GeoStrata Engineering & Geosciences
14425 S. Center Point Way, Bluffdale, Utah 84065 ~ T: (801) 501-0583 ~ F: (801) 501-0584

MEMORANDUM

To: Matt Rasmussen

From: J. Scott Seal, P.E.
Mark I. Christensen, P.E.
Timothy J. Thompson, P.G.

Date: May 4, 2015

Subject: **Review Response for Retaining Wall Review – 6472 and 6498 South Bybee Drive, Weber County Parcel Numbers: 07-753-0001 and 07-753-0002 Uintah, Utah**

GeoStrata has received review questions concerning proposed rockery retaining walls associated with the proposed Dauphine-Savory Piedmont Subdivision Lots 1R and 2R. We understand that the review comments were made concerning a rockery design prepared by Silverpeak Engineering in a report dated October 29, 2014. GeoStrata has been retained to complete a rockery design and respond to the review comments. The reviews were completed by Mr. Alan Taylor, P.E. of Taylor Geotechnical. This memorandum was prepared in response to the review questions presented in a letter dated December 2, 2014.

Review Questions – TGE

1. "The design procedure used by Silverpeak does not cover all aspects of rock retaining wall design. The design should be revised and completed in general accordance with 2006 FHWA-CLF/TD-06-006 "Rockery Design and Construction Guidelines." The document is free online and provides a detailed procedure for the internal and external analysis for rock walls."

GeoStrata Response: GeoStrata has completed an updated rockery design using the site plan provided by Silverpeak Engineering titled "Rasmussen Residence Weber Canyon, Uintah, Utah" and dated October 29, 2014. This site plan contained proposed final wall elevations and heights. The rockery design will be submitted as a separate report attached to this review response document, and will be completed in accordance with the recommendations made in the 2006 FHWA CLF/TD-06-006 document.

2. "The retaining wall design was based on assumed soil parameters. The soil parameters used in the retaining wall design should be substantiated with laboratory testing."

GeoStrata Response: GeoStrata has completed a direct shear test on a sample obtained from the subject property (Trench 3). Based on the results of our testing, the soil parameters consist of a friction angle (ϕ) of 31° and a cohesion of 445 psf. Results of our laboratory testing have been attached to the end of our rockery analysis and design document as Plate D-1.

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3. "The retaining wall design did not address seismic conditions. The seismic analysis should follow the analysis procedure as provided in the FHWA document referenced in Item (1)."

GeoStrata Response: GeoStrata has completed a rockery design as per the FHWA document. It may be found attached to the end of this letter.

4. "The wall design should include global stability analysis under static and seismic conditions. The seismic load should be based on the characteristic earthquake with spectral accelerations factored for site conditions in accordance with the IBC. The input and output files should be included with the results of the analysis."

GeoStrata Response: GeoStrata has completed the analyses recommended in the above comment. The results of which may be found in the attached rockery analysis and design document.

5. "The design should address saturation of the retained soils as a result of spring thaw and the presence of a septic system at the tow of the wall."

GeoStrata Response: GeoStrata recommends that a filter fabric be placed behind the wall in order to provide drainage should saturation of the retained soils occur. Recommendations concerning the construction of the wall may be found in our attached rockery design document.

6. "The construction detail should address a drainage layer behind the wall in accordance with the FHWA document referenced in Item (1) above."

GeoStrata Response: GeoStrata has completed the recommended construction detail discussed above.

7. "The design should address an inspection schedule by the engineer of record."

GeoStrata Response: GeoStrata has established a recommended inspection schedule in the attached rockery analysis and design."

8. "The design engineer should provide a final inspection letter when the wall is complete that verifies inspection during construction and that the wall was constructed in accordance with the approved design."

GeoStrata Response: GeoStrata concurs with the above statement.

Closure

The conclusions and recommendations contained in this memorandum which include professional opinions and judgments, are based on the information available to us at the time of our evaluation, the results of our field observations, our limited subsurface exploration and our understanding of the proposed site development. This memorandum was prepared in accordance with the generally

accepted standard of practice at the time the report was written. No warranty, expressed or implied, is made. Development of property in the immediate vicinity of active faults involves a certain level of inherent risk.

This memorandum was written for the exclusive use of Matt Rasmussen and only for the proposed project described herein. It is the Client's responsibility to see that all parties to the project including the Designer, Contractor, Subcontractors, etc. are made aware of this memorandum in its entirety. We are not responsible for the technical interpretations by others of the information described or documented in this memorandum. The use of information contained in this memorandum for bidding purposes should be done at the Contractor's option and risk.

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May 4, 2015

Matt Rasmussen
2927 Melanie Lane
Ogden, Utah 84403

Subject: **Rockery Analysis and Design**
Dauphine-Savory Piedmont Subdivision Lots 1R and 2R
Weber County, Utah
GeoStrata Project No. 910-001

Mr. Rasmussen,

As requested, GeoStrata has evaluated two proposed rockeries to be constructed on residential building lot 2R within the Dauphine-Savory Piedmont subdivision in Weber County, Utah. Information concerning the rockeries, including location and proposed height, were obtained from a proposed site grading and drainage plan prepared by Silverpeak Engineering and dated October 29, 2014. The first rockery investigated will be located to the east-northeast of the proposed residence and will consist of a single tier with a maximum exposed vertical height of 9 feet (8 feet exposed). The slope above this rockery will consist of a 3.5(H):1(V) ascending slope, whereas the slope below the rockery will be relatively horizontal in order to accommodate the proposed residence and yard area. This rockery has been designated as Rockery 1.

The second rockery investigated will be located the western edge of the proposed residence, and will consist of a single tier with a maximum exposed vertical height of 5 feet (4 feet exposed). The slope above the rockery will be approximately horizontal in order to accommodate the residence, whereas the slope below the rockery will consist of a 2(H):1(V) descending slope. This rockery has been designated as Rockery 2.

The rockeries are shown on the Site Plan which is included as Plate A-1 in Appendix A.

The rockery analysis included in this report was completed in accordance with the accepted industry standards of care including global stability, internal stability and external stability. The rockery design was based on discussions with the Client, our understanding of the project site geometry as observed during site visits and laboratory testing of a sample of on-site soils. The following paragraphs further describe the analysis and design procedures.

Soil Parameters

The native site soils were observed through the advancement of three exploratory trenches as well as two test pits. A sample of the near-surface soils was obtained from Trench 3. The soil consisted of a light brown Silty SAND (SM) with occasional gravel, and appeared to be consistent and homogenous across the cut. A direct shear (ASTM D3080) test was completed on a sample obtained

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from Trench 3. Laboratory test results included in Appendix D of this report indicate a friction angle of 31 degrees with a cohesion value of 445 psf.

Horizontal Ground Acceleration

GeoStrata has previously calculated the anticipated peak ground acceleration for the subject property as part of our 2013 investigation. Results of our calculations indicated that the peak ground acceleration (PGA) is estimated to be 0.57g.

Internal and External Stability Analysis

Engineering analysis of the rockeries included determination of minimum rock sizes. Minimum rock size was evaluated by analyzing overturning and sliding for individual rocks within the rockeries along a 1-foot unit length. Lateral earth pressures were calculated using the Coulomb approach, incorporating back slope and surcharge. Seismic considerations were incorporated using the Mononobe-Okabe equation as well as through using the procedure outlined in publications No. FHWA-CFL/TD-06-006 and FHWA-NHI-10-024. The boulders were considered to be an anisotropic material with a boulder-to-boulder lateral shear resistance characterized by a friction angle of 45° and a cohesion value of 0 psf. A cohesion value of 2,000 psf was assumed to characterize the internal rock strength. It was also assumed that chinking material is not allowed to remain on the boulder surface and the boulders have a contact area equal to 70% of the assumed bottom surface. Typical minimum factor of safety requirements for these conditions are 1.5 for overturning and 1.1 for sliding. Results of our internal stability analysis are included in Appendix B.

It should be noted that due to the presence of the backslope behind Rockery 1, as well as the moderately strong anticipated seismic forces, it was not feasible to utilize the Mononobe-Okabe equation. An alternative methodology is presented in the FHWA-CFL/TD-06-006 document. This methodology utilizes using a global stability program (in this case, SLIDE) in order to determine the seismic forces the wall experiences during a seismic event. Results of our global stability analysis indicate that the slope as proposed will remain stable during a seismic event, and as such the seismic forces put upon the wall have been reduced to 0.

Global Stability Analysis

The global stability analysis included both static and pseudo-static (seismic) analysis of the maximum section of both of the proposed rockeries. The stability analyses were completed using the geometric conditions, soil strengths and assumed rockery construction as observed on site and described in previous paragraphs. The investigated section of Rockery 1 was designated as section A-A'. The investigated section of Rockery 2 was designated as section B-B'. Minimum factors of safety of 1.5 and 1.1 for static and seismic conditions, respectively, were considered acceptable. The results of the global stability analyses are presented in Appendix C.

Rockery Construction Specifications

Based on the analysis and the constraints presented in this report and in accordance with the Associated Rockery Contractors (ARC) *Rock Wall Construction Guidelines*, the attached drawings and specifications presented in Appendix A (Plates A-2 and A-3) were developed. The following paragraphs further describe design elements that should be incorporated into the rockery construction.

Section drawings of the proposed rockeries are included in Appendix A as Plates A-2 and A-3. Based on our design analyses, the rock facing should not be placed steeper than 0.5 to 1 (horizontal to vertical) and the bottom rocks of the rockeries should be keyed into the ground a minimum of 12 inches. Rock facing should be placed in general accordance with the ARC *Rockery Construction Guidelines* as summarized in the attached Construction Specifications, Plate A-4. The guidelines state:

- Rocks should be placed so that there are no continuous joint planes in either the vertical or lateral direction.
- Rocks should be staggered such that each rock bears on the 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.

A channel lined with a minimum of 6 inches of low permeability soil should be constructed above the top course of rock and should slope to the southern end of the rockery. The purpose of the channel is to prevent surface water such as precipitation or irrigation from flowing over the top of the rockery or infiltrating the soil above and behind the rockery.

Conclusions and Limitations

The results of the analyses indicate that the proposed rockeries met adequate factors of safety. Section drawings of the rockery and General Construction Guidelines are provided in Appendix A. The rockeries should be constructed as shown in the drawings. Boulders should be set with the largest dimension perpendicular to the rockery facing. To increase facing stability, voids between boulders should be chinked with smaller rocks.

The design drawings and specifications have been completed to reduce the potential for erosion and scour at the toe of the rockeries and saturation of the slope behind the rockeries. Efforts should be made to quickly vegetate/landscape the area above the rockeries to reduce erosion and infiltration.

A perforated drainage pipe and a 1.0-foot partition of gravel wrapped in geotextile fabric or alternatively a continuously placed prefabricated drainage composite has been included in the section drawings to provide some drainage behind the wall.

Conditions such as leaky or broken irrigation lines and ponding of precipitation or runoff can lead to saturation of the soil behind the rockery, which can lead to slope failure. Erosion and scouring of soils at the toe of the rockery can undermine the rockery which may also eventually lead to slope

failure. The Owner/Client should be aware of the risks if these or other conditions occur that could jeopardize the stability of the rockery.

Inspection Scheduling

In order to facilitate inspection of the rockery during construction and observe compliance with our design documents, we propose the following schedule:

1. Inspect the first course of rocks for size, embedment, and back drain construction.
2. Inspect the second or third course of rocks for size, position and placement, and drainage.
3. Inspect finished rockeries for conformance to design requirements such as maximum heights, batter, front and back slope geometries, and rock sizing, positioning and placement.

The contractor, owner or developer is responsible for informing GeoStrata of the construction schedule to facilitate the inspections. The reviewing engineer also reserves the right to increase the frequency of inspections if conditions warrant.

We appreciate the opportunity to provide you with our services. If you have any questions please don't hesitate to contact us at your convenience.

Respectfully,
GeoStrata

Reviewed by

J. Scott Seal, P.E.
Staff Engineer

Mark I. Christensen, P.E.
Senior Engineer

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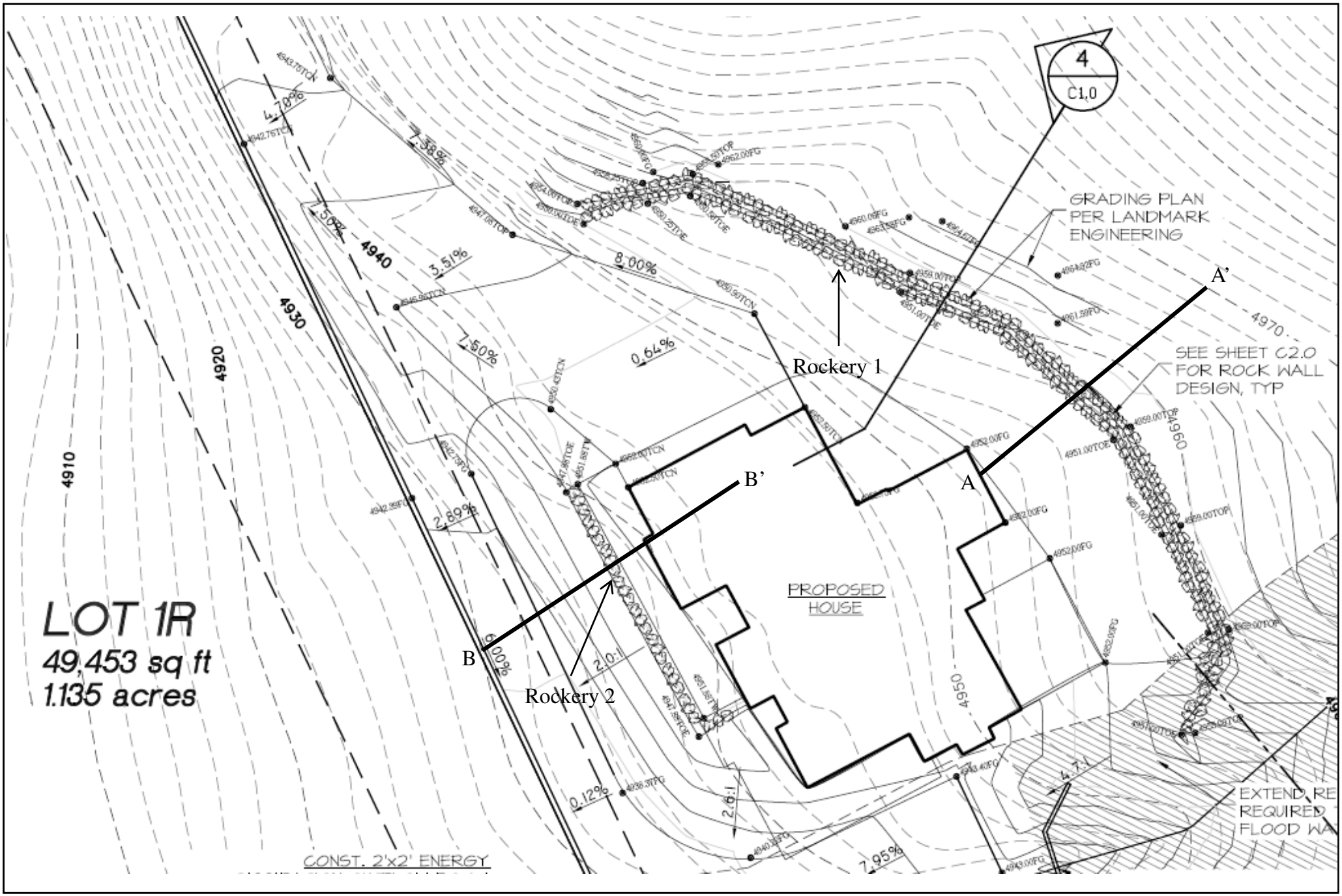

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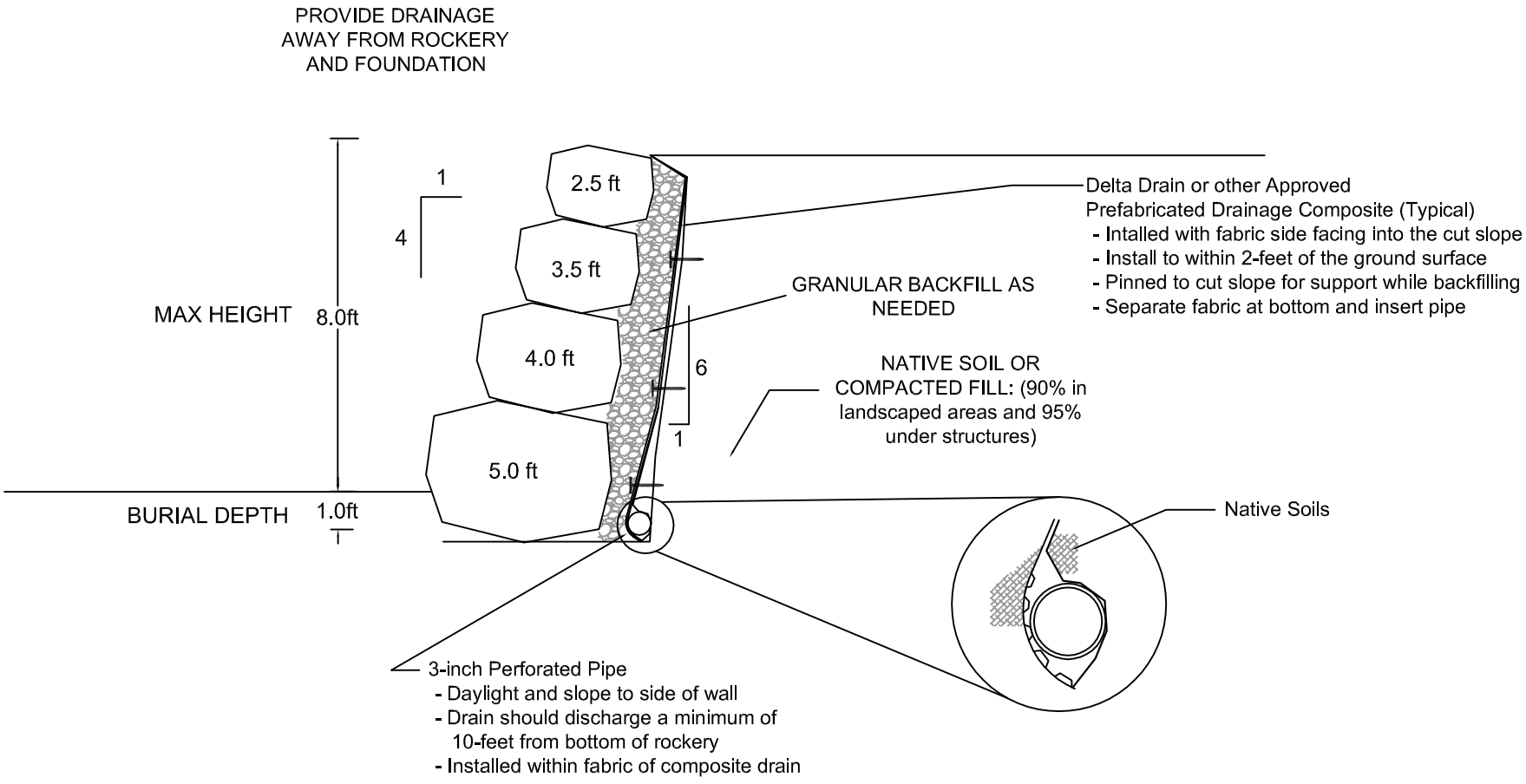
Dauphine-Savory Piedmont – Lot 2R Site Map

Rockery Analysis and Design
Matt Rasmussen
Lot 2R
Weber County, Utah

Plate
A - 1

Rockery 1 Cross Section



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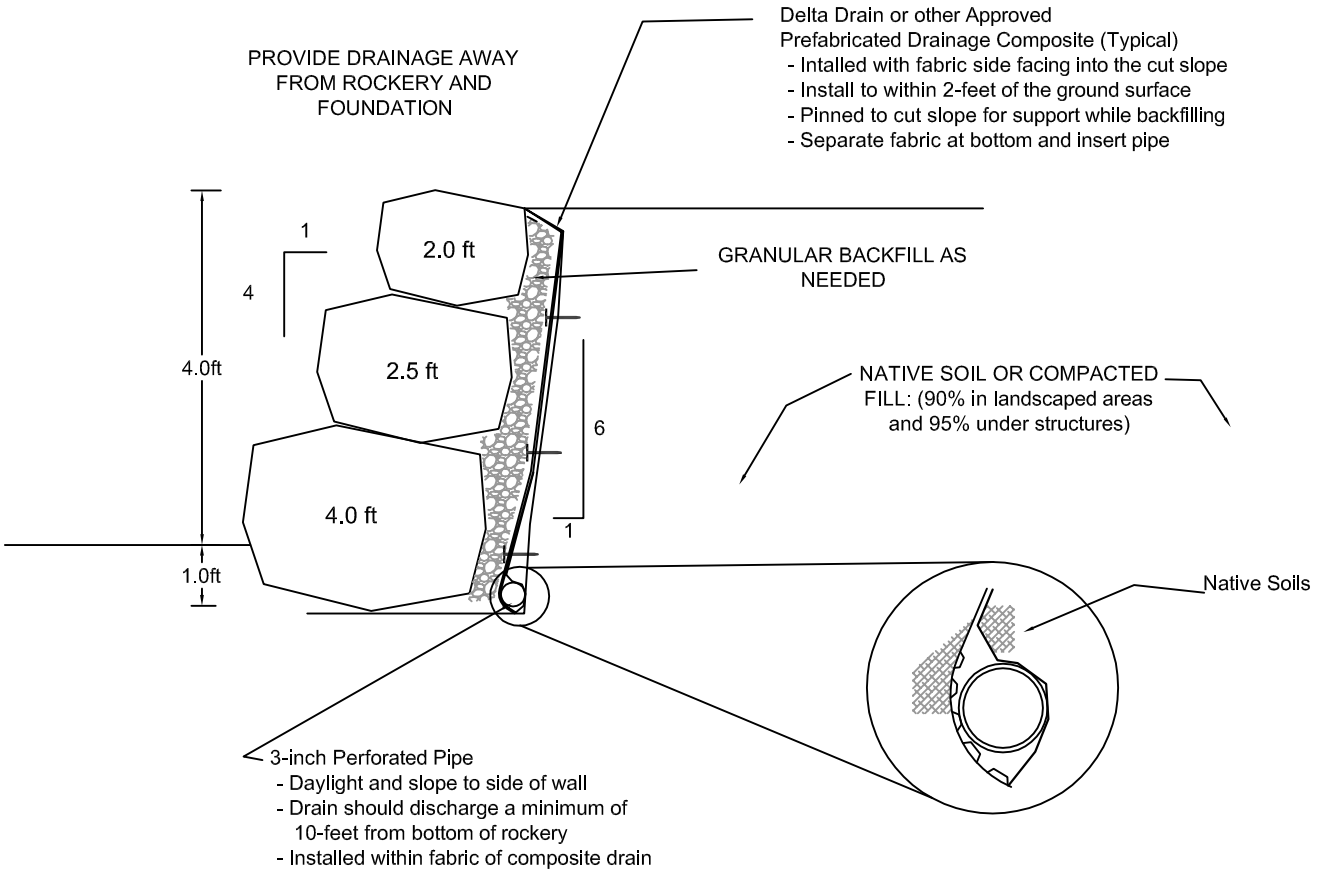
Weber County, UT
Project Number: 910-001

Plate
A-2

Rockery 2 Cross Section



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Dauphine-Savory Piedmont Subdivision Lot 2R
Weber County, UT
Project Number: 910-001

Plate
A-3

Rock Stacking Construction Specifications:

The rock stacking guidelines provided include installation of the rock facing, drain and backfill material. Design and construction information is based on empirical correlations, site geometry and the engineering analysis performed as part of the scope of work for this project.

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 the Geotechnical Engineer prior to importing.
- Rock Boulders to be used as facing should be durable angular particles with a minimum nominal diameter of 1½-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 for all rock slopes greater than 6-feet in height. Rock faced slopes less than 6-feet may be stacked steeper upon approval from the Geotechnical Engineer and if ARC guidelines are followed. Bottom row of rocks should be buried (keyed in) a minimum depth of 1 foot.

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

Interactive Rockery Minimum Rock Size Stability Calculations

SEISMIC INTERNAL STABILITY

Project: Dauphine-Savory Piedmont Subdivision
Proposed Rockery Analysis
Location: Weber County, Utah
Project No: 910-001
Engineer: JSS
Date: May 2, 2015

Minimum Factors of Safety

	Allowable	Actual
Overturning:	1.50	1.70
Sliding:	1.10	1.13
Bearing Capacity:	2.25	4.11
Bulging:	1.50	8.12

Rockery Section Investigated: 8-ft

Geometry of Proposed Rockery — **PGA:** 0.57 — **Minimum Rock Diameter =** 2.5

Backslope (for flat backslope V=0):	**Toeslope** (for flat toeslope V=0):	**Rockery Batter** (for vertical stacking H=0):	**Backcut Slope** (for vertical stacking H=0):
3.5 H. 1 V.	1 H. 0 V.	1 H. 4 V.	1 H. 6 V.
β = 15.95 degrees	β_T = 0.00 degrees	Ψ_{front} = 14.04 degrees	Ψ_{back} = 9.4623 degrees
surcharge, q_B = 0 psf	surcharge, q_T = 0 psf	Number of Rocks (8 max): 4	Appr. Rockery Length = 235

Soil/Rock Properties

Retained Soil Properties		**Foundation Soil Properties:**		**Boulder Properties:**		
$\gamma_{backfill}$ =	120 pcf	$\gamma_{foundation}$ =	120 pcf	$\gamma_{Rock\ Boulder}$ =	145 pcf	
$\phi_{backfill}$ =	31 degrees	$\phi_{foundation}$ =	31 degrees	$\phi_{Boulder\ Interface}$ =	45.0 degrees	
$c_{backfill}$ =	445 psf	$c_{foundation}$ =	445 psf	$\tau_{Boulder\ Interface}$ =	0 lb/ft (Ult. Shear Cap.)	
Friction Factor, α_B =	0.601	Friction Factor, α_F =	0.601	Rockery Embedment, D =	1.0 ft	
$\delta_{backfill} = \alpha_B{}^*\phi_{backfill}$ =	18.63 degrees	$\delta_{found.} = \alpha_F{}^*\phi_{foundation}$ =	18.63 degrees	Rock Interface Red. Factor* =	0.7	*Adjust Depending on Boulder Geometry
K_a = 0.27707	K_{ah} = 0.26256	Depth to Groundwater, z =	100.0 ft	Rock Stacking Red. Factor* =	0.6	

Fae = 0 **Acting at** 0 ft

3. Enter Rock Diamters in Table Below
Actual Back of Rock Batter, θ: -5.28 degrees from vertical (CW)

4. Calculate Hinge Height do not use
Avg. rock diameter: 3.75 ft Hinge Ht., H_h = 40.59 ft

5. Calculate the Factor of Safety against Overturning (Min. FS = 1.5)
Wall Weight, W_1 = 5,075 lb/ft
Effective Weight, W^*_1 = 5,075 lb/ft
Acting At: x = 3.23 y = 4.25
Resisting Moment, M_{res} = 16,543.2 lb — Static Resist 16543
Driving Moment, M_{drv} = 9,713.8 lb — Driving Resist 3962.7
$FS_{ovt} = M_{res}/M_{drv}$ = 1.70 — FS 4.1747

Mononobe-Okabe Equation Fails,
Check Global Stability to determine Fae

6. Calculate the Factor of Safety against Base Sliding (Min. FS = 1.1)
Static Resist 3206.6 — Resisting Force, P_{res} = 3,049.4 lb/ft
Static Drive 1320.9 — Driving Force, P_{ah1} = 2,690.4 lb/ft
FS Static 2.4276 — $FS_{sld} = P_{res}/P_{ah1}$ = 1.13

7. Calculate the Factor of Safety for Bearing Capacity (Min. FS = 2.3)
Soil Wedge Weight, W_s = 447 lb/ft
Static Sress 1250 — Bearing Zone Width, B = 5.83 ft
Static Pressure 9954.8 — Composite Force Acts at x = 3.38 ft
FS Static 7.9639 — Eccentricity, e = 0.143 ft
Effective Bearing Stress, σ_{vb} = 2,421 psf
Max. Allowable Bearing Pressure, q_{ULT} = 9,955 psf
$FS_{bearing} = q_{ULT}/\sigma_{vb}$ = 4.11

8. Calculate the Factors of Safety for Internal Buldging (Min. FS = 1.5)
Values tabulated below. See sheet C-1 for equations

Approximate Maximum Exposed Rockery Height: **8.0** ft

Rock Course (starting from bottom), *i*	Min. Rock Dia. (ft)	Approx. Rock Area (ft^2)	$H_{1,i}$ (top down) (ft)	P_{ahi} (lb/ft)	Rock Weight (lb/ft)	Accum. Wt (lb/ft)	Rock to Rock Slide Resis. (lb/ft)	F.S. Bulging
1	5.0	19.2	9.0000	1,276.0	2,787	6,146	4,302	See Base Sliding
2	4.0	11.0	6.0	567.1	1,588	3,359	2,351	8.12
3	3.5	8.2	3.6	204.2	1,189	1,771	1,239	13.17
4	2.5	4.0	1.5	35.4	581	581	407	53.58

Interactive Rockery Minimum Rock Size Stability Calculations

SEISMIC INTERNAL STABILITY

Project: Dauphine-Savory Piedmont Subdivision
Proposed Rockery Analysis
Location: Weber County, Utah
Project No: 910-001
Engineer: JSS
Date: May 2, 2015

Minimum Factors of Safety

	Allowable	Actual
Overturning:	1.50	1.93
Sliding:	1.10	1.15
Bearing Capacity:	2.25	6.52
Bulging:	1.50	27.25

Rockery Section Investigated: 4-ft

Geometry of Proposed Rockery — **PGA:** 0.57 — **Minimum Rock Diameter =** 2.0

Backslope (for flat backslope V=0):	**Toeslope** (for flat toeslope V=0):	**Rockery Batter** (for vertical stacking H=0):	**Backcut Slope** (for vertical stacking H=0):
3.5 H. 0 V.	2 H. 1 V.	1 H. 4 V.	1 H. 6 V.
β = 0.00 degrees	β_T = -26.57 degrees	Ψ_{front} = 14.04 degrees	Ψ_{back} = 9.4623 degrees
surcharge, q_B = 0 psf	surcharge, q_T = 0 psf	Number of Rocks (8 max): 3	Appr. Rockery Length = 80

Soil/Rock Properties

Retained Soil Properties		**Foundation Soil Properties:**		**Boulder Properties:**		
$\gamma_{backfill}$ =	120 pcf	$\gamma_{foundation}$ =	120 pcf	$\gamma_{Rock\ Boulder}$ =	145 pcf	
$\phi_{backfill}$ =	31 degrees	$\phi_{foundation}$ =	31 degrees	$\phi_{Boulder\ Interface}$ =	45.0 degrees	
$c_{backfill}$ =	445 psf	$c_{foundation}$ =	445 psf	$\tau_{Boulder\ Interface}$ =	0 lb/ft (Ult. Shear Cap.)	
Friction Factor, α_B =	0.601	Friction Factor, α_F =	0.601	Rockery Embedment, D =	1.0 ft	
$\delta_{backfill} = \alpha_B{}^*\phi_{backfill}$ =	18.63 degrees	$\delta_{found.} = \alpha_F{}^*\phi_{foundation}$ =	18.63 degrees	Rock Interface Red. Factor* =	0.7	*Adjust Depending on Boulder Geometry
K_a = 0.22381	K_{ah} = 0.21209	Depth to Groundwater, z =	100.0 ft	Rock Stacking Red. Factor* =	0.6	

Fae = 705.5 **Acting at** 2.387 **ft**

3. Enter Rock Diamters in Table Below
Actual Back of Rock Batter, θ: -1.34 degrees from vertical (CW)

4. Calculate Hinge Height do not use
Avg. rock diameter: 2.83 ft Hinge Ht., H_h = 120.89 ft

5. Calculate the Factor of Safety against Overturning (Min. FS = 1.5)
Wall Weight, W_1 = 2,364 lb/ft
Effective Weight, W^*_1 = 2,364 lb/ft
Acting At: x = 2.33 y = 2.41
Resisting Moment, M_{res} = 6,122.5 lb — Static Resist 5810.4
Driving Moment, M_{drv} = 3,168.9 lb — Driving Resist 582.46
$FS_{ovt} = M_{res}/M_{drv}$ = 1.93 — FS 9.9755

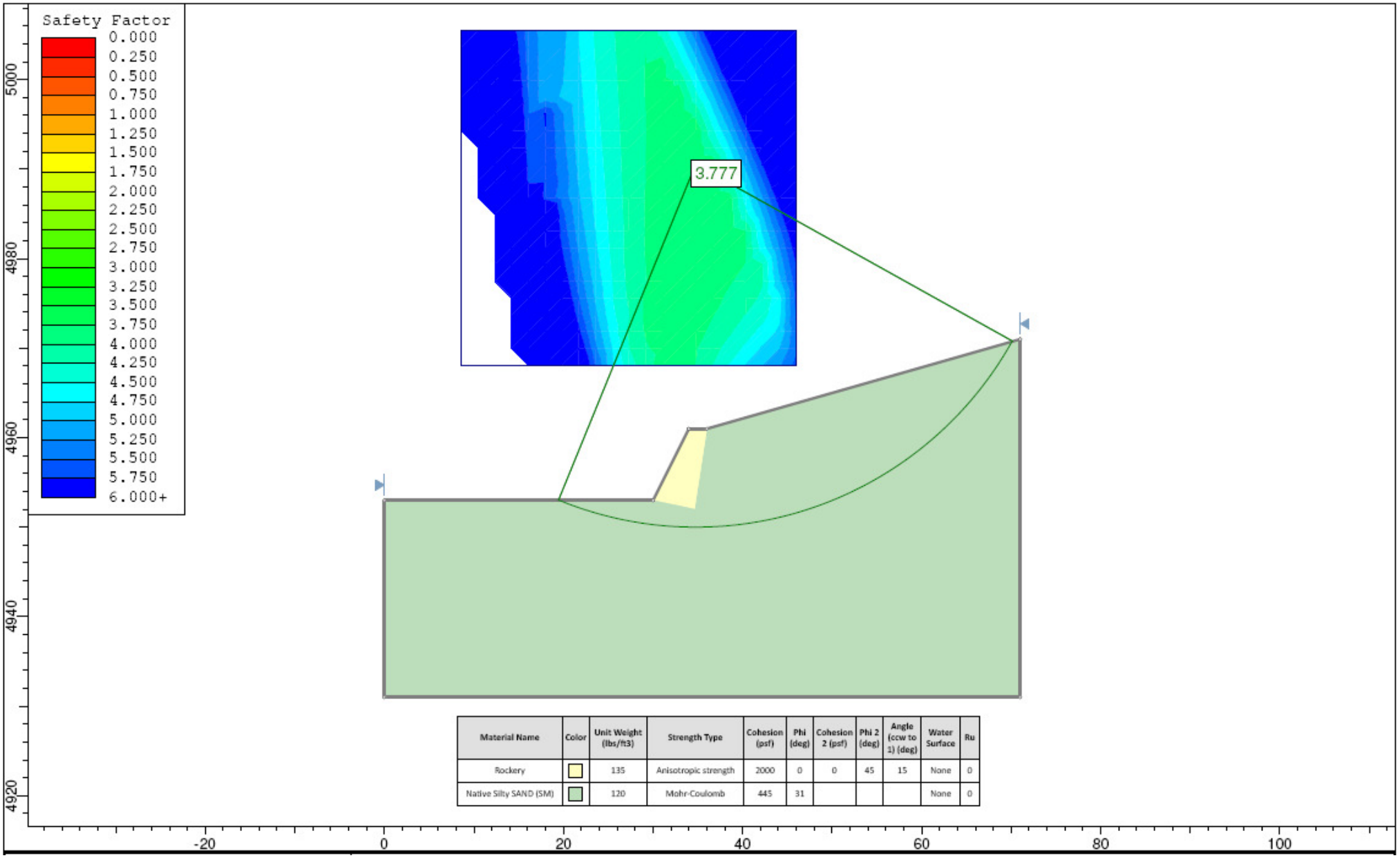
6. Calculate the Factor of Safety against Base Sliding (Min. FS = 1.1)
Static Resist 1460.9 — Resisting Force, P_{res} = 1,536.7 lb/ft
Static Drive 342.63 — Driving Force, P_{ah1} = 1,333.9 lb/ft
FS Static 4.2639 — $FS_{sld} = P_{res}/P_{ah1}$ = 1.15

7. Calculate the Factor of Safety for Bearing Capacity (Min. FS = 2.3)
Soil Wedge Weight, W_s = 37 lb/ft
Static Sress 470.9 — Bearing Zone Width, B = 4.12 ft
Static Pressure 9079.8 — Composite Force Acts at x = 2.35 ft
FS Static 19.282 — Eccentricity, e = -0.150 ft
Effective Bearing Stress, σ_{vb} = 1,393 psf
Max. Allowable Bearing Pressure, q_{ULT} = 9,080 psf
$FS_{bearing} = q_{ULT}/\sigma_{vb}$ = 6.52

8. Calculate the Factors of Safety for Internal Buldging (Min. FS = 1.5)
Values tabulated below. See sheet C-1 for equations

Approximate Maximum Exposed Rockery Height: 4.1 ft

Rock Course (starting from bottom), *i*	Min. Rock Dia. (ft)	Approx. Rock Area (ft^2)	$H_{1,i}$ (top down) (ft)	P_{ahi} (lb/ft)	Rock Weight (lb/ft)	Accum. Wt (lb/ft)	Rock to Rock Slide Resis. (lb/ft)	F.S. Bulging
1	4.0	12.3	5.1000	331.0	1,784	2,747	1,923	See Base Sliding
2	2.5	4.0	2.7	92.8	587	964	675	27.25
3	2.0	2.6	1.2	18.3	377	377	264	45.44



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion 2 (psf)	Phi 2 (deg)	Angle (ccw to 1) (deg)	Water Surface	Ru
Rockery		135	Anisotropic strength	2000	0	0	45	15	None	0
Native Silty SAND (SM)		120	Mohr-Coulomb	445	31				None	0

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Dauphine-Savory Piedmont – Lot 2R Section A-A' Static

Rockery Analysis and Design
Matt Rasmussen
Lot 2R
Weber County, Utah

Plate
C - 1

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: Section A-A' Static
Slide Modeler Version: 6.033
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 5/2/2015, 2:19:31 PM

General Settings

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

Analysis Options

Analysis Methods Used

Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005

Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

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

Property	Rockery	Native Silty SAND (SM)

Color		
Strength Type	Anisotropic strength	Mohr-Coulomb
Unit Weight [lbs/ft3]	135	120
Cohesion [psf]		445
Friction Angle [deg]		31
Cohesion 1 [psf]	2000	
Cohesion 2 [psf]	0	
Friction Angle 1 [deg]	0	
Friction Angle 2 [deg]	45	
Angle from 1 [deg]	15	
Water Surface	None	None
Ru Value	0	0

Global Minimums

Method: bishop simplified

FS: 3.776920
Center: 34.767, 4990.523
Radius: 40.536
Left Slip Surface Endpoint: 19.430, 4953.000
Right Slip Surface Endpoint: 70.159, 4970.760
Resisting Moment=2.22421e+006 lb-ft
Driving Moment=588894 lb-ft
Total Slice Area=396.11 ft2

Method: janbu simplified

FS: 3.466280
Center: 36.635, 4984.920
Radius: 36.365
Left Slip Surface Endpoint: 19.213, 4953.000

Right Slip Surface Endpoint: 70.125, 4970.750
Resisting Horizontal Force=53460.3 lb
Driving Horizontal Force=15422.9 lb
Total Slice Area=464.878 ft2

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 4399
Number of Invalid Surfaces: 452

Error Codes:

Error Code -106 reported for 5 surfaces
Error Code -108 reported for 447 surfaces

Method: janbu simplified

Number of Valid Surfaces: 4276
Number of Invalid Surfaces: 575

Error Codes:

Error Code -106 reported for 5 surfaces
Error Code -108 reported for 570 surfaces

Error Codes

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 3.77692

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	2.02915	93.3405	Native Silty SAND (SM)	445	31	133.135	502.841	96.2638	0	96.2638
2	2.02915	265.331	Native Silty SAND (SM)	445	31	146.013	551.479	177.21	0	177.21
3	2.02915	408.663	Native Silty SAND (SM)	445	31	156.369	590.592	242.306	0	242.306
4	2.02915	524.616	Native Silty SAND (SM)	445	31	164.374	620.829	292.628	0	292.628
5	2.02915	614.17	Native Silty SAND (SM)	445	31	170.164	642.696	329.022	0	329.022
6	2.02915	1030.18	Native Silty SAND (SM)	445	31	201.913	762.611	528.595	0	528.595
7	2.02915	2169.48	Native Silty SAND (SM)	445	31	290.36	1096.67	1084.55	0	1084.55
8	2.02915	2878.4	Native Silty SAND (SM)	445	31	343.649	1297.93	1419.52	0	1419.52
9	2.02915	2722.2	Native Silty SAND (SM)	445	31	328.776	1241.76	1326.03	0	1326.03
10	2.02915	2820.18	Native Silty SAND (SM)	445	31	333.742	1260.52	1357.25	0	1357.25
11	2.02915	2900.41	Native Silty SAND (SM)	445	31	337.232	1273.7	1379.18	0	1379.18
12	2.02915	2955.05	Native Silty SAND (SM)	445	31	338.66	1279.09	1388.16	0	1388.16
13	2.02915	2983.38	Native Silty SAND (SM)	445	31	337.998	1276.59	1384	0	1384
14	2.02915	2984.46	Native Silty SAND (SM)	445	31	335.199	1266.02	1366.4	0	1366.4
15	2.02915	2957.05	Native Silty SAND (SM)	445	31	330.196	1247.12	1334.96	0	1334.96
16	2.02915	2899.54	Native Silty SAND (SM)	445	31	322.899	1219.56	1289.09	0	1289.09
17	2.02915	2809.91	Native Silty SAND (SM)	445	31	313.187	1182.88	1228.05	0	1228.05
18	2.02915	2685.53	Native Silty SAND (SM)	445	31	300.908	1136.51	1150.86	0	1150.86
19	2.02915	2523.05	Native Silty SAND (SM)	445	31	285.861	1079.68	1056.28	0	1056.28
20	2.02915	2318.02	Native Silty SAND (SM)	445	31	267.789	1011.42	942.673	0	942.673
21	2.02915	2064.54	Native Silty SAND (SM)	445	31	246.348	930.436	807.901	0	807.901
22	2.02915	1754.4	Native Silty SAND (SM)	445	31	221.08	835.002	649.071	0	649.071
23	2.02915	1375.71	Native Silty SAND (SM)	445	31	191.346	722.697	462.167	0	462.167

24	2.02915	910.125	Native Silty SAND (SM)	445	31	156.214	590.006	241.33	0	241.33
25	2.02915	326.396	Native Silty SAND (SM)	445	31	114.231	431.44	-22.5674	0	-22.5674

Global Minimum Query (janbu simplified) - Safety Factor: 3.46628

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	2.03648	125.847	Native Silty SAND (SM)	445	31	152.478	528.532	139.02	0	139.02
2	2.03648	358.77	Native Silty SAND (SM)	445	31	171.747	595.323	250.18	0	250.18
3	2.03648	555.58	Native Silty SAND (SM)	445	31	187.401	649.586	340.489	0	340.489
4	2.03648	718.793	Native Silty SAND (SM)	445	31	199.805	692.58	412.042	0	412.042
5	2.03648	850.318	Native Silty SAND (SM)	445	31	209.231	725.253	466.418	0	466.418
6	2.03648	1231.79	Native Silty SAND (SM)	445	31	240.48	833.571	646.692	0	646.692
7	2.03648	2387.22	Native Silty SAND (SM)	445	31	338.386	1172.94	1211.5	0	1211.5
8	2.03648	3217.46	Native Silty SAND (SM)	445	31	406.425	1408.78	1604	0	1604
9	2.03648	3090.29	Native Silty SAND (SM)	445	31	391.632	1357.51	1518.67	0	1518.67
10	2.03648	3204.04	Native Silty SAND (SM)	445	31	397.447	1377.66	1552.21	0	1552.21
11	2.03648	3305.75	Native Silty SAND (SM)	445	31	402.111	1393.83	1579.12	0	1579.12
12	2.03648	3379.04	Native Silty SAND (SM)	445	31	404.261	1401.28	1591.52	0	1591.52
13	2.03648	3423.2	Native Silty SAND (SM)	445	31	403.872	1399.93	1589.28	0	1589.28
14	2.03648	3437.25	Native Silty SAND (SM)	445	31	400.891	1389.6	1572.07	0	1572.07
15	2.03648	3419.79	Native Silty SAND (SM)	445	31	395.234	1369.99	1539.44	0	1539.44
16	2.03648	3368.96	Native Silty SAND (SM)	445	31	386.782	1340.7	1490.69	0	1490.69
17	2.03648	3282.34	Native Silty SAND (SM)	445	31	375.376	1301.16	1424.89	0	1424.89
18	2.03648	3156.69	Native Silty SAND (SM)	445	31	360.799	1250.63	1340.8	0	1340.8
19	2.03648	2987.75	Native Silty SAND (SM)	445	31	342.763	1188.11	1236.75	0	1236.75
20	2.03648	2769.71	Native Silty SAND (SM)	445	31	320.881	1112.26	1110.51	0	1110.51
21	2.03648	2494.43	Native Silty SAND (SM)	445	31	294.618	1021.23	959.005	0	959.005
22	2.03648	2150.03	Native Silty SAND (SM)	445	31	263.215	912.377	777.845	0	777.845
23	2.03648	1717.93	Native Silty SAND (SM)	445	31	225.53	781.751	560.449	0	560.449
24	2.03648	1165.94	Native Silty SAND (SM)	445	31	179.704	622.906	296.085	0	296.085

25	2.03648	427.395	Native Silty SAND (SM)	445	31	122.248	423.744	-35.3757	0	-35.3757

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 3.77692

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	19.4305	4953	0	0	0
2	21.4596	4952.23	343.753	0	0
3	23.4888	4951.59	754.292	0	0
4	25.5179	4951.06	1200.08	0	0
5	27.5471	4950.63	1656.61	0	0
6	29.5762	4950.32	2105.09	0	0
7	31.6054	4950.11	2625.63	0	0
8	33.6345	4950	3331.14	0	0
9	35.6637	4950	4036.32	0	0
10	37.6928	4950.09	4575.92	0	0
11	39.722	4950.29	4983.56	0	0
12	41.7511	4950.59	5250.54	0	0
13	43.7803	4951	5370.07	0	0
14	45.8094	4951.52	5338.15	0	0
15	47.8386	4952.15	5153.71	0	0
16	49.8677	4952.9	4818.96	0	0
17	51.8969	4953.78	4339.88	0	0
18	53.926	4954.8	3726.98	0	0
19	55.9552	4955.97	2996.48	0	0
20	57.9843	4957.29	2172.05	0	0
21	60.0135	4958.81	1287.59	0	0
22	62.0426	4960.54	391.646	0	0

23	64.0718	4962.52	-445.019	0	0
24	66.101	4964.81	-1115.52	0	0
25	68.1301	4967.5	-1448.77	0	0
26	70.1593	4970.76	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 3.46628

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	19.2131	4953	0	0	0
2	21.2496	4951.97	454.141	0	0
3	23.2861	4951.09	1023.63	0	0
4	25.3226	4950.36	1655.87	0	0
5	27.3591	4949.76	2311.13	0	0
6	29.3956	4949.28	2959.4	0	0
7	31.432	4948.93	3678.6	0	0
8	33.4685	4948.69	4654.61	0	0
9	35.505	4948.57	5676.84	0	0
10	37.5415	4948.57	6485.02	0	0
11	39.578	4948.67	7127.94	0	0
12	41.6145	4948.9	7595.44	0	0
13	43.651	4949.24	7877.66	0	0
14	45.6874	4949.7	7967.8	0	0
15	47.7239	4950.29	7862.22	0	0
16	49.7604	4951.01	7560.76	0	0
17	51.7969	4951.87	7067.2	0	0
18	53.8334	4952.88	6390.15	0	0
19	55.8699	4954.06	5544.41	0	0
20	57.9064	4955.43	4553.1	0	0
21	59.9428	4957.01	3451.29	0	0
22	61.9793	4958.84	2292.22	0	0

23	64.0158	4960.99	1158.87	0	0
24	66.0523	4963.54	188.015	0	0
25	68.0888	4966.67	-371.737	0	0
26	70.1253	4970.75	0	0	0

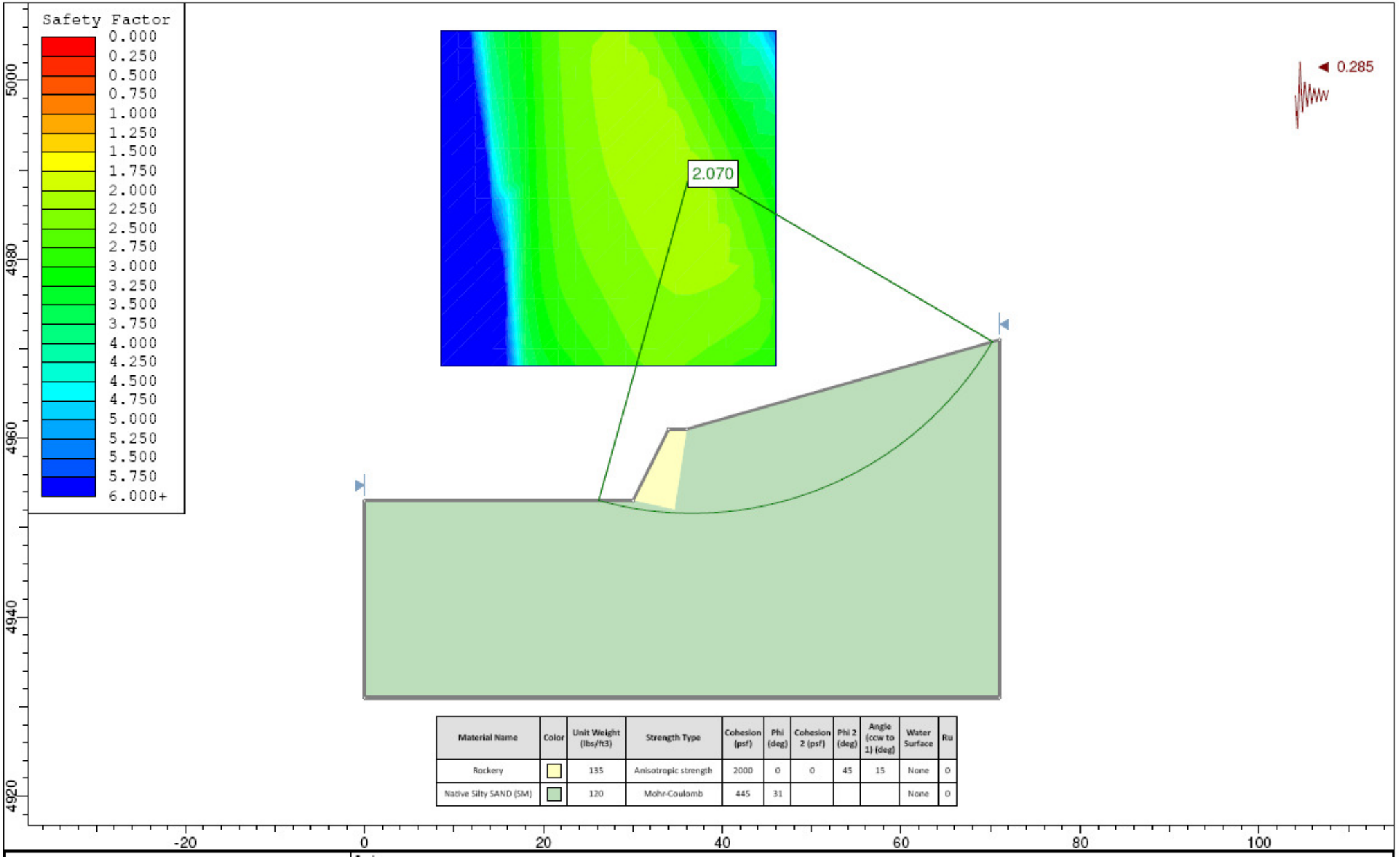
List Of Coordinates

External Boundary

X	Y
0	4931
71	4931
71	4971
36	4961
34	4961
30	4953
0	4953

Material Boundary

X	Y
30	4953
34.6	4952
36	4961



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion 2 (psf)	Phi 2 (deg)	Angle (ccw to 1) (deg)	Water Surface	Ru
Rockery		135	Anisotropic strength	2000	0	0	45	15	None	0
Native Silty SAND (SM)		120	Mohr-Coulomb	445	31				None	0

GeoStrata

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Dauphine-Savory Piedmont – Lot 2R Section A-A' PStatic

Rockery Analysis and Design
Matt Rasmussen
Lot 2R
Weber County, Utah

Plate
C - 2

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: Section A-A' PStatic
Slide Modeler Version: 6.033
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 5/2/2015, 2:19:31 PM

General Settings

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

Analysis Options

Analysis Methods Used

Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005

Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

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): 0.285

Material Properties

Property	Rockery	Native Silty SAND (SM)
Color		
Strength Type	Anisotropic strength	Mohr-Coulomb
Unit Weight [lbs/ft3]	135	120
Cohesion [psf]		445
Friction Angle [deg]		31
Cohesion 1 [psf]	2000	
Cohesion 2 [psf]	0	
Friction Angle 1 [deg]	0	
Friction Angle 2 [deg]	45	
Angle from 1 [deg]	15	
Water Surface	None	None
Ru Value	0	0

Global Minimums

Method: bishop simplified

FS: 2.069640
Center: 36.635, 4990.523
Radius: 38.958
Left Slip Surface Endpoint: 26.159, 4953.000
Right Slip Surface Endpoint: 70.218, 4970.776
Resisting Moment=1.76284e+006 lb-ft
Driving Moment=851758 lb-ft
Total Slice Area=342.642 ft2

Method: janbu simplified

FS: 1.845660
Center: 38.503, 4981.184
Radius: 33.289
Left Slip Surface Endpoint: 20.788, 4953.000
Right Slip Surface Endpoint: 70.113, 4970.747
Resisting Horizontal Force=53329.7 lb
Driving Horizontal Force=28894.7 lb
Total Slice Area=498.946 ft2

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 4846
Number of Invalid Surfaces: 5

Error Codes:

Error Code -106 reported for 5 surfaces

Method: janbu simplified

Number of Valid Surfaces: 4744
Number of Invalid Surfaces: 107

Error Codes:

Error Code -106 reported for 5 surfaces
Error Code -108 reported for 102 surfaces

Error Codes

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 2.06964

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	1.76234	47.3664	Native Silty SAND (SM)	445	31	240.557	497.867	87.9851	0	87.9851
2	1.76234	132.989	Native Silty SAND (SM)	445	31	251.927	521.399	127.149	0	127.149
3	1.76234	486.395	Native Silty SAND (SM)	445	31	309.299	640.138	324.765	0	324.765
4	1.76234	1371.58	Native Silty SAND (SM)	445	31	455.675	943.083	828.952	0	828.952
5	1.76234	2119.12	Native Silty SAND (SM)	445	31	575.037	1190.12	1240.09	0	1240.09
6	1.76234	2051.8	Native Silty SAND (SM)	445	31	556.265	1151.27	1175.43	0	1175.43
7	1.76234	2088.12	Native Silty SAND (SM)	445	31	554.953	1148.55	1170.91	0	1170.91
8	1.76234	2176.77	Native Silty SAND (SM)	445	31	562.097	1163.34	1195.51	0	1195.51
9	1.76234	2248.41	Native Silty SAND (SM)	445	31	566.279	1171.99	1209.92	0	1209.92
10	1.76234	2302.82	Native Silty SAND (SM)	445	31	567.528	1174.58	1214.22	0	1214.22
11	1.76234	2339.67	Native Silty SAND (SM)	445	31	565.854	1171.12	1208.46	0	1208.46
12	1.76234	2358.49	Native Silty SAND (SM)	445	31	561.247	1161.58	1192.59	0	1192.59
13	1.76234	2358.69	Native Silty SAND (SM)	445	31	553.675	1145.91	1166.5	0	1166.5
14	1.76234	2339.5	Native Silty SAND (SM)	445	31	543.084	1123.99	1130.03	0	1130.03
15	1.76234	2299.94	Native Silty SAND (SM)	445	31	529.399	1095.67	1082.89	0	1082.89
16	1.76234	2238.81	Native Silty SAND (SM)	445	31	512.514	1060.72	1024.73	0	1024.73
17	1.76234	2154.61	Native Silty SAND (SM)	445	31	492.294	1018.87	955.083	0	955.083
18	1.76234	2045.45	Native Silty SAND (SM)	445	31	468.566	969.763	873.353	0	873.353
19	1.76234	1908.94	Native Silty SAND (SM)	445	31	441.111	912.941	778.783	0	778.783

20	1.76234	1741.99	Native Silty SAND (SM)	445	31	409.65	847.828	670.419	0	670.419
21	1.76234	1540.55	Native Silty SAND (SM)	445	31	373.827	773.688	547.029	0	547.029
22	1.76234	1299.12	Native Silty SAND (SM)	445	31	333.184	689.57	407.033	0	407.033
23	1.76234	1009.96	Native Silty SAND (SM)	445	31	287.113	594.221	248.346	0	248.346
24	1.76234	661.565	Native Silty SAND (SM)	445	31	234.799	485.95	68.1514	0	68.1514
25	1.76234	235.41	Native Silty SAND (SM)	445	31	175.099	362.391	-137.484	0	-137.484

Global Minimum Query (janbu simplified) - Safety Factor: 1.84566

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	1.973	135.862	Native Silty SAND (SM)	445	31	325.084	599.994	257.953	0	257.953
2	1.973	387.294	Native Silty SAND (SM)	445	31	363.577	671.04	376.194	0	376.194
3	1.973	600.052	Native Silty SAND (SM)	445	31	393.409	726.099	467.828	0	467.828
4	1.973	777.469	Native Silty SAND (SM)	445	31	415.899	767.609	536.912	0	536.912
5	1.973	980.301	Native Silty SAND (SM)	445	31	442.544	816.786	618.755	0	618.755
6	1.973	1919.55	Native Silty SAND (SM)	445	31	598.942	1105.44	1099.16	0	1099.16
7	1.973	3018.77	Native Silty SAND (SM)	445	31	776.79	1433.69	1645.46	0	1645.46
8	1.973	3169.12	Native Silty SAND (SM)	445	31	786.559	1451.72	1675.47	0	1675.47
9	1.973	3201.49	Native Silty SAND (SM)	445	31	776.543	1433.24	1644.7	0	1644.7
10	1.973	3334.36	Native Silty SAND (SM)	445	31	783.4	1445.89	1665.77	0	1665.77
11	1.973	3439.45	Native Silty SAND (SM)	445	31	785.47	1449.71	1672.11	0	1672.11
12	1.973	3516.44	Native Silty SAND (SM)	445	31	782.801	1444.78	1663.92	0	1663.92
13	1.973	3564.72	Native Silty SAND (SM)	445	31	775.404	1431.13	1641.2	0	1641.2
14	1.973	3583.31	Native Silty SAND (SM)	445	31	763.223	1408.65	1603.78	0	1603.78
15	1.973	3570.85	Native Silty SAND (SM)	445	31	746.144	1377.13	1551.32	0	1551.32
16	1.973	3525.44	Native Silty SAND (SM)	445	31	723.984	1336.23	1483.25	0	1483.25
17	1.973	3444.56	Native Silty SAND (SM)	445	31	696.481	1285.47	1398.77	0	1398.77
18	1.973	3324.85	Native Silty SAND (SM)	445	31	663.268	1224.17	1296.75	0	1296.75
19	1.973	3161.72	Native Silty SAND (SM)	445	31	623.846	1151.41	1175.66	0	1175.66
20	1.973	2948.84	Native Silty SAND (SM)	445	31	577.527	1065.92	1033.38	0	1033.38

21	1.973	2677.12	Native Silty SAND (SM)	445	31	523.345	965.917	866.951	0	866.951
22	1.973	2332.75	Native Silty SAND (SM)	445	31	459.889	848.798	672.032	0	672.032
23	1.973	1893.01	Native Silty SAND (SM)	445	31	384.966	710.516	441.894	0	441.894
24	1.973	1315.01	Native Silty SAND (SM)	445	31	294.789	544.081	164.898	0	164.898
25	1.973	492.152	Native Silty SAND (SM)	445	31	181.179	334.395	-184.078	0	-184.078

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 2.06964

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	26.1592	4953	0	0	0
2	27.9215	4952.55	449.603	0	0
3	29.6838	4952.19	901.418	0	0
4	31.4462	4951.91	1397.86	0	0
5	33.2085	4951.72	1972.1	0	0
6	34.9708	4951.6	2524.08	0	0
7	36.7332	4951.57	2960.7	0	0
8	38.4955	4951.61	3291.11	0	0
9	40.2579	4951.73	3512.05	0	0
10	42.0202	4951.94	3620.38	0	0
11	43.7825	4952.23	3614.82	0	0
12	45.5449	4952.6	3495.98	0	0
13	47.3072	4953.06	3266.43	0	0
14	49.0695	4953.6	2930.8	0	0
15	50.8319	4954.24	2496.02	0	0
16	52.5942	4954.98	1971.62	0	0
17	54.3566	4955.83	1370.2	0	0
18	56.1189	4956.79	708.055	0	0

19	57.8812	4957.87	6.12141	0	0
20	59.6436	4959.09	-708.686	0	0
21	61.4059	4960.45	-1401.46	0	0
22	63.1682	4962	-2026.21	0	0
23	64.9306	4963.74	-2520.79	0	0
24	66.6929	4965.74	-2798.26	0	0
25	68.4553	4968.05	-2730.51	0	0
26	70.2176	4970.78	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 1.84566

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	20.788	4953	0	0	0
2	22.761	4951.85	898.693	0	0
3	24.734	4950.88	1872.89	0	0
4	26.707	4950.06	2862.12	0	0
5	28.68	4949.38	3824.96	0	0
6	30.653	4948.83	4754.97	0	0
7	32.626	4948.42	5846.71	0	0
8	34.599	4948.12	7001.28	0	0
9	36.572	4947.95	7940.85	0	0
10	38.545	4947.9	8652.61	0	0
11	40.518	4947.96	9146.25	0	0
12	42.491	4948.13	9416.84	0	0
13	44.464	4948.43	9462.66	0	0
14	46.437	4948.85	9285.16	0	0
15	48.41	4949.4	8889.09	0	0
16	50.383	4950.09	8282.91	0	0
17	52.356	4950.91	7479.34	0	0
18	54.329	4951.9	6496.41	0	0

19	56.302	4953.05	5359.06	0	0
20	58.275	4954.4	4101.67	0	0
21	60.248	4955.98	2772.36	0	0
22	62.221	4957.83	1440.58	0	0
23	64.194	4960.02	211.748	0	0
24	66.167	4962.67	-740.453	0	0
25	68.14	4966.03	-1087.25	0	0
26	70.113	4970.75	0	0	0

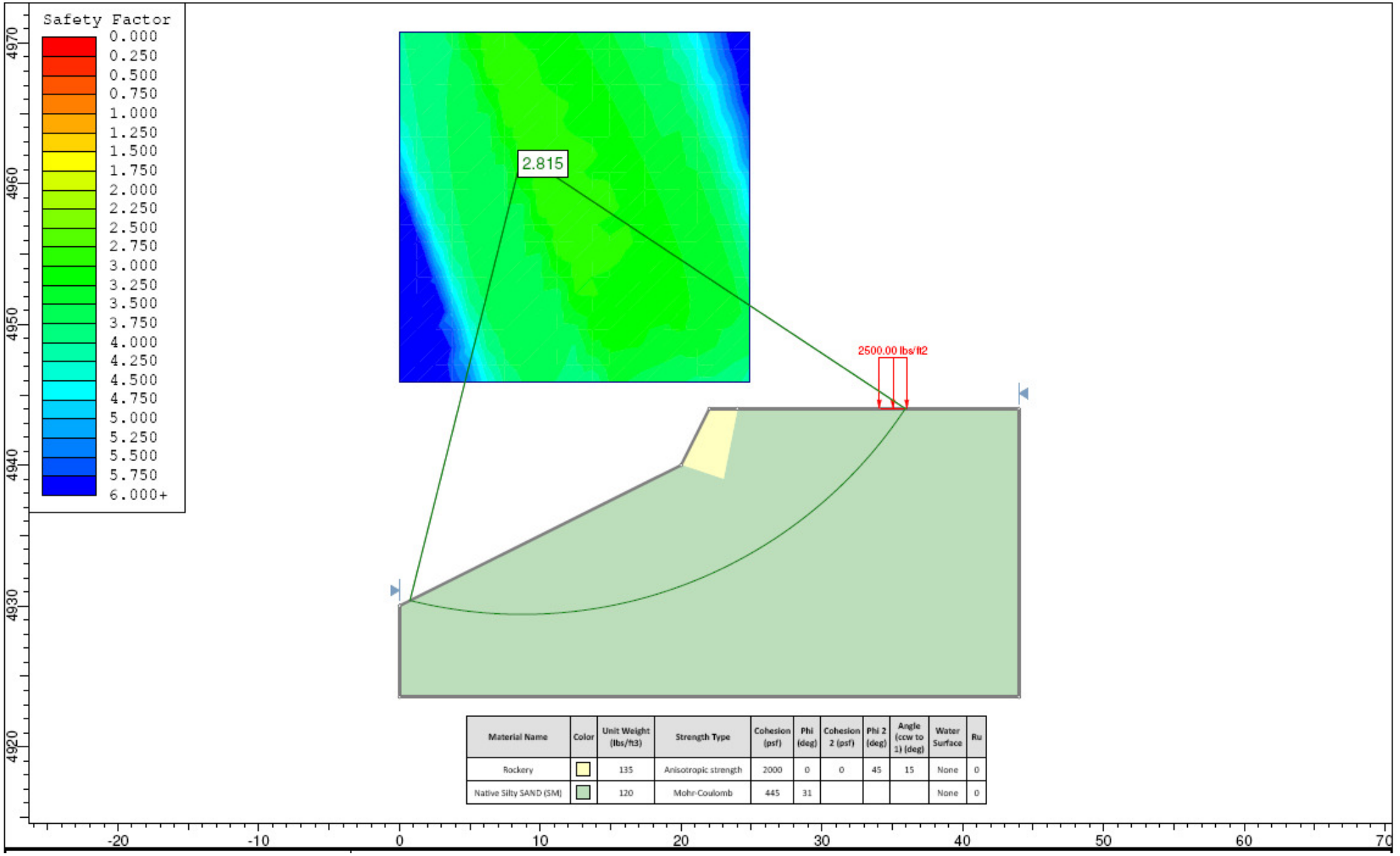
List Of Coordinates

External Boundary

X	Y
0	4931
71	4931
71	4971
36	4961
34	4961
30	4953
0	4953

Material Boundary

X	Y
30	4953
34.6	4952
36	4961



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion 2 (psf)	Phi 2 (deg)	Angle (ccw to 1) (deg)	Water Surface	Ru
Rockery		135	Anisotropic strength	2000	0	0	45	15	None	0
Native Silty SAND (SM)		120	Mohr-Coulomb	445	31				None	0

GeoStrata

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Dauphine-Savory Piedmont – Lot 2R Section B-B' Static

Rockery Analysis and Design
Matt Rasmussen
Lot 2R
Weber County, Utah

Plate
C - 3

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: Section B-B' Static
Slide Modeler Version: 6.033
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 5/2/2015, 2:33:07 PM

General Settings

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

Analysis Options

Analysis Methods Used

Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005

Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

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

1 Distributed Load present

Distributed Load 1

Distribution: Constant
Magnitude [psf]: 2500
Orientation: Normal to boundary

Material Properties

Property	Rockery	Native Silty SAND (SM)
Color		
Strength Type	Anisotropic strength	Mohr-Coulomb
Unit Weight [lbs/ft3]	135	120
Cohesion [psf]		445
Friction Angle [deg]		31
Cohesion 1 [psf]	2000	
Cohesion 2 [psf]	0	
Friction Angle 1 [deg]	0	
Friction Angle 2 [deg]	45	
Angle from 1 [deg]	15	
Water Surface	None	None
Ru Value	0	0

Global Minimums

Method: bishop simplified

FS: 2.814930
Center: 8.709, 4962.066
Radius: 32.687

Left Slip Surface Endpoint: 0.733, 4930.366
Right Slip Surface Endpoint: 35.951, 4944.000
Resisting Moment=1.19491e+006 lb-ft
Driving Moment=424488 lb-ft
Total Slice Area=220.122 ft2

Method: janbu simplified

FS: 2.370280
Center: 11.198, 4955.844
Radius: 27.559
Left Slip Surface Endpoint: 0.714, 4930.357
Right Slip Surface Endpoint: 36.082, 4944.000
Resisting Horizontal Force=34078.7 lb
Driving Horizontal Force=14377.5 lb
Total Slice Area=263.521 ft2

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 4820
Number of Invalid Surfaces: 31

Error Codes:

Error Code -103 reported for 4 surfaces
Error Code -107 reported for 8 surfaces
Error Code -108 reported for 19 surfaces

Method: janbu simplified

Number of Valid Surfaces: 4705
Number of Invalid Surfaces: 146

Error Codes:

Error Code -103 reported for 4 surfaces
Error Code -107 reported for 8 surfaces
Error Code -108 reported for 134 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.
-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 2.81493

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	1.40872	86.7121	Native Silty SAND (SM)	445	31	179.979	506.627	102.565	0	102.565
2	1.40872	254.674	Native Silty SAND (SM)	445	31	204.628	576.013	218.041	0	218.041
3	1.40872	411.843	Native Silty SAND (SM)	445	31	227.15	639.412	323.555	0	323.555
4	1.40872	558.441	Native Silty SAND (SM)	445	31	247.643	697.098	419.562	0	419.562
5	1.40872	694.629	Native Silty SAND (SM)	445	31	266.184	749.29	506.423	0	506.423
6	1.40872	820.504	Native Silty SAND (SM)	445	31	282.833	796.156	584.422	0	584.422
7	1.40872	936.102	Native Silty SAND (SM)	445	31	297.636	837.824	653.769	0	653.769
8	1.40872	1041.41	Native Silty SAND (SM)	445	31	310.623	874.383	714.612	0	714.612
9	1.40872	1136.34	Native Silty SAND (SM)	445	31	321.816	905.889	767.048	0	767.048
10	1.40872	1220.76	Native Silty SAND (SM)	445	31	331.22	932.361	811.103	0	811.103

11	1.40872	1294.46	Native Silty SAND (SM)	445	31	338.832	953.789	846.766	0	846.766
12	1.40872	1357.18	Native Silty SAND (SM)	445	31	344.636	970.125	873.952	0	873.952
13	1.40872	1408.56	Native Silty SAND (SM)	445	31	348.602	981.291	892.536	0	892.536
14	1.40872	1470.4	Native Silty SAND (SM)	445	31	353.821	995.981	916.988	0	916.988
15	1.40872	1826.52	Native Silty SAND (SM)	445	31	399.747	1125.26	1132.14	0	1132.14
16	1.40872	2045.93	Native Silty SAND (SM)	445	31	425.621	1198.09	1253.36	0	1253.36
17	1.40872	1849.98	Native Silty SAND (SM)	445	31	394.032	1109.17	1105.37	0	1105.37
18	1.40872	1696.54	Native Silty SAND (SM)	445	31	368.548	1037.44	985.982	0	985.982
19	1.40872	1546.76	Native Silty SAND (SM)	445	31	343.778	967.712	869.936	0	869.936
20	1.40872	1379.13	Native Silty SAND (SM)	445	31	316.865	891.953	743.855	0	743.855
21	1.40872	1191.52	Native Silty SAND (SM)	445	31	287.619	809.628	606.843	0	606.843
22	1.40872	981.13	Native Silty SAND (SM)	445	31	255.8	720.06	457.776	0	457.776
23	1.40872	744.131	Native Silty SAND (SM)	445	31	221.099	622.378	295.206	0	295.206
24	1.40872	475.105	Native Silty SAND (SM)	445	31	324.483	913.398	779.545	0	779.545
25	1.40872	165.892	Native Silty SAND (SM)	445	31	552.753	1555.96	1848.94	0	1848.94

Global Minimum Query (janbu simplified) - Safety Factor: 2.37028

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	1.41471	105.625	Native Silty SAND (SM)	445	31	228.64	541.941	161.337	0	161.337
2	1.41471	309.547	Native Silty SAND (SM)	445	31	264.543	627.04	302.965	0	302.965
3	1.41471	499.178	Native Silty SAND (SM)	445	31	296.766	703.418	430.08	0	430.08
4	1.41471	675.172	Native Silty SAND (SM)	445	31	325.622	771.815	543.912	0	543.912
5	1.41471	838.025	Native Silty SAND (SM)	445	31	351.35	832.798	645.404	0	645.404
6	1.41471	988.101	Native Silty SAND (SM)	445	31	374.134	886.802	735.285	0	735.285
7	1.41471	1125.65	Native Silty SAND (SM)	445	31	394.113	934.158	814.094	0	814.094
8	1.41471	1250.8	Native Silty SAND (SM)	445	31	411.39	975.11	882.248	0	882.248
9	1.41471	1363.6	Native Silty SAND (SM)	445	31	426.038	1009.83	940.031	0	940.031
10	1.41471	1464	Native Silty SAND (SM)	445	31	438.102	1038.43	987.626	0	987.626
11	1.41471	1551.83	Native Silty SAND (SM)	445	31	447.602	1060.94	1025.1	0	1025.1

12	1.41471	1626.83	Native Silty SAND (SM)	445	31	454.532	1077.37	1052.43	0	1052.43
13	1.41471	1688.61	Native Silty SAND (SM)	445	31	458.864	1087.64	1069.52	0	1069.52
14	1.41471	1765.72	Native Silty SAND (SM)	445	31	465.351	1103.01	1095.11	0	1095.11
15	1.41471	2143.6	Native Silty SAND (SM)	445	31	520.353	1233.38	1312.09	0	1312.09
16	1.41471	2341.45	Native Silty SAND (SM)	445	31	544.359	1290.28	1406.79	0	1406.79
17	1.41471	2140.98	Native Silty SAND (SM)	445	31	504.025	1194.68	1247.68	0	1247.68
18	1.41471	1988.97	Native Silty SAND (SM)	445	31	471.779	1118.25	1120.48	0	1120.48
19	1.41471	1833.01	Native Silty SAND (SM)	445	31	439.157	1040.93	991.788	0	991.788
20	1.41471	1654.68	Native Silty SAND (SM)	445	31	403.35	956.052	850.534	0	850.534
21	1.41471	1450.49	Native Silty SAND (SM)	445	31	363.961	862.689	695.153	0	695.153
22	1.41471	1215.46	Native Silty SAND (SM)	445	31	320.446	759.547	523.494	0	523.494
23	1.41471	942.128	Native Silty SAND (SM)	445	31	272.035	644.799	332.521	0	332.521
24	1.41471	618.238	Native Silty SAND (SM)	445	31	411.535	975.454	882.823	0	882.823
25	1.41471	220.864	Native Silty SAND (SM)	445	31	574.787	1362.41	1526.82	0	1526.82

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 2.81493

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	0.73283	4930.37	0	0	0
2	2.14155	4930.04	286.091	0	0
3	3.55026	4929.79	629.887	0	0
4	4.95898	4929.59	1012.06	0	0
5	6.3677	4929.46	1415.66	0	0
6	7.77642	4929.39	1825.79	0	0
7	9.18513	4929.38	2229.31	0	0
8	10.5939	4929.43	2614.6	0	0
9	12.0026	4929.54	2971.44	0	0

10	13.4113	4929.72	3290.84	0	0
11	14.82	4929.95	3564.98	0	0
12	16.2287	4930.25	3787.14	0	0
13	17.6374	4930.62	3951.7	0	0
14	19.0462	4931.06	4054.11	0	0
15	20.4549	4931.56	4087.98	0	0
16	21.8636	4932.14	3992.98	0	0
17	23.2723	4932.8	3764.72	0	0
18	24.681	4933.55	3496.01	0	0
19	26.0897	4934.38	3190.08	0	0
20	27.4985	4935.32	2859.21	0	0
21	28.9072	4936.37	2525.89	0	0
22	30.3159	4937.54	2218.88	0	0
23	31.7246	4938.85	1975.86	0	0
24	33.1333	4940.34	1847.76	0	0
25	34.542	4942.04	982.263	0	0
26	35.9508	4944	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 2.37028

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	0.714139	4930.36	0	0	0
2	2.12885	4929.82	409.672	0	0
3	3.54356	4929.37	919.963	0	0
4	4.95828	4929	1497.8	0	0
5	6.37299	4928.71	2115.59	0	0
6	7.7877	4928.5	2750.01	0	0
7	9.20242	4928.36	3381.15	0	0
8	10.6171	4928.29	3991.88	0	0
9	12.0318	4928.3	4567.38	0	0

10	13.4466	4928.38	5094.79	0	0
11	14.8613	4928.53	5562.98	0	0
12	16.276	4928.76	5962.34	0	0
13	17.6907	4929.06	6284.73	0	0
14	19.1054	4929.44	6523.34	0	0
15	20.5201	4929.91	6670.75	0	0
16	21.9348	4930.46	6680.34	0	0
17	23.3495	4931.11	6540.5	0	0
18	24.7643	4931.86	6320.93	0	0
19	26.179	4932.71	6027.13	0	0
20	27.5937	4933.69	5675.37	0	0
21	29.0084	4934.81	5292.08	0	0
22	30.4231	4936.1	4913.07	0	0
23	31.8378	4937.58	4589.02	0	0
24	33.2525	4939.32	4396.01	0	0
25	34.6672	4941.4	3141.66	0	0
26	36.082	4944	0	0	0

List Of Coordinates

Distributed Load

X	Y
36.0403	4944
34.0731	4944

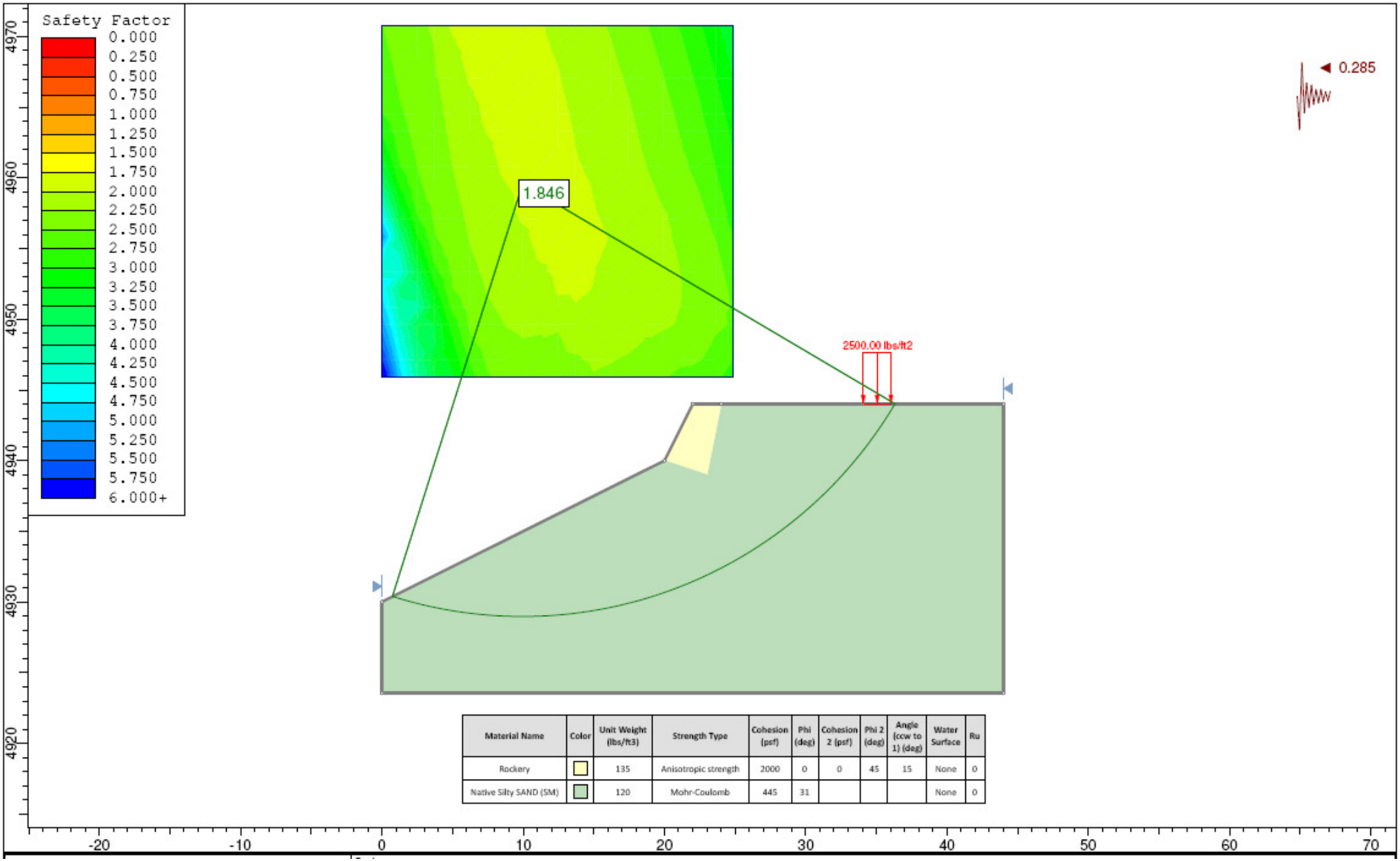
External Boundary

X	Y
0	4923.55

44	4923.55
44	4944
24	4944
22	4944
20	4940
0	4930

Material Boundary

X	Y
20	4940
23	4939
24	4944



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion 2 (psf)	Phi 2 (deg)	Angle (ccw to 1) (deg)	Water Surface	Ru
Rockery		135	Anisotropic strength	2000	0	0	45	15	None	0
Native Silty SAND (SM)		120	Mohr-Coulomb	445	31				None	0

GeoStrata

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Dauphine-Savory Piedmont – Lot 2R Section B-B' PStatic

Rockery Analysis and Design
Matt Rasmussen
Lot 2R
Weber County, Utah

Plate
C - 4

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: Section B-B' PStatic
Slide Modeler Version: 6.033
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 5/2/2015, 2:33:07 PM

General Settings

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

Analysis Options

Analysis Methods Used

Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005

Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

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): 0.285
1 Distributed Load present

Distributed Load 1

Distribution: Constant
Magnitude [psf]: 2500
Orientation: Normal to boundary

Material Properties

Property	Rockery	Native Silty SAND (SM)
Color		
Strength Type	Anisotropic strength	Mohr-Coulomb
Unit Weight [lbs/ft3]	135	120
Cohesion [psf]		445
Friction Angle [deg]		31
Cohesion 1 [psf]	2000	
Cohesion 2 [psf]	0	
Friction Angle 1 [deg]	0	
Friction Angle 2 [deg]	45	
Angle from 1 [deg]	15	
Water Surface	None	None
Ru Value	0	0

Global Minimums

Method: bishop simplified

FS: 1.845700
Center: 9.954, 4959.577
Radius: 30.631

Left Slip Surface Endpoint: 0.733, 4930.367
Right Slip Surface Endpoint: 36.328, 4944.000
Resisting Moment=1.13772e+006 lb-ft
Driving Moment=616417 lb-ft
Total Slice Area=241.493 ft2

Method: janbu simplified

FS: 1.566710
Center: 11.198, 4955.844
Radius: 27.559
Left Slip Surface Endpoint: 0.714, 4930.357
Right Slip Surface Endpoint: 36.082, 4944.000
Resisting Horizontal Force=32734.2 lb
Driving Horizontal Force=20893.6 lb
Total Slice Area=263.521 ft2

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 4845
Number of Invalid Surfaces: 6

Error Codes:

Error Code -103 reported for 4 surfaces
Error Code -108 reported for 2 surfaces

Method: janbu simplified

Number of Valid Surfaces: 4749
Number of Invalid Surfaces: 102

Error Codes:

Error Code -103 reported for 4 surfaces
Error Code -108 reported for 98 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.8457

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	1.42381	95.9996	Native Silty SAND (SM)	445	31	290.371	535.937	151.344	0	151.344
2	1.42381	281.742	Native Silty SAND (SM)	445	31	331.135	611.175	276.562	0	276.562
3	1.42381	455.183	Native Silty SAND (SM)	445	31	367.672	678.613	388.798	0	388.798
4	1.42381	616.691	Native Silty SAND (SM)	445	31	400.295	738.825	489.007	0	489.007
5	1.42381	766.541	Native Silty SAND (SM)	445	31	429.249	792.264	577.944	0	577.944
6	1.42381	904.923	Native Silty SAND (SM)	445	31	454.725	839.286	656.202	0	656.202
7	1.42381	1031.95	Native Silty SAND (SM)	445	31	476.876	880.17	724.246	0	724.246
8	1.42381	1147.65	Native Silty SAND (SM)	445	31	495.816	915.128	782.425	0	782.425
9	1.42381	1251.98	Native Silty SAND (SM)	445	31	511.629	944.313	830.999	0	830.999
10	1.42381	1344.85	Native Silty SAND (SM)	445	31	524.37	967.829	870.136	0	870.136
11	1.42381	1426.04	Native Silty SAND (SM)	445	31	534.069	985.732	899.927	0	899.927
12	1.42381	1495.29	Native Silty SAND (SM)	445	31	540.734	998.032	920.398	0	920.398
13	1.42381	1552.21	Native Silty SAND (SM)	445	31	544.343	1004.69	931.486	0	931.486

14	1.42381	1644.07	Native Silty SAND (SM)	445	31	554.665	1023.75	963.194	0	963.194
15	1.42381	2047.85	Native Silty SAND (SM)	445	31	627.28	1157.77	1186.25	0	1186.25
16	1.42381	2182.36	Native Silty SAND (SM)	445	31	643.35	1187.43	1235.61	0	1235.61
17	1.42381	1976.11	Native Silty SAND (SM)	445	31	591.554	1091.83	1076.51	0	1076.51
18	1.42381	1830.55	Native Silty SAND (SM)	445	31	552.376	1019.52	956.163	0	956.163
19	1.42381	1675.9	Native Silty SAND (SM)	445	31	511.977	944.956	832.07	0	832.07
20	1.42381	1501.3	Native Silty SAND (SM)	445	31	468.4	864.526	698.209	0	698.209
21	1.42381	1304.08	Native Silty SAND (SM)	445	31	421.357	777.698	553.702	0	553.702
22	1.42381	1080.63	Native Silty SAND (SM)	445	31	370.48	683.795	397.422	0	397.422
23	1.42381	825.869	Native Silty SAND (SM)	445	31	315.292	581.934	227.896	0	227.896
24	1.42381	532.173	Native Silty SAND (SM)	445	31	589.412	1087.88	1069.93	0	1069.93
25	1.42381	187.22	Native Silty SAND (SM)	445	31	621.821	1147.7	1169.48	0	1169.48

Global Minimum Query (janbu simplified) - Safety Factor: 1.56671

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	1.41471	105.625	Native Silty SAND (SM)	445	31	366.116	573.597	214.022	0	214.022
2	1.41471	309.547	Native Silty SAND (SM)	445	31	419.321	656.955	352.752	0	352.752
3	1.41471	499.178	Native Silty SAND (SM)	445	31	466.066	730.191	474.637	0	474.637
4	1.41471	675.172	Native Silty SAND (SM)	445	31	507.042	794.387	581.478	0	581.478
5	1.41471	838.025	Native Silty SAND (SM)	445	31	542.77	850.363	674.638	0	674.638
6	1.41471	988.101	Native Silty SAND (SM)	445	31	573.651	898.744	755.157	0	755.157
7	1.41471	1125.65	Native Silty SAND (SM)	445	31	599.99	940.01	823.838	0	823.838
8	1.41471	1250.8	Native Silty SAND (SM)	445	31	622.018	974.522	881.272	0	881.272
9	1.41471	1363.6	Native Silty SAND (SM)	445	31	639.908	1002.55	927.921	0	927.921
10	1.41471	1464	Native Silty SAND (SM)	445	31	653.78	1024.28	964.09	0	964.09
11	1.41471	1551.83	Native Silty SAND (SM)	445	31	663.71	1039.84	989.986	0	989.986
12	1.41471	1626.83	Native Silty SAND (SM)	445	31	669.733	1049.28	1005.68	0	1005.68
13	1.41471	1688.61	Native Silty SAND (SM)	445	31	671.843	1052.58	1011.19	0	1011.19
14	1.41471	1765.72	Native Silty SAND (SM)	445	31	676.993	1060.65	1024.61	0	1024.61

15	1.41471	2143.6	Native Silty SAND (SM)	445	31	752.087	1178.3	1220.42	0	1220.42
16	1.41471	2341.45	Native Silty SAND (SM)	445	31	781.518	1224.41	1297.16	0	1297.16
17	1.41471	2140.98	Native Silty SAND (SM)	445	31	718.571	1125.79	1133.03	0	1133.03
18	1.41471	1988.97	Native Silty SAND (SM)	445	31	667.666	1046.04	1000.29	0	1000.29
19	1.41471	1833.01	Native Silty SAND (SM)	445	31	616.63	966.081	867.225	0	867.225
20	1.41471	1654.68	Native Silty SAND (SM)	445	31	561.537	879.765	723.572	0	723.572
21	1.41471	1450.49	Native Silty SAND (SM)	445	31	501.926	786.372	568.141	0	568.141
22	1.41471	1215.46	Native Silty SAND (SM)	445	31	437.186	684.943	399.332	0	399.332
23	1.41471	942.128	Native Silty SAND (SM)	445	31	366.466	574.146	214.935	0	214.935
24	1.41471	618.238	Native Silty SAND (SM)	445	31	545.777	855.074	682.477	0	682.477
25	1.41471	220.864	Native Silty SAND (SM)	445	31	746.487	1169.53	1205.82	0	1205.82

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.8457

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	0.733086	4930.37	0	0	0
2	2.1569	4929.95	448.062	0	0
3	3.58071	4929.62	932.495	0	0
4	5.00452	4929.35	1429.96	0	0
5	6.42833	4929.15	1920.96	0	0
6	7.85214	4929.02	2389.08	0	0
7	9.27595	4928.95	2820.53	0	0
8	10.6998	4928.95	3203.69	0	0
9	12.1236	4929.02	3528.88	0	0
10	13.5474	4929.16	3788.08	0	0
11	14.9712	4929.36	3974.85	0	0
12	16.395	4929.63	4084.17	0	0

13	17.8188	4929.97	4112.45	0	0
14	19.2426	4930.39	4057.51	0	0
15	20.6664	4930.88	3904.16	0	0
16	22.0902	4931.45	3533.72	0	0
17	23.5141	4932.11	3013.76	0	0
18	24.9379	4932.86	2484.65	0	0
19	26.3617	4933.71	1935.99	0	0
20	27.7855	4934.67	1387.77	0	0
21	29.2093	4935.75	869.621	0	0
22	30.6331	4936.98	419.152	0	0
23	32.0569	4938.37	85.564	0	0
24	33.4807	4939.96	-63.9687	0	0
25	34.9045	4941.81	-1352.6	0	0
26	36.3284	4944	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 1.56671

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	0.714139	4930.36	0	0	0
2	2.12885	4929.82	604.215	0	0
3	3.54356	4929.37	1269.83	0	0
4	4.95828	4929	1963.73	0	0
5	6.37299	4928.71	2659.24	0	0
6	7.7877	4928.5	3334.67	0	0
7	9.20242	4928.36	3972.19	0	0
8	10.6171	4928.29	4557.1	0	0
9	12.0318	4928.3	5077.32	0	0
10	13.4466	4928.38	5522.93	0	0
11	14.8613	4928.53	5885.98	0	0
12	16.276	4928.76	6160.23	0	0

13	17.6907	4929.06	6341.1	0	0
14	19.1054	4929.44	6425.61	0	0
15	20.5201	4929.91	6405.57	0	0
16	21.9348	4930.46	6186.69	0	0
17	23.3495	4931.11	5789.96	0	0
18	24.7643	4931.86	5353.11	0	0
19	26.179	4932.71	4876.08	0	0
20	27.5937	4933.69	4378.33	0	0
21	29.0084	4934.81	3892.49	0	0
22	30.4231	4936.1	3461.13	0	0
23	31.8378	4937.58	3142.37	0	0
24	33.2525	4939.32	3020.56	0	0
25	34.6672	4941.4	2199.44	0	0
26	36.082	4944	0	0	0

List Of Coordinates

Distributed Load

X	Y
36.0403	4944
34.0731	4944

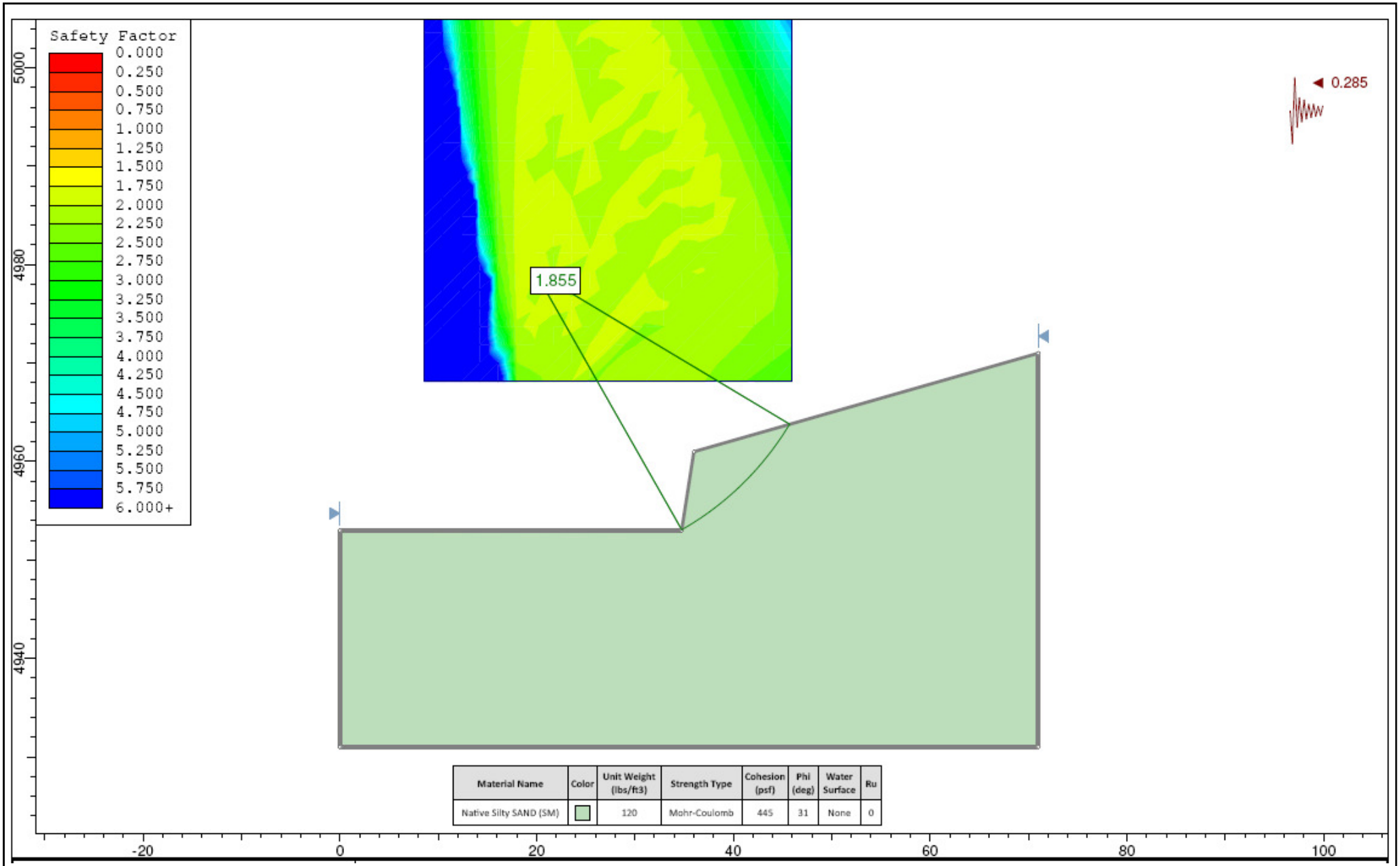
External Boundary

X	Y
0	4923.55
44	4923.55
44	4944
24	4944

22	4944
20	4940
0	4930

Material Boundary

X	Y
20	4940
23	4939
24	4944



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Dauphine-Savory Piedmont – Lot 2R Section A-A' Pstatic Seismic Force Determination

Rockery Analysis and Design
Matt Rasmussen
Lot 2R
Weber County, Utah

Plate C - 5

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: Section A-A' Static Cut Slope
Slide Modeler Version: 6.033
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 5/2/2015, 2:19:31 PM

General Settings

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

Analysis Options

Analysis Methods Used

Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005

Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

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): 0.285

Material Properties

Property	Native Silty SAND (SM)
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	445
Friction Angle [deg]	31
Water Surface	None
Ru Value	0

Global Minimums

Method: bishop simplified

FS: 1.854710
Center: 19.824, 4979.316
Radius: 30.224
Left Slip Surface Endpoint: 34.762, 4953.042
Right Slip Surface Endpoint: 45.753, 4963.787
Resisting Moment=264789 lb-ft
Driving Moment=142766 lb-ft
Total Slice Area=47.2829 ft2

Method: janbu simplified

FS: 1.792280
Center: 40.371, 4981.184
Radius: 31.574
Left Slip Surface Endpoint: 26.136, 4953.000

Right Slip Surface Endpoint: 70.176, 4970.765
Resisting Horizontal Force=44174.2 lb
Driving Horizontal Force=24646.9 lb
Total Slice Area=407.525 ft2

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 4842
Number of Invalid Surfaces: 9

Error Codes:

Error Code -105 reported for 1 surface
Error Code -106 reported for 8 surfaces

Method: janbu simplified

Number of Valid Surfaces: 4737
Number of Invalid Surfaces: 114

Error Codes:

Error Code -105 reported for 1 surface
Error Code -106 reported for 8 surfaces
Error Code -108 reported for 105 surfaces

Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.
-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

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

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.85471

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	0.439657	67.8347	Native Silty SAND (SM)	445	31	244.078	452.694	12.8045	0	12.8045
2	0.439657	203.24	Native Silty SAND (SM)	445	31	326.049	604.727	265.831	0	265.831
3	0.439657	335.689	Native Silty SAND (SM)	445	31	405.126	751.391	509.919	0	509.919
4	0.439657	374.925	Native Silty SAND (SM)	445	31	426.373	790.799	575.507	0	575.507
5	0.439657	366.176	Native Silty SAND (SM)	445	31	418.237	775.709	550.393	0	550.393
6	0.439657	356.835	Native Silty SAND (SM)	445	31	409.755	759.976	524.209	0	524.209
7	0.439657	346.878	Native Silty SAND (SM)	445	31	400.917	743.584	496.927	0	496.927
8	0.439657	336.281	Native Silty SAND (SM)	445	31	391.713	726.514	468.518	0	468.518
9	0.439657	325.019	Native Silty SAND (SM)	445	31	382.135	708.75	438.953	0	438.953
10	0.439657	313.062	Native Silty SAND (SM)	445	31	372.171	690.27	408.197	0	408.197
11	0.439657	300.378	Native Silty SAND (SM)	445	31	361.81	671.052	376.214	0	376.214
12	0.439657	286.932	Native Silty SAND (SM)	445	31	351.037	651.072	342.961	0	342.961
13	0.439657	272.686	Native Silty SAND (SM)	445	31	339.84	630.305	308.4	0	308.4
14	0.439657	257.595	Native Silty SAND (SM)	445	31	328.203	608.722	272.479	0	272.479
15	0.439657	241.61	Native Silty SAND (SM)	445	31	316.109	586.291	235.148	0	235.148
16	0.439657	224.678	Native Silty SAND (SM)	445	31	303.54	562.979	196.351	0	196.351
17	0.439657	206.735	Native Silty SAND (SM)	445	31	290.476	538.749	156.023	0	156.023
18	0.439657	187.712	Native Silty SAND (SM)	445	31	276.894	513.558	114.099	0	114.099
19	0.439657	167.528	Native Silty SAND (SM)	445	31	262.77	487.361	70.5013	0	70.5013
20	0.439657	146.088	Native Silty SAND (SM)	445	31	248.076	460.109	25.1455	0	25.1455
21	0.439657	123.285	Native Silty SAND (SM)	445	31	232.783	431.744	-22.0613	0	-22.0613
22	0.439657	98.9897	Native Silty SAND (SM)	445	31	216.856	402.205	-71.2231	0	-71.2231

23	0.439657	73.0498	Native Silty SAND (SM)	445	31	200.258	371.421	-122.456	0	-122.456
24	0.439657	45.2809	Native Silty SAND (SM)	445	31	182.947	339.314	-175.891	0	-175.891
25	0.439657	15.457	Native Silty SAND (SM)	445	31	164.876	305.797	-231.672	0	-231.672

Global Minimum Query (janbu simplified) - Safety Factor: 1.79228

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	1.7616	86.9494	Native Silty SAND (SM)	445	31	313.991	562.759	195.983	0	195.983
2	1.7616	247.426	Native Silty SAND (SM)	445	31	340.445	610.172	274.892	0	274.892
3	1.7616	381.982	Native Silty SAND (SM)	445	31	360.607	646.309	335.034	0	335.034
4	1.7616	492.249	Native Silty SAND (SM)	445	31	375.231	672.519	378.656	0	378.656
5	1.7616	593.21	Native Silty SAND (SM)	445	31	387.687	694.844	415.81	0	415.81
6	1.7616	1914.39	Native Silty SAND (SM)	445	31	644.034	1154.29	1180.46	0	1180.46
7	1.7616	2475.09	Native Silty SAND (SM)	445	31	741.326	1328.66	1470.66	0	1470.66
8	1.7616	2604.01	Native Silty SAND (SM)	445	31	752.024	1347.84	1502.57	0	1502.57
9	1.7616	2712.08	Native Silty SAND (SM)	445	31	758.462	1359.38	1521.78	0	1521.78
10	1.7616	2799.31	Native Silty SAND (SM)	445	31	760.749	1363.47	1528.6	0	1528.6
11	1.7616	2865.53	Native Silty SAND (SM)	445	31	758.943	1360.24	1523.21	0	1523.21
12	1.7616	2910.34	Native Silty SAND (SM)	445	31	753.062	1349.7	1505.67	0	1505.67
13	1.7616	2933.14	Native Silty SAND (SM)	445	31	743.078	1331.8	1475.89	0	1475.89
14	1.7616	2933.04	Native Silty SAND (SM)	445	31	728.916	1306.42	1433.65	0	1433.65
15	1.7616	2908.88	Native Silty SAND (SM)	445	31	710.458	1273.34	1378.59	0	1378.59
16	1.7616	2859.09	Native Silty SAND (SM)	445	31	687.524	1232.24	1310.18	0	1310.18
17	1.7616	2781.63	Native Silty SAND (SM)	445	31	659.867	1182.67	1227.68	0	1227.68
18	1.7616	2673.78	Native Silty SAND (SM)	445	31	627.157	1124.04	1130.11	0	1130.11
19	1.7616	2531.92	Native Silty SAND (SM)	445	31	588.945	1055.55	1016.13	0	1016.13
20	1.7616	2351.09	Native Silty SAND (SM)	445	31	544.626	976.123	883.938	0	883.938
21	1.7616	2124.2	Native Silty SAND (SM)	445	31	493.361	884.241	731.02	0	731.02
22	1.7616	1840.68	Native Silty SAND (SM)	445	31	433.942	777.746	553.78	0	553.78
23	1.7616	1483.35	Native Silty SAND (SM)	445	31	364.53	653.34	346.738	0	346.738

24	1.7616	1020.7	Native Silty SAND (SM)	445	31	282.039	505.494	100.678	0	100.678
25	1.7616	378.921	Native Silty SAND (SM)	445	31	180.198	322.966	-203.098	0	-203.098

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.85471

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	34.762	4953.04	0	0	0
2	35.2017	4953.3	84.7082	0	0
3	35.6413	4953.56	99.7089	0	0
4	36.081	4953.84	41.7956	0	0
5	36.5207	4954.12	-42.1553	0	0
6	36.9603	4954.42	-126.088	0	0
7	37.4	4954.73	-209.312	0	0
8	37.8396	4955.05	-291.075	0	0
9	38.2793	4955.38	-370.555	0	0
10	38.7189	4955.73	-446.855	0	0
11	39.1586	4956.09	-518.994	0	0
12	39.5983	4956.46	-585.893	0	0
13	40.0379	4956.85	-646.364	0	0
14	40.4776	4957.25	-699.093	0	0
15	40.9172	4957.67	-742.627	0	0
16	41.3569	4958.11	-775.343	0	0
17	41.7965	4958.56	-795.43	0	0
18	42.2362	4959.04	-800.849	0	0
19	42.6759	4959.54	-789.298	0	0
20	43.1155	4960.05	-758.155	0	0
21	43.5552	4960.6	-704.416	0	0

22	43.9948	4961.17	-624.609	0	0
23	44.4345	4961.77	-514.686	0	0
24	44.8741	4962.4	-369.869	0	0
25	45.3138	4963.08	-184.455	0	0
26	45.7535	4963.79	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 1.79228

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	26.1363	4953	0	0	0
2	27.898	4952.18	689.561	0	0
3	29.6596	4951.48	1409.99	0	0
4	31.4212	4950.9	2129.81	0	0
5	33.1828	4950.44	2826.91	0	0
6	34.9444	4950.08	3490.18	0	0
7	36.706	4949.82	4381.73	0	0
8	38.4676	4949.67	5211.63	0	0
9	40.2292	4949.61	5880.01	0	0
10	41.9908	4949.65	6380.34	0	0
11	43.7524	4949.79	6708.61	0	0
12	45.514	4950.03	6863.13	0	0
13	47.2756	4950.37	6844.51	0	0
14	49.0372	4950.82	6655.73	0	0
15	50.7988	4951.38	6302.32	0	0
16	52.5604	4952.06	5792.71	0	0
17	54.322	4952.86	5138.82	0	0
18	56.0836	4953.8	4356.92	0	0
19	57.8452	4954.89	3468.97	0	0
20	59.6068	4956.15	2504.79	0	0
21	61.3684	4957.6	1505.53	0	0

22	63.13	4959.3	529.851	0	0
23	64.8916	4961.29	-334.388	0	0
24	66.6532	4963.69	-944.954	0	0
25	68.4148	4966.68	-1040.07	0	0
26	70.1764	4970.76	0	0	0

List Of Coordinates

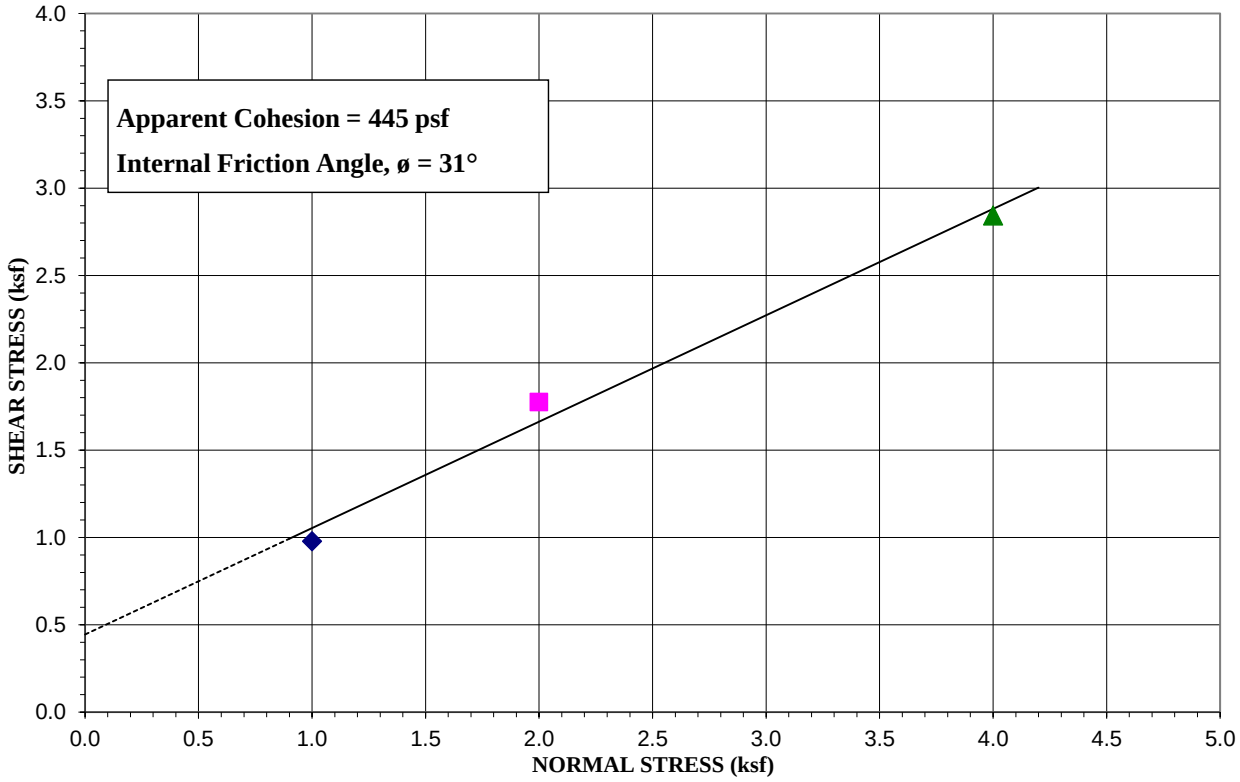
External Boundary

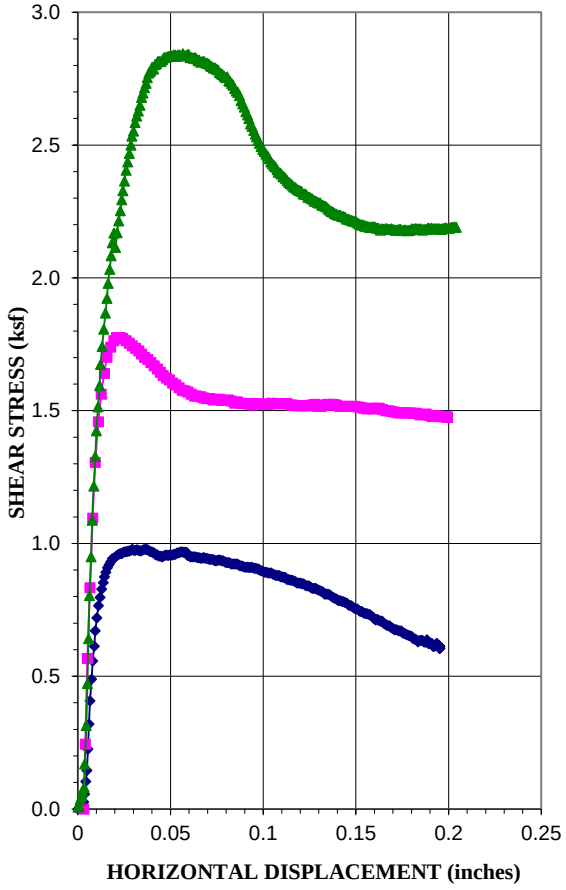
X	Y
0	4931
71	4931
71	4971
36	4961
34.7556	4953
0	4953

Material Boundary

X	Y
34.6	4952
34.7556	4953

DIRECT SHEAR TEST





Sample Location:	Lot 2R
Type of Test:	Consolidated Drained/Saturated

Test No. (Symbol)	**1 (◆)**	**2 (■)**	**3 (▲)**
Sample Type	Remolded		
Initial Height, in.	1	1	1
Diameter, in.	2.5	2.5	2.5
Dry Density Before, pcf	101.2	103.3	103.1
Dry Density After, pcf	102.9	104.9	104.7
Moisture % Before	8.4	7.3	8.8
Moisture % After	15.6	14.9	17.1
Saturation, % Before	35.2	32.2	38.7
Saturation, % After	68.0	68.2	78.2
Normal Load, ksf	1.0	2.0	4.0
Shear Stress, ksf	0.98	1.78	2.84
Strain Rate	0.00333 IN/MIN		

Sample Properties	
Cohesion, psf	445
Friction Angle, ϕ	31
Liquid Limit, %	---
Plasticity Index, %	---
Percent Gravel	---
Percent Sand	---
Percent Passing No. 200 sieve	---
Classification	SM

PROJECT: Dauphine-Savory Piedmont Subdivision

PROJECT NO.: **910-001**

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Plate
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