOCKPILE


Safety Factor
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0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
CASE A-1, SECTION A, BASE CASE, BLOCK FAILURE, STATIC
2.515
W
W
800
700
600
500
400
300
200
200
300
400
500
600
700
800
900
1000
1100
1200
1300

Slide Analysis Information
CASE A-1, SECTION A, BASE CASE, BLOCK FAILURE, STATIC

Document Name

File Name: Section A_B_S.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 135
Right Projection Angle (Start Angle): 45
Right Projection Angle (End Angle): 45
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: Regraded Stockpile
Strength Type: Mohr-Coulomb
Unit Weight: 120.8 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees

Water Surface: None

Material: Interface
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 133 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Bedrock
Strength Type: Mohr-Coulomb
Unit Weight: 160 lb/ft3
Cohesion: 20 psf
Friction Angle: 35 degrees
Water Surface: None

Global Minimums

Method: bishop simplified
FS: 2.514630
Axis Location: 326.761, 731.257
Left Slip Surface Endpoint: 262.502, 349.992
Right Slip Surface Endpoint: 593.218, 451.091
Resisting Moment=1.99001e+008 lb-ft
Driving Moment=7.91375e+007 lb-ft

Method: janbu simplified
FS: 2.424750
Axis Location: 327.562, 748.748
Left Slip Surface Endpoint: 255.739, 348.382
Right Slip Surface Endpoint: 604.761, 451.070
Resisting Horizontal Force=876042 lb
Driving Horizontal Force=361291 lb

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 4999
Number of Invalid Surfaces: 1
Error Codes:
Error Code -111 reported for 1 surface

Method: janbu simplified
Number of Valid Surfaces: 4993
Number of Invalid Surfaces: 7
Error Codes:
Error Code -108 reported for 2 surfaces
Error Code -111 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

List of All Coordinates

Material Boundary

1291.688	363.278
1240.740	353.970
1216.995	346.094
1199.345	346.281
1199.320	346.277
1174.053	351.860
1131.373	371.094
1113.296	376.344
1061.688	391.752
1044.172	398.865
1029.466	400.993
947.478	400.834
870.701	421.094
857.330	433.391
796.867	439.489
776.960	439.461
761.887	438.933
650.181	428.052
619.419	421.977
571.512	396.094
540.375	381.919
477.893	368.798
411.838	346.460
330.514	337.248
274.111	333.715
230.926	336.794
224.606	340.954
245.226	345.800
274.119	343.740
329.840	347.226
408.246	355.794
475.076	378.403
537.398	391.551
566.976	405.016
616.707	431.615
648.750	437.950
761.294	448.915
776.824	449.461
797.340	449.489
865.387	442.700
876.474	429.527
948.207	410.815
1030.335	410.971
1046.357	408.653

1065.340	401.120
1116.271	385.893
1134.796	380.513
1177.286	361.393
1199.576	356.589
1215.380	356.094
1237.957	363.583
1291.688	373.402

External Boundary

1291.688	582.633
1237.205	581.094
1022.521	521.094
771.644	450.779
591.465	451.094
273.976	352.723
225.119	341.094
224.606	340.954
224.606	214.835
1291.688	214.835
1291.688	363.278
1291.688	373.402

Water Table

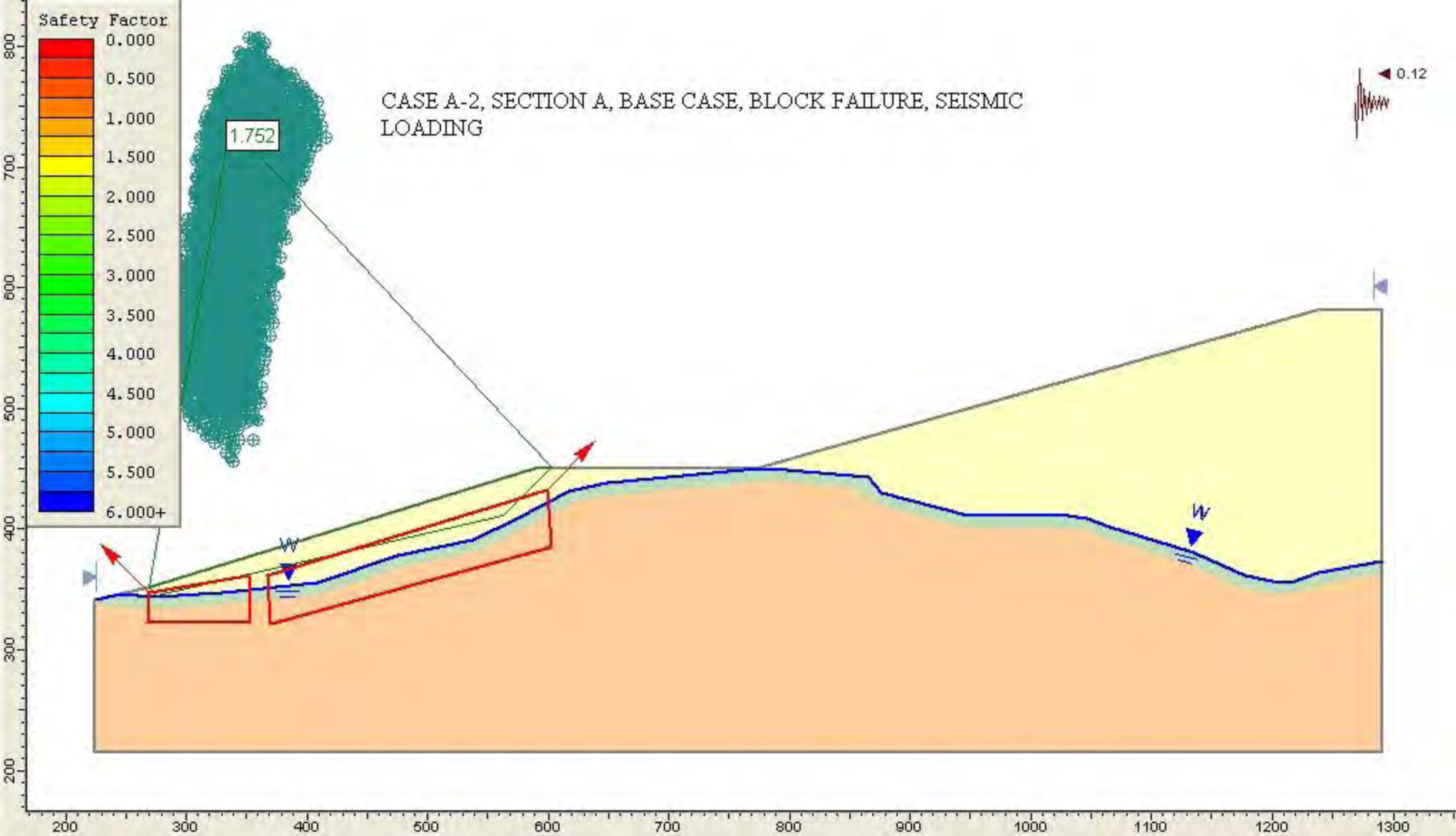
225.119	341.094
245.226	345.800
274.119	343.740
329.840	347.226
408.246	355.794
475.076	378.403
537.398	391.551
573.667	408.595
616.707	431.615
648.750	437.950
761.294	448.915
776.824	449.461
797.340	449.489
865.387	442.700
876.474	429.527
948.207	410.815
1030.335	410.971
1046.357	408.653
1065.340	401.120
1116.271	385.893
1134.796	380.513
1177.286	361.393
1199.576	356.589
1215.380	356.094
1237.957	363.583
1291.688	373.402

Focus/Block Search Window

269.653	347.799
268.470	322.958
352.456	322.958
351.274	361.994

Focus/Block Search Window

366.651	361.994
369.017	321.775
603.234	385.652
598.502	432.968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0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
1.752
CASE A-2, SECTION A, BASE CASE, BLOCK FAILURE, SEISMIC LOADING
0.12
800
700
600
500
400
300
200
200
300
400
500
600
700
800
900
1000
1100
1200
1300

Slide Analysis Information
CASE A-2, SECTION A, BASE CASE, BLOCK FAILURE, SEISMIC LOADING

Document Name

File Name: Section A_B_S.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 135
Right Projection Angle (Start Angle): 45
Right Projection Angle (End Angle): 45
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.12

Material Properties

Material: Regraded Stockpile

Strength Type: Mohr-Coulomb
Unit Weight: 120.8 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: None

Material: Interface
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 133 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Bedrock
Strength Type: Mohr-Coulomb
Unit Weight: 160 lb/ft3
Cohesion: 20 psf
Friction Angle: 35 degrees
Water Surface: None

Global Minimums

Method: bishop simplified
FS: 1.751690
Axis Location: 335.897, 735.033
Left Slip Surface Endpoint: 268.634, 351.452
Right Slip Surface Endpoint: 602.404, 451.075
Resisting Moment=1.86847e+008 lb-ft
Driving Moment=1.06667e+008 lb-ft

Method: janbu simplified
FS: 1.685060
Axis Location: 327.562, 748.748
Left Slip Surface Endpoint: 255.739, 348.382
Right Slip Surface Endpoint: 604.761, 451.070
Resisting Horizontal Force=851832 lb
Driving Horizontal Force=505519 lb

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 4999
Number of Invalid Surfaces: 1
Error Codes:
Error Code -108 reported for 1 surface

Method: janbu simplified
Number of Valid Surfaces: 4988
Number of Invalid Surfaces: 12
Error Codes:
Error Code -108 reported for 5 surfaces
Error Code -111 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

List of All Coordinates

Material Boundary

1291.688	363.278
1240.740	353.970
1216.995	346.094
1199.345	346.281
1199.320	346.277
1174.053	351.860
1131.373	371.094
1113.296	376.344
1061.688	391.752
1044.172	398.865
1029.466	400.993
947.478	400.834
870.701	421.094
857.330	433.391
796.867	439.489
776.960	439.461
761.887	438.933
650.181	428.052
619.419	421.977
571.512	396.094
540.375	381.919
477.893	368.798
411.838	346.460
330.514	337.248
274.111	333.715
230.926	336.794
224.606	340.954
245.226	345.800
274.119	343.740
329.840	347.226
408.246	355.794
475.076	378.403
537.398	391.551
566.976	405.016
616.707	431.615
648.750	437.950
761.294	448.915
776.824	449.461
797.340	449.489

865.387	442.700
876.474	429.527
948.207	410.815
1030.335	410.971
1046.357	408.653
1065.340	401.120
1116.271	385.893
1134.796	380.513
1177.286	361.393
1199.576	356.589
1215.380	356.094
1237.957	363.583
1291.688	373.402

External Boundary

1291.688	582.633
1237.205	581.094
1022.521	521.094
771.644	450.779
591.465	451.094
273.976	352.723
225.119	341.094
224.606	340.954
224.606	214.835
1291.688	214.835
1291.688	363.278
1291.688	373.402

Water Table

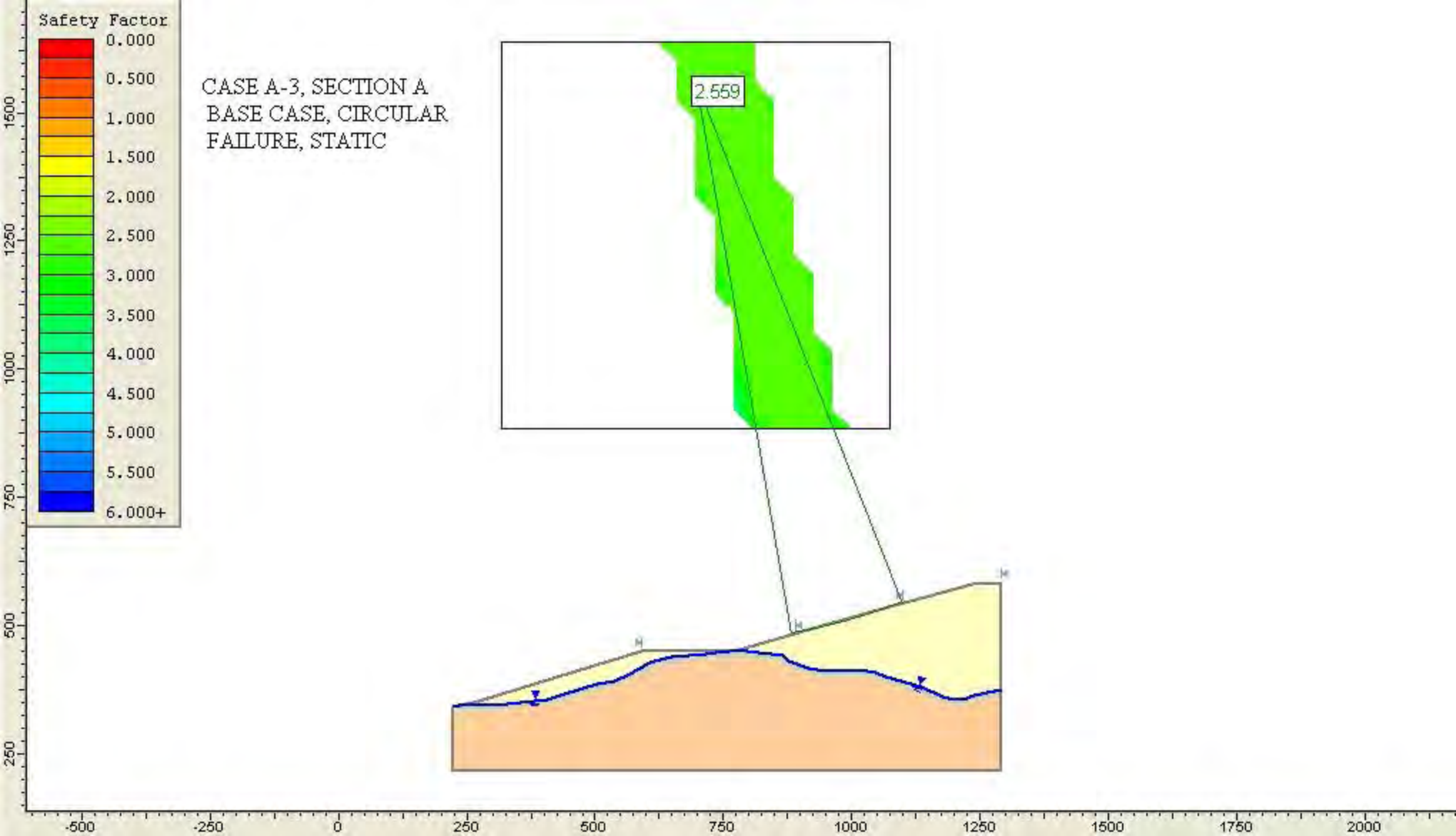
225.119	341.094
245.226	345.800
274.119	343.740
329.840	347.226
408.246	355.794
475.076	378.403
537.398	391.551
573.667	408.595
616.707	431.615
648.750	437.950
761.294	448.915
776.824	449.461
797.340	449.489
865.387	442.700
876.474	429.527
948.207	410.815
1030.335	410.971
1046.357	408.653
1065.340	401.120
1116.271	385.893
1134.796	380.513
1177.286	361.393
1199.576	356.589
1215.380	356.094
1237.957	363.583
1291.688	373.402

Focus/Block Search Window

269.653	347.799
268.470	322.958
352.456	322.958
351.274	361.994

Focus/Block Search Window

366.651	361.994
369.017	321.775
603.234	385.652
598.502	432.968


Safety Factor
0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
CASE A-3, SECTION A
BASE CASE, CIRCULAR
FAILURE, STATIC
2.559
1500
1250
1000
750
500
250
-500
-250
0
250
500
750
1000
1250
1500
1750
2000

Slide Analysis Information
CASE A-3, SECTION A, BASE CASE, CIRCULAR FAILURE, STATIC

Document Name

File Name: Section A_C_S.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: Regraded Stockpile
Strength Type: Mohr-Coulomb
Unit Weight: 120.8 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: None

Material: Interface

Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 133 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Bedrock
Strength Type: Mohr-Coulomb
Unit Weight: 160 lb/ft3
Cohesion: 20 psf
Friction Angle: 35 degrees
Water Surface: None

Global Minimums

Method: bishop simplified
FS: 2.558550
Center: 696.518, 1562.823
Radius: 1096.833
Left Slip Surface Endpoint: 882.722, 481.912
Right Slip Surface Endpoint: 1098.681, 542.379
Resisting Moment=7.85998e+007 lb-ft
Driving Moment=3.07204e+007 lb-ft

Method: janbu simplified
FS: 2.552850
Center: 696.518, 1562.823
Radius: 1096.833
Left Slip Surface Endpoint: 882.722, 481.912
Right Slip Surface Endpoint: 1098.681, 542.379
Resisting Horizontal Force=68936.3 lb
Driving Horizontal Force=27003.6 lb

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 1251
Number of Invalid Surfaces: 3600
Error Codes:
Error Code -101 reported for 14 surfaces
Error Code -1000 reported for 3586 surfaces

Method: janbu simplified
Number of Valid Surfaces: 1251
Number of Invalid Surfaces: 3600
Error Codes:
Error Code -101 reported for 14 surfaces
Error Code -1000 reported for 3586 surfaces

Error Codes

The following errors were encountered during the computation:

-101 = Only one (or zero)
surface / slope intersections.

-1000 = No valid slip surfaces are generated
at a grid center. Unable to draw a surface.

List of All Coordinates

Search Grid

318.887	883.087
1074.149	883.087
1074.149	1638.349
318.887	1638.349

Material Boundary

1291.688	363.278
1240.740	353.970
1216.995	346.094
1199.345	346.281
1199.320	346.277
1174.053	351.860
1131.373	371.094
1113.296	376.344
1061.688	391.752
1044.172	398.865
1029.466	400.993
993.756	401.160
978.616	399.671
947.478	400.834
914.276	407.514
870.701	421.094
857.330	433.391
796.867	439.489
776.960	439.461
761.887	438.933
735.340	437.280
716.065	435.316
650.181	428.052
619.419	421.977
611.606	418.707
571.512	396.094
540.375	381.919
505.247	375.803
477.893	368.798
426.136	351.222
411.838	346.460
330.514	337.248
274.111	333.715
230.926	336.794
224.606	340.954
245.226	345.800
274.119	343.740
329.840	347.226
408.246	355.794
422.935	360.696

475.076	378.403
503.168	385.592
537.398	391.551
566.976	405.016
607.050	427.619
616.707	431.615
648.750	437.950
715.020	445.262
734.621	447.255
761.294	448.915
776.824	449.461
797.340	449.489
865.387	442.700
876.474	429.527
917.044	417.125
948.207	410.815
978.325	409.691
993.180	411.152
1030.335	410.971
1046.357	408.653
1065.340	401.120
1116.271	385.893
1134.796	380.513
1177.286	361.393
1199.576	356.589
1215.380	356.094
1237.957	363.583
1291.688	373.402

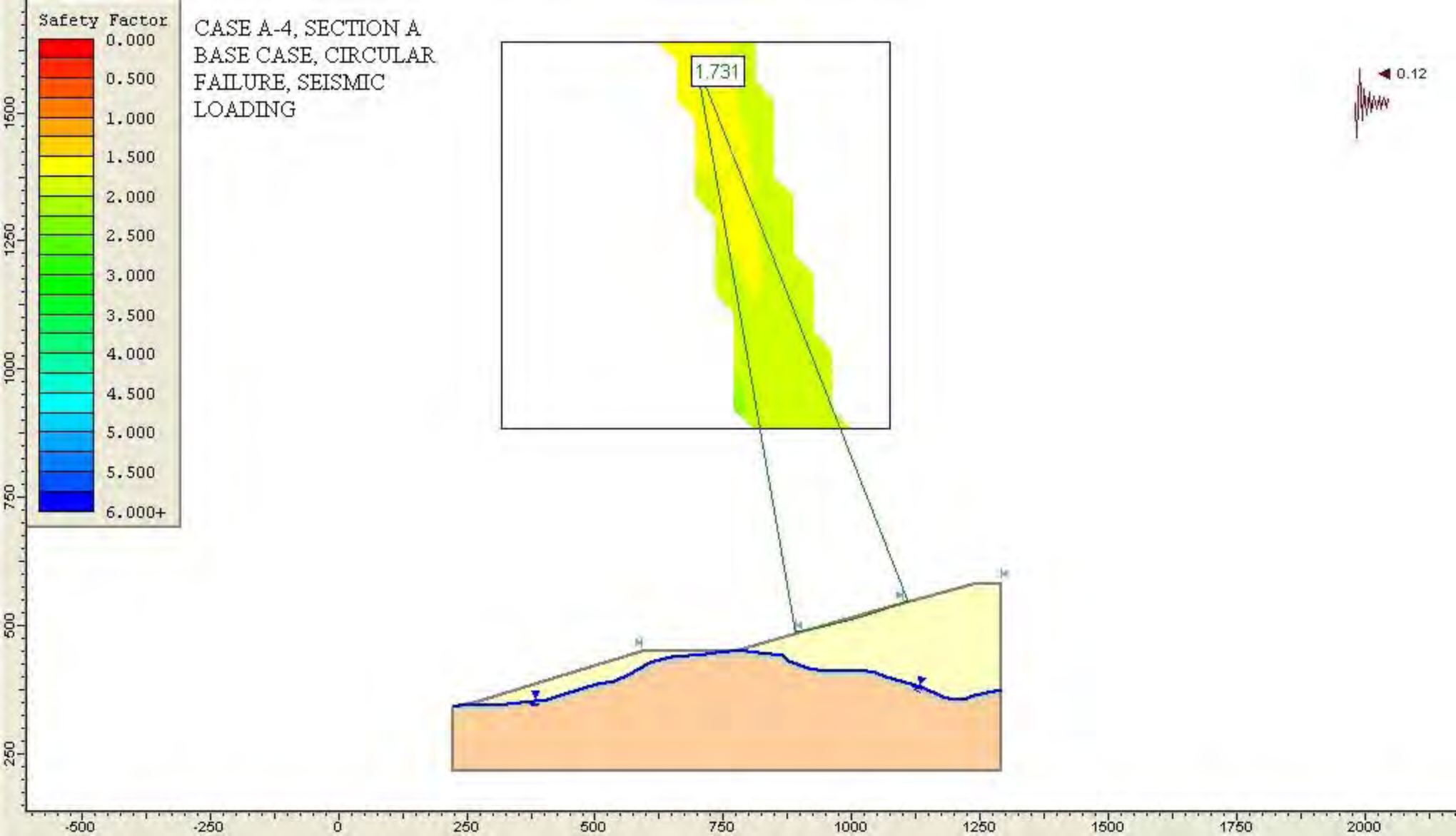
External Boundary

1291.688	582.633
1237.205	581.094
1022.521	521.094
771.644	450.779
591.465	451.094
426.475	401.094
273.976	352.723
225.119	341.094
224.606	340.954
224.606	214.835
1291.688	214.835
1291.688	363.278
1291.688	373.402

Water Table

224.606	340.954
245.226	345.800
274.119	343.740
329.840	347.226
408.246	355.794
422.935	360.696
475.076	378.403
503.168	385.592
537.398	391.551
566.976	405.016
607.050	427.619

616.707	431.615
648.750	437.950
715.020	445.262
734.621	447.255
761.294	448.915
776.824	449.461
797.340	449.489
865.387	442.700
876.474	429.527
917.044	417.125
948.207	410.815
978.325	409.691
993.180	411.152
1030.335	410.971
1046.357	408.653
1065.340	401.120
1116.271	385.893
1134.796	380.513
1177.286	361.393
1199.576	356.589
1215.380	356.094
1237.957	363.583
1291.688	373.402


Safety Factor
0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
CASE A-4, SECTION A
BASE CASE, CIRCULAR
FAILURE, SEISMIC
LOADING
1.731
0.12
1500
1250
1000
750
500
250
-500
-250
0
250
500
750
1000
1250
1500
1750
2000

Slide Analysis Information
CASE A-4, SECTION A, BASE CASE, CIRCULAR FAILURE, SEISMIC LOADING

Document Name

File Name: Section A_C_S.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.12

Material Properties

Material: Regraded Stockpile
Strength Type: Mohr-Coulomb
Unit Weight: 120.8 lb/ft3
Cohesion: 0 psf

Friction Angle: 35.5 degrees
Water Surface: None

Material: Interface
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 133 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Bedrock
Strength Type: Mohr-Coulomb
Unit Weight: 160 lb/ft3
Cohesion: 20 psf
Friction Angle: 35 degrees
Water Surface: None

Global Minimums

Method: bishop simplified
FS: 1.731190
Center: 696.518, 1600.586
Radius: 1133.156
Left Slip Surface Endpoint: 891.122, 484.266
Right Slip Surface Endpoint: 1109.818, 545.491
Resisting Moment=7.8914e+007 lb-ft
Driving Moment=4.55837e+007 lb-ft

Method: janbu simplified
FS: 1.727180
Center: 696.518, 1562.823
Radius: 1096.833
Left Slip Surface Endpoint: 882.722, 481.912
Right Slip Surface Endpoint: 1098.681, 542.379
Resisting Horizontal Force=66631.7 lb
Driving Horizontal Force=38578.3 lb

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 1251
Number of Invalid Surfaces: 3600
Error Codes:
Error Code -101 reported for 14 surfaces
Error Code -1000 reported for 3586 surfaces

Method: janbu simplified
Number of Valid Surfaces: 1251
Number of Invalid Surfaces: 3600
Error Codes:
Error Code -101 reported for 14 surfaces
Error Code -1000 reported for 3586 surfaces

Error Codes

The following errors were encountered during the computation:

-101 = Only one (or zero)
surface / slope intersections.

-1000 = No valid slip surfaces are generated
at a grid center. Unable to draw a surface.

List of All Coordinates

Search Grid

318.887	883.087
1074.149	883.087
1074.149	1638.349
318.887	1638.349

Material Boundary

1291.688	363.278
1240.740	353.970
1216.995	346.094
1199.345	346.281
1199.320	346.277
1174.053	351.860
1131.373	371.094
1113.296	376.344
1061.688	391.752
1044.172	398.865
1029.466	400.993
993.756	401.160
978.616	399.671
947.478	400.834
914.276	407.514
870.701	421.094
857.330	433.391
796.867	439.489
776.960	439.461
761.887	438.933
735.340	437.280
716.065	435.316
650.181	428.052
619.419	421.977
611.606	418.707
571.512	396.094
540.375	381.919
505.247	375.803
477.893	368.798
426.136	351.222
411.838	346.460
330.514	337.248
274.111	333.715
230.926	336.794
224.606	340.954

245.226	345.800
274.119	343.740
329.840	347.226
408.246	355.794
422.935	360.696
475.076	378.403
503.168	385.592
537.398	391.551
566.976	405.016
607.050	427.619
616.707	431.615
648.750	437.950
715.020	445.262
734.621	447.255
761.294	448.915
776.824	449.461
797.340	449.489
865.387	442.700
876.474	429.527
917.044	417.125
948.207	410.815
978.325	409.691
993.180	411.152
1030.335	410.971
1046.357	408.653
1065.340	401.120
1116.271	385.893
1134.796	380.513
1177.286	361.393
1199.576	356.589
1215.380	356.094
1237.957	363.583
1291.688	373.402

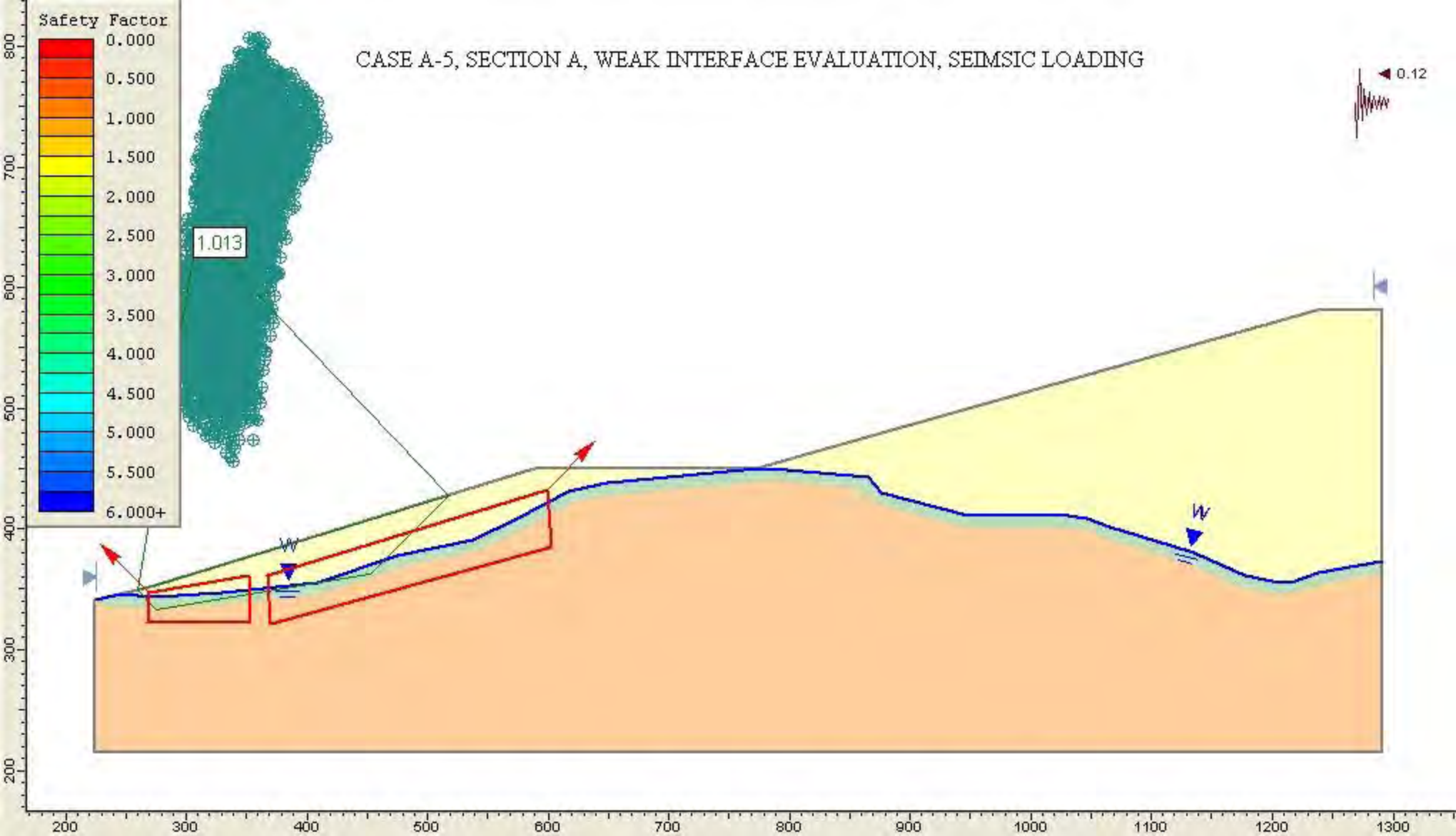
External Boundary

1291.688	582.633
1237.205	581.094
1022.521	521.094
771.644	450.779
591.465	451.094
426.475	401.094
273.976	352.723
225.119	341.094
224.606	340.954
224.606	214.835
1291.688	214.835
1291.688	363.278
1291.688	373.402

Water Table

224.606	340.954
245.226	345.800
274.119	343.740
329.840	347.226
408.246	355.794
422.935	360.696

475.076	378.403
503.168	385.592
537.398	391.551
566.976	405.016
607.050	427.619
616.707	431.615
648.750	437.950
715.020	445.262
734.621	447.255
761.294	448.915
776.824	449.461
797.340	449.489
865.387	442.700
876.474	429.527
917.044	417.125
948.207	410.815
978.325	409.691
993.180	411.152
1030.335	410.971
1046.357	408.653
1065.340	401.120
1116.271	385.893
1134.796	380.513
1177.286	361.393
1199.576	356.589
1215.380	356.094
1237.957	363.583
1291.688	373.402


CASE A-5, SECTION A, WEAK INTERFACE EVALUATION, SEIMSIC LOADING
Safety Factor
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0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
1.013
0.12
800
700
600
500
400
300
200
200
300
400
500
600
700
800
900
1000
1100
1200
1300

Slide Analysis Information
CASE A-5, SECTION A, WEAK INTERFACE EVAL, BLOCK FAILURE, SEISMIC LOADING

Document Name

File Name: Section A_B_S.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 135
Right Projection Angle (Start Angle): 45
Right Projection Angle (End Angle): 45
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.12

Material Properties

Material: Regraded Stockpile

Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: None

Material: Interface
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 133 lb/ft3
Cohesion: 0 psf
Friction Angle: 19 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Bedrock
Strength Type: Mohr-Coulomb
Unit Weight: 160 lb/ft3
Cohesion: 20 psf
Friction Angle: 35 degrees
Water Surface: None

Global Minimums

Method: bishop simplified
FS: 1.012550
Axis Location: 309.761, 646.929
Left Slip Surface Endpoint: 259.643, 349.312
Right Slip Surface Endpoint: 517.784, 428.264
Resisting Moment=9.71569e+007 lb-ft
Driving Moment=9.59528e+007 lb-ft

Method: janbu simplified
FS: 0.996630
Axis Location: 307.641, 627.375
Left Slip Surface Endpoint: 260.888, 349.608
Right Slip Surface Endpoint: 501.803, 423.313
Resisting Horizontal Force=261375 lb
Driving Horizontal Force=262259 lb

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 4999
Number of Invalid Surfaces: 1
Error Codes:
Error Code -108 reported for 1 surface

Method: janbu simplified
Number of Valid Surfaces: 4983
Number of Invalid Surfaces: 17
Error Codes:
Error Code -108 reported for 5 surfaces
Error Code -111 reported for 9 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).

-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.

List of All Coordinates

Material Boundary

1291.688	363.278
1240.740	353.970
1216.995	346.094
1199.345	346.281
1199.320	346.277
1174.053	351.860
1131.373	371.094
1113.296	376.344
1061.688	391.752
1044.172	398.865
1029.466	400.993
947.478	400.834
870.701	421.094
857.330	433.391
796.867	439.489
776.960	439.461
761.887	438.933
650.181	428.052
619.419	421.977
571.512	396.094
540.375	381.919
477.893	368.798
411.838	346.460
330.514	337.248
274.111	333.715
230.926	336.794
224.606	340.954
245.226	345.800
274.119	343.740
329.840	347.226
408.246	355.794
475.076	378.403

537.398	391.551
566.976	405.016
616.707	431.615
648.750	437.950
761.294	448.915
776.824	449.461
797.340	449.489
865.387	442.700
876.474	429.527
948.207	410.815
1030.335	410.971
1046.357	408.653
1065.340	401.120
1116.271	385.893
1134.796	380.513
1177.286	361.393
1199.576	356.589
1215.380	356.094
1237.957	363.583
1291.688	373.402

External Boundary

1291.688	582.633
1237.205	581.094
1022.521	521.094
771.644	450.779
591.465	451.094
273.976	352.723
225.119	341.094
224.606	340.954
224.606	214.835
1291.688	214.835
1291.688	363.278
1291.688	373.402

Water Table

225.119	341.094
245.226	345.800
274.119	343.740
329.840	347.226
408.246	355.794
475.076	378.403
537.398	391.551
573.667	408.595
616.707	431.615
648.750	437.950
761.294	448.915
776.824	449.461
797.340	449.489
865.387	442.700
876.474	429.527
948.207	410.815
1030.335	410.971
1046.357	408.653
1065.340	401.120
1116.271	385.893

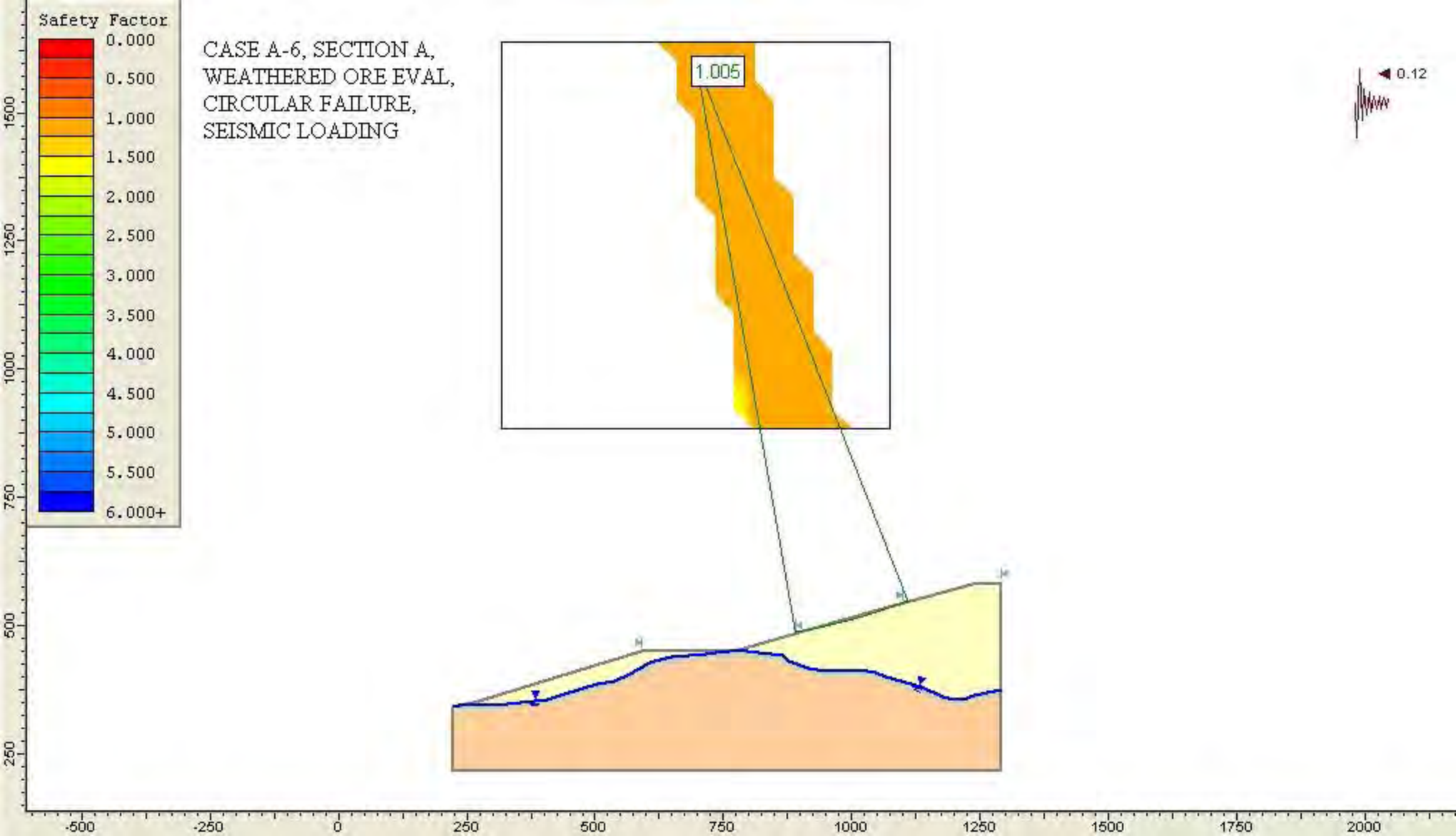
1134.796	380.513
1177.286	361.393
1199.576	356.589
1215.380	356.094
1237.957	363.583
1291.688	373.402

Focus/Block Search Window

269.653	347.799
268.470	322.958
352.456	322.958
351.274	361.994

Focus/Block Search Window

366.651	361.994
369.017	321.775
603.234	385.652
598.502	432.968


Safety Factor
0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
CASE A-6, SECTION A,
WEATHERED ORE EVAL,
CIRCULAR FAILURE,
SEISMIC LOADING
1.005
0.12
1500
1250
1000
750
500
250
-500
-250
0
250
500
750
1000
1250
1500
1750
2000

Slide Analysis Information
CASE A-6, SECTION A, WEATHERED ORE EVAL, CIRCULAR FAILURE, SEISMIC LOADING

Document Name

File Name: Section A_C_S.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.12

Material Properties

Material: Regraded Stockpile
Strength Type: Mohr-Coulomb
Unit Weight: 120.8 lb/ft3
Cohesion: 0 psf

Friction Angle: 22.5 degrees
Water Surface: None

Material: Interface
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 133 lb/ft3
Cohesion: 0 psf
Friction Angle: 22.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Bedrock
Strength Type: Mohr-Coulomb
Unit Weight: 160 lb/ft3
Cohesion: 20 psf
Friction Angle: 35 degrees
Water Surface: None

Global Minimums

Method: bishop simplified
FS: 1.004840
Center: 696.518, 1600.586
Radius: 1133.156
Left Slip Surface Endpoint: 891.122, 484.266
Right Slip Surface Endpoint: 1109.818, 545.491
Resisting Moment=4.58041e+007 lb-ft
Driving Moment=4.55837e+007 lb-ft

Method: janbu simplified
FS: 1.002910
Center: 696.518, 1562.823
Radius: 1096.833
Left Slip Surface Endpoint: 882.722, 481.912
Right Slip Surface Endpoint: 1098.681, 542.379
Resisting Horizontal Force=38684.3 lb
Driving Horizontal Force=38572 lb

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 1251
Number of Invalid Surfaces: 3600
Error Codes:
Error Code -101 reported for 14 surfaces
Error Code -1000 reported for 3586 surfaces

Method: janbu simplified
Number of Valid Surfaces: 1251
Number of Invalid Surfaces: 3600
Error Codes:
Error Code -101 reported for 14 surfaces
Error Code -1000 reported for 3586 surfaces

Error Codes

The following errors were encountered during the computation:

-101 = Only one (or zero)
surface / slope intersections.

-1000 = No valid slip surfaces are generated
at a grid center. Unable to draw a surface.

List of All Coordinates

Search Grid

318.887	883.087
1074.149	883.087
1074.149	1638.349
318.887	1638.349

Material Boundary

1291.688	363.278
1240.740	353.970
1216.995	346.094
1199.345	346.281
1199.320	346.277
1174.053	351.860
1131.373	371.094
1113.296	376.344
1061.688	391.752
1044.172	398.865
1029.466	400.993
993.756	401.160
978.616	399.671
947.478	400.834
914.276	407.514
870.701	421.094
857.330	433.391
796.867	439.489
776.960	439.461
761.887	438.933
735.340	437.280
716.065	435.316
650.181	428.052
619.419	421.977
611.606	418.707
571.512	396.094
540.375	381.919
505.247	375.803
477.893	368.798
426.136	351.222
411.838	346.460
330.514	337.248
274.111	333.715
230.926	336.794
224.606	340.954

245.226	345.800
274.119	343.740
329.840	347.226
408.246	355.794
422.935	360.696
475.076	378.403
503.168	385.592
537.398	391.551
566.976	405.016
607.050	427.619
616.707	431.615
648.750	437.950
715.020	445.262
734.621	447.255
761.294	448.915
776.824	449.461
797.340	449.489
865.387	442.700
876.474	429.527
917.044	417.125
948.207	410.815
978.325	409.691
993.180	411.152
1030.335	410.971
1046.357	408.653
1065.340	401.120
1116.271	385.893
1134.796	380.513
1177.286	361.393
1199.576	356.589
1215.380	356.094
1237.957	363.583
1291.688	373.402

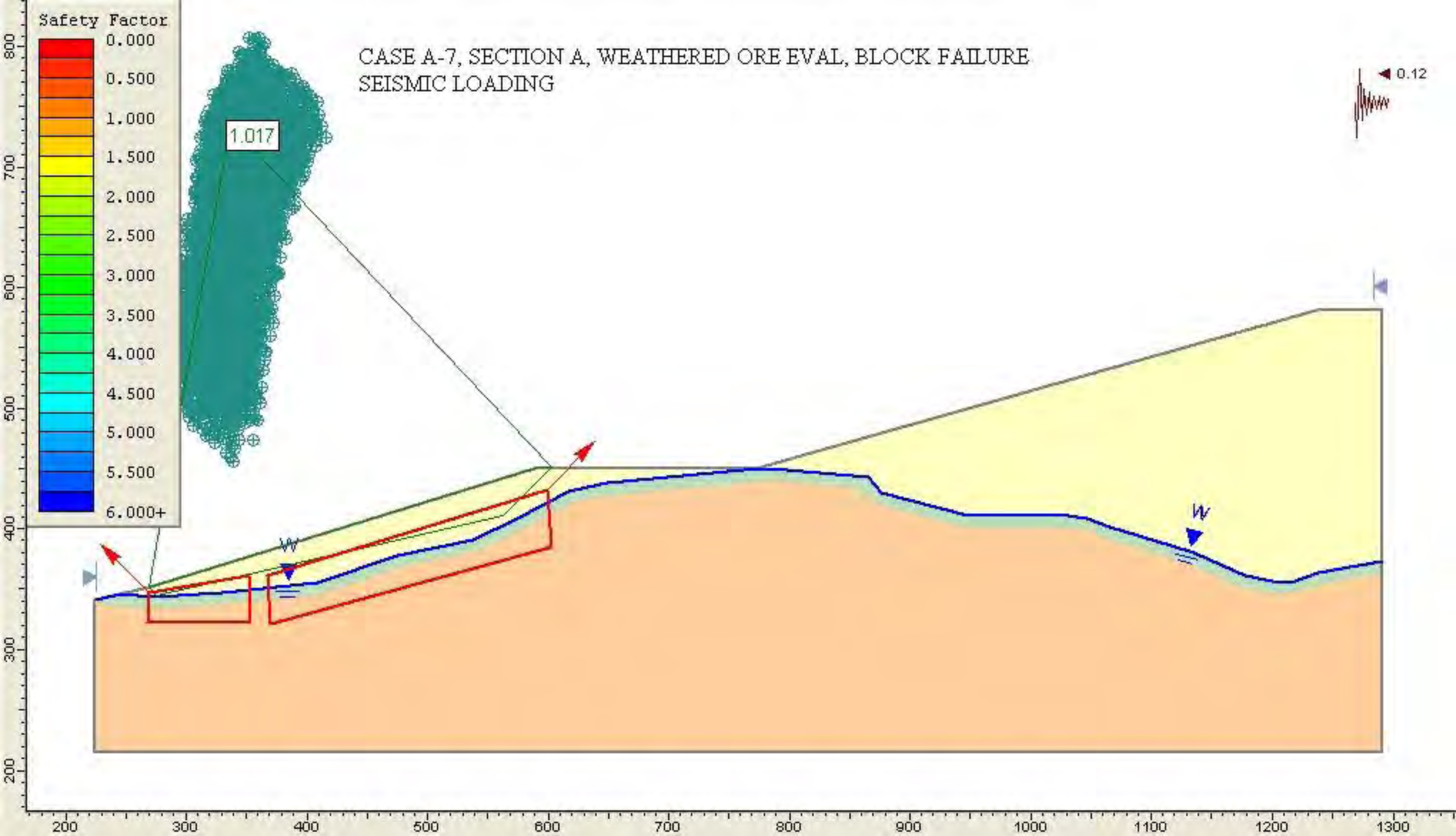
External Boundary

1291.688	582.633
1237.205	581.094
1022.521	521.094
771.644	450.779
591.465	451.094
426.475	401.094
273.976	352.723
225.119	341.094
224.606	340.954
224.606	214.835
1291.688	214.835
1291.688	363.278
1291.688	373.402

Water Table

224.606	340.954
245.226	345.800
274.119	343.740
329.840	347.226
408.246	355.794
422.935	360.696

475.076	378.403
503.168	385.592
537.398	391.551
566.976	405.016
607.050	427.619
616.707	431.615
648.750	437.950
715.020	445.262
734.621	447.255
761.294	448.915
776.824	449.461
797.340	449.489
865.387	442.700
876.474	429.527
917.044	417.125
948.207	410.815
978.325	409.691
993.180	411.152
1030.335	410.971
1046.357	408.653
1065.340	401.120
1116.271	385.893
1134.796	380.513
1177.286	361.393
1199.576	356.589
1215.380	356.094
1237.957	363.583
1291.688	373.402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0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
CASE A-7, SECTION A, WEATHERED ORE EVAL, BLOCK FAILURE
SEISMIC LOADING
1.017
0.12
W
W
800
700
600
500
400
300
200
200
300
400
500
600
700
800
900
1000
1100
1200
1300

Slide Analysis Information
CASE A-7, SECTION A, WEATHERED ORE EVAL, BLOCK FAILURE, SEISMIC LOADING

Document Name

File Name: Section A_B_S.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 135
Right Projection Angle (Start Angle): 45
Right Projection Angle (End Angle): 45
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.12

Material Properties

Material: Regraded Stockpile

Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 22.5 degrees
Water Surface: None

Material: Interface
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 133 lb/ft3
Cohesion: 0 psf
Friction Angle: 22.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Bedrock
Strength Type: Mohr-Coulomb
Unit Weight: 160 lb/ft3
Cohesion: 20 psf
Friction Angle: 35 degrees
Water Surface: None

Global Minimums

Method: bishop simplified
FS: 1.017100
Axis Location: 335.897, 735.033
Left Slip Surface Endpoint: 268.634, 351.452
Right Slip Surface Endpoint: 602.404, 451.075
Resisting Moment=1.07772e+008 lb-ft
Driving Moment=1.0596e+008 lb-ft

Method: janbu simplified
FS: 0.980983
Axis Location: 327.009, 741.491
Left Slip Surface Endpoint: 258.358, 349.006
Right Slip Surface Endpoint: 599.807, 451.079
Resisting Horizontal Force=464935 lb
Driving Horizontal Force=473948 lb

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 4998
Number of Invalid Surfaces: 2
Error Codes:
Error Code -108 reported for 1 surface
Error Code -111 reported for 1 surface

Method: janbu simplified
Number of Valid Surfaces: 4981
Number of Invalid Surfaces: 19
Error Codes:
Error Code -108 reported for 5 surfaces
Error Code -111 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

List of All Coordinates

Material Boundary

1291.688	363.278
1240.740	353.970
1216.995	346.094
1199.345	346.281
1199.320	346.277
1174.053	351.860
1131.373	371.094
1113.296	376.344
1061.688	391.752
1044.172	398.865
1029.466	400.993
947.478	400.834
870.701	421.094
857.330	433.391
796.867	439.489
776.960	439.461
761.887	438.933
650.181	428.052
619.419	421.977
571.512	396.094
540.375	381.919
477.893	368.798
411.838	346.460
330.514	337.248
274.111	333.715
230.926	336.794
224.606	340.954
245.226	345.800
274.119	343.740
329.840	347.226
408.246	355.794
475.076	378.403
537.398	391.551
566.976	405.016
616.707	431.615
648.750	437.950
761.294	448.915
776.824	449.461

797.340	449.489
865.387	442.700
876.474	429.527
948.207	410.815
1030.335	410.971
1046.357	408.653
1065.340	401.120
1116.271	385.893
1134.796	380.513
1177.286	361.393
1199.576	356.589
1215.380	356.094
1237.957	363.583
1291.688	373.402

External Boundary

1291.688	582.633
1237.205	581.094
1022.521	521.094
771.644	450.779
591.465	451.094
273.976	352.723
225.119	341.094
224.606	340.954
224.606	214.835
1291.688	214.835
1291.688	363.278
1291.688	373.402

Water Table

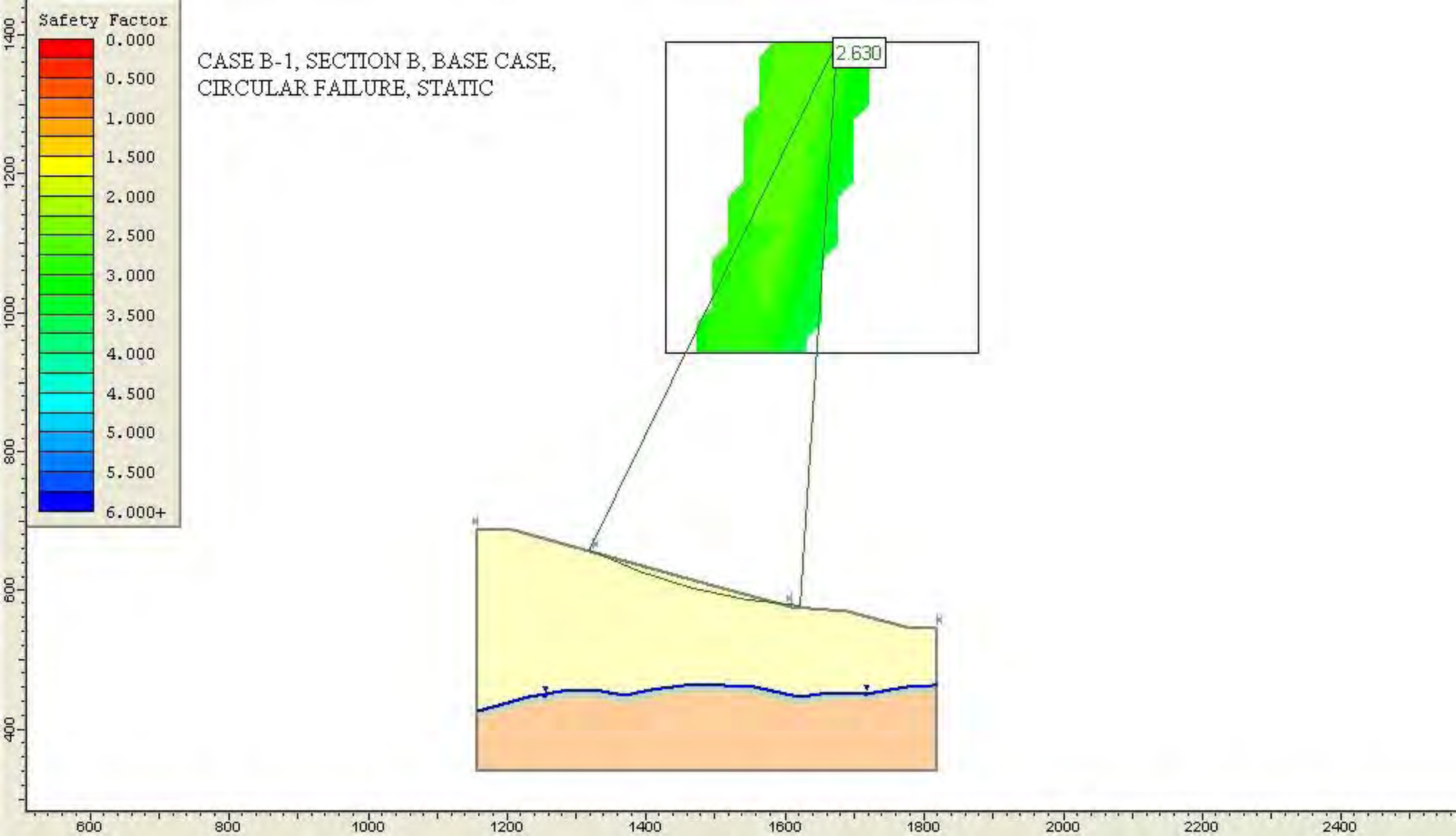
225.119	341.094
245.226	345.800
274.119	343.740
329.840	347.226
408.246	355.794
475.076	378.403
537.398	391.551
573.667	408.595
616.707	431.615
648.750	437.950
761.294	448.915
776.824	449.461
797.340	449.489
865.387	442.700
876.474	429.527
948.207	410.815
1030.335	410.971
1046.357	408.653
1065.340	401.120
1116.271	385.893
1134.796	380.513
1177.286	361.393
1199.576	356.589
1215.380	356.094
1237.957	363.583
1291.688	373.402

Focus/Block Search Window

269.653	347.799
268.470	322.958
352.456	322.958
351.274	361.994

Focus/Block Search Window

366.651	361.994
369.017	321.775
603.234	385.652
598.502	432.968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0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
CASE B-1, SECTION B, BASE CASE,
CIRCULAR FAILURE, STATIC
2.630
1400
1200
1000
800
600
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400

Slide Analysis Information
CASE B-1, SECTION B, BASE CASE, CIRCULAR FAILURE, STATIC

Document Name

File Name: Section B_C_S.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: Regraded Stockpile
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: None

Material: Interface

Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 133 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Bedrock
Strength Type: Mohr-Coulomb
Unit Weight: 160 lb/ft3
Cohesion: 20 psf
Friction Angle: 35 degrees
Water Surface: None

Global Minimums

Method: bishop simplified
FS: 2.630450
Center: 1674.994, 1389.672
Radius: 816.491
Left Slip Surface Endpoint: 1317.329, 655.687
Right Slip Surface Endpoint: 1620.126, 575.026
Resisting Moment=1.82165e+008 lb-ft
Driving Moment=6.92525e+007 lb-ft

Method: janbu simplified
FS: 2.609110
Center: 1652.544, 1389.672
Radius: 814.954
Left Slip Surface Endpoint: 1274.744, 667.580
Right Slip Surface Endpoint: 1607.914, 575.941
Resisting Horizontal Force=327733 lb
Driving Horizontal Force=125611 lb

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 1794
Number of Invalid Surfaces: 3057
Error Codes:
Error Code -101 reported for 65 surfaces
Error Code -1000 reported for 2992 surfaces

Method: janbu simplified
Number of Valid Surfaces: 1794
Number of Invalid Surfaces: 3057
Error Codes:
Error Code -101 reported for 65 surfaces
Error Code -1000 reported for 2992 surfaces

Error Codes

The following errors were encountered during the computation:

-101 = Only one (or zero)
surface / slope intersections.

-1000 = No valid slip surfaces are generated
at a grid center. Unable to draw a surface.

List of All Coordinates

Search Grid

1428.049	940.681
1877.040	940.681
1877.040	1389.672
1428.049	1389.672

Material Boundary

1156.538	415.720
1182.802	423.450
1231.798	435.941
1291.861	445.902
1300.967	445.560
1324.874	447.192
1370.074	439.472
1408.187	447.559
1453.839	453.488
1512.433	453.860
1553.487	450.530
1599.402	440.794
1623.164	437.350
1663.642	442.386
1716.036	441.635
1777.054	450.334
1810.195	453.949
1817.289	452.401

Material Boundary

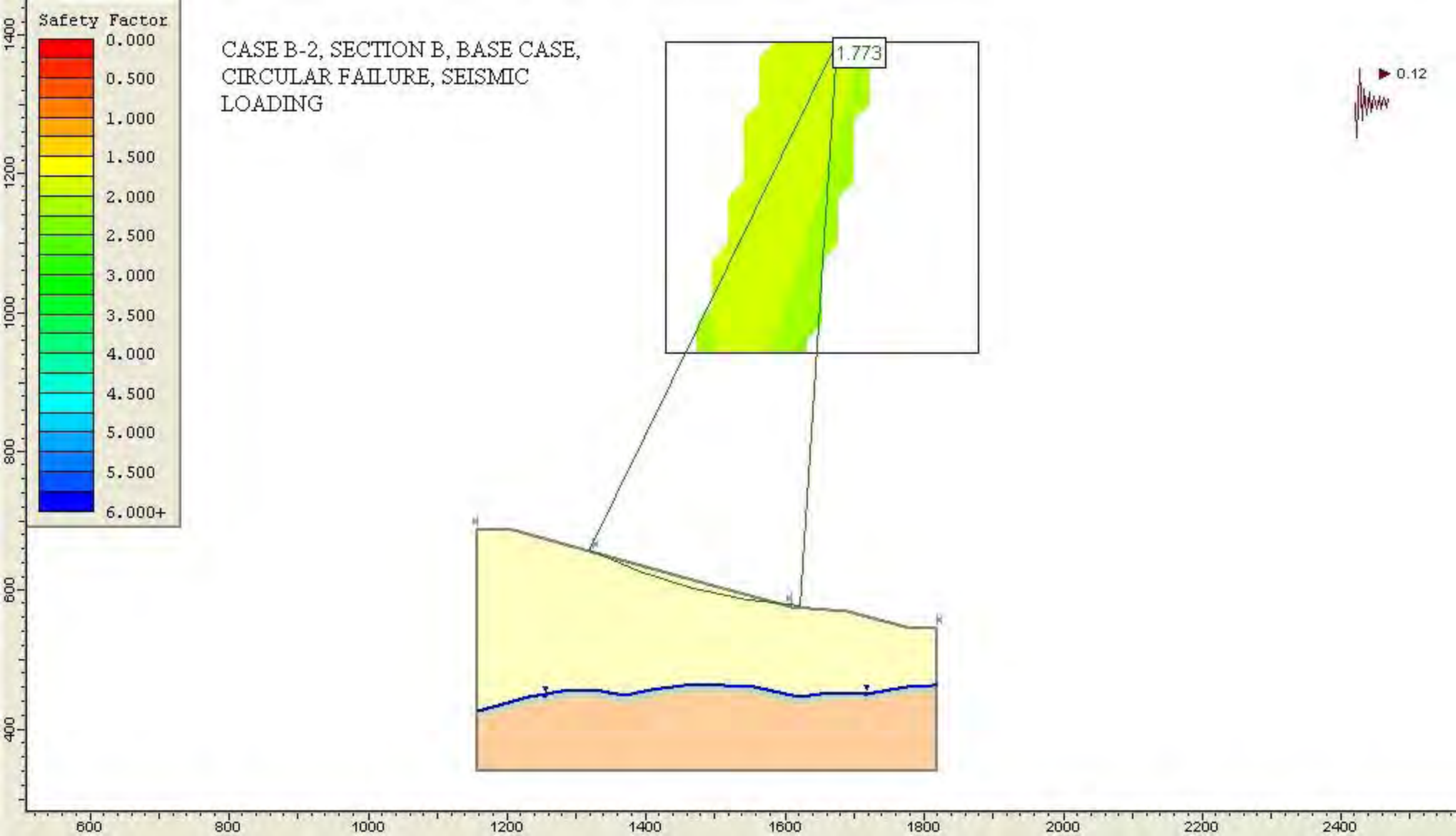
1156.538	426.144
1180.146	433.092
1230.029	445.783
1291.144	455.936
1300.152	455.598
1326.011	457.155
1369.253	449.500
1406.475	457.422
1452.956	463.458
1512.977	463.846
1555.145	460.400
1601.325	450.609
1621.844	447.302
1663.290	452.392
1715.757	451.640
1775.461	460.207
1810.754	464.063
1817.289	462.636

External Boundary

1817.289	545.421
1781.314	545.941
1688.201	569.928
1607.914	575.941
1495.458	605.941
1208.997	685.941
1156.538	685.941
1156.538	426.144
1156.538	415.720
1156.538	338.888
1817.289	338.888
1817.289	452.401
1817.289	462.636

Water Table

1156.538	426.144
1180.146	433.092
1230.029	445.783
1291.144	455.936
1300.152	455.598
1326.011	457.155
1369.253	449.500
1406.475	457.422
1452.956	463.458
1512.977	463.846
1555.145	460.400
1601.325	450.609
1621.844	447.302
1663.290	452.392
1715.757	451.640
1775.461	460.207
1810.754	464.063
1817.289	462.636


Safety Factor
0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
CASE B-2, SECTION B, BASE CASE, CIRCULAR FAILURE, SEISMIC LOADING
1.773
0.12
1400
1200
1000
800
600
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400

Slide Analysis Information
CASE B-2, SECTION B, BASE CASE, CIRCULAR FAILURE, SEISMIC LOADING

Document Name

File Name: Section B_C_S.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.12

Material Properties

Material: Regraded Stockpile
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf

Friction Angle: 35.5 degrees
Water Surface: None

Material: Interface
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 133 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Bedrock
Strength Type: Mohr-Coulomb
Unit Weight: 160 lb/ft3
Cohesion: 20 psf
Friction Angle: 35 degrees
Water Surface: None

Global Minimums

Method: bishop simplified
FS: 1.772530
Center: 1674.994, 1389.672
Radius: 816.491
Left Slip Surface Endpoint: 1317.329, 655.687
Right Slip Surface Endpoint: 1620.126, 575.026
Resisting Moment=1.76292e+008 lb-ft
Driving Moment=9.94579e+007 lb-ft

Method: janbu simplified
FS: 1.758800
Center: 1674.994, 1389.672
Radius: 816.491
Left Slip Surface Endpoint: 1317.329, 655.687
Right Slip Surface Endpoint: 1620.126, 575.026
Resisting Horizontal Force=207451 lb
Driving Horizontal Force=117951 lb

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 1794
Number of Invalid Surfaces: 3057
Error Codes:
Error Code -101 reported for 65 surfaces
Error Code -1000 reported for 2992 surfaces

Method: janbu simplified
Number of Valid Surfaces: 1794
Number of Invalid Surfaces: 3057
Error Codes:
Error Code -101 reported for 65 surfaces
Error Code -1000 reported for 2992 surfaces

Error Codes

The following errors were encountered during the computation:

-101 = Only one (or zero)
surface / slope intersections.

-1000 = No valid slip surfaces are generated
at a grid center. Unable to draw a surface.

List of All Coordinates

Search Grid

1428.049	940.681
1877.040	940.681
1877.040	1389.672
1428.049	1389.672

Material Boundary

1156.538	415.720
1182.802	423.450
1231.798	435.941
1291.861	445.902
1300.967	445.560
1324.874	447.192
1370.074	439.472
1408.187	447.559
1453.839	453.488
1512.433	453.860
1553.487	450.530
1599.402	440.794
1623.164	437.350
1663.642	442.386
1716.036	441.635
1777.054	450.334
1810.195	453.949
1817.289	452.401

Material Boundary

1156.538	426.144
1180.146	433.092
1230.029	445.783
1291.144	455.936
1300.152	455.598
1326.011	457.155
1369.253	449.500
1406.475	457.422
1452.956	463.458
1512.977	463.846
1555.145	460.400
1601.325	450.609
1621.844	447.302
1663.290	452.392
1715.757	451.640

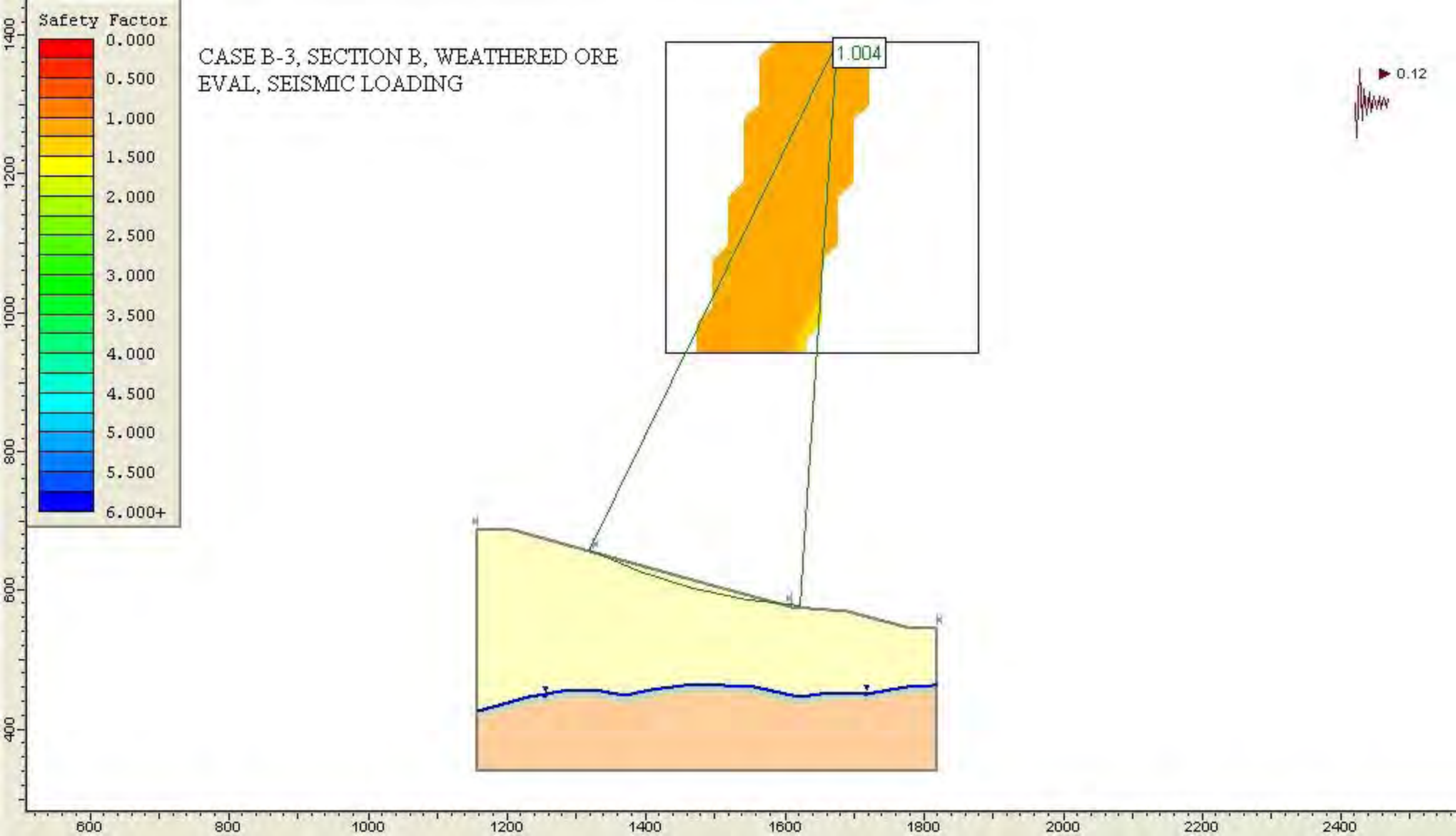
1775.461	460.207
1810.754	464.063
1817.289	462.636

External Boundary

1817.289	545.421
1781.314	545.941
1688.201	569.928
1607.914	575.941
1495.458	605.941
1208.997	685.941
1156.538	685.941
1156.538	426.144
1156.538	415.720
1156.538	338.888
1817.289	338.888
1817.289	452.401
1817.289	462.636

Water Table

1156.538	426.144
1180.146	433.092
1230.029	445.783
1291.144	455.936
1300.152	455.598
1326.011	457.155
1369.253	449.500
1406.475	457.422
1452.956	463.458
1512.977	463.846
1555.145	460.400
1601.325	450.609
1621.844	447.302
1663.290	452.392
1715.757	451.640
1775.461	460.207
1810.754	464.063
1817.289	462.636


Safety Factor
0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
CASE B-3, SECTION B, WEATHERED ORE
EVAL, SEISMIC LOADING
1.004
0.12
1400
1200
1000
800
600
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400

Slide Analysis Information
CASE B-3, SECTION B, WEATHERED ORE EVAL, SEISMIC LOADING

Document Name

File Name: Section B_C_S.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.12

Material Properties

Material: Regraded Stockpile
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf

Friction Angle: 22 degrees
Water Surface: None

Material: Interface
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 133 lb/ft3
Cohesion: 0 psf
Friction Angle: 22 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Bedrock
Strength Type: Mohr-Coulomb
Unit Weight: 160 lb/ft3
Cohesion: 20 psf
Friction Angle: 35 degrees
Water Surface: None

Global Minimums

Method: bishop simplified
FS: 1.003670
Center: 1674.994, 1389.672
Radius: 816.491
Left Slip Surface Endpoint: 1317.329, 655.687
Right Slip Surface Endpoint: 1620.126, 575.026
Resisting Moment=9.98229e+007 lb-ft
Driving Moment=9.94579e+007 lb-ft

Method: janbu simplified
FS: 0.996335
Center: 1674.994, 1389.672
Radius: 816.491
Left Slip Surface Endpoint: 1317.329, 655.687
Right Slip Surface Endpoint: 1620.126, 575.026
Resisting Horizontal Force=117555 lb
Driving Horizontal Force=117987 lb

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 1794
Number of Invalid Surfaces: 3057
Error Codes:
Error Code -101 reported for 65 surfaces
Error Code -1000 reported for 2992 surfaces

Method: janbu simplified
Number of Valid Surfaces: 1794
Number of Invalid Surfaces: 3057
Error Codes:
Error Code -101 reported for 65 surfaces
Error Code -1000 reported for 2992 surfaces

Error Codes

The following errors were encountered during the computation:

-101 = Only one (or zero)
surface / slope intersections.

-1000 = No valid slip surfaces are generated
at a grid center. Unable to draw a surface.

List of All Coordinates

Search Grid

1428.049	940.681
1877.040	940.681
1877.040	1389.672
1428.049	1389.672

Material Boundary

1156.538	415.720
1182.802	423.450
1231.798	435.941
1291.861	445.902
1300.967	445.560
1324.874	447.192
1370.074	439.472
1408.187	447.559
1453.839	453.488
1512.433	453.860
1553.487	450.530
1599.402	440.794
1623.164	437.350
1663.642	442.386
1716.036	441.635
1777.054	450.334
1810.195	453.949
1817.289	452.401

Material Boundary

1156.538	426.144
1180.146	433.092
1230.029	445.783
1291.144	455.936
1300.152	455.598
1326.011	457.155
1369.253	449.500
1406.475	457.422
1452.956	463.458
1512.977	463.846
1555.145	460.400
1601.325	450.609
1621.844	447.302
1663.290	452.392
1715.757	451.640

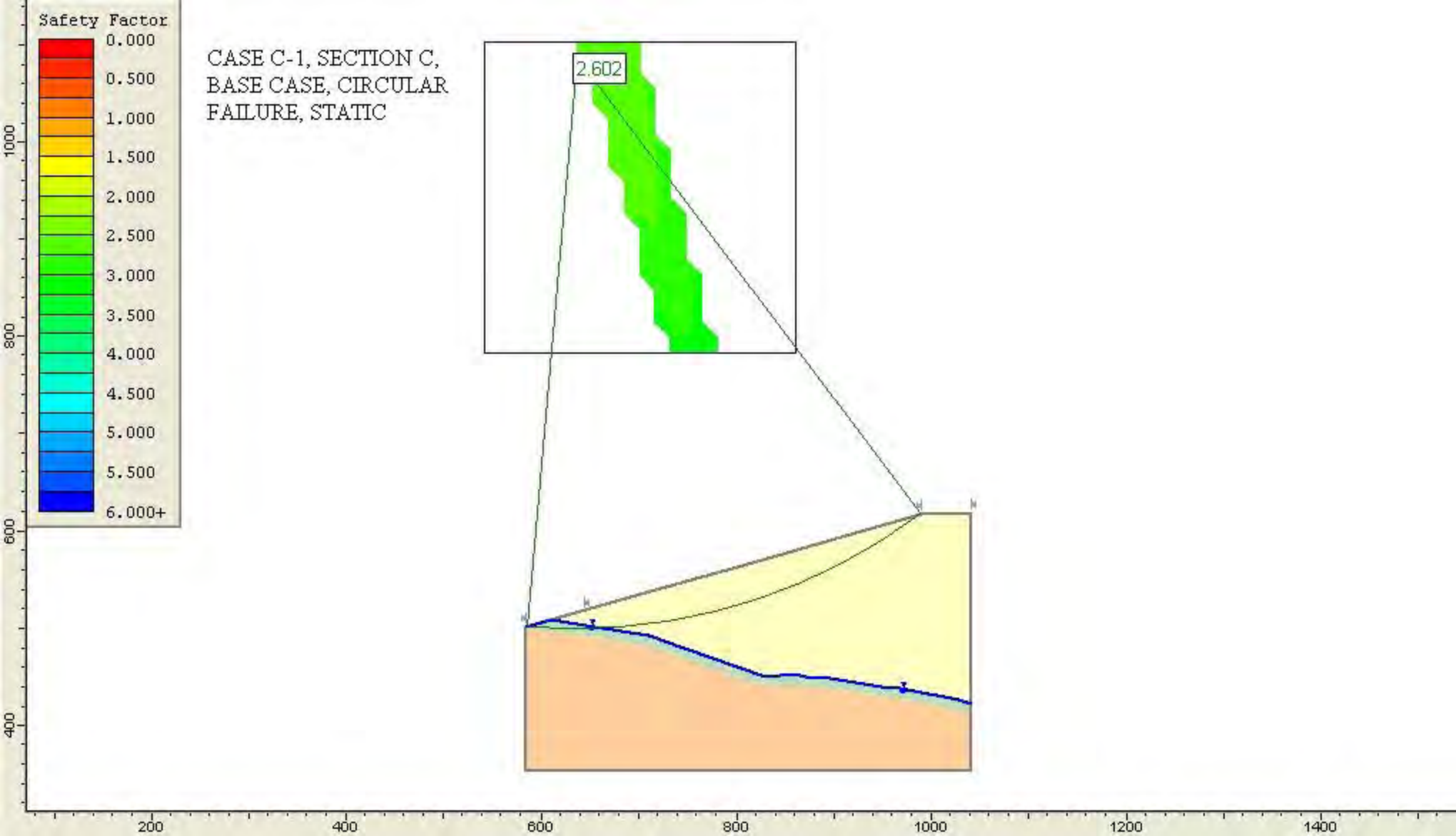
1775.461	460.207
1810.754	464.063
1817.289	462.636

External Boundary

1817.289	545.421
1781.314	545.941
1688.201	569.928
1607.914	575.941
1495.458	605.941
1208.997	685.941
1156.538	685.941
1156.538	426.144
1156.538	415.720
1156.538	338.888
1817.289	338.888
1817.289	452.401
1817.289	462.636

Water Table

1156.538	426.144
1180.146	433.092
1230.029	445.783
1291.144	455.936
1300.152	455.598
1326.011	457.155
1369.253	449.500
1406.475	457.422
1452.956	463.458
1512.977	463.846
1555.145	460.400
1601.325	450.609
1621.844	447.302
1663.290	452.392
1715.757	451.640
1775.461	460.207
1810.754	464.063
1817.289	462.636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1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
CASE C-1, SECTION C,
BASE CASE, CIRCULAR
FAILURE, STATIC
2.602
1000
800
600
400
200
400
600
800
1000
1200
1400

Slide Analysis Information
CASE C-1, SECTION C, BASE CASE, CIRCULAR FAILURE, STATIC

Document Name

File Name: Section C_C_S.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: Regraded Stockpile
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: None

Material: Interface

Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 133 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Bedrock
Strength Type: Mohr-Coulomb
Unit Weight: 160 lb/ft3
Cohesion: 20 psf
Friction Angle: 35 degrees
Water Surface: None

Global Minimums

Method: bishop simplified
FS: 2.601510
Center: 636.556, 1086.277
Radius: 587.183
Left Slip Surface Endpoint: 584.668, 501.391
Right Slip Surface Endpoint: 990.139, 617.489
Resisting Moment=5.32859e+008 lb-ft
Driving Moment=2.04827e+008 lb-ft

Method: janbu simplified
FS: 2.528480
Center: 636.556, 1086.277
Radius: 587.183
Left Slip Surface Endpoint: 584.668, 501.391
Right Slip Surface Endpoint: 990.139, 617.489
Resisting Horizontal Force=860193 lb
Driving Horizontal Force=340202 lb

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 987
Number of Invalid Surfaces: 3864
Error Codes:
Error Code -101 reported for 25 surfaces
Error Code -1000 reported for 3839 surfaces

Method: janbu simplified
Number of Valid Surfaces: 987
Number of Invalid Surfaces: 3864
Error Codes:
Error Code -101 reported for 25 surfaces
Error Code -1000 reported for 3839 surfaces

Error Codes

The following errors were encountered during the computation:

-101 = Only one (or zero)
surface / slope intersections.

-1000 = No valid slip surfaces are generated
at a grid center. Unable to draw a surface.

List of All Coordinates

Search Grid

540.842	783.183
859.888	783.183
859.888	1102.229
540.842	1102.229

Material Boundary

591.073	500.848
707.501	482.473

Material Boundary

895.194	438.969
958.108	428.772

Material Boundary

1040.593	412.867
1025.032	417.308
966.533	428.303
958.108	428.772
938.189	432.473
895.194	438.969
869.743	440.668
859.489	443.596
828.821	439.918
742.869	469.464
707.501	482.473
652.454	491.904
591.073	500.848
584.511	501.347
610.709	508.513
654.066	501.773
710.093	492.174
746.092	478.934
829.913	450.019
860.563	453.689
871.342	450.611
896.369	448.901
940.261	442.259
959.157	438.748
967.939	438.215
1027.331	427.051
1040.593	423.266

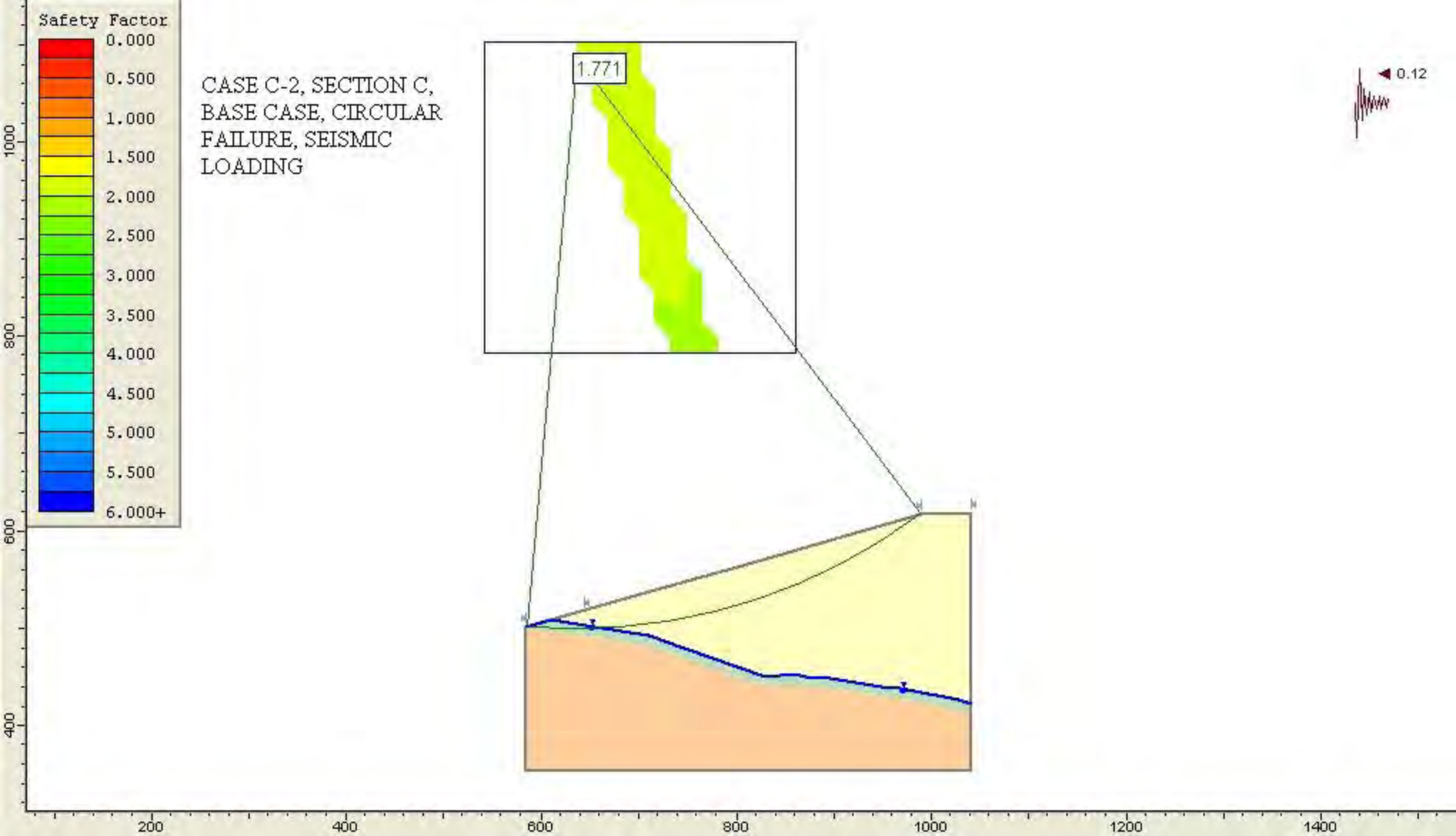
External Boundary

1040.593	619.473
989.731	617.473
931.840	600.542

826.424	570.405
691.192	531.768
584.511	501.347
584.511	353.026
1040.593	353.026
1040.593	412.867
1040.593	423.266

Water Table

584.511	501.347
610.709	508.513
654.066	501.773
710.093	492.174
746.092	478.934
829.913	450.019
860.563	453.689
871.342	450.611
896.369	448.901
940.261	442.259
959.157	438.748
967.939	438.215
1027.331	427.051
1040.593	423.266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3.000
3.500
4.000
4.500
5.000
5.500
6.000+
CASE C-2, SECTION C, BASE CASE, CIRCULAR FAILURE, SEISMIC LOADING
1.771
0.12
1000
800
600
400
200
400
600
800
1000
1200
1400

Slide Analysis Information
CASE C-2, SECTION C, BASE CASE, CIRCULAR FAILURE, SEISMIC LOADING

Document Name

File Name: Section C_C_S.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.12

Material Properties

Material: Regraded Stockpile
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf

Friction Angle: 35.5 degrees
Water Surface: None

Material: Interface
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 133 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Bedrock
Strength Type: Mohr-Coulomb
Unit Weight: 160 lb/ft3
Cohesion: 20 psf
Friction Angle: 35 degrees
Water Surface: None

Global Minimums

Method: bishop simplified
FS: 1.770930
Center: 636.556, 1086.277
Radius: 587.183
Left Slip Surface Endpoint: 584.668, 501.391
Right Slip Surface Endpoint: 990.139, 617.489
Resisting Moment=5.15609e+008 lb-ft
Driving Moment=2.91152e+008 lb-ft

Method: janbu simplified
FS: 1.718260
Center: 636.556, 1086.277
Radius: 587.183
Left Slip Surface Endpoint: 584.668, 501.391
Right Slip Surface Endpoint: 990.139, 617.489
Resisting Horizontal Force=832355 lb
Driving Horizontal Force=484418 lb

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 987
Number of Invalid Surfaces: 3864
Error Codes:
Error Code -101 reported for 25 surfaces
Error Code -1000 reported for 3839 surfaces

Method: janbu simplified
Number of Valid Surfaces: 987
Number of Invalid Surfaces: 3864
Error Codes:
Error Code -101 reported for 25 surfaces
Error Code -1000 reported for 3839 surfaces

Error Codes

The following errors were encountered during the computation:

-101 = Only one (or zero)
surface / slope intersections.

-1000 = No valid slip surfaces are generated
at a grid center. Unable to draw a surface.

List of All Coordinates

Search Grid

540.842	783.183
859.888	783.183
859.888	1102.229
540.842	1102.229

Material Boundary

591.073	500.848
707.501	482.473

Material Boundary

895.194	438.969
958.108	428.772

Material Boundary

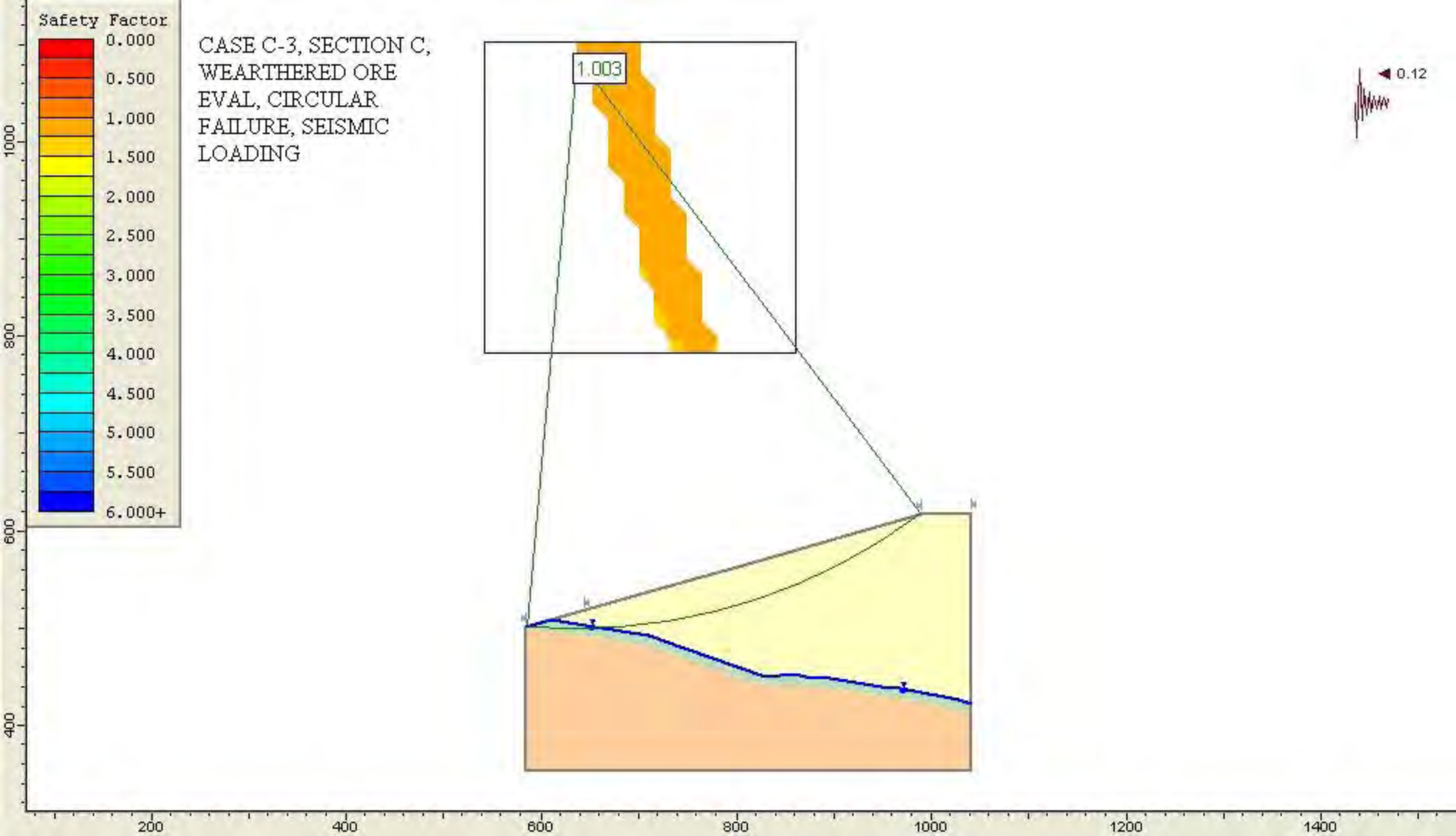
1040.593	412.867
1025.032	417.308
966.533	428.303
958.108	428.772
938.189	432.473
895.194	438.969
869.743	440.668
859.489	443.596
828.821	439.918
742.869	469.464
707.501	482.473
652.454	491.904
591.073	500.848
584.511	501.347
610.709	508.513
654.066	501.773
710.093	492.174
746.092	478.934
829.913	450.019
860.563	453.689
871.342	450.611
896.369	448.901
940.261	442.259
959.157	438.748
967.939	438.215
1027.331	427.051
1040.593	423.266

External Boundary

1040.593	619.473
989.731	617.473
931.840	600.542
826.424	570.405
691.192	531.768
584.511	501.347
584.511	353.026
1040.593	353.026
1040.593	412.867
1040.593	423.266

Water Table

584.511	501.347
610.709	508.513
654.066	501.773
710.093	492.174
746.092	478.934
829.913	450.019
860.563	453.689
871.342	450.611
896.369	448.901
940.261	442.259
959.157	438.748
967.939	438.215
1027.331	427.051
1040.593	423.266


Safety Factor
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1.000
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2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
CASE C-3, SECTION C, WEARTHERED ORE EVAL, CIRCULAR FAILURE, SEISMIC LOADING
1.003
0.12
1000
800
600
400
200
400
600
800
1000
1200
1400

Slide Analysis Information
CASE C-3, SECTION C, WEATHERED ORE EVAL, CIRCULAR FAILURE, SEISMIC LOADING

Document Name

File Name: Section C_C_S.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.12

Material Properties

Material: Regraded Stockpile
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf

Friction Angle: 22 degrees
Water Surface: None

Material: Interface
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 133 lb/ft3
Cohesion: 0 psf
Friction Angle: 22 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Bedrock
Strength Type: Mohr-Coulomb
Unit Weight: 160 lb/ft3
Cohesion: 20 psf
Friction Angle: 35 degrees
Water Surface: None

Global Minimums

Method: bishop simplified
FS: 1.002850
Center: 636.556, 1086.277
Radius: 587.183
Left Slip Surface Endpoint: 584.668, 501.391
Right Slip Surface Endpoint: 990.139, 617.489
Resisting Moment=2.91983e+008 lb-ft
Driving Moment=2.91152e+008 lb-ft

Method: janbu simplified
FS: 0.973265
Center: 636.556, 1086.277
Radius: 587.183
Left Slip Surface Endpoint: 584.668, 501.391
Right Slip Surface Endpoint: 990.139, 617.489
Resisting Horizontal Force=471478 lb
Driving Horizontal Force=484430 lb

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 987
Number of Invalid Surfaces: 3864
Error Codes:
Error Code -101 reported for 25 surfaces
Error Code -1000 reported for 3839 surfaces

Method: janbu simplified
Number of Valid Surfaces: 987
Number of Invalid Surfaces: 3864
Error Codes:
Error Code -101 reported for 25 surfaces
Error Code -1000 reported for 3839 surfaces

Error Codes

The following errors were encountered during the computation:

-101 = Only one (or zero)
surface / slope intersections.

-1000 = No valid slip surfaces are generated
at a grid center. Unable to draw a surface.

List of All Coordinates

Search Grid

540.842	783.183
859.888	783.183
859.888	1102.229
540.842	1102.229

Material Boundary

591.073	500.848
707.501	482.473

Material Boundary

895.194	438.969
958.108	428.772

Material Boundary

1040.593	412.867
1025.032	417.308
966.533	428.303
958.108	428.772
938.189	432.473
895.194	438.969
869.743	440.668
859.489	443.596
828.821	439.918
742.869	469.464
707.501	482.473
652.454	491.904
591.073	500.848
584.511	501.347
610.709	508.513
654.066	501.773
710.093	492.174
746.092	478.934
829.913	450.019
860.563	453.689
871.342	450.611
896.369	448.901
940.261	442.259
959.157	438.748
967.939	438.215
1027.331	427.051
1040.593	423.266

External Boundary

1040.593	619.473
989.731	617.473
931.840	600.542
826.424	570.405
691.192	531.768
584.511	501.347
584.511	353.026
1040.593	353.026
1040.593	412.867
1040.593	423.266

Water Table

584.511	501.347
610.709	508.513
654.066	501.773
710.093	492.174
746.092	478.934
829.913	450.019
860.563	453.689
871.342	450.611
896.369	448.901
940.261	442.259
959.157	438.748
967.939	438.215
1027.331	427.051
1040.593	423.266