Intermountain GeoEnvironmental Services, Inc.
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May 8, 2013

Summit, LLC
c/o Mr. Rick Everson, P.E.
1335 North 5900 East
Eden, Utah 84310

IGES Project No. 01628-005

Subject: Rockery Construction Guidelines
Powder Mountain Resort
Weber County, Utah

Reference: IGES, Inc., 2012, Design Geotechnical Investigation, Powder Mountain Resort, Weber County, Utah, Project No. 01628-003, dated November 9, 2012

Blake, T.F., Hollingsworth, R.A. and Stewart, J.P., Editors (2002), Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for analyzing and mitigating landslide hazards in California: organized by the Southern California Earthquake Center.

Mr. Everson:

As requested, IGES has prepared the following general guidelines for rockery construction within the Powder Mountain Resort, Weber County, Utah. This document is intended to provide guidance for rockery construction throughout the 200-acre Powder Mountain resort expansion project, the limits of which are detailed in our referenced geotechnical report (IGES, 2012). We understand that several dozen rockeries of varying heights will be constructed throughout the project, most being associated with bridge structures or roadway cuts and fills. These guidelines are intended for basic non-tiered rockeries with a maximum height of eight feet, absent any surcharge beyond an ordinary traffic load of 250 psf, and having backslopes no steeper than 2H:1V; rockeries that fall outside of these parameters shall be assessed and designed by IGES on a case-by-case basis. If there is any question as to the applicability of this document to a particular rockery, IGES must be consulted to assess the proposed rockery configuration for compliance/applicability with these recommendations.

Modes of Failure

When considering rockery design, there are three common modes of failure we have observed in rockeries constructed along the Wasatch Front area:

1) Poor rock to rock support *and* outward facing slip planes,

2) Loss of support from loose material placed behind the rock facing, and

3) Migration of soils from behind the rock facing due to water runoff.

In all of these modes of failure, the introduction of water ultimately causes movement or failure. However, even a poorly constructed rockery can remain stable for a long period of time if water is prevented from saturating the soils above and behind the rocks. Every effort should be made to reduce to the potential for water to impact the rockery. The contractor and owner should be conscious of the circumstances surrounding each rockery constructed and efforts should be made to direct runoff away from the rockery, prevent ponding above and below the rockery, and provide drainage from behind the rockery if necessary.

The information presented in the following paragraphs addresses each of these potential modes of failure. If these recommendations are followed *and* measures are implemented to prevent water from impacting the rockery, then the potential for a failure will be greatly reduced.

Rockery Construction

For rockery construction, the rock facing should not be placed steeper than 0.5 to 1 (horizontal to vertical). The bottom rocks of the rockery should be keyed into the ground a minimum of 12 inches. Rock facing should be placed in general accordance with the Associated Rockery Contractors (ARC) *Rockery Construction Guidelines* as summarized in the *Construction Specifications* and the details shown on Sheet A-2. The guidelines state "rocks should be placed so that there are no continuous joint planes in either the vertical or lateral direction and wherever possible, each rock should bear on at least two rocks below it." In addition, the guidelines state "the upper plane of each rock between courses (the top surface of rock), should slope back towards the protected soil face and away from the face of the rock wall." Conceptualized construction drawings and specifications are included in Appendix A.

Engineering Characteristics of Earth Materials

During our referenced geotechnical investigation (IGES, 2012), the subsurface was observed at several locations across the site. Earth materials were quite variable across the site, ranging from Fat CLAY (CH) to coarse gravel, cobbles, and boulders; however, the majority of the soils encountered consisted of Clayey GRAVEL (GC), grading to Clayey SAND (SC), containing varying amounts of cobble- and boulder-size constituents. Based on our observations, laboratory data presented in our referenced geotechnical report, and experience with similar soil types, a representative soil strength value was selected for the project-wide rockery construction guidelines. For preparation of these guidelines, the following soil parameters were selected:

- **Soil Type**: Clayey SAND
- **Friction Angle**: 30 degrees
- **Cohesion**: 150 psf
- **Unit Weight of Soil**: 120 pcf

Since stacked rocks are expected to behave quite differently than relatively homogenous/isotropic engineered fill, the stacked rocks were modeled as having *anisotropic properties*, with a rock-rock interface strength of φ=45° and c=0 psf, and solid rock strength of φ=0° and c=3,000 psf. Based on common practice and the recommendations contained in

this report, we expect the rocks to be stacked such that the rock-rock planar interface will be sloped back into the slope on the order of 10 degrees, as illustrated on Sheet A-2. However, to account for possible poor construction practices and/or unusually shaped rocks, we have modeled the rock-rock planar interface strengths ranging from -5 to -12 degrees.

Horizontal Ground Acceleration

Using the criteria outlined in the 2012 IBC, the maximum considered earthquake (MCE) ground motion is taken as that motion represented by an acceleration response spectrum having a 2% probability of exceedance within a 50-year period (2PE50). The probabilistic Peak Horizontal Ground Acceleration (PHGA) corresponding to a 2PE50 event was identified in our referenced geotechnical report as 0.35g (representative PHGA for the site). For pseudo-static (seismic) analysis, a *seismic coefficient* equal to 43% of the PHGA was selected for our model (seismic coefficient equals 0.15g) (Blake et al., 2002).

Internal Stability Analysis

Engineering analysis of representative rockery heights and backslope conditions included determination of minimum rock sizes. Minimum rock size was evaluated by analyzing overturning and sliding for individual rocks within the rockery along a 1-foot unit length. Lateral earth pressures were calculated using the Coulomb approach, incorporating back slope and surcharge. Ultimate minimum shear capacity for boulder-to-boulder contact was assumed to be zero psf and the angle of friction between boulders was assumed to be 45°. It is also assumed that chinking material is not allowed to remain on the boulder surface and that the boulders have a contact area equal to 70% of the assumed bottom surface. Typical minimum factor of safety requirements for these conditions are 2.0 for overturning and 1.5 for sliding. Internal stability design calculations are presented in Appendix B.

Global Stability

The global stability of the maximum rockery height was modeled using GSTABL7 slope stability software, using the soil parameters listed previously. For our global stability model, we have assumed the failure mode will be a circular-type (arcuate) failure surface shearing through homogenous/isotropic earth materials, with the failure surface passing either under or through the rockery. For the maximum rockery height, two conditions were modeled; one with a flat backfill and a traffic surcharge of 250 psf, and one with a 2H:1V backslope and no external surcharge.

The problem associated with modeling global stability of a rockery is in using a circular failure surface through homogenous/isotropic material (engineered fill), which in turn must pass through stacked rocks that have heterogeneous/anisotropic engineering characteristics. IGES has evaluated this unusual slope stability problem and has developed a method of analysis that we believe provides a realistic approach with respect to rock slope stability. Our method of analysis is a two-step approach, detailed below:

- **Model A**: The rock slope is analyzed as if there were no rockery, i.e., the stacked rocks are given the same strength parameters as the backfill. The point of this first step is to evaluate the circular failure surface with the lowest factor-of-safety *as if the stacked rocks were not present*.

- **Model B**: A second model is analyzed using the circular failure surface obtained in the Model A analysis. However, for this analysis the Model A failure surface is truncated at the rock/soil interface. The circular failure surface is now modeled as a series of point-blocks using the method prescribed by Janbu. At the rock/soil interface, the GSTABL7 software randomly searches to find the lowest factor-of-safety through the rockery.

In addition to the two slope stability models discussed above, circular failure surfaces passing *under* the rockery were also modeled.

For this project minimum design factors-of-safety of 1.5 and 1.0 for static and pseudo-static conditions, respectfully, were considered reasonable. The results of global stability analysis on the most critical rockery sections are presented in Appendix C.

Conclusions and Limitations

The results of our analysis indicate adequate factors of safety will be achieved provided the rockeries are constructed as recommended in this report. The batter, bench widths, and burial depth were established in order to meet the factor of safety requirements. A representative profile drawing of the maximum 8-foot section and *General Construction Guidelines* are provided in Appendix A.

Conditions such as leaky or broken irrigation lines and/or runoff from precipitation or snow melt can lead to saturation of the soil behind the rockery, which can cause slope and/or rock movement. The Owner/Client should be aware of the risks if these or similar conditions occur that could saturate or erode the soil behind the rockery. We recommend irrigation above the rockeries and on benches be minimized or avoided. Drip irrigation or hand watering should be considered.

It is imperative that rockeries do not exceed the maximum heights or other constraints presented in this document; if the proposed rockery geometry exceeds the maximums set forth herein, IGES shall be contacted so that the proposed configuration can be evaluated. Also, if water is observed emanating from any cut slope, IGES should be consulted to assess any drainage requirements that may be necessary.

Inspection Scheduling

In order to evaluate compliance with our design documents and facilitate a final acceptance letter (if required), we propose the following inspection schedule:

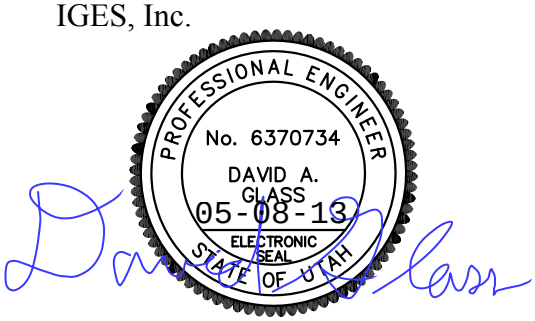
1. Inspect the first course of rocks for size, embedment and filter fabric (if needed).
2. Inspect the second or third course of rocks for size, position and placement, and filter fabric.
3. Inspect finished walls for conformance to design requirements such as maximum heights, batter, minimum terrace widths, front and back slope geometries, and rock sizing, positioning and placement.

Closure

The construction recommendations presented assume an appropriate amount of testing and inspection will be performed. An IGES representative should visit the site during construction to observe compliance with the recommendations and drawings provided.

We appreciate the opportunity to provide you with our services. If you have any questions please contact the undersigned at your convenience (801) 748-4044.

Respectfully Submitted,
IGES, Inc.



David A. Glass, P.E.
Senior Geotechnical Engineer

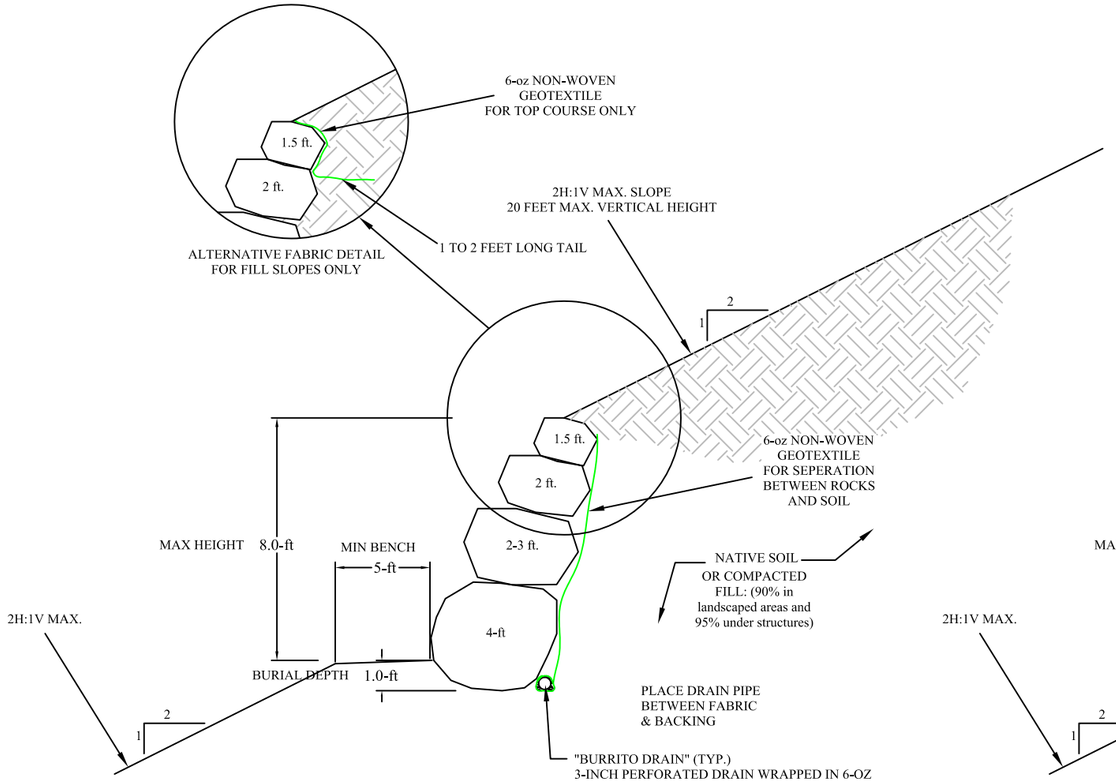
Attachments:

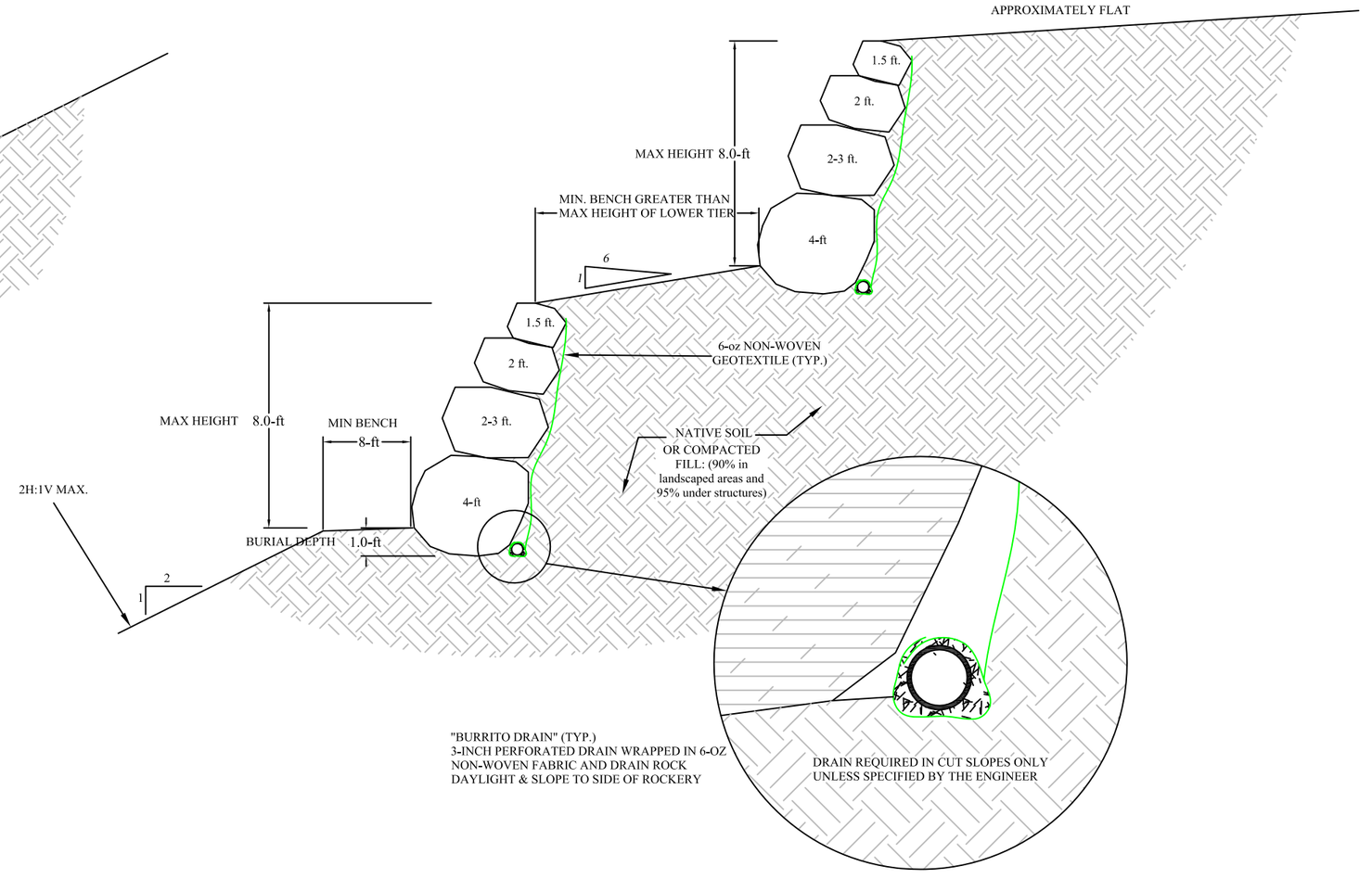
Appendix A – Rockery Construction Specifications and Drawings

Appendix B – Internal/External Analysis

Appendix C – Global Stability Analysis

APPENDIX A





CONCEPTUAL CROSS-SECTION - TYPICAL ROCKERY

APPROXIMATE GRAPHICAL SCALE: 1 INCH ~ 5 FEET (11X17 ONLY)

PLOT DATE: MAY 08, 2013

MARK		DATE	BY	CHK

REVISIONS

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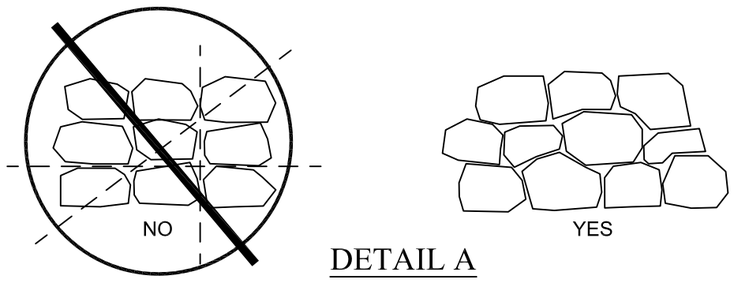
ROCKERY CONSTRUCTION GUIDELINES
POWDER MOUNTAIN RESORT
WEBER COUNTY, UTAH
CONCEPTUAL SECTION VIEW

DESIGNED BY:	DAG	MAY 07, 2013	PLOT SCALE 1=1
DRAWN BY:	DAG	MAY 07, 2013	
CHECKED BY:	KAH	MAY 08, 2013	DWG SCALE 1"=5'
APPROVED BY:	DAG	MAY 07, 2013	
IGES PROJECT NO. 01628-005	SHEET NO. A-1		REV. N/A

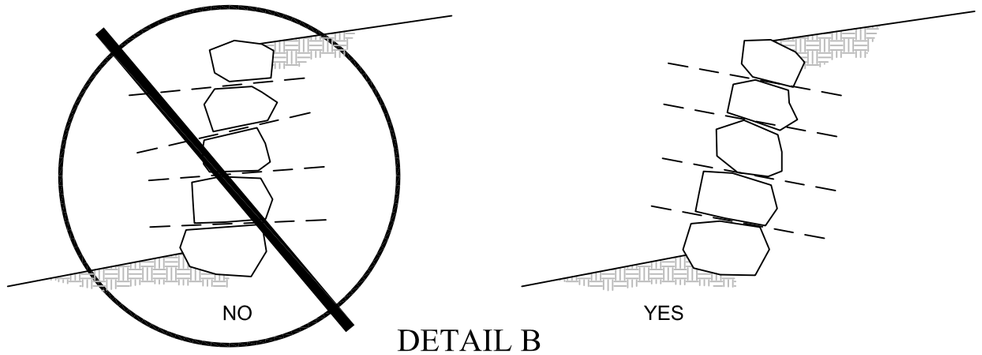
Rock Stacking Construction Guidelines:

Rocks should be stacked in general accordance with the Associated Rockery Contractors (ARC) Rockery Construction Guidelines, summarized as follows:

· Rocks should be placed so that there are no continuous joint planes in either the vertical or lateral direction (see detail A)
· Wherever possible, each rock should bear on at least two rocks below it.
· The upper plane of each rock between courses (the top surface of rock), should slope back towards the slope face and away from the face of the rock wall (see detail B)



DETAIL A



DETAIL B

Rock Stacking Construction Specifications:

INTRODUCTION

- The rock stacking guidelines provided include installation of the rock facing, erosion protection fabric, and backfill material.

MATERIALS

- Retained soils are to consist of native cut soils. If granular fill is required the material should consist of 4-inch minus granular soils compacted to a minimum of 90 percent ASTM D-1557 in landscape areas and 95 percent underneath structures. Any backfill material should be approved by IGES prior to importing.
- Erosion protection fabric (filter fabric) shall consist of a 6-oz. non-woven fabric or an approved equivalent.
- Rock Boulders to be used as facing should be durable angular particles with a minimum nominal diameter of 1.5 feet. Rock sizes should be in accordance with design drawings.

INSTALLATION

- Rocks should be stacked in general accordance with the Associated Rockery Contractors (ARC) Rockery Construction Guidelines, summarized as follows:

  - Rocks should be placed so that there are no continuous joint planes in either the vertical or lateral direction.
  - Wherever possible, each rock should bear on at least two rocks below it.
  - The upper plane of each rock between courses (the top surface of rock), should slope back towards the slope face and away from the face of the rock wall.

- Rock facing should be stacked at a maximum steepness of ½ horizontal to 1 vertical. Bottom row of rocks should be buried (keyed in) a minimum depth of 1 foot.

- Rock wall should be inspected at regular intervals by IGES to accommodate final inspection and acceptance letter.

PLOT DATE: MAY 08, 2013

MARK		DATE	BY	CHK

REVISIONS

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ROCKERY CONSTRUCTION GUIDELINES
POWDER MOUNTAIN RESORT
WEBER COUNTY, UTAH
GENERAL NOTES

DESIGNED BY:	DAG	MAY 07, 2013	PLOT SCALE 1=1
DRAWN BY:	DAG	MAY 07, 2013	
CHECKED BY:	KAH	MAY 08, 2013	DWG SCALE NTS
APPROVED BY:	DAG	MAY 07, 2013	
IGES PROJECT NO. 01628-005	SHEET NO. A-2		REV. N/A

APPENDIX B

Lateral Earth Pressure Coefficients

Project: **Powder Mountain Resort** | **Engineer** | **DAG**
Location: **Weber County, Utah** | **Date:** | **05/07/13**
Project No: **01628-005**
Case: **Flat Backfill, 250 psf surcharge**

Input Parameters:

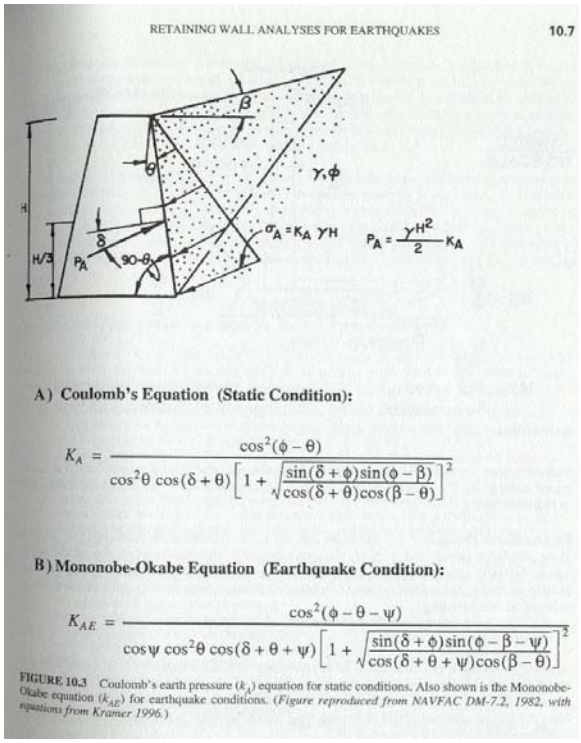
Wall Inclination (θ) =	-26.6	degrees
Friction Angle of Backfill (φ) =	30	degrees
Backfill Slope Inclination (β) =	0	degrees
Backfill/Wall Friction Angle (δ) =	20.0	degrees (typically 2/3 x phi of backfill)
Seismic Coefficient =	0.15	g
Friction Angle of Subgrade =	40	degrees

Couloumbs Equation:

K_a =	0.1390	
K_{ah} =	0.1168	
K_p =	40.9719	
K_{ph} =	34.4258	

Mononobe-Okabe Equation:

ψ =	8.5308	degrees
K_{ae} =	0.2322	



Rockery Minimum Rock Size Stability Checks

Project: Powder Mountain Resort
Location: Weber County, Utah
Project No: 01628-005
Case: Flat backfill, 250psf surcharge

Engineer DAG
Date: 05/07/13

Soil and Wall Parameters:

INPUT ONLY VALUES IN BLUE

γ Rock Boulder =	135 pcf	δbackfill =	20.00 degrees
γsoil =	120 pcf	β =	0 degrees
Csoil =	150 psf	θ =	-26.6 degrees
surcharge =	250 psf	Kah =	0.117
φfoundation =	40 degrees	δfoundation =	26.67 degrees
Burial Depth =	1 ft	φbackfill =	30 degrees
Ult. Shear Cap. Between Boulders =	0 lb/ft	φsubgrade =	40 degrees
Angle of Friction Between Boulders =	45 degrees		
Rock Interface Red. Factor =	0.7 * Adjust Depending on Boulder Geometry		
Rock Stacking Red. Factor =	0.8		

Factor of Safety (FOS) against OVERTURNING = 2.0, FOS against SLIDING = 1.5, FOS for BEARING = 3.0
(vertical force along back of wall neglected in sliding and overturning)

*Rock Diameter (ft)	1.5	2.0	3.0	4.0	5.0				
Rock Area (ft^2)	1.8	3.1	7.1	12.6	19.6	0.0	0.0	0.0	0.0
D From Top of Rockery (ft)	1.5	3.1	5.5	8.7	12.7	12.7	12.7	12.7	12.7
P_{ah} (lb/ft)	60	158	373	785	1501	1501	1501	1501	1501
Center of Gravity	0.8	1.0	1.5	2.0	2.5	0.0	0.0	0.0	0.0
Hinge Ht (H_h) (ft)	1.5	3.1	5.5	8.0	10.0	0.0	0.0	0.0	0.0
Avg Col. Diam. Above H_h (ft)	1.5	1.8	2.2	3.0	4.0	4.5	5.0	#DIV/0!	#DIV/0!
Wt Above Base Rock (lb/ft)		239	663	1617	3313	5964	#DIV/0!	#DIV/0!	#DIV/0!
Total Wt (lb/ft)	239	663	1617	3313	5964	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Wt Above H_h (lb/ft)	0	0	0	227	1152	6060	6733	#DIV/0!	#DIV/0!
Adjusted Total Wt (lb/ft)	239	663	1617	3087	4813	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

*CHECK: Minimum Average Base Course Diameter = 0.4(Ht_{wall}) ARC Guidelines

OVERTURNING ANALYSIS:

Wall Ht (ft)	1.5	3.1	5.5	8.7	12.7	12.7	12.7	12.7	12.7
M_{ovt}	30	163	683	2275	6355	6355	6355	6355	6355
M_{res}	125	592	2406	6479	12627	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
FS_{ovt}	4.2	3.6	3.5	2.8	2.0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
CHECK	OK	OK	OK	OK	ARS	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

SLIDING/BULGING ANALYSIS:

Wall Ht (ft)	1.5	3.1	5.5	8.7	12.7	12.7	12.7	12.7	12.7
R_{slide}	60	158	373	785	1501	1501	1501	1501	1501
$R_{res\ at\ wall\ base}$ (lb/ft)	2450	2870	3938	5615	8006	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
$R_{res\ rock\ to\ rock}$ (lb/ft)	167	464	1132	2319	4175	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
**$FS_{base\ slide}$	41.1	18.2	10.6	7.2	5.3	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
CHECK	OK	OK	OK	OK	OK	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
$FS_{rock\ to\ rock\ slide\ (bulging)}$	2.8	2.9	3.0	3.0	2.8	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
CHECK	OK	OK	OK	OK	OK	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

BEARING CAPACITY:

Wall Ht (ft)	1.5	3.1	5.5	8.7	12.7	12.7	12.7	12.7	12.7
Soil Load (lb/ft)	159.0	331.3	539.0	828.3	1192.8	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Soil Capacity	16402.5	19302.1	25101.5	30900.8	36700.2	7703.4	7703.4	7703.4	7703.4
$FS_{bearing}$	103.1	58.3	46.6	37.3	30.8	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
CHECK	OK	OK	OK	OK	OK	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Wall Ht (ft)	1.5	3.1	5.5	8.7	12.7	12.7	12.7	12.7	12.7
	PASS	PASS	PASS	PASS	FAIL	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

MAXIMUM ACCEPTABLE HEIGHT: 8 FT

**Resisting force for Rockery Foundation - Only Value at Maximum D Applies
ARS: ADJUST ROCK SIZE

Lateral Earth Pressure Coefficients

Project: Powder Mountain Resort
Location: Weber County, Utah
Project No: 01628-005
Case: 2H:1V Backfill, no surcharge

Engineer DAG
Date: 05/07/13

Input Parameters:

Wall Inclination (θ) =	-26.6	degrees
Friction Angle of Backfill (φ) =	30	degrees
Backfill Slope Inclination (β) =	26.5	degrees
Backfill/Wall Friction Angle (δ) =	20.0	degrees (typically 2/3 x phi of backfill)
Seismic Coefficient =	0.15	g
Friction Angle of Subgrade =	40	degrees

Couloumbs Equation:

K_a =	0.2329	
K_{ah} =	0.1957	
K_p =	3.3206	
K_{ph} =	2.7901	

Mononobe-Okabe Equation:

ψ =	8.5308	degrees
K_{ae} =	#NUM!	

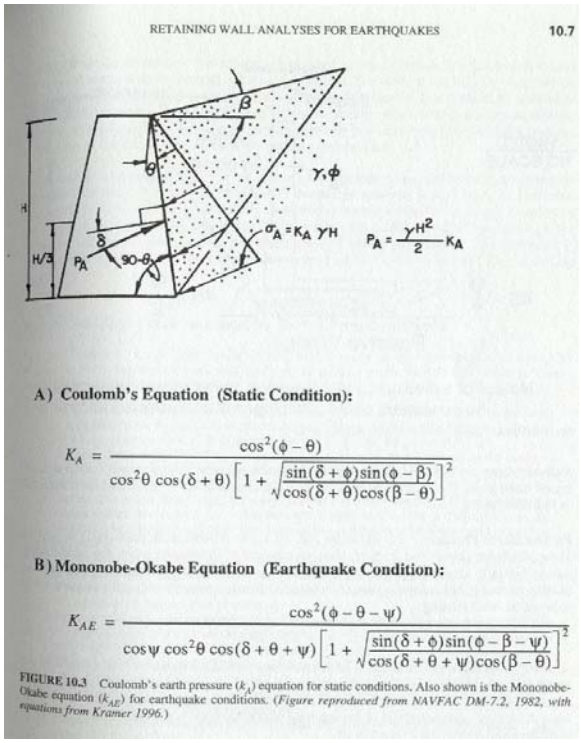


FIGURE 10.3 Coulomb's earth pressure (k_A) equation for static conditions. Also shown is the Mononobe-Okabe equation (k_{AE}) for earthquake conditions. (*Figure reproduced from NAVFAC DM-7.2, 1982, with equations from Kramer 1996.*)

Rockery Minimum Rock Size Stability Checks

Project: Powder Mountain Resort
Location: Weber County, Utah
Project No: 01628-005
Case: 2H:1V backfill, no surcharge

Engineer DAG
Date: 05/07/13

Soil and Wall Parameters:

INPUT ONLY VALUES IN BLUE

γ Rock Boulder =	135 pcf	δbackfill =	20.00 degrees
γsoil =	120 pcf	β =	26.5 degrees
Csoil =	150 psf	θ =	-26.6 degrees
surcharge =	0 psf	Kah =	0.196
φfoundation =	40 degrees	δfoundation =	26.67 degrees
Burial Depth =	1 ft	φbackfill =	30 degrees
Ult. Shear Cap. Between Boulders =	0 lb/ft	φsubgrade =	40 degrees
Angle of Friction Between Boulders =	45 degrees		
Rock Interface Red. Factor =	0.7 * Adjust Depending on Boulder Geometry		
Rock Stacking Red. Factor =	0.8		

Factor of Safety (FOS) against OVERTURNING = 2.0, FOS against SLIDING = 1.5, FOS for BEARING = 3.0
(vertical force along back of wall neglected in sliding and overturning)

*Rock Diameter (ft)	1.5	2.0	3.0	4.0	5.0				
Rock Area (ft^2)	1.8	3.1	7.1	12.6	19.6	0.0	0.0	0.0	0.0
D From Top of Rockery (ft)	1.5	3.1	5.5	8.7	12.7	12.7	12.7	12.7	12.7
P_{ah} (lb/ft)	26	113	355	889	1894	1894	1894	1894	1894
Center of Gravity	0.8	1.0	1.5	2.0	2.5	0.0	0.0	0.0	0.0
Hinge Ht (H_h) (ft)	1.5	3.1	5.5	8.0	10.0	0.0	0.0	0.0	0.0
Avg Col. Diam. Above H_h (ft)	1.5	1.8	2.2	3.0	4.0	4.5	5.0	#DIV/0!	#DIV/0!
Wt Above Base Rock (lb/ft)		239	663	1617	3313	5964	#DIV/0!	#DIV/0!	#DIV/0!
Total Wt (lb/ft)	239	663	1617	3313	5964	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Wt Above H_h (lb/ft)	0	0	0	227	1152	6060	6733	#DIV/0!	#DIV/0!
Adjusted Total Wt (lb/ft)	239	663	1617	3087	4813	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

*CHECK: Minimum Average Base Course Diameter = 0.4(Ht_{wall}) ARC Guidelines

OVERTURNING ANALYSIS:

Wall Ht (ft)	1.5	3.1	5.5	8.7	12.7	12.7	12.7	12.7	12.7
M_{ovt}	13	117	651	2577	8016	8016	8016	8016	8016
M_{res}	125	592	2406	6479	12627	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
FS_{ovt}	9.5	5.1	3.7	2.5	1.6	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
CHECK	OK	OK	OK	OK	ARS	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

SLIDING/BULGING ANALYSIS:

Wall Ht (ft)	1.5	3.1	5.5	8.7	12.7	12.7	12.7	12.7	12.7
R_{slide}	26	113	355	889	1894	1894	1894	1894	1894
$R_{res\ at\ wall\ base}$ (lb/ft)	552	971	2040	3716	6108	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
$R_{res\ rock\ to\ rock}$ (lb/ft)	167	464	1132	2319	4175	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
**$FS_{base\ slide}$	20.9	8.6	5.7	4.2	3.2	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
CHECK	OK	OK	OK	OK	OK	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
$FS_{rock\ to\ rock\ slide\ (bulging)}$	6.3	4.1	3.2	2.6	2.2	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
CHECK	OK	OK	OK	OK	OK	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

BEARING CAPACITY:

Wall Ht (ft)	1.5	3.1	5.5	8.7	12.7	12.7	12.7	12.7	12.7
Soil Load (lb/ft)	159.0	331.3	539.0	828.3	1192.8	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Soil Capacity	16402.5	19302.1	25101.5	30900.8	36700.2	7703.4	7703.4	7703.4	7703.4
$FS_{bearing}$	103.1	58.3	46.6	37.3	30.8	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
CHECK	OK	OK	OK	OK	OK	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Wall Ht (ft)	1.5	3.1	5.5	8.7	12.7	12.7	12.7	12.7	12.7
	PASS	PASS	PASS	PASS	FAIL	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

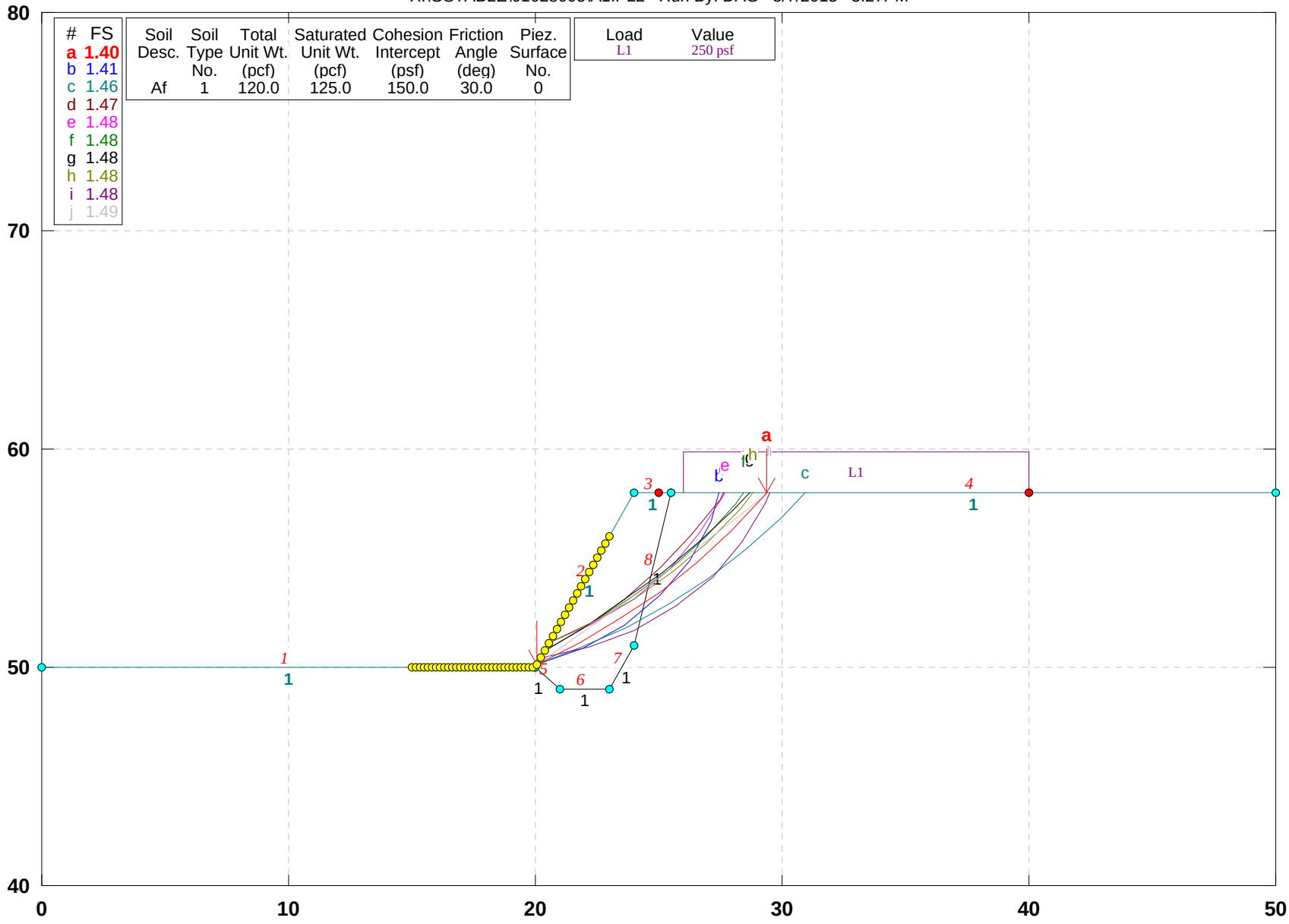
MAXIMUM ACCEPTABLE HEIGHT: 8 FT

**Resisting force for Rockery Foundation - Only Value at Maximum D Applies
ARS: ADJUST ROCK SIZE

APPENDIX C

01628-005; Powder Mtn.; Global Stability; 8' H Max; Flat w/ Traffic; "A"; Static

X:\GSTABLE\01628005\A1.PL2 Run By: DAG 5/7/2013 3:27PM



GSTABL7 v.2 FSmin=1.40

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.002, December 2001 **

****

SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.

****

Analysis Run Date: 5/7/2013
Time of Run: 3:27PM
Run By: DAG
Input Data Filename: X:A1.
Output Filename: X:A1.OUT
Unit System: English

Plotted Output Filename: X:A1.PLT

PROBLEM DESCRIPTION: 01628-005; Powder Mtn.; Global Stability ; 8' H Max; Flat w/ Traffic; "A"; Static

BOUNDARY COORDINATES

4 Top Boundaries
8 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	50.00	20.00	50.00	1
2	20.00	50.00	24.00	58.00	1
3	24.00	58.00	25.50	58.00	1
4	25.50	58.00	50.00	58.00	1
5	20.00	50.00	21.00	49.00	1
6	21.00	49.00	23.00	49.00	1
7	23.00	49.00	24.00	51.00	1
8	24.00	51.00	25.50	58.00	1

1

User Specified Y-Origin = 40.00(ft)

1

ISOTROPIC SOIL PARAMETERS

1 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	125.0	150.0	30.0	0.00	0.0	0

1

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (psf)	Deflection (deg)
1	26.00	40.00	250.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed Force Acting On A Horizontally Projected Surface.

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

2500 Trial Surfaces Have Been Generated.

50 Surface(s) Initiate(s) From Each Of 50 Points Equally Spaced Along The Ground Surface Between X = 15.00(ft)
and X = 23.00(ft)

Each Surface Terminates Between X = 25.00(ft)
and X = 40.00(ft)

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 0.00(ft)

2.00(ft) Line Segments Define Each Trial Failure Surface.

Following Is Displayed The Most Critical Of The Trial
Failure Surfaces Evaluated.

**** END OF GSTABL7 OUTPUT ****

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 2500

Statistical Data On All Valid FS Values:
FS Max = 11.358 FS Min = 1.398 FS Ave = 3.307
Standard Deviation = 1.393 Coefficient of Variation = 42.13 %

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	20.06	50.12
2	21.80	51.11
3	23.46	52.22
4	25.04	53.45
5	26.53	54.79
6	27.92	56.22
7	29.21	57.76
8	29.38	58.00

Circle Center At X = 7.12 ; Y = 74.89 ; and Radius = 27.95

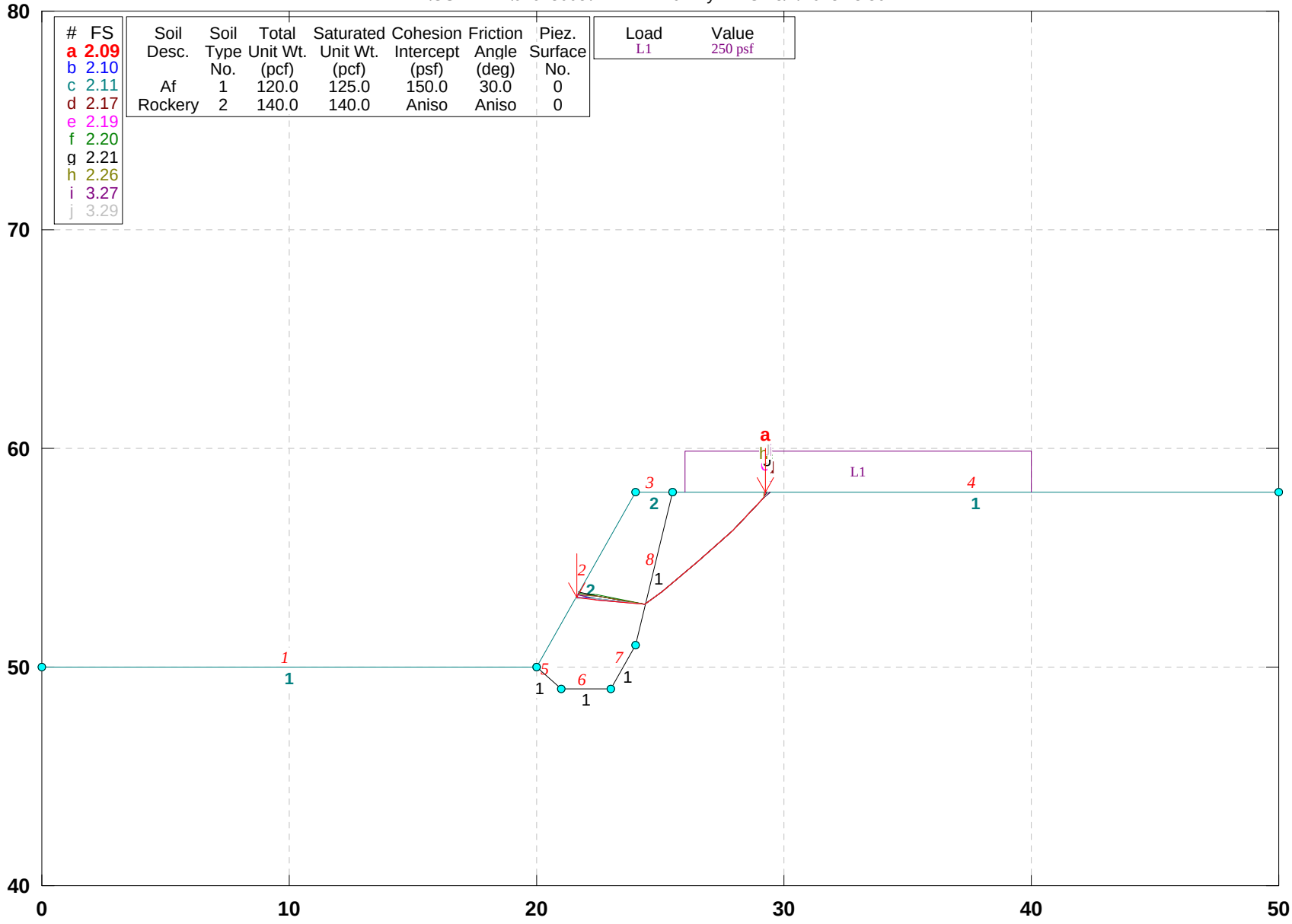
Factor of Safety
*** 1.398 ***

Individual data on the 11 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.7	259.2	0.0	0.0	0.	0.	0.0	0.0	0.0
2	1.7	717.1	0.0	0.0	0.	0.	0.0	0.0	0.0
3	0.5	324.3	0.0	0.0	0.	0.	0.0	0.0	0.0
4	0.4	263.0	0.0	0.0	0.	0.	0.0	0.0	0.0
5	0.6	356.8	0.0	0.0	0.	0.	0.0	0.0	0.0
6	0.5	238.4	0.0	0.0	0.	0.	0.0	0.0	0.0
7	0.5	234.9	0.0	0.0	0.	0.	0.0	0.0	0.0
8	0.5	220.2	0.0	0.0	0.	0.	0.0	0.0	132.9
9	1.4	416.3	0.0	0.0	0.	0.	0.0	0.0	347.6
10	1.3	155.7	0.0	0.0	0.	0.	0.0	0.0	321.1
11	0.2	2.6	0.0	0.0	0.	0.	0.0	0.0	44.0

01628-005; Powder Mtn.; Global Stability; 8' H Max; Flat w/ Traffic; "B"; Static

X:\GSTABLE\01628005\A2.PL2 Run By: DAG 5/7/2013 3:36PM



GSTABL7 v.2 FSmin=2.09

Safety Factors Are Calculated By The Simplified Janbu Method for the case of c & phi both > 0

GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.002, December 2001 **

****

SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.

****

Analysis Run Date: 5/7/2013
Time of Run: 3:36PM
Run By: DAG
Input Data Filename: X:A2.
Output Filename: X:A2.OUT
Unit System: English

Plotted Output Filename: X:A2.PLT

PROBLEM DESCRIPTION: 01628-005; Powder Mtn.; Global Stability ; 8' H Max; Flat w/ Traffic; "B"; Static

BOUNDARY COORDINATES

4 Top Boundaries
8 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	50.00	20.00	50.00	1
2	20.00	50.00	24.00	58.00	2
3	24.00	58.00	25.50	58.00	2
4	25.50	58.00	50.00	58.00	1
5	20.00	50.00	21.00	49.00	1
6	21.00	49.00	23.00	49.00	1
7	23.00	49.00	24.00	51.00	1
8	24.00	51.00	25.50	58.00	1

User Specified Y-Origin = 40.00(ft)

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	125.0	150.0	30.0	0.00	0.0	0
2	140.0	140.0	0.0	45.0	0.00	0.0	0

ANISOTROPIC STRENGTH PARAMETERS
1 soil type(s)

Soil Type 2 Is Anisotropic

Number Of Direction Ranges Specified = 3

Direction Range No.	Counterclockwise Direction Limit (deg)	Cohesion Intercept (psf)	Friction Angle (deg)
1	-12.0	3000.00	0.00
2	-5.0	0.00	45.00
3	90.0	3000.00	0.00

ANISOTROPIC SOIL NOTES:
(1) An input value of 0.01 for C and/or Phi will cause Aniso C and/or Phi to be ignored in that range.
(2) An input value of 0.02 for Phi will set both Phi and C equal to zero, with no water weight in the tension crack.
(3) An input value of 0.03 for Phi will set both Phi and C equal to zero, with water weight in the tension crack.

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (psf)	Deflection (deg)
1	26.00	40.00	250.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

Janbus Empirical Coef is being used for the case of c & phi both > 0

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.

1000 Trial Surfaces Have Been Generated.

5 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 2.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	24.40	52.90	24.40	52.90	0.00
2	25.04	53.45	25.04	53.45	0.00
3	26.53	54.79	26.53	54.79	0.00
4	27.92	56.22	27.92	56.22	0.00
5	29.21	57.76	29.21	57.76	0.00

Following Is Displayed The Most Critical Of The Trial Failure Surfaces Evaluated.

* * Safety Factors Are Calculated By The Simplified Janbu Method * *

Total Number of Trial Surfaces Evaluated = 1000

Statistical Data On All Valid FS Values:
FS Max = 10.397 FS Min = 2.087 FS Ave = 7.516
Standard Deviation = 1.759 Coefficient of Variation = 23.41 %

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	21.60	53.21
2	22.41	53.08
3	24.40	52.90
4	25.04	53.45
5	26.53	54.79
6	27.92	56.22
7	29.21	57.76
8	29.28	58.00

Factor of Safety
*** 2.087 ***

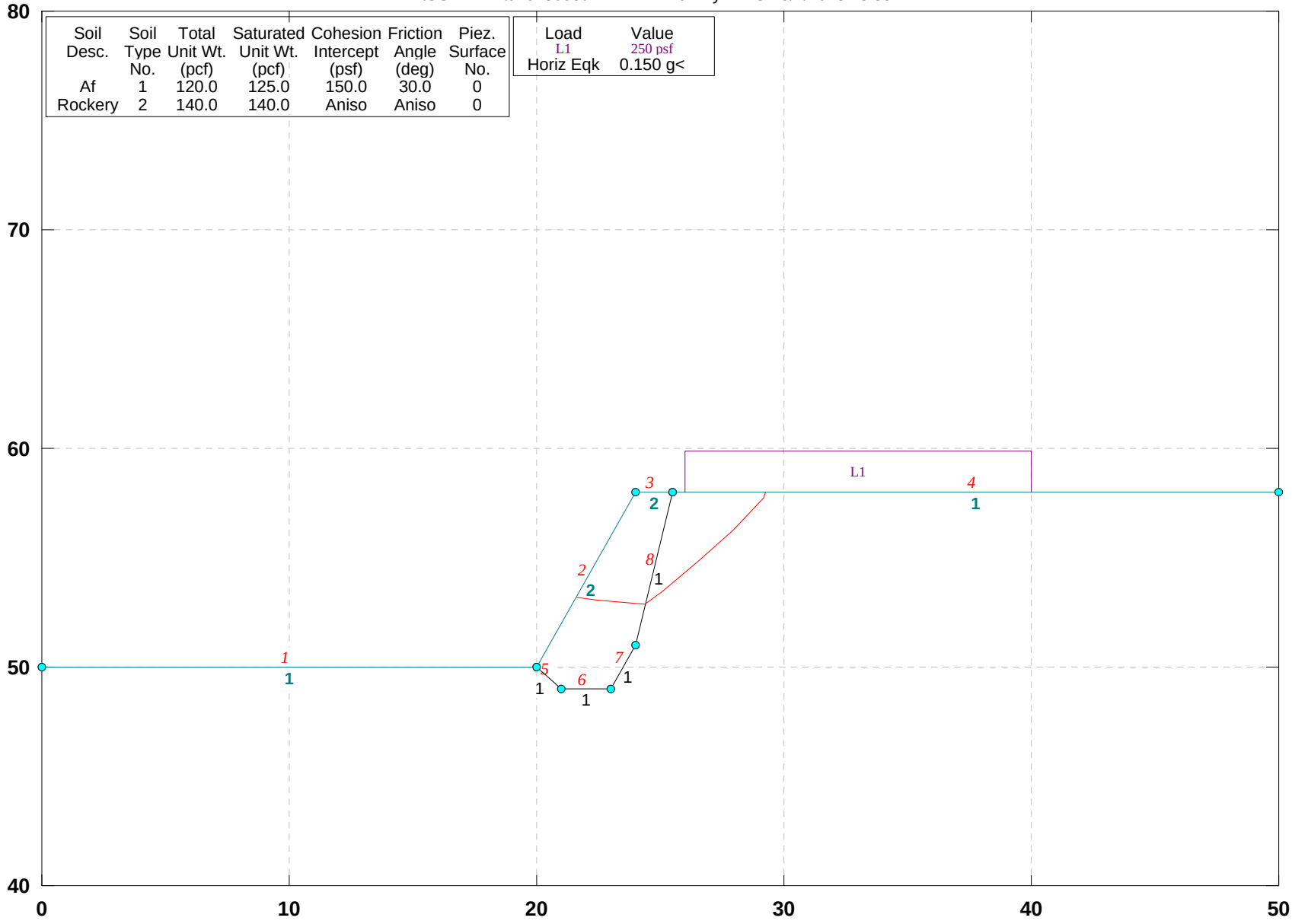
Individual data on the 11 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	0.8	97.8	0.0	0.0	0.	0.	0.0	0.0	0.0
2	1.6	758.4	0.0	0.0	0.	0.	0.0	0.0	0.0
3	0.4	284.6	0.0	0.0	0.	0.	0.0	0.0	0.0
4	0.0	6.2	0.0	0.0	0.	0.	0.0	0.0	0.0
5	0.6	410.9	0.0	0.0	0.	0.	0.0	0.0	0.0
6	0.5	249.6	0.0	0.0	0.	0.	0.0	0.0	0.0
7	0.5	234.7	0.0	0.0	0.	0.	0.0	0.0	0.0
8	0.5	219.3	0.0	0.0	0.	0.	0.0	0.0	132.5
9	1.4	416.2	0.0	0.0	0.	0.	0.0	0.0	347.5
10	1.3	156.3	0.0	0.0	0.	0.	0.0	0.0	322.5
11	0.1	1.0	0.0	0.0	0.	0.	0.0	0.0	17.8

**** END OF GSTABL7 OUTPUT ****

01628-005; Powder Mtn.; Global Stability; 8' HMax; Flat w/ Traffic; "B";P-Static

X:\GSTABLE\01628005\A2P.PLT Run By: DAG 5/7/2013 3:38PM



GSTABL7 v.2 FSmin=1.72

Factor Of Safety Is Calculated By The Simplified Janbu Method

GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.002, December 2001 **

****

SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.

****

Analysis Run Date: 5/7/2013
Time of Run: 3:38PM
Run By: DAG
Input Data Filename: X:A2P.
Output Filename: X:A2P.OUT
Unit System: English

Plotted Output Filename: X:A2P.PLT

PROBLEM DESCRIPTION: 01628-005; Powder Mtn.; Global Stability ; 8' HMax; Flat w/ Traffic; "B";P-Static

BOUNDARY COORDINATES

4 Top Boundaries
8 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	50.00	20.00	50.00	1
2	20.00	50.00	24.00	58.00	2
3	24.00	58.00	25.50	58.00	2
4	25.50	58.00	50.00	58.00	1
5	20.00	50.00	21.00	49.00	1
6	21.00	49.00	23.00	49.00	1
7	23.00	49.00	24.00	51.00	1
8	24.00	51.00	25.50	58.00	1

User Specified Y-Origin = 40.00(ft)

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	125.0	150.0	30.0	0.00	0.0	0
2	140.0	140.0	0.0	45.0	0.00	0.0	0

ANISOTROPIC STRENGTH PARAMETERS

1 soil type(s)

Soil Type 2 Is Anisotropic

Number Of Direction Ranges Specified = 3

Direction Range No.	Counterclockwise Direction Limit (deg)	Cohesion Intercept (psf)	Friction Angle (deg)
1	-12.0	3000.00	0.00
2	-5.0	0.00	45.00
3	90.0	3000.00	0.00

ANISOTROPIC SOIL NOTES:
(1) An input value of 0.01 for C and/or Phi will cause Aniso C and/or Phi to be ignored in that range.
(2) An input value of 0.02 for Phi will set both Phi and C equal to zero, with no water weight in the tension crack.
(3) An input value of 0.03 for Phi will set both Phi and C equal to zero, with water weight in the tension crack.

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (psf)	Deflection (deg)
1	26.00	40.00	250.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

A Horizontal Earthquake Loading Coefficient
Of0.150 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of0.000 Has Been Assigned

Cavitation Pressure = 0.0(psf)

Janbu's Empirical Coef. is being used for the case of c & phi both > 0
1

Trial Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	21.60	53.20
2	22.41	53.08
3	24.40	52.90
4	25.04	53.45
5	26.53	54.79
6	27.92	56.22
7	29.21	57.76
8	29.28	58.00

Janbu's Empirical Coefficient (fo) = 1.070

* * Factor Of Safety Is Calculated By The Simplified Janbu Method * *

Factor Of Safety For The Preceding Specified Surface = 1.717

Table 1 - Individual Data on the 11 Slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	0.8	98.7	0.0	0.0	0.0	0.0	14.8	0.0	0.0
2	1.6	757.3	0.0	0.0	0.0	0.0	113.6	0.0	0.0
3	0.4	284.6	0.0	0.0	0.0	0.0	42.7	0.0	0.0
4	0.0	6.2	0.0	0.0	0.0	0.0	0.9	0.0	0.0
5	0.6	410.9	0.0	0.0	0.0	0.0	61.6	0.0	0.0
6	0.5	249.6	0.0	0.0	0.0	0.0	37.4	0.0	0.0
7	0.5	234.7	0.0	0.0	0.0	0.0	35.2	0.0	0.0
8	0.5	219.3	0.0	0.0	0.0	0.0	32.9	0.0	132.5
9	1.4	416.2	0.0	0.0	0.0	0.0	62.4	0.0	347.5
10	1.3	156.3	0.0	0.0	0.0	0.0	23.5	0.0	322.5
11	0.1	1.0	0.0	0.0	0.0	0.0	0.2	0.0	17.5

Table 2 - Base Stress Data on the 11 Slices

Slice No. *	Alpha (deg)	X-Coord. Slice Cntr (ft)	Base Leng. (ft)	Available Shear Strength (psf)	Mobilized Shear Stress (psf)
1	-8.43	22.01	0.82	134.76	0.22
2	-5.17	23.20	1.60	504.81	28.25
3	-5.17	24.20	0.40	754.11	42.19
4	40.67	24.40	0.01	3955.59	546.18
5	40.67	24.72	0.83	537.86	498.31
6	41.97	25.27	0.62	478.40	423.38
7	41.97	25.75	0.67	434.72	366.22
8	41.97	26.26	0.71	550.63	490.03
9	45.81	27.23	1.99	497.99	425.26
10	50.05	28.57	2.01	404.81	296.23
11	73.74	29.25	0.25	502.02	254.43

Sum of the Resisting Forces (including Pier/Pile, Tieback, Reinforcing Soil Nail, and Applied Forces if applicable) = 4567.80 (lbs)

Average Available Shear Strength (including Tieback, Pier/Pile, Reinforcing, Soil Nail, and Applied Forces if applicable) = 460.56(psf)

Sum of the Driving Forces = 2847.54 (lbs)

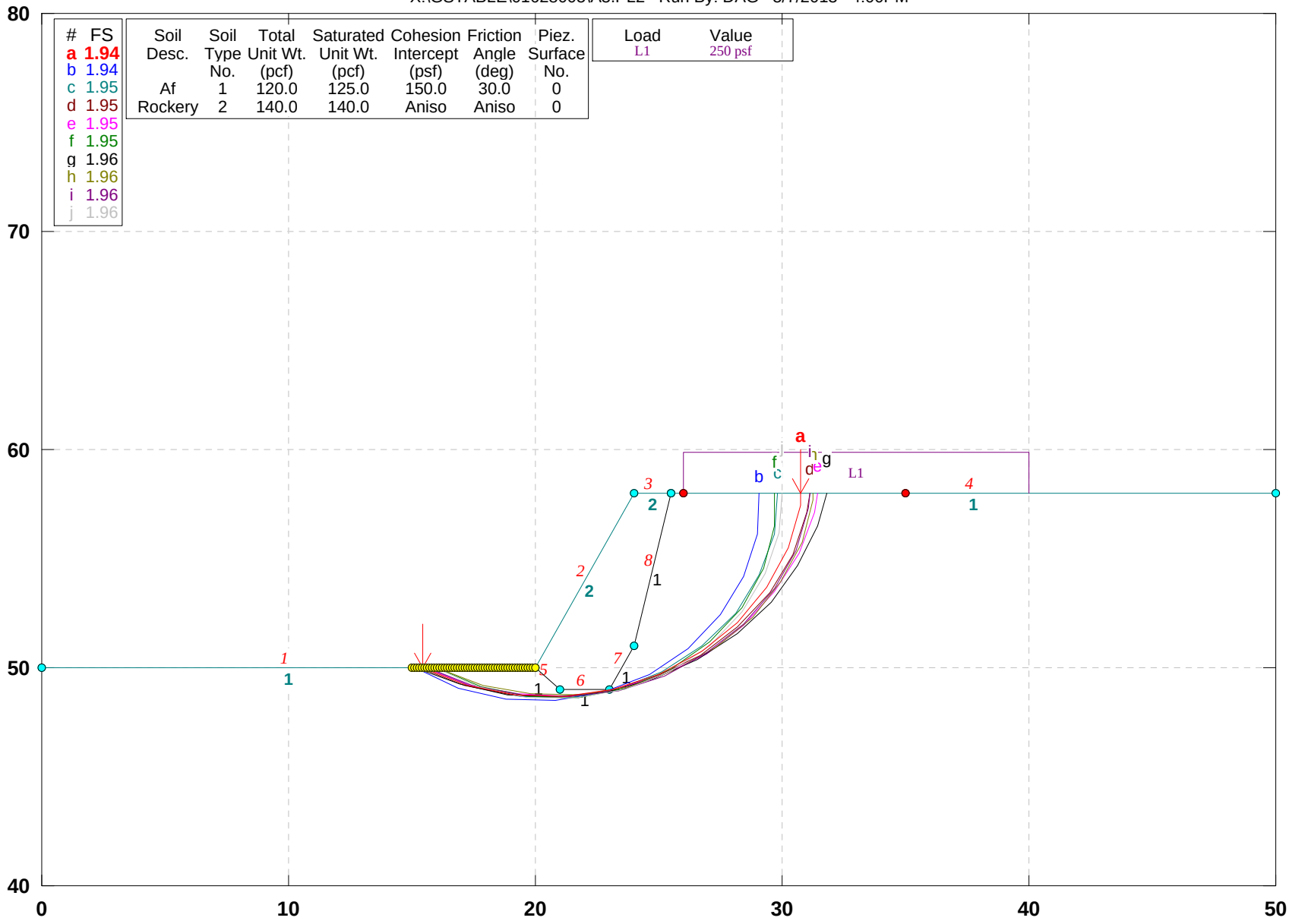
Average Mobilized Shear Stress = 287.11(psf)

Total length of the failure surface = 9.92(ft)

**** END OF GSTABL7 OUTPUT ****

01628-005; Powder Mtn.; Global Stability; 8' H Max; Flat w/ Traffic; Static

X:\GSTABLE\01628005\A3.PL2 Run By: DAG 5/7/2013 4:00PM



GSTABL7 v.2 FSmin=1.94

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.002, December 2001 **

****

SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.

****

Analysis Run Date: 5/7/2013
Time of Run: 4:00PM
Run By: DAG
Input Data Filename: X:a3.
Output Filename: X:a3.OUT
Unit System: English

Plotted Output Filename: X:a3.PLT

PROBLEM DESCRIPTION: 01628-005; Powder Mtn.; Global Stability ; 8' H Max; Flat w/ Traffic; Static

BOUNDARY COORDINATES

4 Top Boundaries
8 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	50.00	20.00	50.00	1
2	20.00	50.00	24.00	58.00	2
3	24.00	58.00	25.50	58.00	2
4	25.50	58.00	50.00	58.00	1
5	20.00	50.00	21.00	49.00	1
6	21.00	49.00	23.00	49.00	1
7	23.00	49.00	24.00	51.00	1
8	24.00	51.00	25.50	58.00	1

User Specified Y-Origin = 40.00(ft)

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	125.0	150.0	30.0	0.00	0.0	0
2	140.0	140.0	0.0	45.0	0.00	0.0	0

ANISOTROPIC STRENGTH PARAMETERS

1 soil type(s)

Soil Type 2 Is Anisotropic

Number Of Direction Ranges Specified = 3

Direction Range No.	Counterclockwise Direction Limit (deg)	Cohesion Intercept (psf)	Friction Angle (deg)
1	-12.0	3000.00	0.00
2	-5.0	0.00	45.00
3	90.0	3000.00	0.00

ANISOTROPIC SOIL NOTES:
(1) An input value of 0.01 for C and/or Phi will cause Aniso C and/or Phi to be ignored in that range.
(2) An input value of 0.02 for Phi will set both Phi and C equal to zero, with no water weight in the tension crack.
(3) An input value of 0.03 for Phi will set both Phi and C equal to zero, with water weight in the tension crack.

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (psf)	Deflection (deg)
1	26.00	40.00	250.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

2500 Trial Surfaces Have Been Generated.

50 Surface(s) Initiate(s) From Each Of 50 Points Equally Spaced
Along The Ground Surface Between X = 15.00(ft)
and X = 20.00(ft)

Each Surface Terminates Between X = 26.00(ft)
and X = 35.00(ft)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)

2.00(ft) Line Segments Define Each Trial Failure Surface.

Following Is Displayed The Most Critical Of The Trial
Failure Surfaces Evaluated.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 2500

Statistical Data On All Valid FS Values:
FS Max = 17.278 FS Min = 1.937 FS Ave = 3.071
Standard Deviation = 0.979 Coefficient of Variation = 31.86 %

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	15.41	50.00
2	17.23	49.18
3	19.18	48.73
4	21.18	48.67
5	23.16	48.99
6	25.03	49.68
7	26.74	50.73
8	28.21	52.08
9	29.39	53.69
10	30.24	55.50
11	30.73	57.44
12	30.75	58.00

Circle Center At X = 20.52 ; Y = 58.91 ; and Radius = 10.28

Factor of Safety
*** 1.937 ***

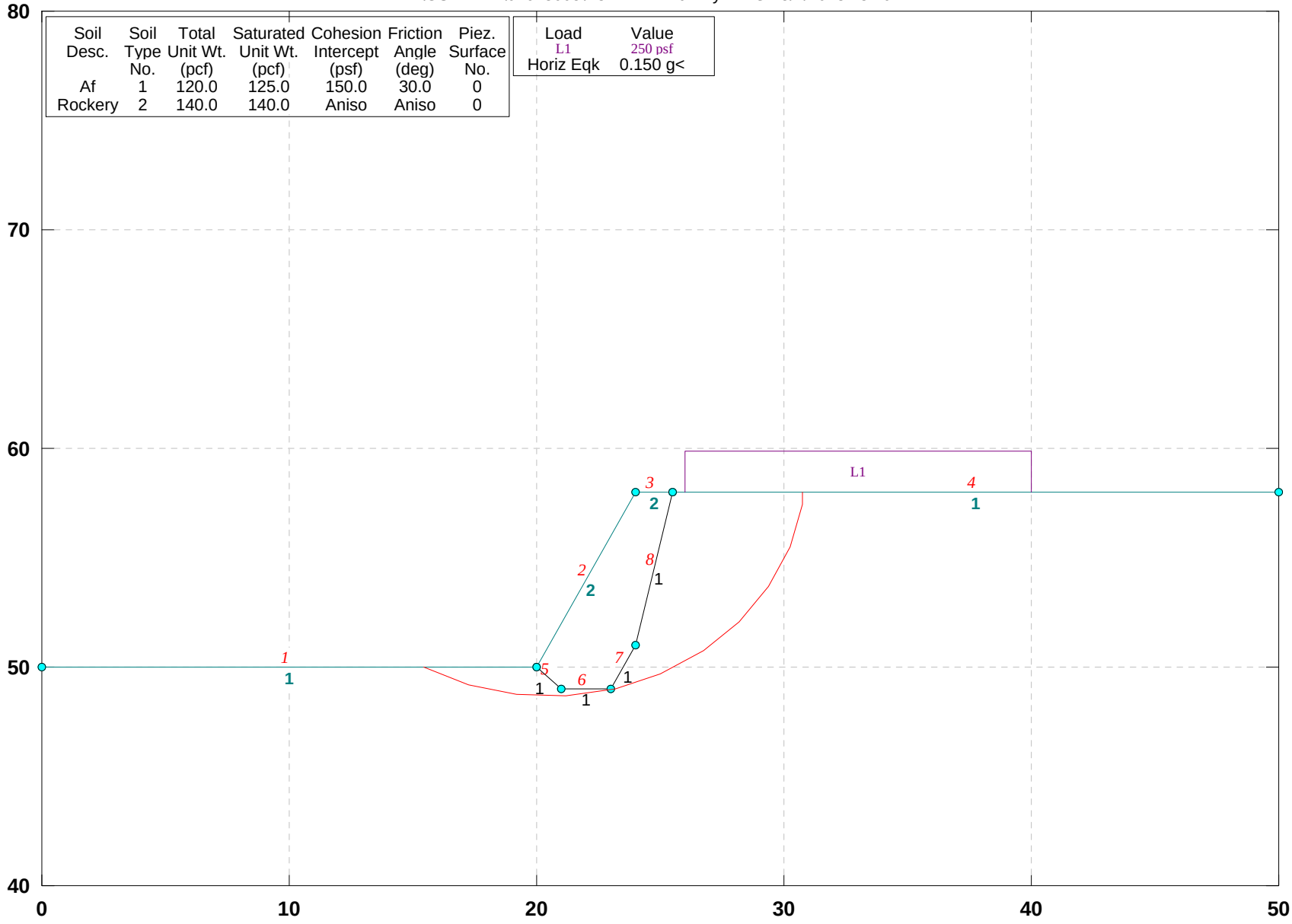
Individual data on the 17 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.8	89.6	0.0	0.0	0.	0.	0.0	0.0	0.0
2	1.9	243.9	0.0	0.0	0.	0.	0.0	0.0	0.0
3	0.8	125.8	0.0	0.0	0.	0.	0.0	0.0	0.0
4	1.0	307.4	0.0	0.0	0.	0.	0.0	0.0	0.0
5	0.2	87.9	0.0	0.0	0.	0.	0.0	0.0	0.0
6	1.8	1360.0	0.0	0.0	0.	0.	0.0	0.0	0.0
7	0.2	155.6	0.0	0.0	0.	0.	0.0	0.0	0.0
8	0.8	930.3	0.0	0.0	0.	0.	0.0	0.0	0.0
9	1.0	1146.9	0.0	0.0	0.	0.	0.0	0.0	0.0
10	0.5	470.9	0.0	0.0	0.	0.	0.0	0.0	0.0
11	0.5	472.6	0.0	0.0	0.	0.	0.0	0.0	0.0
12	0.7	662.3	0.0	0.0	0.	0.	0.0	0.0	184.0
13	1.5	1165.2	0.0	0.0	0.	0.	0.0	0.0	368.0
14	1.2	726.0	0.0	0.0	0.	0.	0.0	0.0	295.8
15	0.8	346.9	0.0	0.0	0.	0.	0.0	0.0	212.4
16	0.5	88.7	0.0	0.0	0.	0.	0.0	0.0	121.1
17	0.0	0.9	0.0	0.0	0.	0.	0.0	0.0	7.0

**** END OF GSTABL7 OUTPUT ****

01628-005; Powder Mtn.; Global Stability; 8' HMax; Flat w/ Traffic; P-Static

X:\GSTABLE\01628005\A3P.PLT Run By: DAG 5/7/2013 3:40PM



GSTABL7 v.2 FSmin=1.50

Factor Of Safety Is Calculated By The Simplified Janbu Method

GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.002, December 2001 **

****

SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.

****

Analysis Run Date: 5/7/2013
Time of Run: 3:40PM
Run By: DAG
Input Data Filename: X:A3P.
Output Filename: X:A3P.OUT
Unit System: English

Plotted Output Filename: X:A3P.PLT

PROBLEM DESCRIPTION: 01628-005; Powder Mtn.; Global Stability ; 8' HMax; Flat w/ Traffic; P-Static

BOUNDARY COORDINATES

4 Top Boundaries
8 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	50.00	20.00	50.00	1
2	20.00	50.00	24.00	58.00	2
3	24.00	58.00	25.50	58.00	2
4	25.50	58.00	50.00	58.00	1
5	20.00	50.00	21.00	49.00	1
6	21.00	49.00	23.00	49.00	1
7	23.00	49.00	24.00	51.00	1
8	24.00	51.00	25.50	58.00	1

User Specified Y-Origin = 40.00(ft)

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	125.0	150.0	30.0	0.00	0.0	0
2	140.0	140.0	0.0	45.0	0.00	0.0	0

ANISOTROPIC STRENGTH PARAMETERS
1 soil type(s)

Soil Type 2 Is Anisotropic

Number Of Direction Ranges Specified = 3

Direction Range No.	Counterclockwise Direction Limit (deg)	Cohesion Intercept (psf)	Friction Angle (deg)
1	-12.0	3000.00	0.00
2	-5.0	0.00	45.00
3	90.0	3000.00	0.00

ANISOTROPIC SOIL NOTES:
(1) An input value of 0.01 for C and/or Phi will cause Aniso C and/or Phi to be ignored in that range.
(2) An input value of 0.02 for Phi will set both Phi and C equal to zero, with no water weight in the tension crack.
(3) An input value of 0.03 for Phi will set both Phi and C equal to zero, with water weight in the tension crack.

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (psf)	Deflection (deg)
1	26.00	40.00	250.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed

Force Acting On A Horizontally Projected Surface.

A Horizontal Earthquake Loading Coefficient
Of0.150 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of0.000 Has Been Assigned

Cavitation Pressure = 0.0(psf)

Janbu's Empirical Coef. is being used for the case of c & phi both > 0

1

Trial Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	15.41	50.00
2	17.23	49.18
3	19.18	48.73
4	21.18	48.67
5	23.16	48.99
6	25.03	49.68
7	26.74	50.73
8	28.21	52.08
9	29.39	53.69
10	30.24	55.50
11	30.73	57.44
12	30.75	58.00

Janbu's Empirical Coefficient (fo) = 1.084

* * Factor Of Safety Is Calculated By The Simplified Janbu Method * *

Factor Of Safety For The Preceding Specified Surface = 1.500

Table 1 - Individual Data on the 17 Slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.8	89.5	0.0	0.0	0.0	0.0	13.4	0.0	0.0
2	1.9	244.5	0.0	0.0	0.0	0.0	36.7	0.0	0.0
3	0.8	126.2	0.0	0.0	0.0	0.0	18.9	0.0	0.0
4	1.0	307.2	0.0	0.0	0.0	0.0	46.1	0.0	0.0
5	0.2	87.2	0.0	0.0	0.0	0.0	13.1	0.0	0.0
6	1.8	1359.8	0.0	0.0	0.0	0.0	204.0	0.0	0.0
7	0.2	160.3	0.0	0.0	0.0	0.0	24.0	0.0	0.0
8	0.8	925.5	0.0	0.0	0.0	0.0	138.8	0.0	0.0
9	1.0	1146.5	0.0	0.0	0.0	0.0	172.0	0.0	0.0
10	0.5	471.4	0.0	0.0	0.0	0.0	70.7	0.0	0.0
11	0.5	472.7	0.0	0.0	0.0	0.0	70.9	0.0	0.0
12	0.7	665.8	0.0	0.0	0.0	0.0	99.9	0.0	185.0
13	1.5	1163.4	0.0	0.0	0.0	0.0	174.5	0.0	367.5
14	1.2	724.3	0.0	0.0	0.0	0.0	108.6	0.0	295.0
15	0.9	347.3	0.0	0.0	0.0	0.0	52.1	0.0	212.5
16	0.5	90.0	0.0	0.0	0.0	0.0	13.5	0.0	122.5
17	0.0	0.7	0.0	0.0	0.0	0.0	0.1	0.0	5.0

Table 2 - Base Stress Data on the 17 Slices

Slice No. *	Alpha (deg)	X-Coord. Slice Cntr (ft)	Base Leng. (ft)	Available Shear Strength (psf)	Mobilized Shear Stress (psf)
1	-24.25	16.32	2.00	236.72	-13.48
2	-12.99	18.21	2.00	250.49	-9.87
3	-1.72	19.59	0.82	241.74	18.46
4	-1.72	20.50	1.00	331.31	36.84
5	-1.72	21.09	0.18	434.93	58.11
6	9.18	22.09	1.84	554.43	229.84
7	9.18	23.08	0.16	694.72	308.23
8	20.25	23.58	0.90	733.75	536.46
9	20.25	24.51	1.10	739.86	541.98
10	31.55	25.26	0.55	692.05	653.05
11	31.55	25.75	0.59	660.44	615.50
12	31.55	26.37	0.87	772.41	716.58
13	42.56	27.48	2.00	753.65	791.84
14	53.76	28.80	2.00	719.58	751.14
15	64.84	29.82	2.00	685.61	622.19
16	75.82	30.49	2.00	647.81	427.14
17	87.95	30.74	0.56	746.53	283.60

Sum of the Resisting Forces (including Pier/Pile, Tieback, Reinforcing Soil Nail, and Applied Forces if applicable) = 11408.86 (lbs)

Average Available Shear Strength (including Tieback, Pier/Pile, Reinforcing, Soil Nail, and Applied Forces if applicable) = 554.99(psf)

Sum of the Driving Forces = 8245.94 (lbs)

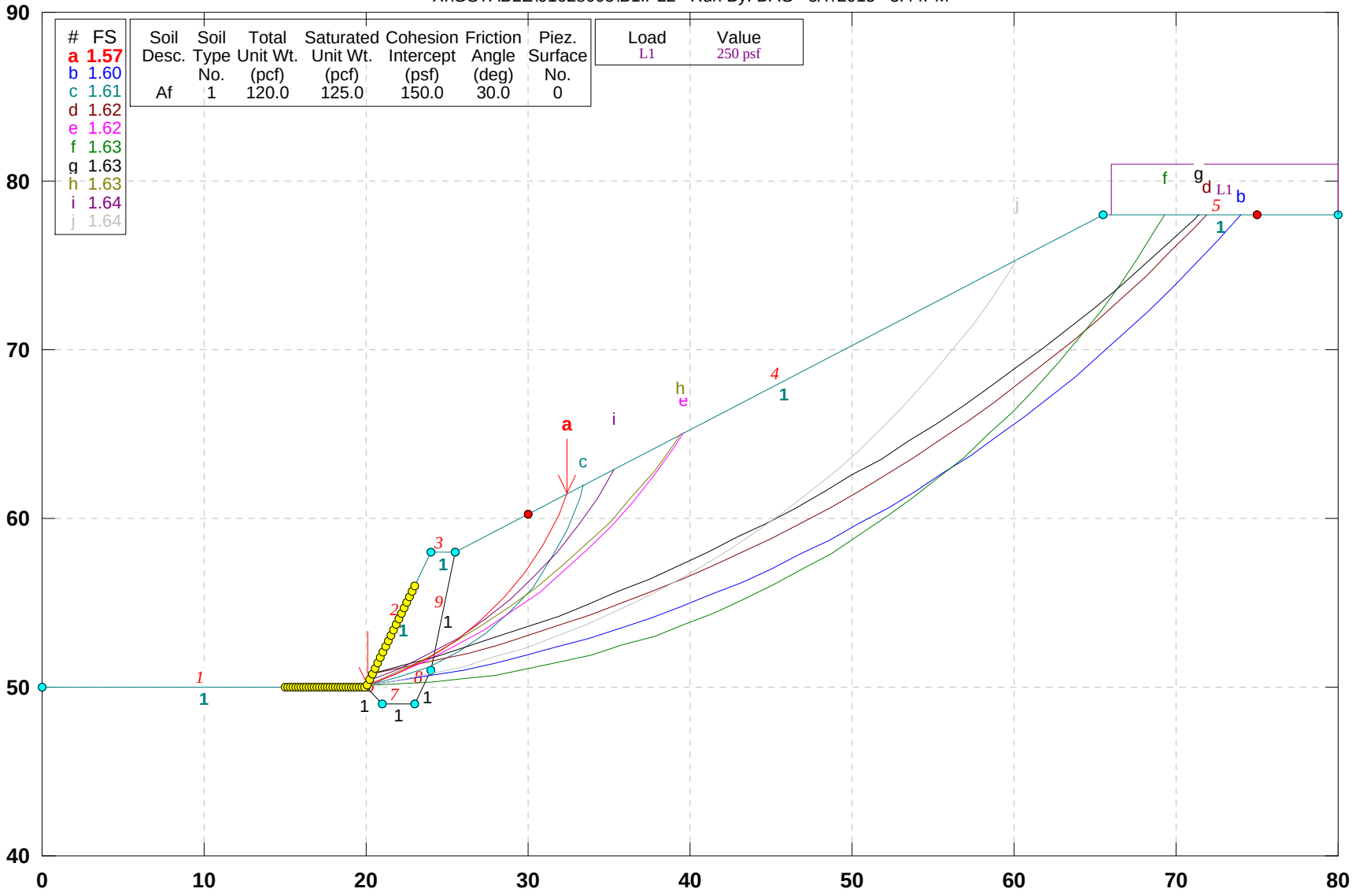
Average Mobilized Shear Stress = 401.13(psf)

Total length of the failure surface = 20.56(ft)

**** END OF GSTABL7 OUTPUT ****

01628-005; Powder Mtn.; Global Stability; 8' H Max;2H:1V; "A"; Static

X:\GSTABLE\01628005\B1.PL2 Run By: DAG 5/7/2013 3:44PM



GSTABL7 v.2 FSmin=1.57

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.002, December 2001 **

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SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.

****

Analysis Run Date: 5/7/2013
Time of Run: 3:44PM
Run By: DAG
Input Data Filename: X:B1.
Output Filename: X:B1.OUT
Unit System: English

Plotted Output Filename: X:B1.PLT

PROBLEM DESCRIPTION: 01628-005; Powder Mtn.; Global Stability ; 8' H Max;2H:1V; "A"; Static

BOUNDARY COORDINATES

5 Top Boundaries
9 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	50.00	20.00	50.00	1
2	20.00	50.00	24.00	58.00	1
3	24.00	58.00	25.50	58.00	1
4	25.50	58.00	65.50	78.00	1
5	65.50	78.00	80.00	78.00	1
6	20.00	50.00	21.00	49.00	1
7	21.00	49.00	23.00	49.00	1
8	23.00	49.00	24.00	51.00	1
9	24.00	51.00	25.50	58.00	1

User Specified Y-Origin = 40.00(ft)

ISOTROPIC SOIL PARAMETERS

1 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	125.0	150.0	30.0	0.00	0.0	0

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (psf)	Deflection (deg)
1	66.00	80.00	250.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed Force Acting On A Horizontally Projected Surface.

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

2500 Trial Surfaces Have Been Generated.

50 Surface(s) Initiate(s) From Each Of 50 Points Equally Spaced Along The Ground Surface Between X = 15.00(ft)
and X = 23.00(ft)

Each Surface Terminates Between X = 30.00(ft)
and X = 75.00(ft)

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 0.00(ft)

2.00(ft) Line Segments Define Each Trial Failure Surface.

Following Is Displayed The Most Critical Of The Trial
Failure Surfaces Evaluated.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 2500

Statistical Data On All Valid FS Values:
FS Max = 7.128 FS Min = 1.567 FS Ave = 2.200
Standard Deviation = 0.407 Coefficient of Variation = 18.49 %

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	20.06	50.12
2	21.95	50.79
3	23.75	51.66
4	25.46	52.70
5	27.04	53.92
6	28.50	55.29
7	29.80	56.80
8	30.94	58.45
9	31.91	60.20
10	32.44	61.47

Circle Center At X = 14.60 ; Y = 68.52 ; and Radius = 19.19

Factor of Safety
*** 1.567 ***

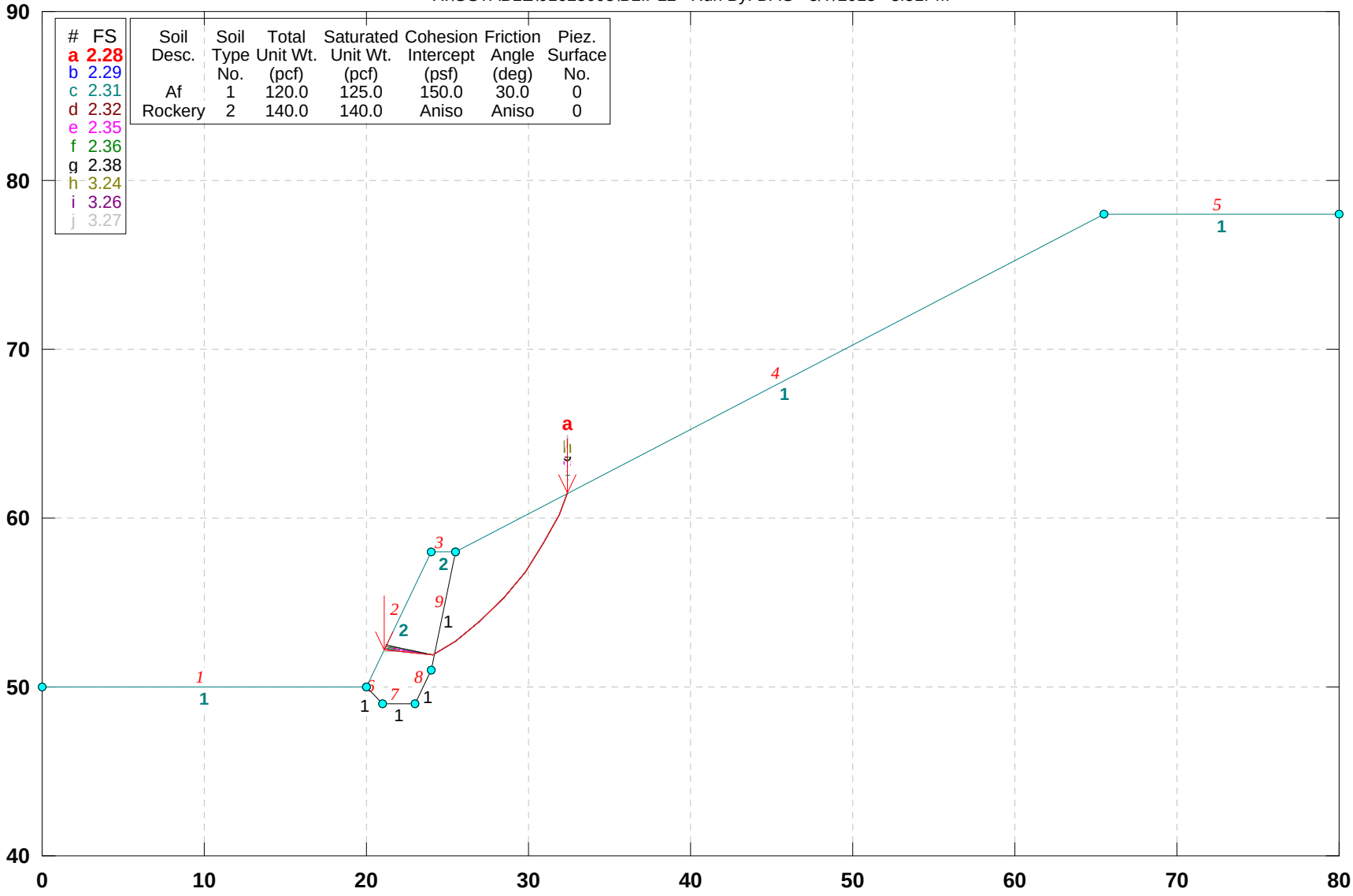
Individual data on the 12 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.9	350.3	0.0	0.0	0.	0.	0.0	0.0	0.0
2	1.8	968.4	0.0	0.0	0.	0.	0.0	0.0	0.0
3	0.2	180.1	0.0	0.0	0.	0.	0.0	0.0	0.0
4	0.2	146.7	0.0	0.0	0.	0.	0.0	0.0	0.0
5	1.3	857.5	0.0	0.0	0.	0.	0.0	0.0	0.0
6	0.0	27.6	0.0	0.0	0.	0.	0.0	0.0	0.0
7	1.5	938.4	0.0	0.0	0.	0.	0.0	0.0	0.0
8	1.5	791.2	0.0	0.0	0.	0.	0.0	0.0	0.0
9	1.3	591.4	0.0	0.0	0.	0.	0.0	0.0	0.0
10	1.1	384.5	0.0	0.0	0.	0.	0.0	0.0	0.0
11	1.0	189.5	0.0	0.0	0.	0.	0.0	0.0	0.0
12	0.5	32.3	0.0	0.0	0.	0.	0.0	0.0	0.0

**** END OF GSTABL7 OUTPUT ****

01628-005; Powder Mtn.; Global Stability; 8' H Max;2H:1V; "B"; Static

X:\GSTABLE\01628005\B2.PL2 Run By: DAG 5/7/2013 3:51PM



#	FS
a	2.28
b	2.29
c	2.31
d	2.32
e	2.35
f	2.36
g	2.38
h	3.24
i	3.26
j	3.27

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Af	1	120.0	125.0	150.0	30.0	0
Rockery	2	140.0	140.0	Aniso	Aniso	0

GSTABL7 v.2 FSmin=2.28

Safety Factors Are Calculated By The Simplified Janbu Method for the case of c & phi both > 0

GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.002, December 2001 **

****

SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.

****

Analysis Run Date: 5/7/2013
Time of Run: 3:51PM
Run By: DAG
Input Data Filename: X:B2.
Output Filename: X:B2.OUT
Unit System: English

Plotted Output Filename: X:B2.PLT

PROBLEM DESCRIPTION: 01628-005; Powder Mtn.; Global Stability
; 8' H Max;2H:1V; "B"; Static

BOUNDARY COORDINATES

5 Top Boundaries
9 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	50.00	20.00	50.00	1
2	20.00	50.00	24.00	58.00	2
3	24.00	58.00	25.50	58.00	2
4	25.50	58.00	65.50	78.00	1
5	65.50	78.00	80.00	78.00	1
6	20.00	50.00	21.00	49.00	1
7	21.00	49.00	23.00	49.00	1
8	23.00	49.00	24.00	51.00	1
9	24.00	51.00	25.50	58.00	1

1

User Specified Y-Origin = 40.00(ft)

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	125.0	150.0	30.0	0.00	0.0	0
2	140.0	140.0	0.0	45.0	0.00	0.0	0

ANISOTROPIC STRENGTH PARAMETERS
1 soil type(s)

Soil Type 2 Is Anisotropic

Number Of Direction Ranges Specified = 3

Direction Range No.	Counterclockwise Direction Limit (deg)	Cohesion Intercept (psf)	Friction Angle (deg)
1	-12.0	3000.00	0.00
2	-5.0	0.00	45.00
3	90.0	3000.00	0.00

ANISOTROPIC SOIL NOTES:
(1) An input value of 0.01 for C and/or Phi will cause Aniso C and/or Phi to be ignored in that range.
(2) An input value of 0.02 for Phi will set both Phi and C equal to zero, with no water weight in the tension crack.
(3) An input value of 0.03 for Phi will set both Phi and C equal to zero, with water weight in the tension crack.

Janbus Empirical Coef is being used for the case of c & phi both > 0

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.

1000 Trial Surfaces Have Been Generated.

8 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of
Sliding Block Is 2.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	24.10	51.90	24.10	51.90	0.00
2	25.46	52.70	25.46	52.70	0.00
3	27.04	53.92	27.04	53.92	0.00
4	28.50	55.29	28.50	55.29	0.00
5	29.80	56.80	29.80	56.80	0.00
6	30.94	58.45	30.94	58.45	0.00
7	31.91	60.20	31.91	60.20	0.00
8	32.44	61.47	32.44	61.47	0.00

Following Is Displayed The Most Critical Of The Trial
Failure Surfaces Evaluated.

* * Safety Factors Are Calculated By The Simplified Janbu Method * *

Total Number of Trial Surfaces Evaluated = 1000

Statistical Data On All Valid FS Values:
FS Max = 7.666 FS Min = 2.278 FS Ave = 5.958
Standard Deviation = 1.142 Coefficient of Variation = 19.17 %

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	21.12	52.23
2	22.11	52.13
3	24.10	51.90
4	25.46	52.70
5	27.04	53.92
6	28.50	55.29
7	29.80	56.80
8	30.94	58.45
9	31.91	60.20
10	32.44	61.47

Factor of Safety
*** 2.278 ***

Individual data on the 12 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.0	146.4	0.0	0.0	0.	0.	0.0	0.0	0.0
2	1.9	1080.4	0.0	0.0	0.	0.	0.0	0.0	0.0
3	0.1	85.3	0.0	0.0	0.	0.	0.0	0.0	0.0
4	0.1	90.3	0.0	0.0	0.	0.	0.0	0.0	0.0
5	1.3	930.9	0.0	0.0	0.	0.	0.0	0.0	0.0
6	0.0	25.4	0.0	0.0	0.	0.	0.0	0.0	0.0
7	1.5	935.0	0.0	0.0	0.	0.	0.0	0.0	0.0
8	1.5	793.7	0.0	0.0	0.	0.	0.0	0.0	0.0
9	1.3	589.7	0.0	0.0	0.	0.	0.0	0.0	0.0
10	1.1	384.4	0.0	0.0	0.	0.	0.0	0.0	0.0
11	1.0	190.6	0.0	0.0	0.	0.	0.0	0.0	0.0
12	0.5	32.0	0.0	0.0	0.	0.	0.0	0.0	0.0

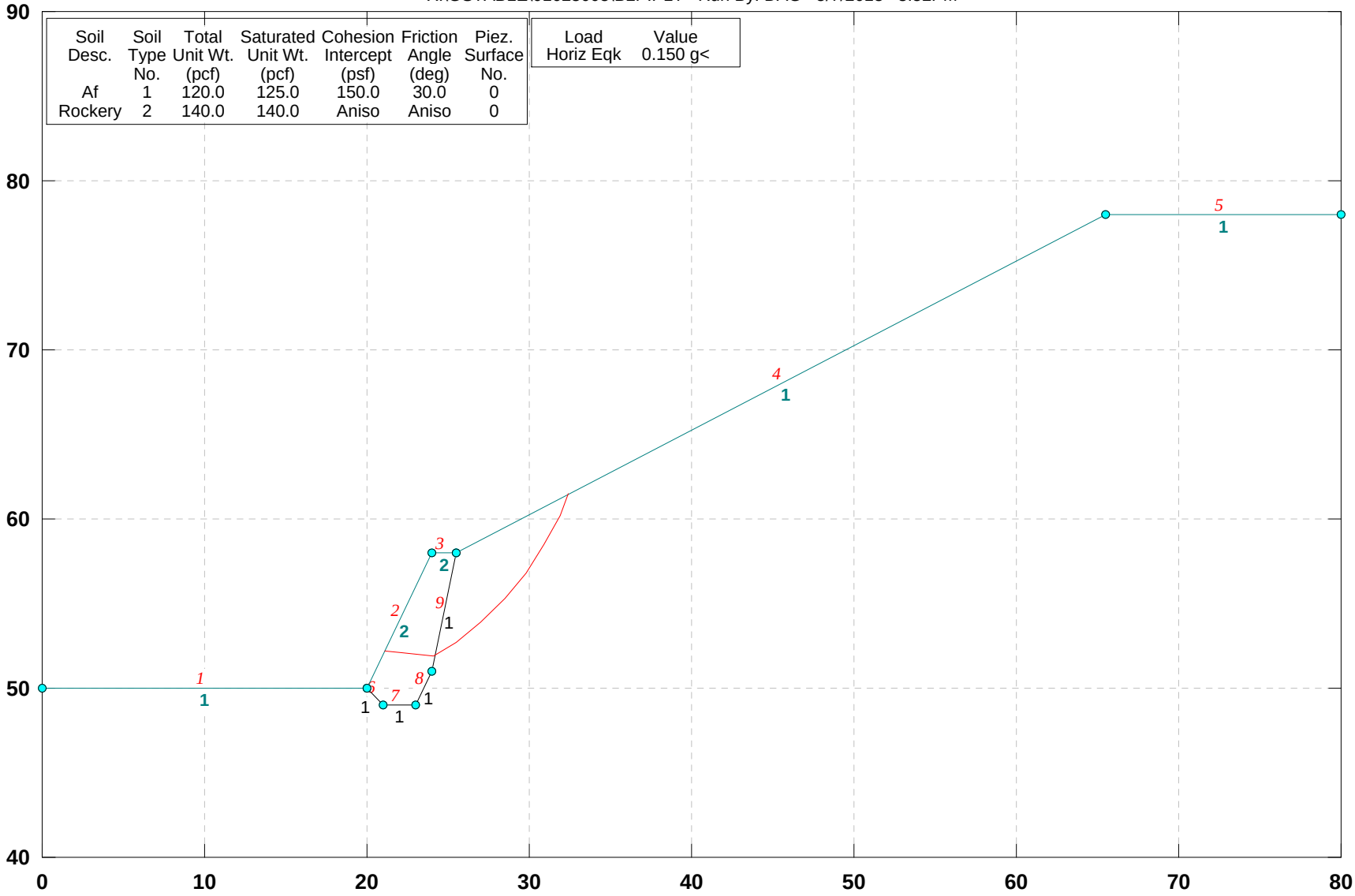
**** END OF GSTABL7 OUTPUT ****

01628-005; Powder Mtn.; Global Stability; 8' H Max;2H:1V; "B"; P-Static

X:\GSTABLE\01628005\B2P.PLT Run By: DAG 5/7/2013 3:52PM

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Af	1	120.0	125.0	150.0	30.0	0
Rockery	2	140.0	140.0	Aniso	Aniso	0

Load	Value
Horiz Eqk	0.150 g<



GSTABL7 v.2 FSmin=1.79

Factor Of Safety Is Calculated By The Simplified Janbu Method

GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. ** 1

** Original Version 1.0, January 1996; Current Version 2.002, December 2001 **

****

SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.

****

Analysis Run Date: 5/7/2013
Time of Run: 3:52PM
Run By: DAG
Input Data Filename: X:B2P.
Output Filename: X:B2P.OUT
Unit System: English

Plotted Output Filename: X:B2P.PLT

PROBLEM DESCRIPTION: 01628-005; Powder Mtn.; Global Stability
; 8' H Max;2H:1V; "B"; P-Static

BOUNDARY COORDINATES

5 Top Boundaries
9 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	50.00	20.00	50.00	1
2	20.00	50.00	24.00	58.00	2
3	24.00	58.00	25.50	58.00	2
4	25.50	58.00	65.50	78.00	1
5	65.50	78.00	80.00	78.00	1
6	20.00	50.00	21.00	49.00	1
7	21.00	49.00	23.00	49.00	1
8	23.00	49.00	24.00	51.00	1
9	24.00	51.00	25.50	58.00	1

User Specified Y-Origin = 40.00(ft)

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	125.0	150.0	30.0	0.00	0.0	0
2	140.0	140.0	0.0	45.0	0.00	0.0	0

ANISOTROPIC STRENGTH PARAMETERS
1 soil type(s)

Soil Type 2 Is Anisotropic

Number Of Direction Ranges Specified = 3

Direction Range No.	Counterclockwise Direction Limit (deg)	Cohesion Intercept (psf)	Friction Angle (deg)
1	-12.0	3000.00	0.00
2	-5.0	0.00	45.00
3	90.0	3000.00	0.00

ANISOTROPIC SOIL NOTES:
(1) An input value of 0.01 for C and/or Phi will cause Aniso C and/or Phi to be ignored in that range.
(2) An input value of 0.02 for Phi will set both Phi and C equal to zero, with no water weight in the tension crack.
(3) An input value of 0.03 for Phi will set both Phi and C equal to zero, with water weight in the tension crack.

A Horizontal Earthquake Loading Coefficient
Of0.150 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of0.000 Has Been Assigned

Cavitation Pressure = 0.0(psf)

Janbu's Empirical Coef. is being used for the case of c & phi both > 0

1

Trial Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	21.12	52.24
2	22.11	52.13
3	24.10	51.90
4	25.46	52.70
5	27.04	53.92
6	28.50	55.29
7	29.80	56.80
8	30.94	58.45
9	31.91	60.20
10	32.44	61.47

Janbu's Empirical Coefficient (fo) = 1.064

* * Factor Of Safety Is Calculated By The Simplified Janbu Method * *

Factor Of Safety For The Preceding Specified Surface = 1.787

Table 1 - Individual Data on the 12 Slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.0	144.8	0.0	0.0	0.0	0.0	21.7	0.0	0.0
2	1.9	1082.0	0.0	0.0	0.0	0.0	162.3	0.0	0.0
3	0.1	85.3	0.0	0.0	0.0	0.0	12.8	0.0	0.0
4	0.1	90.3	0.0	0.0	0.0	0.0	13.5	0.0	0.0
5	1.3	930.9	0.0	0.0	0.0	0.0	139.6	0.0	0.0
6	0.0	25.4	0.0	0.0	0.0	0.0	3.8	0.0	0.0
7	1.5	935.0	0.0	0.0	0.0	0.0	140.3	0.0	0.0
8	1.5	793.7	0.0	0.0	0.0	0.0	119.0	0.0	0.0
9	1.3	589.7	0.0	0.0	0.0	0.0	88.5	0.0	0.0
10	1.1	384.4	0.0	0.0	0.0	0.0	57.7	0.0	0.0
11	1.0	190.6	0.0	0.0	0.0	0.0	28.6	0.0	0.0
12	0.5	32.0	0.0	0.0	0.0	0.0	4.8	0.0	0.0

Table 2 - Base Stress Data on the 12 Slices

Slice No.	Alpha (deg)	X-Coord. Slice Cntr (ft)	Base Leng. (ft)	Available Shear Strength (psf)	Mobilized Shear Stress (psf)
1	-6.34	21.62	1.00	156.96	5.65
2	-6.59	23.06	1.90	616.16	19.58
3	-6.59	24.05	0.10	918.27	29.18
4	30.47	24.15	0.12	3480.54	540.63
5	30.47	24.83	1.45	564.14	472.45
6	37.67	25.48	0.05	522.96	464.22
7	37.67	26.27	1.95	506.11	443.15
8	43.18	27.77	2.00	488.09	431.43
9	49.27	29.15	1.99	459.02	388.15
10	55.36	30.37	2.01	413.15	306.18
11	61.00	31.42	2.00	343.30	186.15
12	67.35	32.18	1.38	270.46	59.13

Sum of the Resisting Forces (including Pier/Pile, Tieback, Reinforcing Soil Nail, and Applied Forces if applicable) = 7373.14 (lbs)

Average Available Shear Strength (including Tieback, Pier/Pile, Reinforcing, Soil Nail, and Applied Forces if applicable) = 462.25(psf)

Sum of the Driving Forces = 4390.41 (lbs)

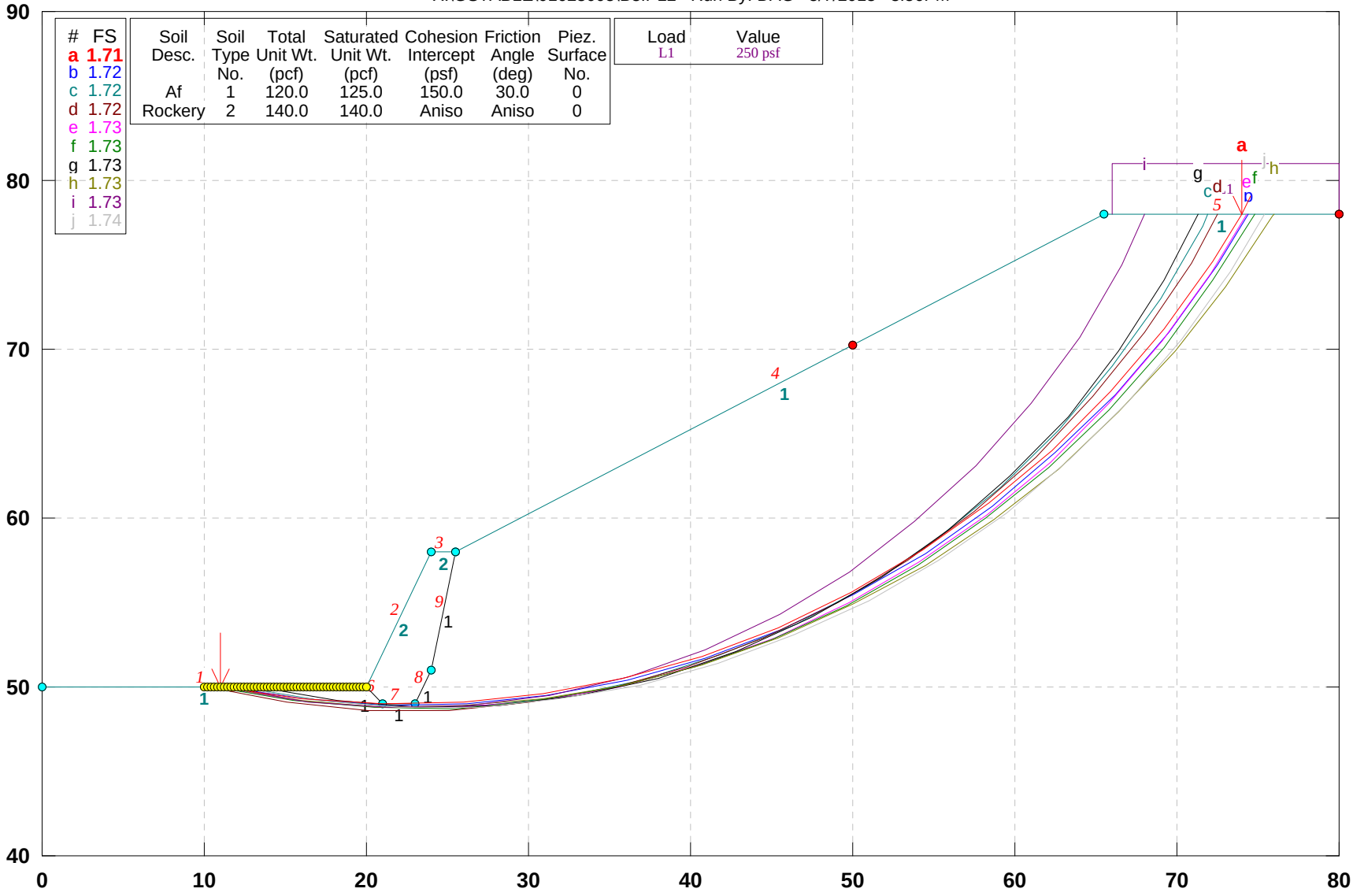
Average Mobilized Shear Stress = 275.25(psf)

Total length of the failure surface = 15.95(ft)

**** END OF GSTABL7 OUTPUT ****

01628-005; Powder Mtn.; Global Stability; 8' H Max;2H:1V; Static

X:\GSTABLE\01628005\B3.PL2 Run By: DAG 5/7/2013 3:56PM



#	FS
a	1.71
b	1.72
c	1.72
d	1.72
e	1.73
f	1.73
g	1.73
h	1.73
i	1.73
j	1.74

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Af	1	120.0	125.0	150.0	30.0	0
Rockery	2	140.0	140.0	Aniso	Aniso	0

Load	Value
L1	250 psf

GSTABL7 v.2 FSmin=1.71

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.002, December 2001 **

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SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.

****

Analysis Run Date: 5/7/2013
Time of Run: 3:56PM
Run By: DAG
Input Data Filename: X:B3.
Output Filename: X:B3.OUT
Unit System: English

Plotted Output Filename: X:B3.PLT

PROBLEM DESCRIPTION: 01628-005; Powder Mtn.; Global Stability
; 8' H Max;2H:1V; Static

BOUNDARY COORDINATES

5 Top Boundaries
9 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	50.00	20.00	50.00	1
2	20.00	50.00	24.00	58.00	2
3	24.00	58.00	25.50	58.00	2
4	25.50	58.00	65.50	78.00	1
5	65.50	78.00	80.00	78.00	1
6	20.00	50.00	21.00	49.00	1
7	21.00	49.00	23.00	49.00	1
8	23.00	49.00	24.00	51.00	1
9	24.00	51.00	25.50	58.00	1

User Specified Y-Origin = 40.00(ft)

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	125.0	150.0	30.0	0.00	0.0	0
2	140.0	140.0	0.0	45.0	0.00	0.0	0

ANISOTROPIC STRENGTH PARAMETERS
1 soil type(s)

Soil Type 2 Is Anisotropic

Number Of Direction Ranges Specified = 3

Direction Range No.	Counterclockwise Direction Limit (deg)	Cohesion Intercept (psf)	Friction Angle (deg)
1	-12.0	3000.00	0.00
2	-5.0	0.00	45.00
3	90.0	3000.00	0.00

ANISOTROPIC SOIL NOTES:
(1) An input value of 0.01 for C and/or Phi will cause Aniso C and/or Phi to be ignored in that range.
(2) An input value of 0.02 for Phi will set both Phi and C equal to zero, with no water weight in the tension crack.
(3) An input value of 0.03 for Phi will set both Phi and C equal to zero, with water weight in the tension crack.

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (psf)	Deflection (deg)
1	66.00	80.00	250.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

2500 Trial Surfaces Have Been Generated.

50 Surface(s) Initiate(s) From Each Of 50 Points Equally Spaced
Along The Ground Surface Between X = 10.00(ft)
and X = 20.00(ft)

Each Surface Terminates Between X = 50.00(ft)
and X = 80.00(ft)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)

5.00(ft) Line Segments Define Each Trial Failure Surface.

Following Is Displayed The Most Critical Of The Trial
Failure Surfaces Evaluated.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 2500

Statistical Data On All Valid FS Values:
FS Max = 4.378 FS Min = 1.713 FS Ave = 2.207
Standard Deviation = 0.255 Coefficient of Variation = 11.53 %

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	11.02	50.00
2	15.97	49.27
3	20.96	48.96
4	25.96	49.05
5	30.93	49.56
6	35.85	50.48
7	40.67	51.79
8	45.37	53.50
9	49.91	55.59
10	54.26	58.05
11	58.40	60.86
12	62.29	64.00
13	65.91	67.45
14	69.24	71.19
15	72.24	75.18
16	74.01	78.00

Circle Center At X = 22.31 ; Y = 109.47 ; and Radius = 60.53

Factor of Safety
*** 1.713 ***

Individual data on the 22 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	4.9	215.5	0.0	0.0	0.	0.	0.0	0.0	0.0
2	4.0	413.1	0.0	0.0	0.	0.	0.0	0.0	0.0
3	1.0	253.9	0.0	0.0	0.	0.	0.0	0.0	0.0
4	0.0	17.6	0.0	0.0	0.	0.	0.0	0.0	0.0
5	2.0	1405.3	0.0	0.0	0.	0.	0.0	0.0	0.0
6	1.0	1099.2	0.0	0.0	0.	0.	0.0	0.0	0.0
7	1.5	1719.5	0.0	0.0	0.	0.	0.0	0.0	0.0
8	0.5	497.1	0.0	0.0	0.	0.	0.0	0.0	0.0
9	5.0	6067.3	0.0	0.0	0.	0.	0.0	0.0	0.0
10	4.9	7034.4	0.0	0.0	0.	0.	0.0	0.0	0.0
11	4.8	7665.8	0.0	0.0	0.	0.	0.0	0.0	0.0
12	4.7	7956.1	0.0	0.0	0.	0.	0.0	0.0	0.0
13	4.5	7913.8	0.0	0.0	0.	0.	0.0	0.0	0.0
14	4.4	7560.2	0.0	0.0	0.	0.	0.0	0.0	0.0
15	4.1	6929.5	0.0	0.0	0.	0.	0.0	0.0	0.0
16	3.9	6067.0	0.0	0.0	0.	0.	0.0	0.0	0.0
17	3.2	4491.4	0.0	0.0	0.	0.	0.0	0.0	0.0
18	0.4	531.3	0.0	0.0	0.	0.	0.0	0.0	0.0
19	0.1	110.8	0.0	0.0	0.	0.	0.0	0.0	0.0
20	3.2	3351.3	0.0	0.0	0.	0.	0.0	0.0	808.8
21	3.0	1735.9	0.0	0.0	0.	0.	0.0	0.0	751.0
22	1.8	299.9	0.0	0.0	0.	0.	0.0	0.0	443.6

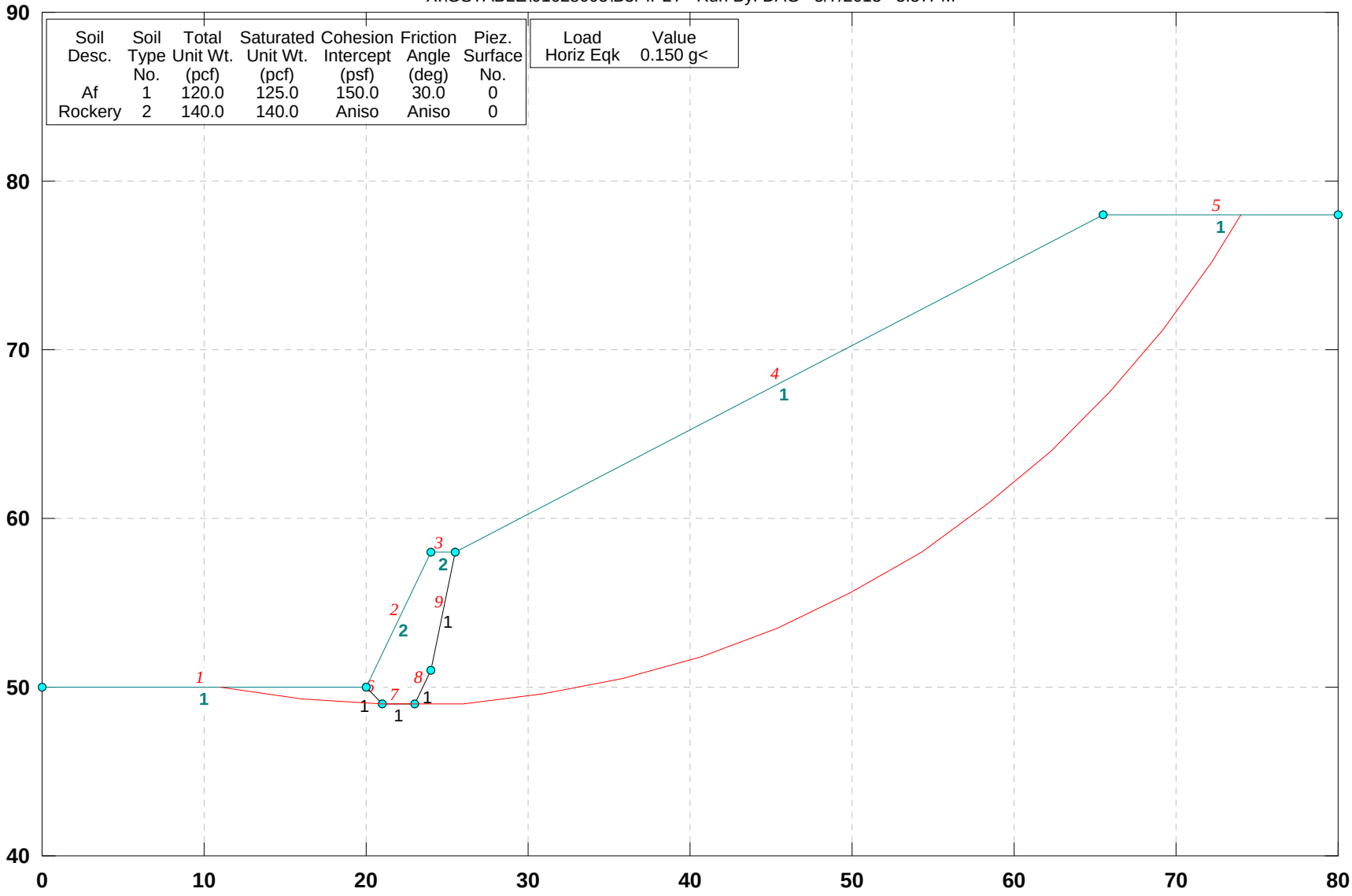
**** END OF GSTABL7 OUTPUT ****

01628-005; Powder Mtn.; Global Stability; 8' H Max;2H:1V; P-Static

X:\GSTABLE\01628005\B3P.PLT Run By: DAG 5/7/2013 3:57PM

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Af	1	120.0	125.0	150.0	30.0	0
Rockery	2	140.0	140.0	Aniso	Aniso	0

Load	Value
Horiz Eqk	0.150 g<



GSTABL7 v.2 FSmin=1.27

Factor Of Safety Is Calculated By The Simplified Janbu Method

GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.002, December 2001 **

****

SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.

****

Analysis Run Date: 5/7/2013
Time of Run: 3:57PM
Run By: DAG
Input Data Filename: X:B3P.
Output Filename: X:B3P.OUT
Unit System: English

Plotted Output Filename: X:B3P.PLT

PROBLEM DESCRIPTION: 01628-005; Powder Mtn.; Global Stability ; 8' H Max;2H:1V; P-Static

BOUNDARY COORDINATES

5 Top Boundaries
9 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	50.00	20.00	50.00	1
2	20.00	50.00	24.00	58.00	2
3	24.00	58.00	25.50	58.00	2
4	25.50	58.00	65.50	78.00	1
5	65.50	78.00	80.00	78.00	1
6	20.00	50.00	21.00	49.00	1
7	21.00	49.00	23.00	49.00	1
8	23.00	49.00	24.00	51.00	1
9	24.00	51.00	25.50	58.00	1

User Specified Y-Origin = 40.00(ft)
1

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	125.0	150.0	30.0	0.00	0.0	0
2	140.0	140.0	0.0	45.0	0.00	0.0	0

ANISOTROPIC STRENGTH PARAMETERS
1 soil type(s)

Soil Type 2 Is Anisotropic

Number Of Direction Ranges Specified = 3

Direction Range No.	Counterclockwise Direction Limit (deg)	Cohesion Intercept (psf)	Friction Angle (deg)
1	-12.0	3000.00	0.00
2	-5.0	0.00	45.00
3	90.0	3000.00	0.00

ANISOTROPIC SOIL NOTES:
(1) An input value of 0.01 for C and/or Phi will cause Aniso C and/or Phi to be ignored in that range.
(2) An input value of 0.02 for Phi will set both Phi and C equal to zero, with no water weight in the tension crack.
(3) An input value of 0.03 for Phi will set both Phi and C equal to zero, with water weight in the tension crack.

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (psf)	Deflection (deg)
1	66.00	80.00	250.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed Force Acting On A Horizontally Projected Surface.

SURCHARGE BOUNDARY LOAD DATA HAS BEEN SUPPRESSED

A Horizontal Earthquake Loading Coefficient
Of0.150 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of0.000 Has Been Assigned

Cavitation Pressure = 0.0(psf)

Janbu's Empirical Coef. is being used for the case of c & phi both > 0
1

Trial Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	11.02	50.00
2	15.97	49.27
3	20.96	48.96
4	25.96	49.05
5	30.93	49.56
6	35.85	50.48
7	40.67	51.79
8	45.37	53.50
9	49.91	55.59
10	54.26	58.05
11	58.40	60.86
12	62.29	64.00
13	65.91	67.45
14	69.24	71.19
15	72.24	75.18
16	74.01	78.00

Janbu's Empirical Coefficient (fo) = 1.061

* * Factor Of Safety Is Calculated By The Simplified Janbu Method * *

Factor Of Safety For The Preceding Specified Surface = 1.268

Table 1 - Individual Data on the 21 Slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	4.9	216.8	0.0	0.0	0.0	0.0	32.5	0.0	0.0
2	4.0	413.6	0.0	0.0	0.0	0.0	62.0	0.0	0.0
3	1.0	254.6	0.0	0.0	0.0	0.0	38.2	0.0	0.0
4	0.0	16.8	0.0	0.0	0.0	0.0	2.5	0.0	0.0
5	2.0	1405.1	0.0	0.0	0.0	0.0	210.8	0.0	0.0
6	1.0	1099.3	0.0	0.0	0.0	0.0	164.9	0.0	0.0
7	1.5	1719.9	0.0	0.0	0.0	0.0	258.0	0.0	0.0
8	0.5	500.6	0.0	0.0	0.0	0.0	75.1	0.0	0.0
9	5.0	6063.9	0.0	0.0	0.0	0.0	909.6	0.0	0.0
10	4.9	7040.5	0.0	0.0	0.0	0.0	1056.1	0.0	0.0
11	4.8	7660.9	0.0	0.0	0.0	0.0	1149.1	0.0	0.0
12	4.7	7960.9	0.0	0.0	0.0	0.0	1194.1	0.0	0.0
13	4.5	7913.2	0.0	0.0	0.0	0.0	1187.0	0.0	0.0
14	4.4	7554.6	0.0	0.0	0.0	0.0	1133.2	0.0	0.0
15	4.1	6935.3	0.0	0.0	0.0	0.0	1040.3	0.0	0.0
16	3.9	6064.9	0.0	0.0	0.0	0.0	909.7	0.0	0.0
17	3.2	4494.5	0.0	0.0	0.0	0.0	674.2	0.0	0.0
18	0.4	528.7	0.0	0.0	0.0	0.0	79.3	0.0	0.0
19	3.3	3468.5	0.0	0.0	0.0	0.0	520.3	0.0	0.0
20	3.0	1733.4	0.0	0.0	0.0	0.0	260.0	0.0	0.0
21	1.8	299.5	0.0	0.0	0.0	0.0	44.9	0.0	0.0

Table 2 - Base Stress Data on the 21 Slices

Slice No. *	Alpha (deg)	X-Coord. Slice Cntr (ft)	Base Leng. (ft)	Available Shear Strength (psf)	Mobilized Shear Stress (psf)
1	-8.39	13.49	5.00	189.94	0.11
2	-3.55	17.99	4.04	215.75	9.00
3	-3.55	20.48	0.96	312.55	23.26
4	1.03	20.98	0.04	388.65	70.34
5	1.03	22.00	2.00	551.19	118.01
6	1.03	23.50	1.00	778.44	184.65
7	1.03	24.75	1.50	805.53	192.60
8	1.03	25.73	0.46	772.13	182.80
9	5.86	28.44	5.00	820.57	306.61
10	10.59	33.39	5.01	915.19	474.02
11	15.20	38.26	4.99	984.54	646.92
12	19.99	43.02	5.00	1029.68	817.87
13	24.72	47.64	5.00	1052.38	966.36
14	29.49	52.08	5.00	1053.08	1081.66
15	34.17	56.33	5.00	1031.45	1148.70
16	38.91	60.35	5.00	986.88	1161.25
17	43.62	63.90	4.43	923.27	1118.00
18	43.62	65.71	0.57	861.70	1029.61
19	48.32	67.57	5.01	747.60	881.82
20	53.06	70.74	4.99	501.20	513.91
21	57.89	73.12	3.33	270.03	156.80

Sum of the Resisting Forces (including Pier/Pile, Tieback, Reinforcing Soil Nail, and Applied Forces if applicable) = 56070.69 (lbs)

Average Available Shear Strength (including Tieback, Pier/Pile, Reinforcing, Soil Nail, and Applied Forces if applicable) = 764.64(psf)

Sum of the Driving Forces = 46914.41 (lbs)

Average Mobilized Shear Stress = 639.78(psf)

Total length of the failure surface = 73.33(ft)

**** END OF GSTABL7 OUTPUT ****