ENERCON SERVICES, INC.	CALCULATION COVER SHEET	CALC. NO. : TXUT-001-FSAR-2.5-CALC-018			
		REV.	5		
		PAGE NO.	1	Of	51
Title:	**Slope Stability**	Client: MNES			
		Project: MITS194			

Item	Cover Sheet Items	Yes	No
1	Does this calculation contain any assumptions that require confirmation? (If **YES**, Identify the assumptions) _____		X
2	Does this calculation serve as an "Alternate Calculation"? (If **YES**, Identify the design verified calculation.) **Design Verified Calculation No.**_____		X
3	Does this calculation Supersede an existing Calculation? (If **YES**, identify the superseded calculation.) **Superseded Calculation No.**_____		X

Scope of Revision:

Incorporated updated Grading and Drainage Plan (Revision I) and updated maximum groundwater level. Figures 1, 2, 3, 6, 7, 8, 9, 10, 18, 19, 20, 21, 22, 25, 26, 27, 28, and 29, and Appendix A are updated.

Revision Impact on Results:

None.

Preliminary Calculation	☐	**Final Calculation**	X
Safety-Related	X	**Non-Safety Related**	☐

(Print Name and Sign)

Approver: Osman A. El Menchawi 	**Date: 09-20-13**
Design Verifier: Kathy Reyes 	**Date: 09-20-13**
Approver: Joseph Mancinelli, Project Manager 	**Date: 09-20-13**

CALCULATION REVISION STATUS

REVISION	DATE	DESCRIPTION
0	08-21-08	Initial Issuance of Calculation Package.
1	10-15-09	Sections 2.0, 6.0, 7.0, and Appendix A are revised to address vertical ground motion and provide additional information [RAI No. 2930 (CP RAI #19), Questions 02.05.05-1 and 02.05.05.-2]. Appendix D is added to provide additional sample calculations. Figures 6-11, and 17-26 are revised to include material color consistency and few editorial corrections.
2	11-06-11	Sections 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, and Appendix A are updated to address the revised Grading and Drainage Plan (Revision H) and the assumed groundwater level of 813.5 ft. A number of figures are revised and new figures are also added. Appendix D is deleted.
3	11-16-11	Figure 2 is updated to reflect the latest plot plan. Figures 6, 7, 8, 9, and 9a are updated to show the boundary lines as smooth lines.
4	12-05-11	Page 12 and Figures 6, 7, 8, 9, 9a, 19, 20, 20a, 25, 26, and 26a are updated with some editorial changes.
5	09-20-13	Incorporated updated Grading and Drainage Plan (Revision I), updated references from Section 3.0 and updated maximum groundwater level. Figures 1, 2, 3, 6, 7, 8, 9, 10, 18, 19, 20, 21, 22, 25, 26, 27, 28, and 29, and Appendix A are updated.

PAGE REVISION STATUS

PAGE NO.	REVISION	PAGE NO.	REVISION
1-51	5		

APPENDIX REVISION STATUS

APPENDIX NO.	PAGE NO.	REVISION NO.	APPENDIX NO.	PAGE NO.	REVISION NO.
A	1-135	5			
B	1-31	0			
C	1-2	0			
D	Removed	2			

Calculation Design Verification Plan:

1. Apply CSP 3.01 Rev. 6 Section 4.5a (Design Review Method)

2. Check revised calculation and Figures 1, 2, 3, 6, 7, 8, 9, 10, 18, 19, 20, 21, 22, 25, 26, 27, 28, and 29, and Appendix A.

(Print Name and Sign)

Approver: Joseph Mancinelli, Project Manager 

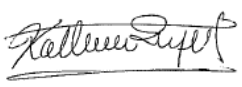
Date: 09-20-13

Calculation Design Verification Summary:

1. Compared documented input with the source reference and checked validity of reference for intended use.
2. Evaluated and verified assumptions to determine that they were based on sound engineering practices and principles.
3. Checked revised calculation and Figures 1, 2, 3, 6, 7, 8, 9, 10, 18, 19, 20, 21, 22, 25, 26, 27, 28, and 29, and Appendix A.

Based On The Above Summary, The Calculation Is Determined To Be Acceptable.

(Print Name and Sign)

Design Verifier: Kathy Reyes 

Date: 09-20-13

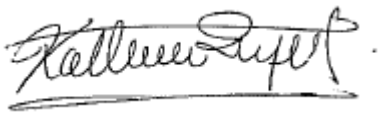
Others:

Date:

Item	Checklist Items	Yes	No	N/A
1	**Design Inputs** - Were the design inputs correctly selected, referenced (latest revision), consistent with the design basis and incorporated in the calculation?	X		
2	**Assumptions** – Were the assumptions reasonable and adequately described, justified and/or verified, and documented?	X		
3	**Quality Assurance** – Were the appropriate QA classification and requirements assigned to the calculation?	X		
4	**Codes, Standard and Regulatory Requirements** – Were the applicable codes, standards and regulatory requirements, including issue and addenda, properly identified and their requirements satisfied?			X
5	**Construction and Operating Experience** – Have applicable construction and operating experience been considered?			X
6	**Interfaces** – Have the design interface requirements been satisfied, including interactions with other calculations?	X		
7	**Methods** – Was the calculation methodology appropriate and properly applied to satisfy the calculation objective?	X		
8	**Design Outputs** – Was the conclusion of the calculation clearly stated, did it correspond directly with the objectives and are the results reasonable compared to the inputs?	X		
9	**Radiation Exposure** – Has the calculation properly considered radiation exposure to the public and plant personnel?			X
10	**Acceptance Criteria** – Are the acceptance criteria incorporated in the calculation sufficient to allow verification that the design requirements have been satisfactorily accomplished?			X
11	**Computer Software** – Is a computer program or software used, and if so, are the requirements of CSP 3.02 met?	X		

COMMENTS:

(Print Name and Sign)

Design Verifier: Kathy Reyes 	**Date: 09-20-13**
Others:	**Date:**

COMANCHE PEAK COMBINED OPERATING LICENSE APPLICATION
Calculation No. TXUT-001-FSAR-2.5-CALC-018
SLOPE STABILITY

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APPENDICES

1.0 PURPOSE AND SCOPE

This calculation package summarizes the results of the stability analyses for the slopes in the vicinity of the proposed seismic category I structures for Units 3 and 4 at the Comanche Peak Nuclear Power Plant (CPNPP) for the Combined Operating License Application (COLA). Per Regulatory Guide (RG) 1.206, information should be presented on the static and dynamic stability of all natural and man-made earth or rock slopes (e.g., cuts, fills, embankments, dams) for which failure under any of the conditions to which they may be exposed during the life of the plant could adversely affect the safety of the nuclear power plant facilities. The objective of the slope stability analyses is to identify site-specific critical slopes within the project site, and to characterize and assess the stability state of the critical slopes for both the static and seismic conditions.

2.0 SUMMARY OF RESULTS AND CONCLUSIONS

This document provides discussions and results of slope stability analyses performed for the most severe slopes adjacent to CPNPP Units 3 and 4 seismic category I and II structures, as well as temporary cut slopes for construction of the Nuclear Island foundations. Calculations are provided in the appendices. The following is a brief summary of the results and conclusions.

- The results of slope stability analyses of the permanent slopes in the near vicinity of seismic category I and II structures indicate acceptable static long-term factors of safety with values greater than 1.5.
- All compacted fill slopes indicate adequate factors of safety against surficial instability, provided that the compacted fill materials exhibit the specified effective cohesion value of at least 200 psf and an effective friction angle of at least 32 degrees.
- Pseudo-static factors of safety, estimated using horizontal and vertical seismic coefficients equal to the design PGA of 0.1g, range between 1.45 and 6.02. The results of the dynamic stability analyses of the permanent slopes demonstrate that the seismic performance is acceptable and that no seismically induced permanent slope displacement is expected at the CPNPP Units 3 and 4 site.
- Analyses of the temporary construction cut slope within the rock layers indicate acceptable static factors of safety with values greater than 1.3, provided that cut slopes are not steeper than 0.25(H):1.0(V).

3.0 REFERENCES

3.1 Project References

3.1.1 Not Used.

3.1.2 Not Used.

3.1.3 Fugro Consultants, Inc. (2013), Settlement and Bearing Capacity Calculation Package No. TXUT-001-FSAR-2.5-CALC-009, Rev. 3.

3.1.4 Mitsubishi Heavy Industries (2012), Grading and Drainage Plan, Document No. 4CS-CP34-20080060, Rev. 4, Final, dated 12-19-12.

3.1.5 Mitsubishi Heavy Industries (2012), Nuclear and Turbine Island Excavation Plan and Sections, Document No. 4CS-CP34-20110023, Rev. 1, dated 12-14-12.

3.1.6 Mitsubishi Heavy Industries (2013), Site Specific SSI Analyses of US-APWR Reactor Building – SSI-12-05-100-003, Document No. 4DS-CP34-20130007, Rev. 0, dated 6-17-13.

3.1.7 Fugro Consultants, Inc. (formerly William Lettis and Associates, Inc.) (2007), Engineering Stratigraphy, Calculation Package No. TXUT-001-FSAR-2.5-CALC-004, Rev. 0.

3.1.8 Fugro Consultants, Inc. (2013), Dynamic Profile, Project Report No. TXUT-001-PR-007, Rev. 9.

3.1.9 Fugro Consultants, Inc. (formerly William Lettis and Associates, Inc.) (2008), Boring Log Data Report, Project Report No. TXUT-001-PR-005, Rev. 0.

3.1.10 Not Used.

3.1.11 Mitsubishi Heavy Industries (2013), R/B Complex Foundation Overturning Stability, Document No. N0-EF00U04, Rev. 1, dated 9-6-13.

3.1.12 Mitsubishi Heavy Industries (2013), Site Specific Structural Design of US-APWR Ultimate Heat Sink Related Structure – SSI-12-05-100-009, Document No. 4DS-CP34-20080052, Rev. 4, dated 8-6-13.

3.1.13 Mitsubishi Heavy Industries (2013), Site Specific Structural Design of US-APWR ESWPT – SSI-12-05-100-007, Document No. 4DS-CP34-20080054, Rev. 4, dated 7-26-13.

3.1.14 Mitsubishi Heavy Industries (2013), Site Specific Structural Design of US-APWR PSFSV – SSI-12-05-100-005, Document No. 4DS-CP34-20080056, Rev. 4, dated 7-30-13.

3.1.15 Enercon Services, Inc. (2012), Evaluation of Maximum Post-Construction Groundwater Level, Calculation No. TXUT-001-FSAR-2.4.12-CALC-038, Rev. 2.

3.1.16 Fugro Consultants Inc. (2013), Documentation of Smooth Horizontal and Vertical GMRS and FIRS for Comanche Peak Units 3 and 4, FCL QA record 0737-ACR-040, Rev. 7.

3.2 General References

3.2.1 Geo-Slope International Ltd. (2007), “Stability Modeling with Slope/W 2007, An Engineering Methodology,” Slope/W User Manual and Instructions, Second Edition.

3.2.2 Hoek, E. (2007), Practical Rock Engineering, notes from Rock Engineering Course, on-line webpage document at www.rocscience.com.

3.2.3 Hoek, E. and Brown, E.T. (1997), Practical Estimates of Rock Mass Strength, International Journal of Rock Mechanics and Mining Sciences, Vol. 34, No. 8, pages. 1165-1186.

3.2.4 Not used.

3.2.5 Stark, T.D., Choi, H., and McCone, S. (2005), Drained Shear Strength Parameters for Analysis of Landslides, Journal of Geotechnical and Environmental Engineering, ASCE, May 2005.

3.2.6 Stark, T.D., Eid, H.T. (1994), Drained Residual Strength of Cohesive Soils, Journal of Geotechnical Engineering, ASCE, May 1994.

3.2.7 U.S. Army Corps of Engineers (2003), EM 1110-2-1902, Engineering and Design – Slope Stability Manual.

3.2.8 Not used.

3.2.9 Janbu, N. (1968), Slope Stability Computations, Soils Mechanics and Foundation Engineering, the Technical University of Norway.

3.2.10 Janbu, N. (1973), Slope Stability Computations, Embankment Dam Engineering – Casagrande Volume, R.C. Hirschfield and S.J. Poulos, eds., John Wiley and Sons, New York, pages 47-86.

3.2.11 Bishop, A.W. (1955), The Use of the Slip Circle in the Stability Analysis of Slopes, Geotechnique, Vol. 5, No. 1, pages 7-17.

3.2.12 Spencer, E. (1967), A Method of Analysis of the Stability of Embankments Assuming Inter-Slice Forces, Geotechnique, Vol. 17, No. 1, pages 11-26.

3.2.13 Campbell, R.H. (1975), Soil Slips, Debris Flows, and Rainstorms in the Santa Monica Mountains and Vicinity, Southern California, USGS Prof. Paper 851, pages 19-20.

4.0 ASSUMPTIONS

The following assumptions were made during evaluation of site slopes:

- The existing undocumented fill materials northeast of Unit 4 and east to southeast of Unit 3 are generally located outside of the structural areas. All undocumented fill encountered during construction or those deemed to provide any kind of support to plant facilities will be removed completely and replaced with compacted fill.
- If undocumented fill or weak shale materials daylight within any permanent slopes, an engineered buttress consisting of compacted fill founded into limestone Layer C or other competent material is constructed to increase the stability performance of the slope.
- Fill slopes will be constructed using compacted fill that consists of granular materials that have a minimum internal friction angle of 32 degrees and a cohesion intercept of 200 psf.
- All slope backfill materials will be compacted to 95 percent of the maximum dry density at a moisture content within about 2 percent of the optimum moisture content determined in accordance with ASTM D1557.

- All fill slopes will be constructed with adequate surface and subsurface drainage so that significant pore water pressure does not develop within the fill.

5.0 DESIGN INPUT

The following paragraphs provide a summary of the data and information for the plant structures, proposed conceptual site grading, and subsurface material properties used for this report.

5.1 General Plant Information

The CPNPP structures of each unit consist of the Reactor Building (R/B), Auxiliary Building (A/B), East Power Source Building (EPS/B), and West Power Source Building (WPS/B) all of which share the same foundation mat forming the Reactor Building Complex (R/B Complex). The other structures consist of the Power Source Fuel Storage Vault (PSFSV), Essential Service Water Pipe Tunnel (ESWPT), Ultimate Heat Sink Related Structures (UHSRS), Turbine Building (T/B), and Turbine Generator Pedestal (T/G). There are no seismic category I Duct Banks. The preliminary general plant arrangement showing the layout and plan dimensions of the main structures, foundation loadings, and basement embedment depths have been provided for the proposed CPNPP Units 3 and 4 by Mitsubishi Heavy Industries (MHI) (Ref. 3.1.4 through 3.1.6 and 3.1.11 through 3.1.14). All seismic category I and II structures will be founded on or embedded in the competent Layer C limestone which is approximately at an average elevation of 782 ft or on fill concrete which extends from the foundation bottom to the top of solid limestone at average elevation of 782 ft. If the foundation bottom elevation is higher than the top of Layer C limestone, the current design requires that all of the materials above the Layer C limestone be removed and replaced with fill concrete.

A map showing the locations of the CPNPP Units 3 and 4 main structures, with respect to site setting, is shown on Figure 1. Safety-related seismic classification of the Units 3 and 4 facilities are shown on Figure 2. The following Table 5.1-1 provides a summary of the pertinent data for the primary seismic category I and II structures within each unit:

Table 5.1-1: Main Seismic Category I and II Structures' Details

Structure	Category	Foundation Length (ft)		Foundation Bottom Elev. (ft)	Static Pressure (ksf)	Seismic Pressure (ksf)
		E-W	N-S			
R/B Complex	I	347	334.58	779.75	13.1	20.9
T/B	II	265.5	342.67	794.83	--	--
T/G	II	62.33	233.42	786.83	--	--
PSFSV	I	98	95	782	4.0	7.6
UHSRS	I	267	160	786	4.9	14.9
ESWPT	I	26 (Tunnel Width)		791.08	4.6	8.5

5.2 Site Grading

Based on the site grading plans provided by MHI (Ref. 3.1.4), the final finish grade for the main plant area will be at elevation 822 ft. The pre-construction grades vary between elevation 830 and 855 ft within the Unit 3 main plant area and between elevation 842 and 868 ft within the Unit 4 main plant area. Therefore, approximate cuts range from 8 to 36 ft for Unit 3 and 20 to 49 ft for the Unit 4 main plant areas. A map showing the pre- and post-construction ground surface elevations is shown on Figure 3.

5.3 Permanent Slope Conditions

The plant grade transitions into gently sloping natural and artificial ground along the west, south, and eastern margins of the pad. No slopes of significant gradient and/or height exist in these areas to present a potential slope stability issue. As shown on Figure 3, a combination of natural and graded slopes descends from the northern margin of the plant yard to Squaw Creek Reservoir along the north margin of the plant site, and in the area of the UHSRS. The reservoir pool elevation is 775 ft, and the side slopes rising above reservoir level to plant grade are between 42 ft and 44 ft high. The closest approaches of these slopes to the plant power blocks are northeast of Unit 3 and north to northwest of Unit 4. The pre-construction slopes along the northeast of Unit 3 have an overall maximum inclination of approximately 5(H):1(V), and those along the north and northwest of Unit 4 have an overall maximum inclination of approximately 3(H):1(V). There are also some localized areas that may have slightly steeper inclinations. Portions of the slopes also continue for some distance below reservoir water level.

Table 5.2-1 provides a summary of the post-construction slopes and their pertinent data such as conditions, types, locations, heights, maximum inclinations, and their distances to seismic category I structures.

Table 5.2-1: Permanent Slopes within CPNPP Units 3 and 4 Vicinity

Slope Location	Adjacent Category I Structure	Slope Type	Slope Orientation Relative to Yard Grade	Minimum Distance to Slope Crest/Toe	Slope Height[1]	Maximum Slope Inclination (H:V)
Northwest of Unit 4	R/B Complex UHSRS	Fill	Descending	360 ft to R/B Complex 100 ft to UHSRS	38 ft	2:1
West of Unit 4	R/B Complex PSFSV	Cut	Ascending	180 ft to R/B Complex 170 ft to PSFSV	20 ft	2:1
Southwest of Unit 4	R/B Complex PSFSV	Cut	Ascending	260 ft to R/B Complex 210 ft to PSFSV	30 ft	2.5:1
South of Unit 4	R/B Complex PSFSV	Cut	Ascending	540 ft to R/B Complex 420 ft to PSFSV	45 ft	2:1
East-Northeast of Unit 3	R/B Complex EPS/B UHSRS	Cut	Descending	250 ft to R/B Complex 130 ft to EPS/B 110 ft to UHSRS	15 ft	3:1
South of Unit 3	R/B Complex PSFSV	Cut	Ascending	580 ft to R/B 500 ft to PSFSV	20 ft	2:1

[1]Slope heights are determined with respect to yard grade elevation of 822 ft for ascending slopes and with respect to Squaw Creek Lake elevation level of 775 ft for descending slopes.

In general, all seismic category I and II structures within the nuclear islands are founded on stable and competent Glen Rose Formation limestone Layer C at a targeted average elevation of 782 ft or on fill concrete which extends from the foundation bottom to the top of solid limestone an average elevation of 782 ft. The design of UHSRS consists of reinforced concrete structures that are also founded on Glen Rose Formation limestone Layer C, and does not include any earth embankments for side wall support. Consequently, performance or failure of soil, fill, or rock materials above Layer C (El. 782 ft) in any slopes in the vicinity of the plant does not adversely affect the safety or performance of any of the seismic category I and II structures.

Based on their proximity and maximum slope inclinations, five representative cross sections were selected for analysis. The five cross sections are labeled D-D', E-E', F-F', G-G', and H-H', and their locations are shown on Figure 1. These cross sections are described below:

- Cross Section D-D' (Figure 6): This cross section is oriented roughly in a south-north direction and is located northwest of Unit 4, passing through the western UHSRS unit from plant yard grade into the Squaw Creek Reservoir and through an intervening retaining wall structure. Cross Section D-D' ranges in elevation from 819 ft to 758 ft with a resulting total height difference of approximately 61 ft (44 ft above reservoir pool elevation 775 ft). The retaining wall within this cross section is about 17 feet high and extends from elevation 817 ft to 800 ft. This retaining wall extends further below grade to an elevation of about 780 ft in order to be founded a minimum of 2 ft into competent limestone Layer C. This sloping section of the cross section contains one break in slope at approximately elevation 780 ft. Maximum gradients above, and below the slope break are approximately 2(H):1(V) (compacted fill and shale over limestone slope) and 1.25(H):1(V) (limestone slope within Squaw Creek Reservoir), respectively.
- Cross Section E-E' (Figure 7): This cross section is oriented in a southwest-northeast direction and is located northeast of Unit 3, passing through the eastern UHSRS unit into Squaw Creek Reservoir and through an intervening retaining wall structure. Cross Section E-E' ranges in elevation from 819 ft to 762 ft, with a resulting total height difference of approximately 57 ft (44 ft above reservoir pool elevation 775 ft). The retaining wall within this cross section is about 37 feet high and extends from elevation 817 ft to 780 ft. This retaining wall extends further below grade to an elevation of about 778 ft in order to be founded a minimum of 2 ft into competent limestone Layer C. The sloping section of this cross section has a maximum gradient of approximately 3(H):1(V) (limestone slope within Squaw Creek Reservoir).
- Cross Section F-F' (Figure 8): This cross section is oriented in a southeast-northwest direction, and passes through undocumented fill between Units 3 and 4 and into Squaw Creek Reservoir. Cross Section F-F' ranges in elevation from 817 ft to 744 ft, with a resulting total height difference of approximately 73 ft (42 ft above reservoir pool elevation 775 ft). This section contains two breaks in slope at approximately elevation 795 ft and elevation 780 ft. Maximum gradients above, between, and below these slope breaks are approximately 2(H):1(V) (compacted fill, undocumented fill, residual soils, and limestone slope), 3(H):1(V) (compacted fill and limestone slope), and 2(H):1(V) (limestone within Squaw Creek Reservoir), respectively.
- Cross Section G-G' (Figure 9): This cross section is oriented roughly in a south-north direction and is located northwest of Unit 4, passing through the area west of the western UHS unit into the Squaw Creek Reservoir. Cross Section G-G' ranges in elevation from 817 ft to 757 ft, with a resulting total height difference of approximately 60

ft (42 ft above reservoir pool elevation 775 ft). This section contains two main breaks in slope at approximately elevation 795 ft and elevation 790 ft. Maximum gradients above, between, and below these slope breaks are approximately 2(H):1(V) (compacted fill, shale, and limestone slope), 7(H):1(V) (compacted fill, shale, and limestone slope), and 2(H):1(V) (limestone within Squaw Creek Reservoir), respectively.

- Cross Section H-H' (Figure 10): This cross section is oriented roughly in an east-west direction and is located northwest of Unit 4, passing through western UHS unit into a drainage pond located northwest of Unit 4. Cross Section H-H' ranges in elevation from 819 ft to 799 ft with a resulting total height difference of approximately 20 ft. The maximum gradient of this slope is 3(H):1(V) (compacted fill, shale, and limestone slope).

The cross sections show the post-construction site grading as interpreted from the site grading plans, the interpreted vertical and lateral extent of the surficial soils, and the depth to various bedrock layers. Based on the site grading plans (Figure 3), engineered compacted fill is placed on the reservoir side of the UHS units, as shown on Cross Sections D-D', E-E', and G-G' (Figures 6, 7, and 9). Along the northeast and northwest boundaries of the site, a retaining wall is used to provide a relatively level pad within the plant area (Figures 6 and 7). A Vehicle Barrier System (VBS) is also provided along the site boundaries in areas where there are no perimeter retaining walls (Figures 8, 9, and 10). In areas where undocumented fill or weak shale materials daylight within the slopes, an engineered buttress consisting of compacted fill founded into limestone Layer C is provided to maintain an acceptable stability performance of the slope (Figures 8, 9, and 10).

5.4 Temporary Excavation Cut Slopes

The proposed general site grading completely strips surficial soils and the upper weathered zones of the Glen Rose Formation engineering Layer A. For foundation installations of the structures within the power block and UHS areas, additional temporary excavations are required to depths of approximately 40 ft below the yard grade elevation of 822 ft. Glen Rose Formation Layer B, which consists of shale beds, daylights into the temporary excavation sidecuts near the bottom of the excavation, creating potential low strength beds and interfaces. The shale strata are generally horizontal, a geometry that typically is favorable for stability. However, shale strata are considerably weaker materials than limestone strata, and may undergo significant softening and pose potential sliding surfaces that may undermine the rock masses within the excavation banks. Although the construction experience from CPNPP Units 1 and 2 suggests that vertical cuts are viable, construction precautionary and preventive methods (e.g. rock anchors or angle cut) that are typical procedures in bedded rock formations with potential weak zones provide an acceptable level of construction stability and increase the safety of personnel and workers during construction.

Two construction conditions (cut slopes) were modeled; one for each of the units. These sections show the typical conditions during the construction of the main structures for Unit 3 and Unit 4, and are shown on Figures 11 and 12.

5.5 Subsurface Conditions

Subsurface materials within the project site consist of three main geologic formations in descending order: Glen Rose Formation, Twin Mountain Formation, and Mineral Wells Formation. The Glen Rose Formation consists primarily of limestone with interbedded layers of

claystone and shale, and is generally overlain by a layer of fill or residual soils, which varies in thickness from a few feet to a few tens of feet. Boring log and geophysical data further refined the subsurface into twelve major stratigraphic layers labeled A through I. A summary of the refined stratigraphic layers for the site is provided in Table 5.5-1. More detailed information and data regarding the project subsurface materials and stratigraphic layers are provided in References 3.1.7 through 3.1.9.

Table 5.5-1 Stratigraphic Layer Depth Profile

Formation	Stratigraphic Layers	Primary Lithology	Top of Layer Average Elevation (ft)	Average Thickness (ft)
Glen Rose	A	Limestone	834	35
	B1	Shale	798	8
	B2	Shale with Limestone interbeds	790	8
	C	Limestone	782	65
	D	Shale	717	4
	E1	Limestone	714	23
	E2	Limestone	690	35
	E3	Limestone	656	33
Twin Mountains	F	Limestone with Shale and Sand interbeds	622	30
	G	Sandstone	593	80
	H	Shale	513	63
	I	Sandstone	451	67
Mineral Wells	MW	Shale with Sandstone and Limestone interbeds	388	--

Residual soil material types ranged from sand and gravel with varying amounts of fines, silt, and sandy lean clay. Some areas of the site (northeast of Unit 4 and east to southeast of Unit 3) contain areas of randomly placed, uncompacted fill. These fill materials are located in areas of previous topographic lows and range in thickness from 5 to about 70 feet deep.

The inferred subsurface stratigraphy for the steepest slope section northwest of Unit 4 is shown on Figure 4 and that for the steepest slope northeast of Unit 3 is shown on Figure 5.

The subsurface materials encountered within the project site that are relevant to the slope stability analysis include fill soils, residual soil, and the Glen Rose Formation bedrock. The Glen Rose Formation within the depth of the stability analysis models consists of interbedded limestone and shale. The bedrock is generally overlain by fill or residual soil that varies in thickness from a few feet to a few tens of feet.

The locations of the field exploration, in situ tests, and geophysical surveys performed in the area of Units 3 and 4 are shown on Figure 1. Engineering strength properties for the cross sections are based on the interpretation of field and laboratory test data, and are presented in

Table 5.5-2 and shown on Figures 15 and 17 for shale and limestone materials, respectively. The basis for selection of these properties is discussed in the subsequent sections.

Table 5.5-2: Summary of Material Parameters for Stability Analysis

Material	Total Unit Weight (pcf)	Permanent Slopes	
		Friction Angle (degrees)	Cohesion (psf)
Residual Soil	110	25	200
Undocumented Fill	110	25	200
Compacted Fill	125	32	200
Shale (Layer B)	135	Non-linear (Lower Bound Envelope, see Figure 15)	
Limestone (Layer A)	145	Non-linear (Layer A Lower Bound Envelope, see Figure 17)	
Limestone (Layer C)	155	Non-linear (Layer C Lower Bound Envelope, see Figure 17)	

5.5.1 Residual Soil

Residual soil materials ranged from sand and gravel with varying amounts of fines to silt and lean sandy clay. Shear strength for the residual soil is based on soil descriptions, Standard Penetration Test (SPT) blow counts from exploratory borings, and Cone Penetration Test (CPT) soundings, and empirical correlations.

Results of Atterberg Limits tests performed on silty and clayey residual soil samples were used in conjunction with an ultimate drained shear strength correlation published by Stark et al. (Reference 3.2.5) for fully-softened materials. The fully-softened (ultimate) strength was selected to perform slope stability analysis. The undrained shear strength of fine-grained residual soils was empirically estimated from CPT sounding results, and ranged from approximately 0.5 to 3.5 kips per square foot (ksf). The effective friction angles for granular residual soils were estimated based on the CPT sounding test results, and ranged from about 35 to 45 degrees. For stability analysis, a cohesion value of 200 psf and a friction angle of 25 degrees were selected for the strength model.

5.5.2 Non-Structural (Undocumented) Fill

Undocumented fill in swale areas is quite heterogeneous and variable in composition, including layers and zones of granular soil intermixed with fine-grained soil. The undocumented fill consists primarily of material similar to the residual soils, and was placed during the construction of CPNPP Units 1 and 2.

The consistency of the granular materials ranges from loose to medium dense, and that of fine-grained materials ranges from soft to stiff. The effective friction angles for granular materials are estimated to range from approximately 30 to 45 degrees, based on the CPT sounding results. The undrained shear strength of the fine-grained materials was empirically estimated

from the CPT sounding results, and ranged from approximately 1.5 to 2.5 ksf. For stability analysis, a cohesion value of 200 psf and a friction angle of 25 degrees were selected for the strength model.

5.5.3 Compacted Fill

Compacted fill will be predominantly used for constructing fill slopes and backfilling against all below-grade portions of seismic category I and II structures and any retaining walls planned within the main plant area. Fill soils for construction of compacted fill should conform to the following properties:

- Should consist of durable materials free from organic matter and any other deleterious or perishable substances, and shall be of such nature that it can be compacted readily under moisture conditioning and rolling to a firm and non-yielding state.
- Should be granular in nature with a well-graded grain size distribution and less than 30 percent fines fraction (percent passing No. 200 sieve, per ASTM D422 and D1140),
- Should not contain particles greater than 3 inches in the maximum dimension, with less than 15 percent by weight larger than 2.5 inches,
- Should have an expansion index (per ASTM D4829) of less than 20. Material with an expansion index greater than 20 is deemed to be expansive and is not acceptable, and
- Should have a liquid limit less than 40 percent and a plasticity index not exceeding 12 (per ASTM D4318).

In general, all compacted fills shall be placed in lifts no thicker than 8 inches (measured in loose state); moisture conditioned to within 2 percent of the optimum moisture content and compacted to a minimum relative compaction of 95 percent per ASTM D1557.

Based on the above requirements, the geotechnical properties for the compacted fill materials are estimated as follow:

- Total Unit Weight ~ 125 pcf
- Internal Effective Friction Angle ~ 32^{o}
- Effective Cohesion Intercept ~ 200 psf

5.5.4 Shale

Shale bedding is essentially horizontal at the site. The stratigraphy at the site is essentially flat-lying and bedding has not been folded. Along-bedding, fully-softened drained shear strength parameters for shale were estimated based primarily on laboratory direct shear test results, as shown on Figure 15. The plot shows the range of the ultimate (fully-softened) shear strength values, with a shaded zone identifying the most likely lower- and upper-bound values. Based on borehole core samples and field outcrop exposures, the shale appears to be consolidated and does not show extensive or persistent shear fabric or slickensides. Also, no evidence of past landsliding was observed in the CPNPP Units 3 and 4 site area. Therefore, the fully-softened strength (ultimate) strength criterion is considered more appropriate for stability analysis than residual strength values that are warranted if pre-existing sheared sliding planes are present.

For comparison purposes, the procedure developed by Stark et al. (References 3.2.5 and 3.2.6) was also used to estimate the range of fully-softened shear strength of shale based on correlations with liquid limit and clay fraction index test results. The Stark et al. correlations were developed for soil and soft rock materials that have not previously undergone substantial shearing, and based on comparison of the results of torsional ring shear tests with the soil and rock index property tests. The upper-, and lower-bound fully-softened shear strength envelopes estimated by the Stark et al. procedure are also shown on Figure 15. The shear strength envelopes estimated from Stark et al. are generally comparable with the lower-bound fully-softened envelope from direct shear tests presented on Figure 15.

The curved lower-bound shear strength envelope from the direct shear test results, as shown on Figure 15, was conservatively selected for stability analyses of the permanent slopes. This non-linear lower-bound failure envelope was used directly in the slope stability analysis for permanent slopes.

For analyzing the temporary construction cut slopes, the shear strength of the shale was modeled using the linear Mohr-Coulomb failure criterion for both along-bedding and across-bedding to consider its anisotropic behavior. The across-bedding strength envelope was based primarily on the results of the triaxial compression tests because they are more indicative of the across-bedding strength of the rock. The direct shear test data were used for estimating the along-bedding strength envelope. The triaxial test data are shown on Figures 13 and 14 as peak and ultimate strength values, respectively. Based on the triaxial test data the secant internal friction angle ranges between 22 and 58 degrees for the peak strength case, and between 18 and 46 degrees for the ultimate strength case. The range of the along-bedding ultimate shear strength data from direct shear tests (Figure 15) is also shown on Figure 16, along with the ultimate shear strength data from the triaxial test results. For temporary construction cut slope analysis the linear Mohr-Coulomb ultimate failure strength model was conservatively selected for both along-bedding (cohesion of 400 psf and friction angle of 25 degrees) and across-bedding (cohesion of 3,000 psf and friction angle of 25 degrees) cases, as shown on Figure 15.

5.5.5 Limestone

Glen Rose Formation limestone typically is massive and well-cemented, and it exhibits brittle hard rock strength properties. The shear strength parameters for limestone were derived from laboratory unconfined compression test results that were modified to account for rock mass properties using published strength correlations initially developed by Hoek and Brown (References 3.2.2 and 3.2.3), and subsequently refined to include rock mass disturbance factors (from blasting and stress relief) by Hoek et al. (Reference 3.2.4). The Hoek-Brown criteria consider the scale effect of potential rock mass failure and the weakening influence of joints and other discontinuities in the rock mass. To develop a range of strength values, the range of uniaxial compressive strength of the intact rock along with other rock mass parameters defined in Reference 3.1.3 were used to develop Hoek-Brown shear strength vs. normal stress relations using the RocLab software. The range of rock strength envelopes was used to estimate the Layers A and C limestone shear strength, as shown on Figure 17. The lower-bound Hoek-Brown shear strength envelope curves for Layers A and C were selected for a conservative strength model of the in situ limestone rock mass. These lower-bound envelopes were used in the slope stability analyses of both the permanent and temporary slopes to estimate the shear strength as a function of effective normal stress.

5.5.6 Groundwater Conditions

Groundwater within the existing fill is controlled by the water level in the adjacent Squaw Creek Reservoir. According to the USGS, the pool elevation of the Squaw Creek Reservoir is normally about elevation 775 ft, and has historically fluctuated between elevations 773 ft and 778 ft. Filled swale areas northeast of CPNPP Unit 4, and east of Unit 3, extend to the reservoir shoreline. The fill appears to be in hydraulic communication with the reservoir, and a perched groundwater table at, or near, the elevation of the reservoir pool exists in the fill. The subsurface native soils and most of the rock, especially the Glen Rose Formation, are considered relatively impermeable and water tight. However, monitoring well data from onsite piezometers indicate the presence of some localized perched water at shallower elevations. Based on the general data available, the permanent groundwater level at the site is expected to occur deep in the rock mass below plant grade and foundation subgrade elevations. Based on theoretical maximum precipitation events, the maximum groundwater level calculated in Ref. 3.1.15 around the nuclear island is 794.94 ft msl. The areas of Units 3 and 4 within the ESWPT is essentially a closed basin which had not been included in the model area in Ref. 3.1.15. The pipe tunnels enclose this area, with the tops of individual segments of the pipe tunnels ranging from 804 ft msl to 810 ft msl. Because this is a closed area, the water level within this area can theoretically reach a maximum of 804 ft msl; once it has reached this elevation, the water will drain outward across those portions of the pipe tunnel having tops at that elevation.

For the purpose of modeling the slope stability, the groundwater table was conservatively assumed to be located at elevation 804 ft within the engineered fill surrounding the main plant structures with a steady state seepage toward the shores of the Squaw Creek Reservoir.

5.6 External Loads

External loading conditions modeled in the slope stability analyses consisted of structural loads, traffic loads, and earthquake loads, as discussed in the following paragraphs.

5.6.1 Structural Loads

Structural loads (Table 5.1-1) for the structures located in the near vicinity of the slopes were included as part of the stability modeling. These loads are modeled as a uniform distributed areal pressure over the flat surface of the foundation subgrade level.

5.6.2 Traffic Loads

Traffic loads are assumed to be approximately 250 psf and are modeled as a distributed areal pressure over the road sections.

5.6.3 Seismic Loading

Based on the results of the ground motion and site response analyses performed for CPNPP Units 3 and 4 site, the horizontal peak ground acceleration (PGA) ranges between 0.046g and 0.077g (Ref. 3.1.16). Therefore, the minimum PGA of 0.1g was used as the design value for both the horizontal and vertical PGA (Ref. 3.1.16).

6.0 ANALYTICAL METHODOLOGY

The slope stability analyses were performed for static and dynamic (pseudo-static) loading conditions. The latter analysis was performed using both horizontal and vertical seismic coefficients.

Conventional two-dimensional limit-equilibrium analyses were performed considering permanent (long-term) slope stability conditions.

Various methods of analysis, including Janbu and Bishop's (References 3.2.9, 3.2.10, and 3.2.11), were used for initial screening of possible failure surface geometries. Various failure surface shapes were considered, including Rankine-type, random block, and circular surfaces. Refined analyses were performed using Spencer's method (Reference 3.2.12) on targeted failure surfaces identified by the screening analysis. Spencer's method is considered more appropriate because it satisfies both force and moment equilibrium.

Soil and rock materials that exhibit anisotropic shear strength properties are more appropriately modeled through assigning Mohr-Coulomb strength parameters with two sets of shear strength parameters; "along" and "across" bedding. For conservatism, only along-bedding shear strength parameters of the shale were used in the stability analysis of permanent slopes. This option was used to model the Glen Rose Formation shale beds. Hoek-Brown criterion for rock-mass shear strength parameters were used to model the massive Glen Rose Formation limestone. For temporary construction cut slope evaluation, the anisotropic behavior of the shale was modeled through assigning Mohr-Coulomb strength parameters for both the along-bedding and the across-bedding cases.

A pseudo-static method of analysis was used for dynamic evaluation of the permanent slopes. In this method, the effects of seismic loading conditions on the slopes are accounted for through the application of constant horizontal and vertical seismic coefficients to the slope and computation of a pseudo-static factor of safety. With the conservative assumption of a vertical-to-horizontal ratio of 1.0, the vertical coefficient is assumed to be equal to the horizontal PGA. Both positive (downward) and negative (upward) vertical coefficients were considered. The orientation resulting in the lower factor of safety was considered the critical condition. As indicated in Section 5.6.3, the US-APWR DCD minimum PGA of 0.10g was assumed for the purposes of pseudo-static slope stability analyses for both the horizontal and vertical seismic coefficients.

If pseudo-static slope stability analyses, in which the horizontal and vertical seismic coefficients are assumed to be equal to the PGA, result in factors of safety greater than 1.1, seismic slope performance is considered acceptable.

Each section was analyzed for the following conditions using Spencer's method. Permanent slopes at the site were considered, and analyses were performed for the cases of circular (rotational), block/wedge (translational), or random potential failure modes as follows:

- Global (deep-seated) stability conditions
- Surficial stability conditions
- Pseudo-static (seismic or transient) loading conditions

Surficial stability of the 2(H):1(V) compacted fill slopes was also analyzed using the procedure suggested in Reference 3.2.13.

The following minimum factors of safety were established for this project based on the U.S. Army Corps of Engineers' Slope Stability Manual (Reference 3.2.7):

- Static Long-Term Factor of Safety: 1.5
- Static Temporary Factor of Safety: 1.3
- Pseudo-static Factor of Safety: 1.1

The computer program Slope/W 2007 (Geo-Slope International) was used to perform the slope stability analyses. This program models heterogeneous soil types, soil and rock anisotropy, complex stratigraphic and slip surface geometry, and variable pore water pressure conditions. The program was validated and verified for this project.

Due to the iterative nature of slope stability modeling, not all analyses performed are presented in this report.

7.0 RESULTS

The results of slope stability analyses are summarized in Table 7.0-1 and indicate acceptable static long-term factors of safety for permanent slopes with values greater than 1.5. Pseudo-static factors of safety for these slopes are also acceptable, with values greater than 1.1. Factors of safety for temporary slopes also exceed the minimum value of 1.3.

Table 7.0-1: Summary Results of Stability Analyses

Cases	Cross Section	Static Slope Stability Factor of Safety	Pseudo-static Slope Stability Factor of Safety
Permanent	D-D'	8.23	6.02
Permanent	E-E'	6.35	5.26
Permanent	F-F'	1.97	1.49
Permanent	G-G'	1.89	1.47
Permanent	H-H'	2.39	1.45
Temporary	Unit 3 cut	1.42	NA
Temporary	Unit 4 Cut	1.39	NA

Example slope stability sections showing final optimized critical surfaces and factor of safety values are included as follows:

- Figures 18, 19, 20, 21, and 22 for static global stability of permanent Cross Sections D-D', E-E', F-F', G-G', and H-H', respectively.
- Figures 25, 26, 27, 28, and 29 for seismic global stability of permanent Cross Sections D-D', E-E', F-F', G-G', and H-H', respectively.

The results of the surficial stability for 2(H):1(V) compacted fill slopes also indicate that the engineered compacted fill slopes do have adequate surficial slope stability factors of safety (>1.5), provided that the compacted fill materials exhibit the specified effective cohesion value of at least 200 psf and an effective friction angle of at least 32 degrees.

In areas where undocumented fill or weak shale materials daylight within the slopes, such as Cross Sections F-F', G-G', and H-H', an engineered buttress consisting of compacted fill with dimensions similar to those shown on Figures 8, 9, and 10 is required at the face of the slopes to maintain an acceptable stability performance. The engineered compacted fill buttress should be founded and keyed into limestone Layer C or another competent material to a minimum depth of 1 foot and a length of at least 20 ft.

For Cross Sections D-D' and E-E' where the section contains a retaining wall, it is assumed that the retaining wall is designed to adequately resist and contain the backfill materials. Therefore, the stability analyses for these sections were performed to analyze the global stability of the wall and backfill for the potential transitional failure surfaces passing through the zone below the retaining wall foundations.

For Cross Section H-H' where the slope descends into a drainage pond, the analysis was conservatively performed using a rapid drawdown condition. In that analysis, the water level inside the pond is assumed to be lowered from its maximum level (elevation 804 ft) to the lowest level (elevation 799 ft) instantaneously (most severe case).

As shown in Table 7.0-1, estimated static factors of safety for permanent slopes satisfy the minimum required value of 1.5.

Pseudo-static factors of safety were estimated using both horizontal and vertical acceleration coefficients equal to the PGA value of 0.1g. Those factors of safety range between 1.45 and 6.02 and are considerably greater than the minimum value of 1.1. These results demonstrate that the seismic performance of analyzed slopes is acceptable and that no seismically induced permanent slope displacement is expected at the CPNPP Units 3 and 4 site.

The post-construction cut slopes around the west and south periphery of the CPNPP Units 3 and 4 site presented in Table 5.2-1 and shown on Figure 3, are not expected to pose slope stability issues or hazards to Category I and II structures. The closest approach between the toe of the cut slopes and Category I or II structures is approximately 150 ft, with a minimum ratio of at least three times the height of slope, which provides a substantially safe distance from the cut slopes. Additionally, the inclination of cut slopes is generally 2(H):1(V) or flatter. Considering the strength properties of the materials comprising the cut slopes (residual soil over Glen Rose Formation rock) and the maximum inclination of 2(H):1(V), cut slopes are considered to have adequate factors of safety.

Analyses of stability of temporary cut slopes indicate that if deep tension cracks were to develop, the computed short-term static factor of safety (construction period) would be less than the conventionally accepted minimum value of 1.3. Slope stability analyses indicate that adequate factors of safety (equal to or greater than 1.3) could be achieved with 0.25(H):1(V) or flatter rock cut slopes.

Two options are considered to permit safe excavation conditions:

- Vertical cuts with rows of rock anchors placed in a top-down sequence during excavation to prevent development of tension cracks; or
- Reduced slopes excavated at a maximum inclination of 0.25(H):1(V) without rock anchors.

Temporary cut slope inclinations in rock no steeper than 0.25(H):1(V) are expected to minimize the adverse effect of tension cracks, although flatter slopes might be locally recommended during construction quality control evaluation, depending on the actual rock conditions encountered in the field. Results of the slope stability analyses of the temporary construction cut slopes are shown on Figures 23 and 24 for typical cut slopes in the areas of Units 3 and 4, respectively.

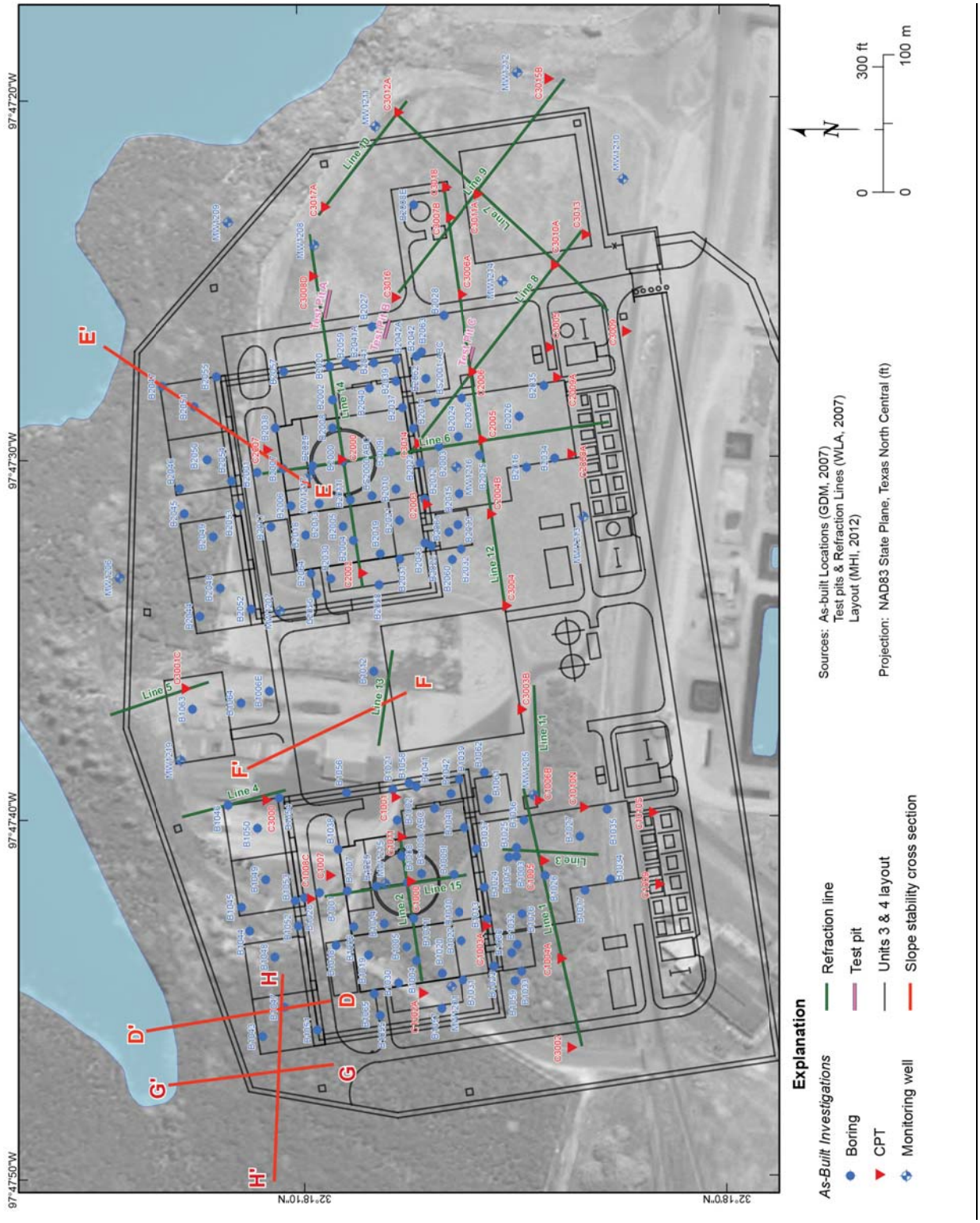
Cut slopes 40 ft or greater in height should be provided with 10-foot wide flat benches at the mid height of the slope to control drainage from runoff during storm events, to provide a catchment to protect workers from loose rocks or materials dropped into the excavation, and to provide a potential access road if additional scaling of the rock surface or any other slope repairs are necessary.

Copies of the calculation reports are presented in Appendices A, B, and C for temporary slopes, permanent slopes, and infinite slopes (surficial stability), respectively.

8.0 SOFTWARE

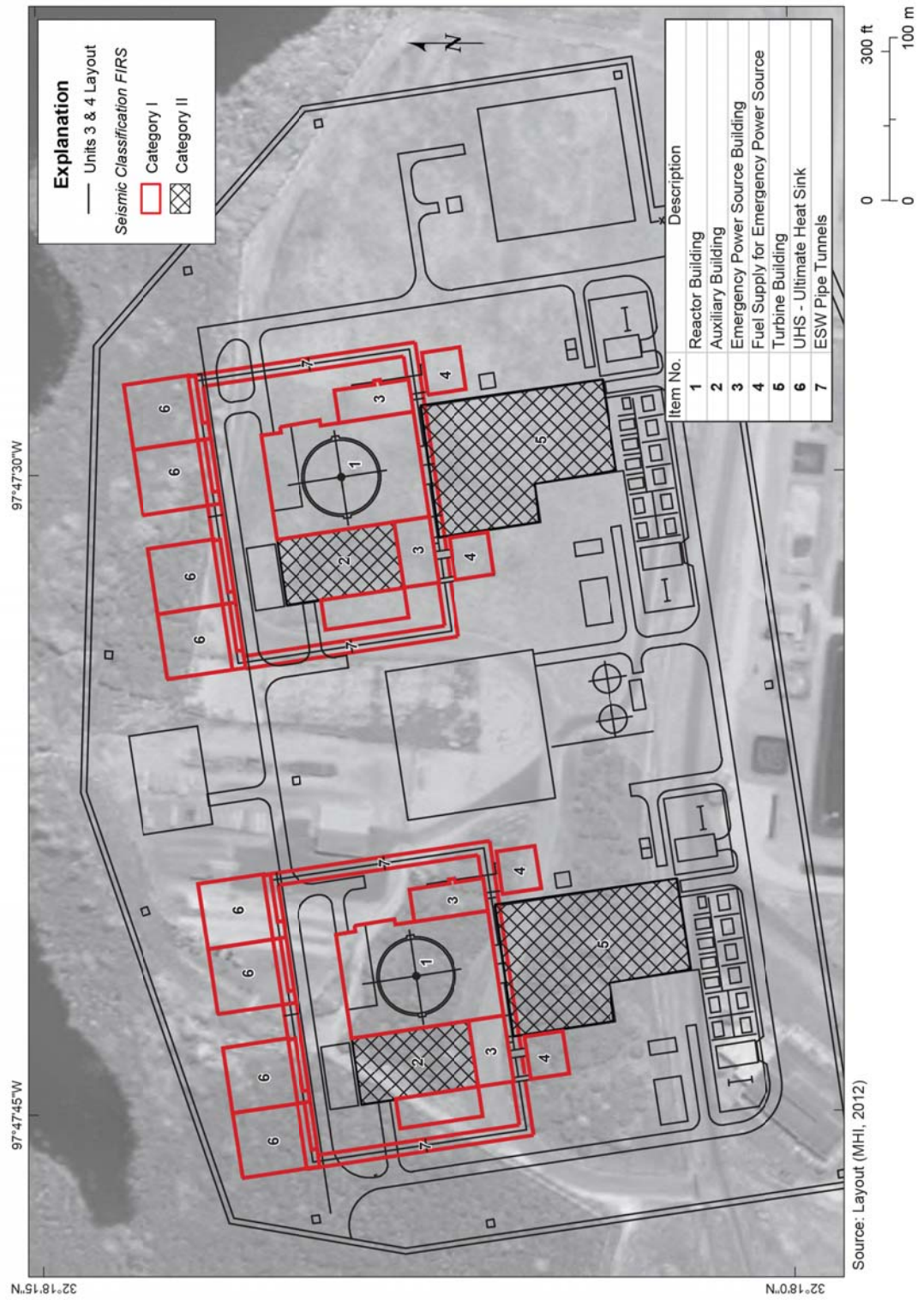
The commercially available computer program Slope/W version 7.16 (2007), developed by Geo-Slope International, was used to perform the slope stability analyses. This software package can model heterogeneous soil types, soil and rock anisotropy, complex stratigraphic and slip surface geometry, and variable pore water pressure conditions. The software RocLab (Version v1.031) developed by Rocsciences Inc. was also used for calculating the Hoek-Brown shear strength envelopes of the limestone rock materials. Both the Slope/W and RocLab software programs were validated and verified for this project.

In addition, Microsoft Excel (Version 2003 SP2) software program was used for calculations and presentations provided in this report.



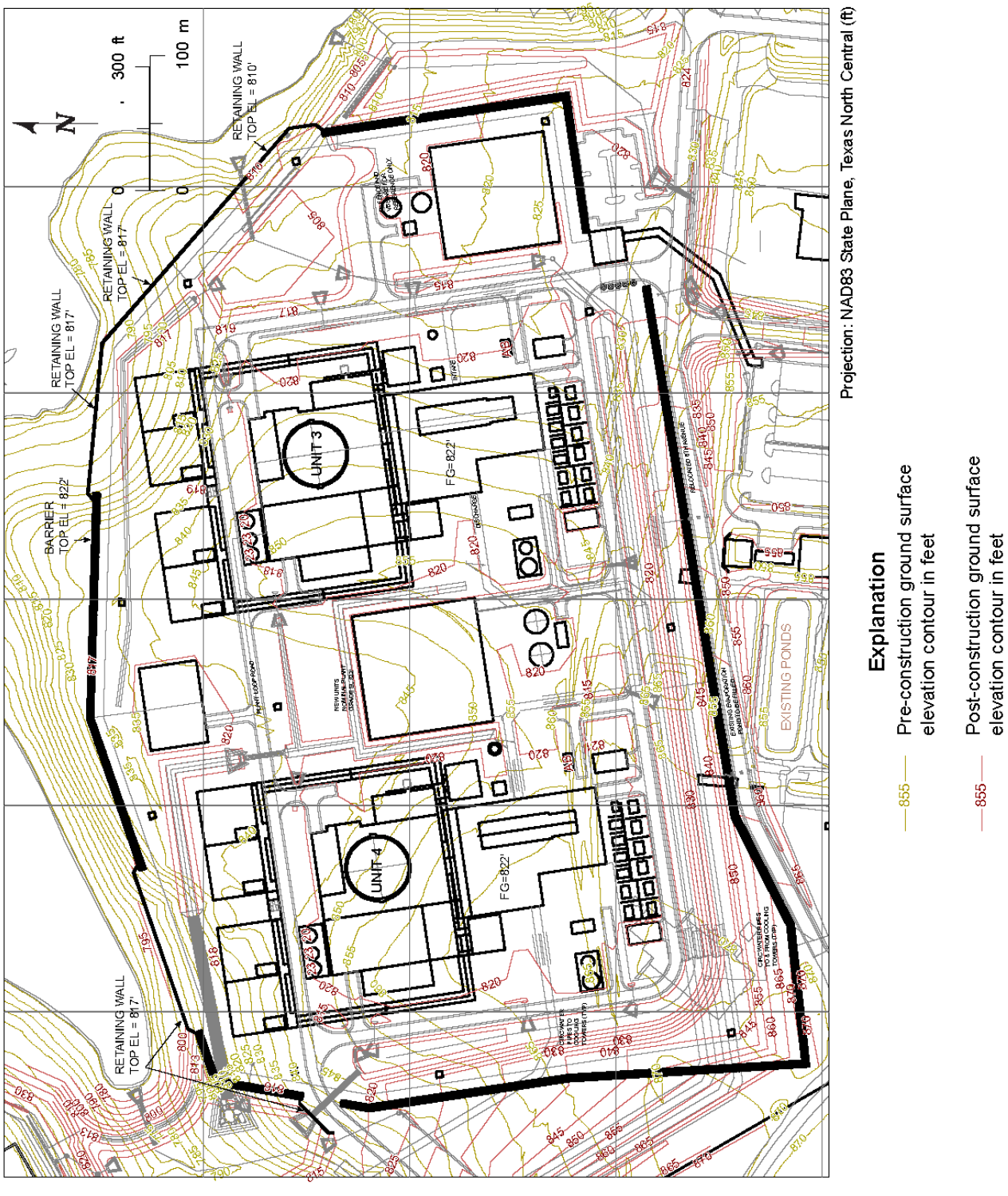
Site Plan and Exploration Locations

FIGURE 1



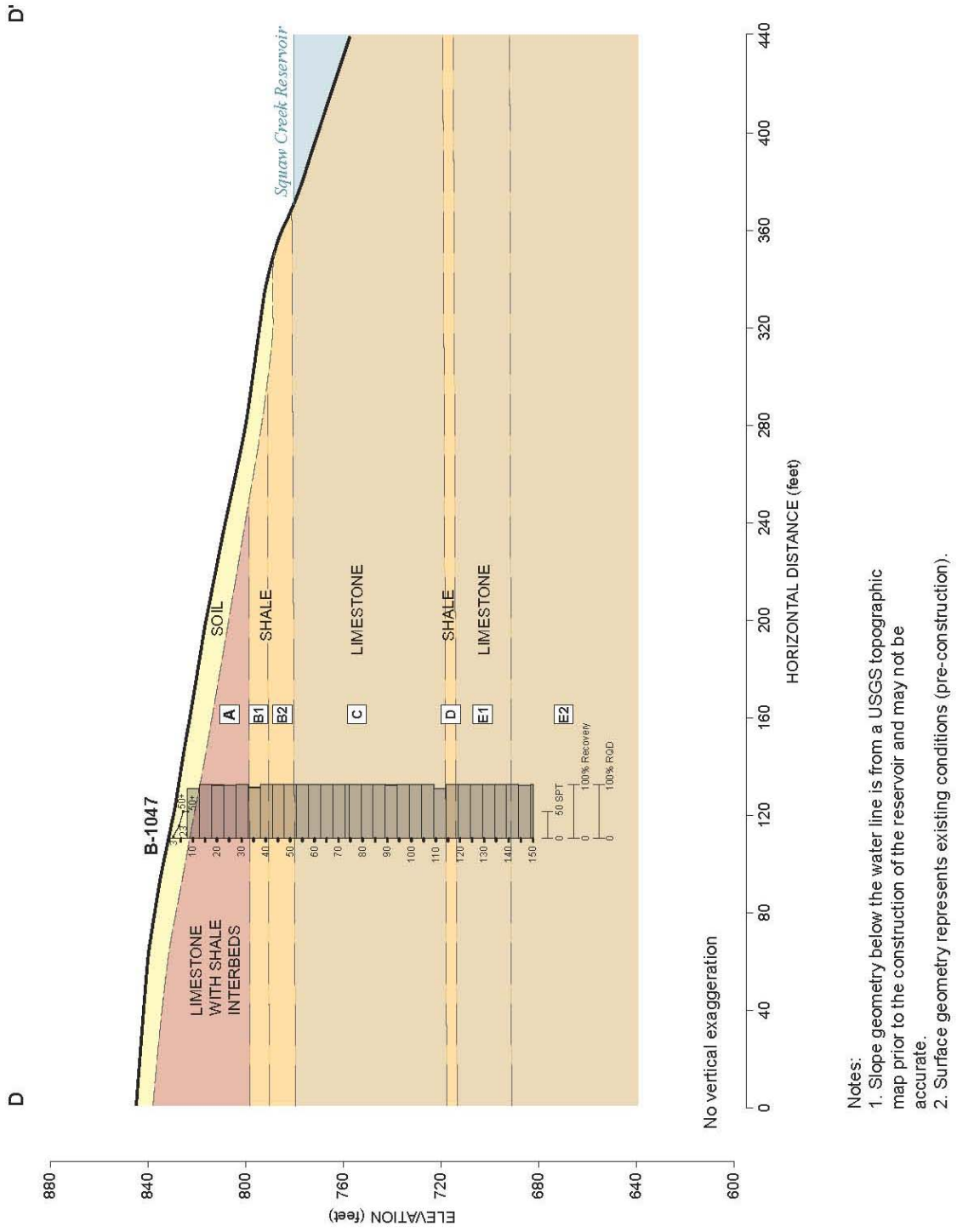
Seismic Classification for Units 3 and 4 Structures

FIGURE 2



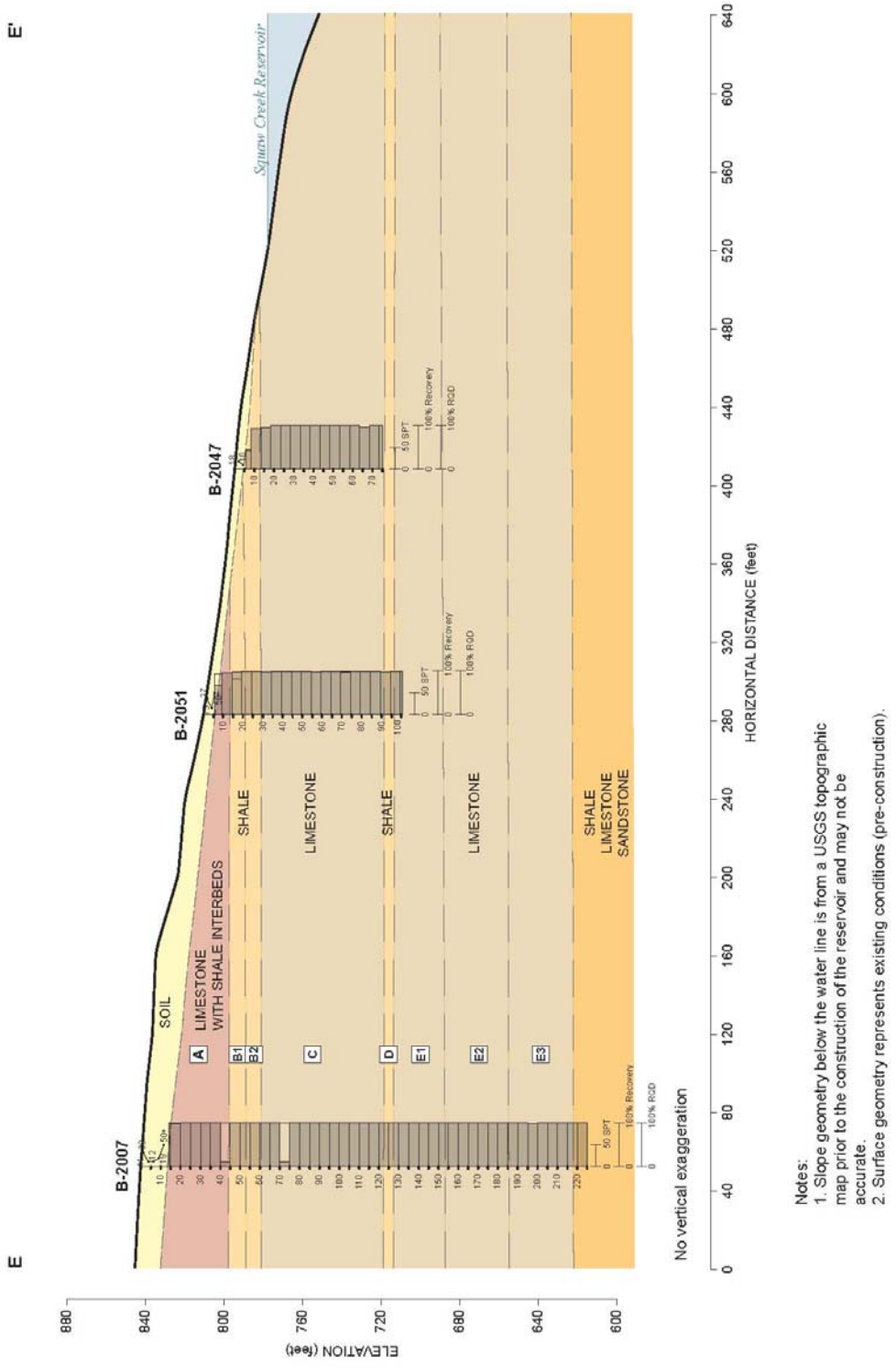
Site Grading Map

FIGURE 3



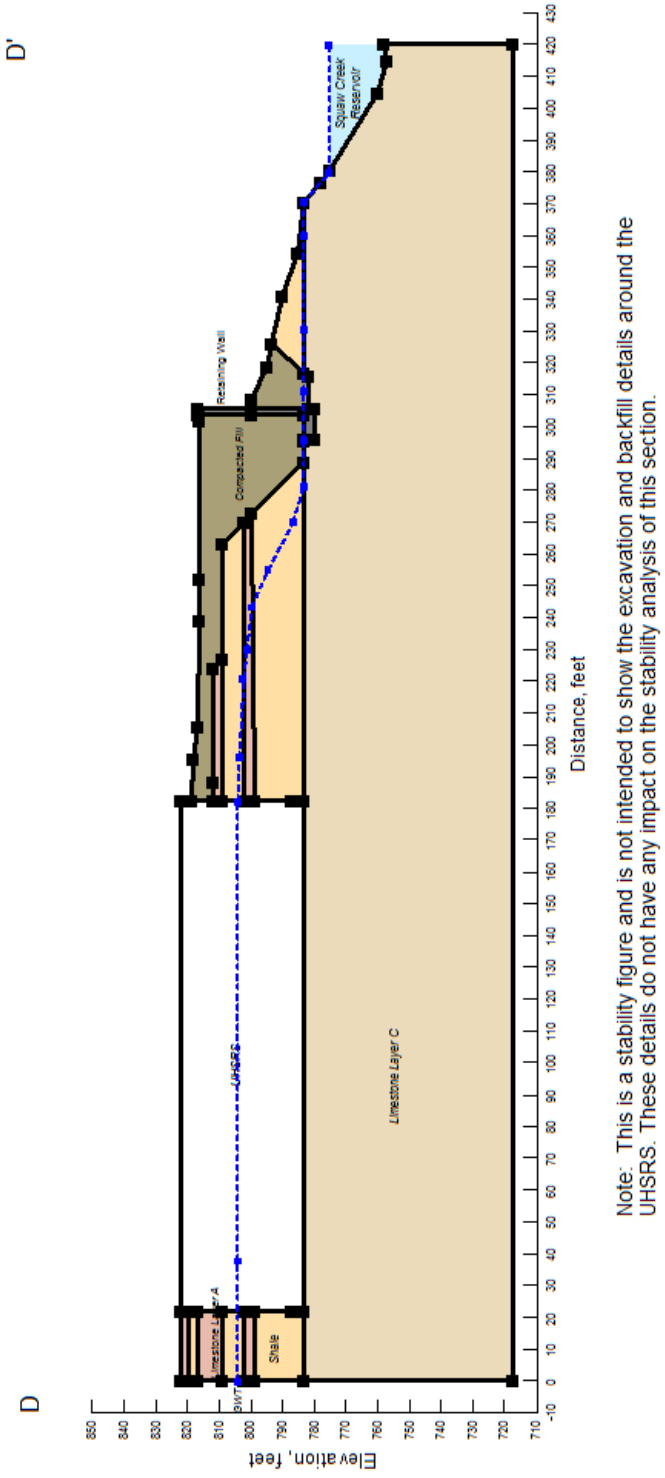
Pre-Construction Cross Section D-D'

FIGURE 4



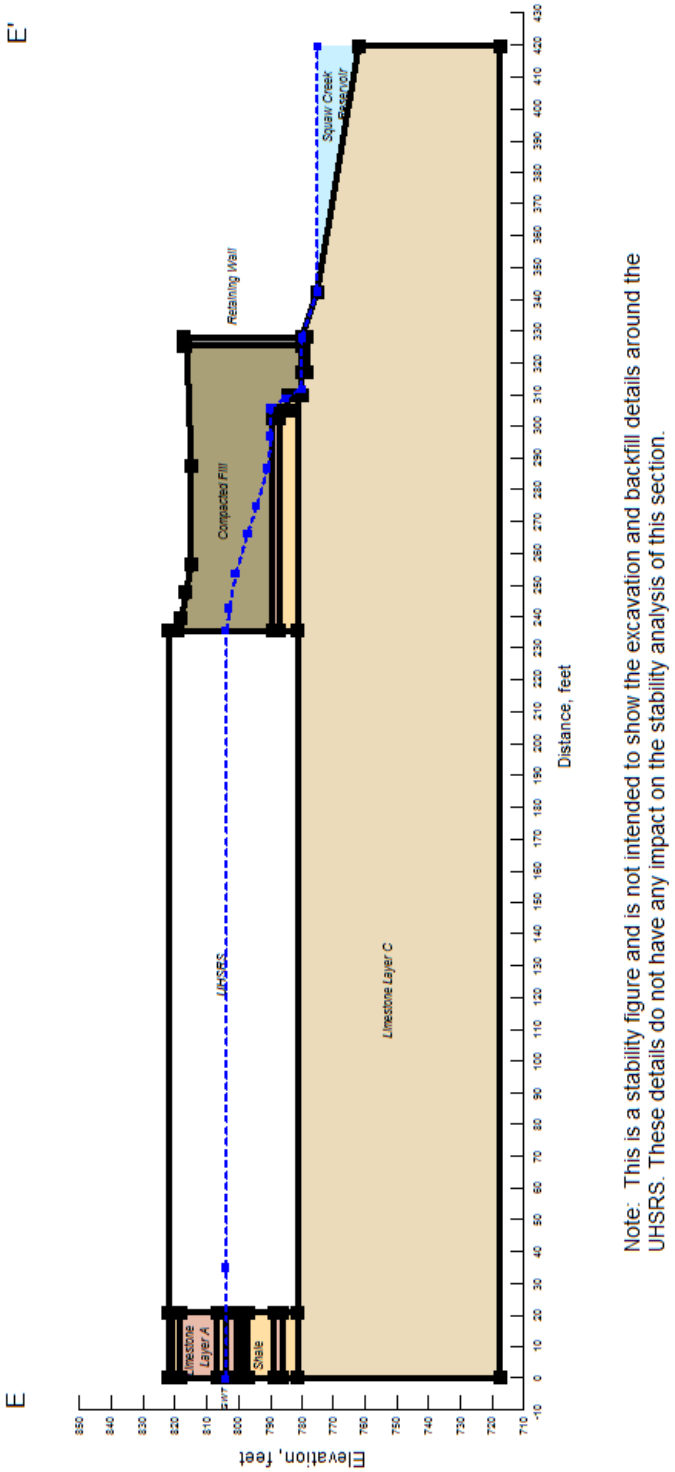
Pre-Construction Cross Section E-E'

FIGURE 5



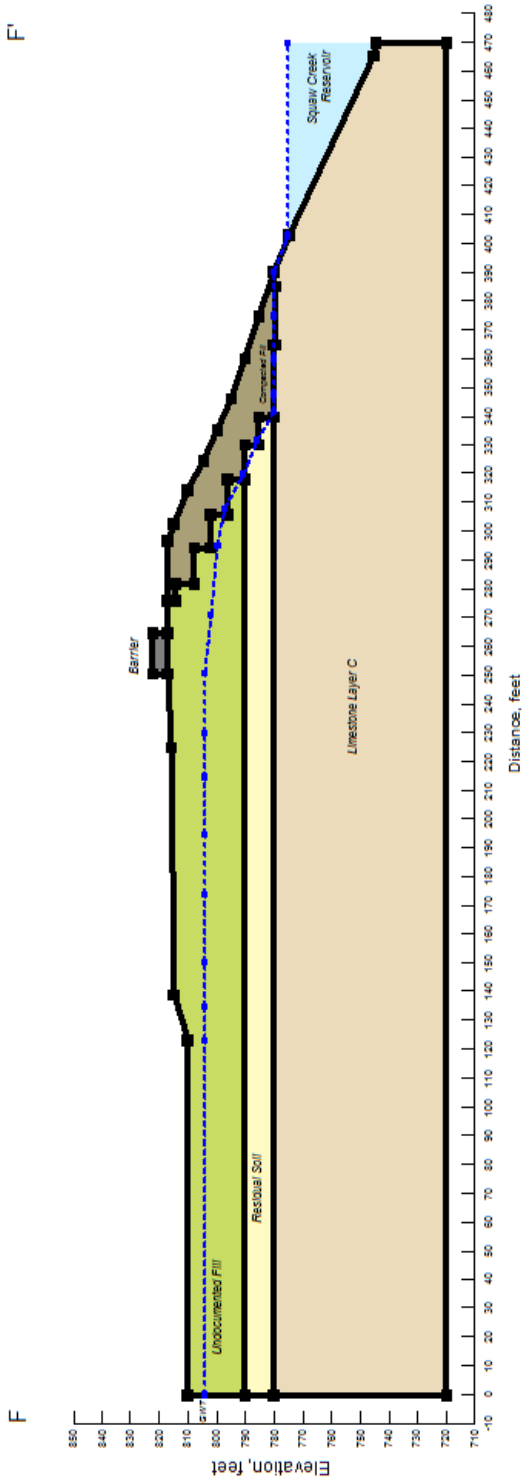
Post-Construction Cross Section D-D'

FIGURE 6



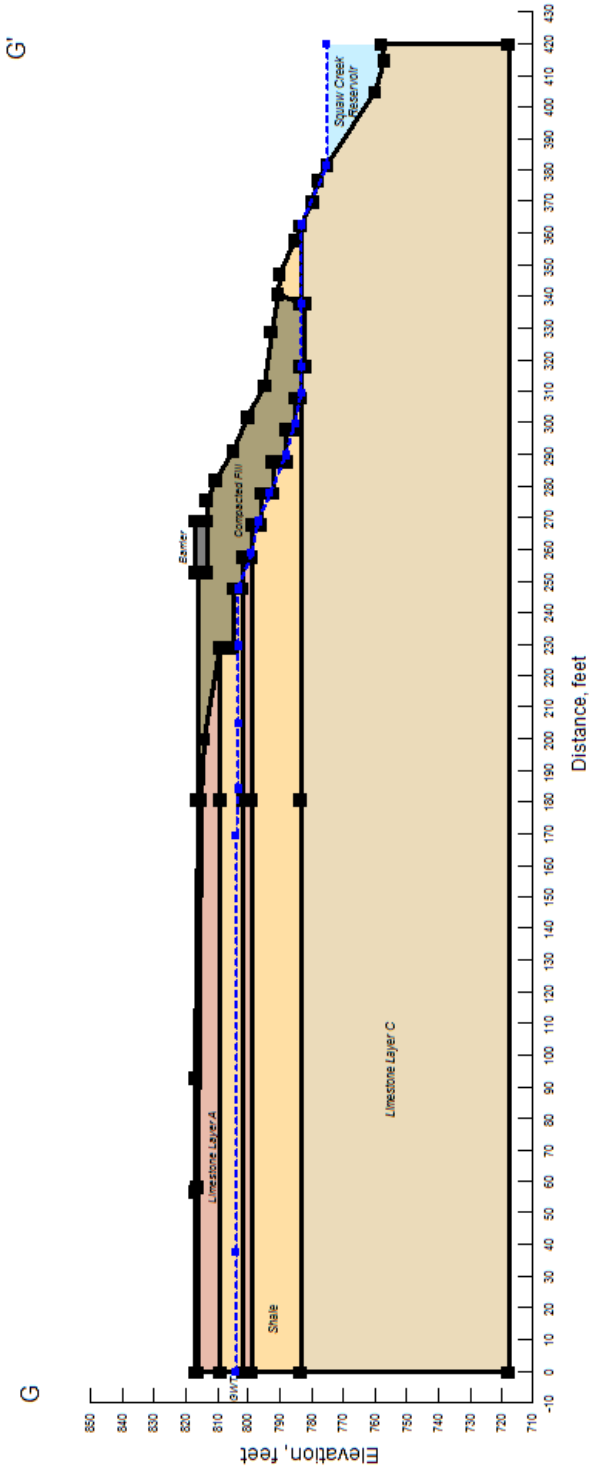
Post-Construction Cross Section E-E'

FIGURE 7



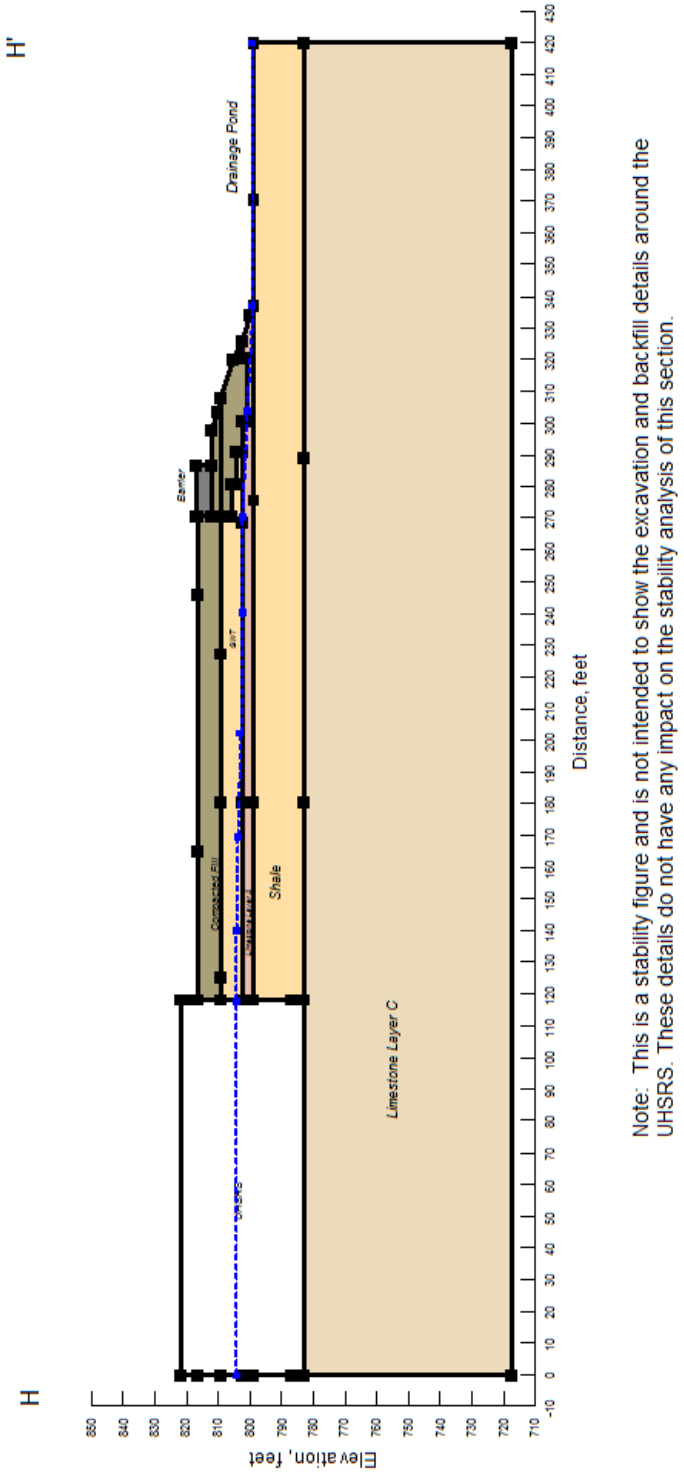
Post-Construction Cross Section F-F'

FIGURE 8



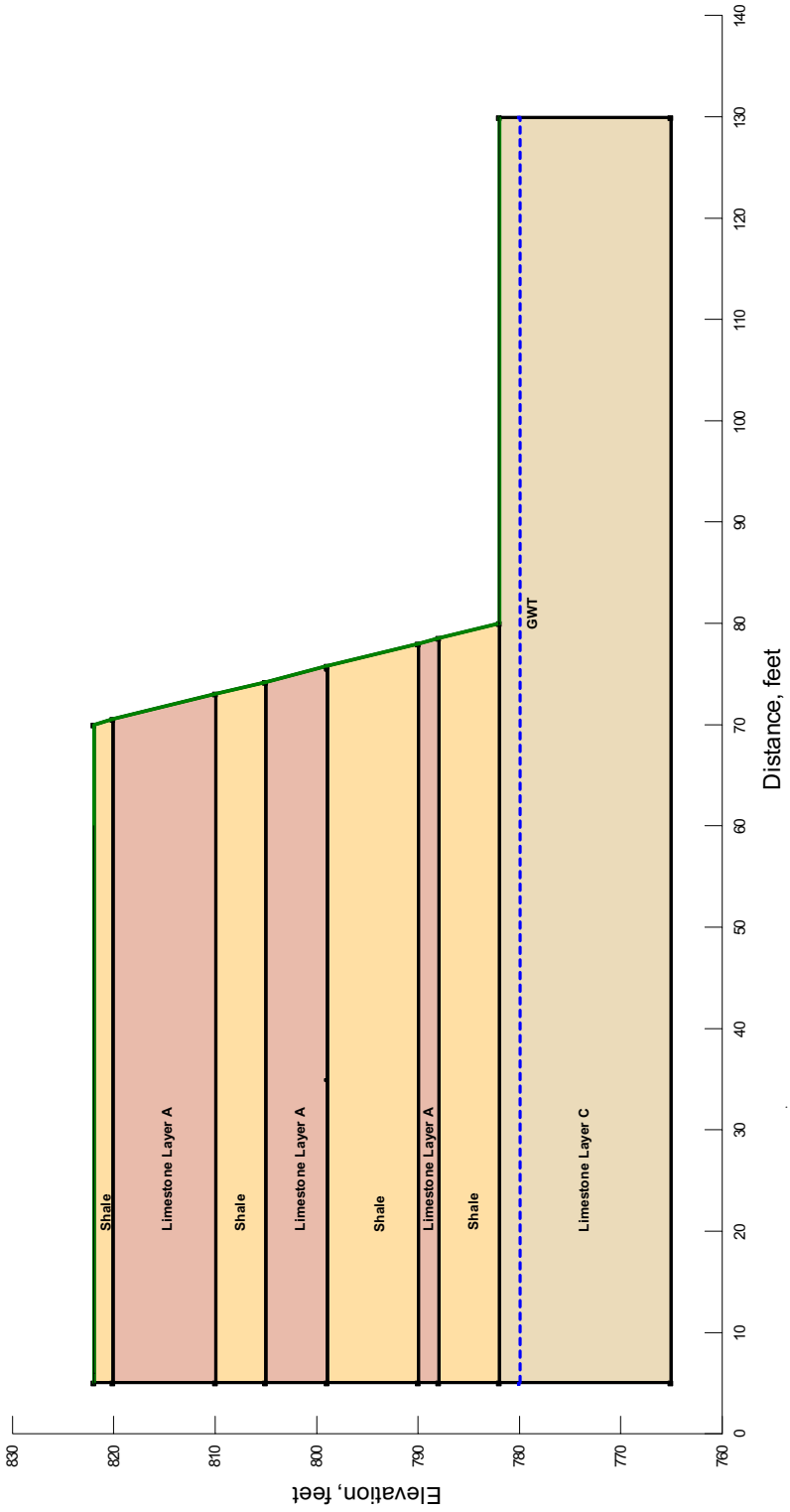
Post-Construction Cross Section G-G'

FIGURE 9



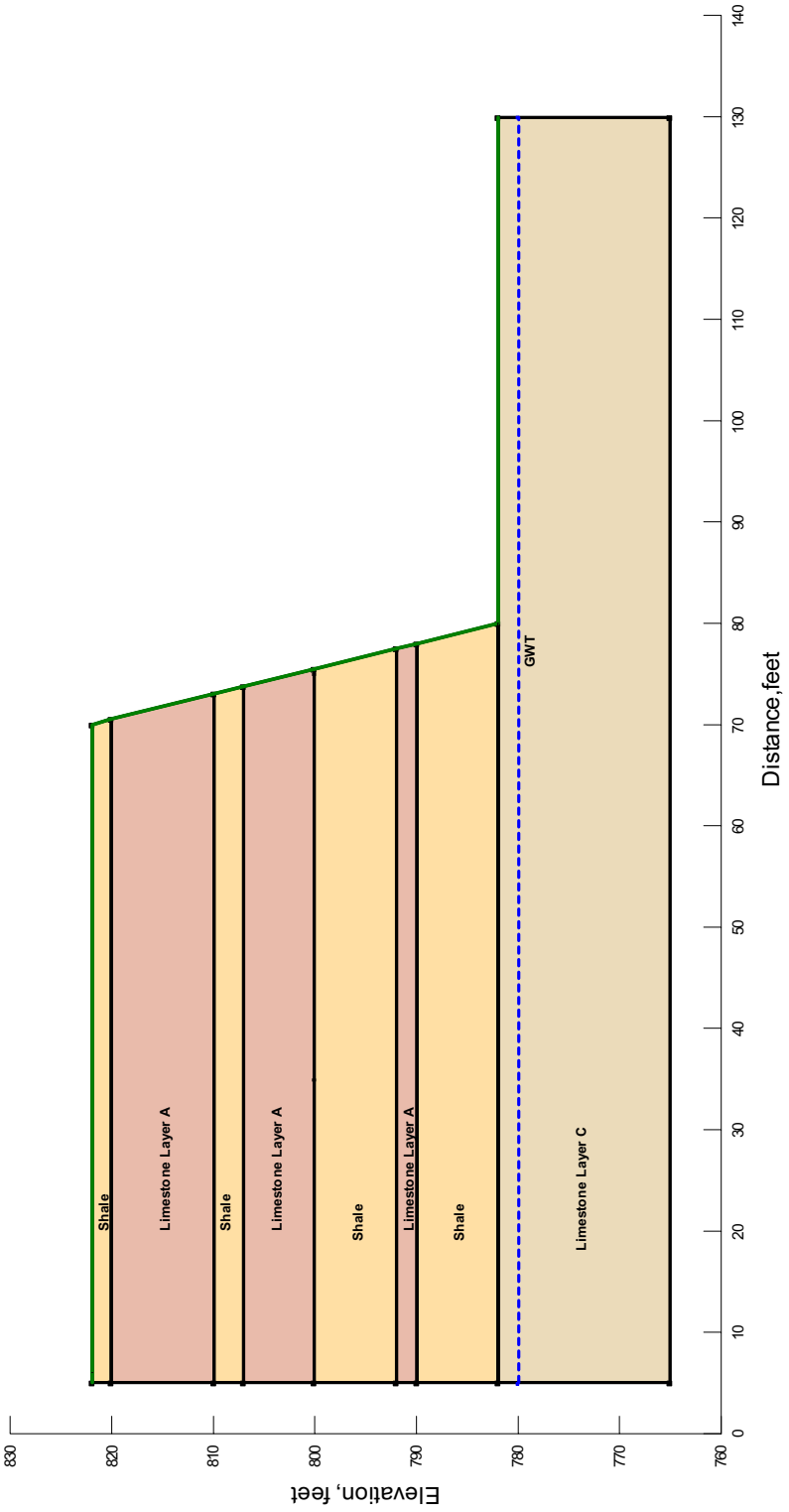
Post-Construction Cross Section H-H'

FIGURE 10



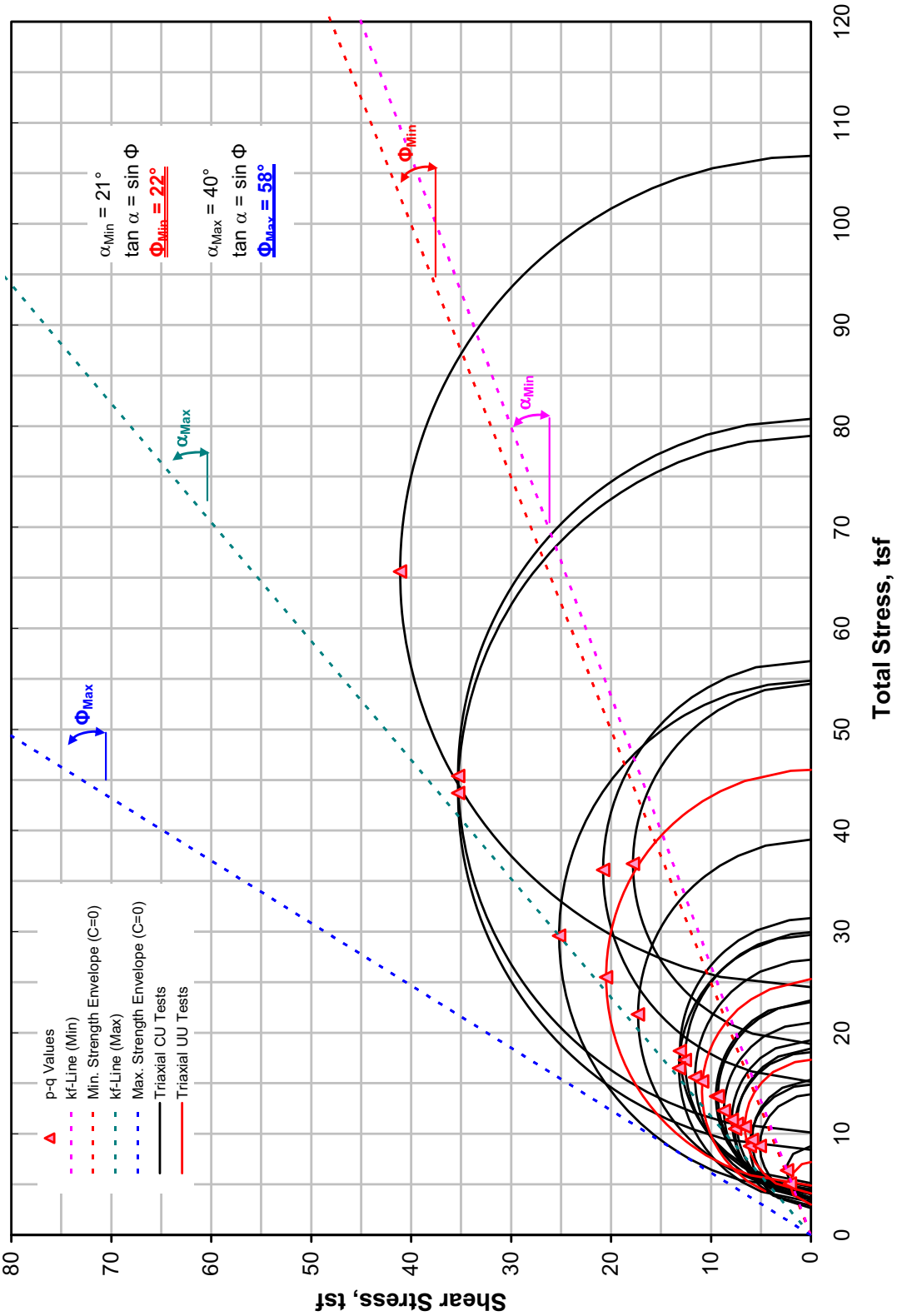
Temporary Construction Cut at Unit 3

FIGURE 11



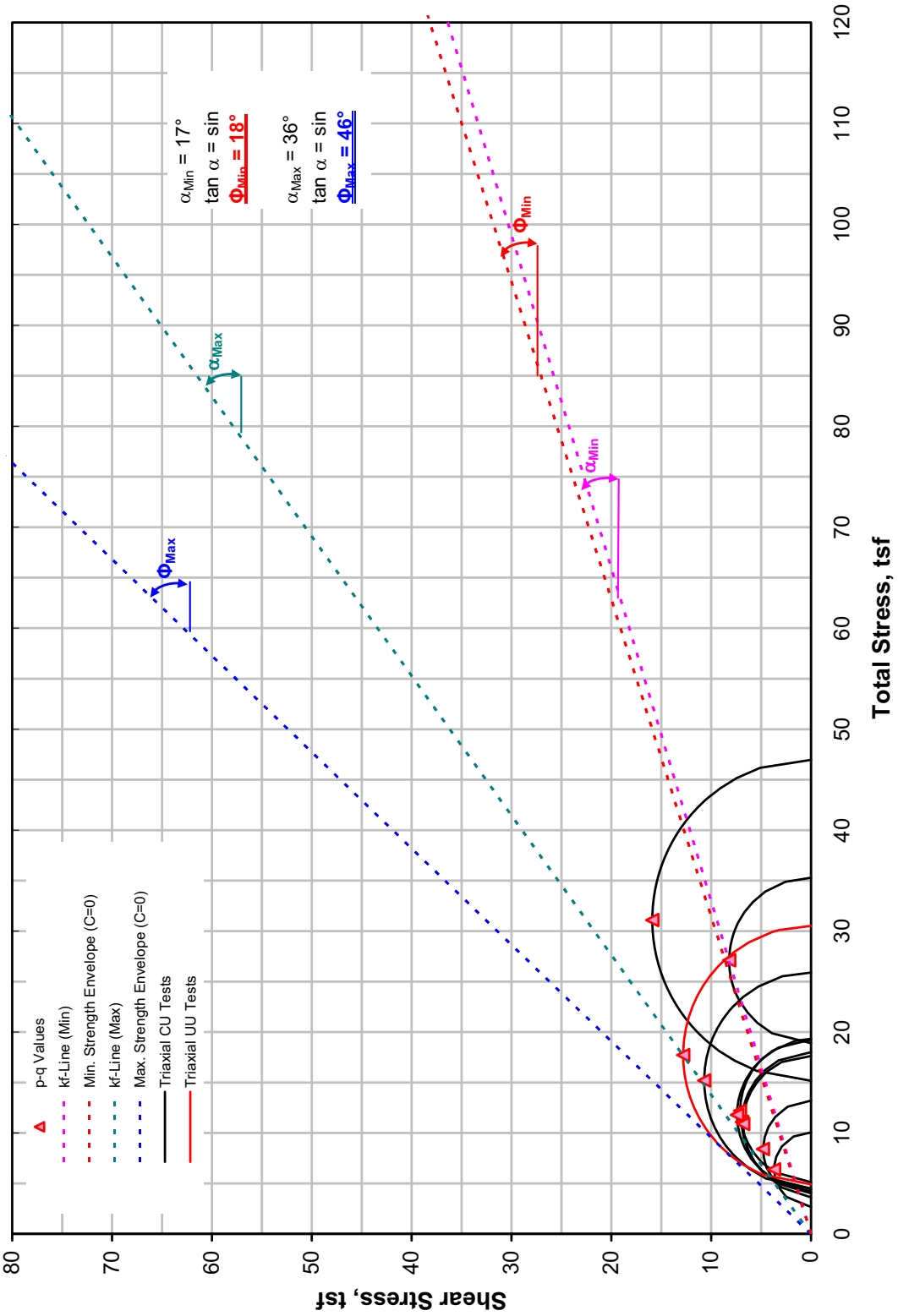
Temporary Construction Cut at Unit 4

FIGURE 12



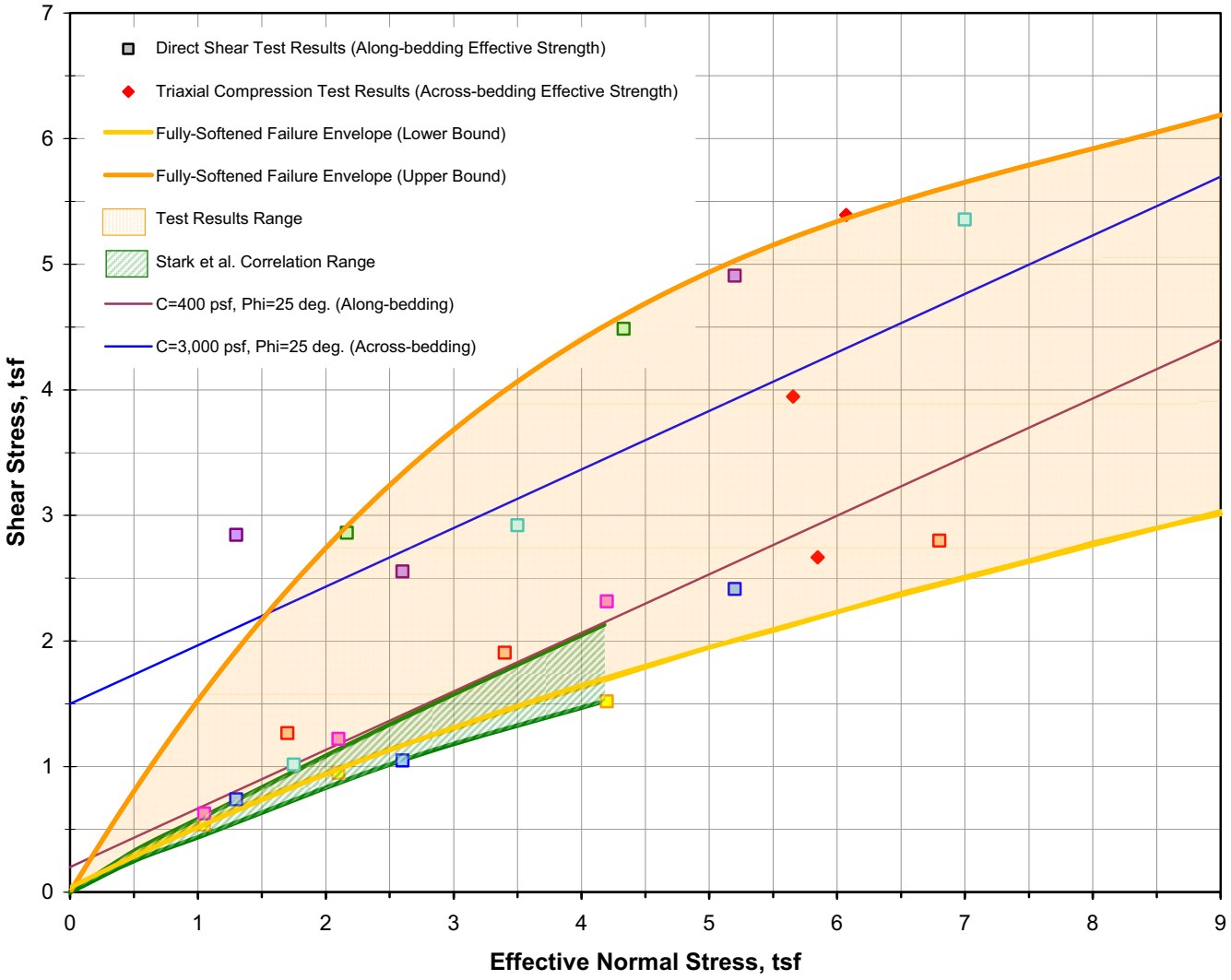
Peak Strength of Shale from CU and UU Triaxial Tests

FIGURE 13



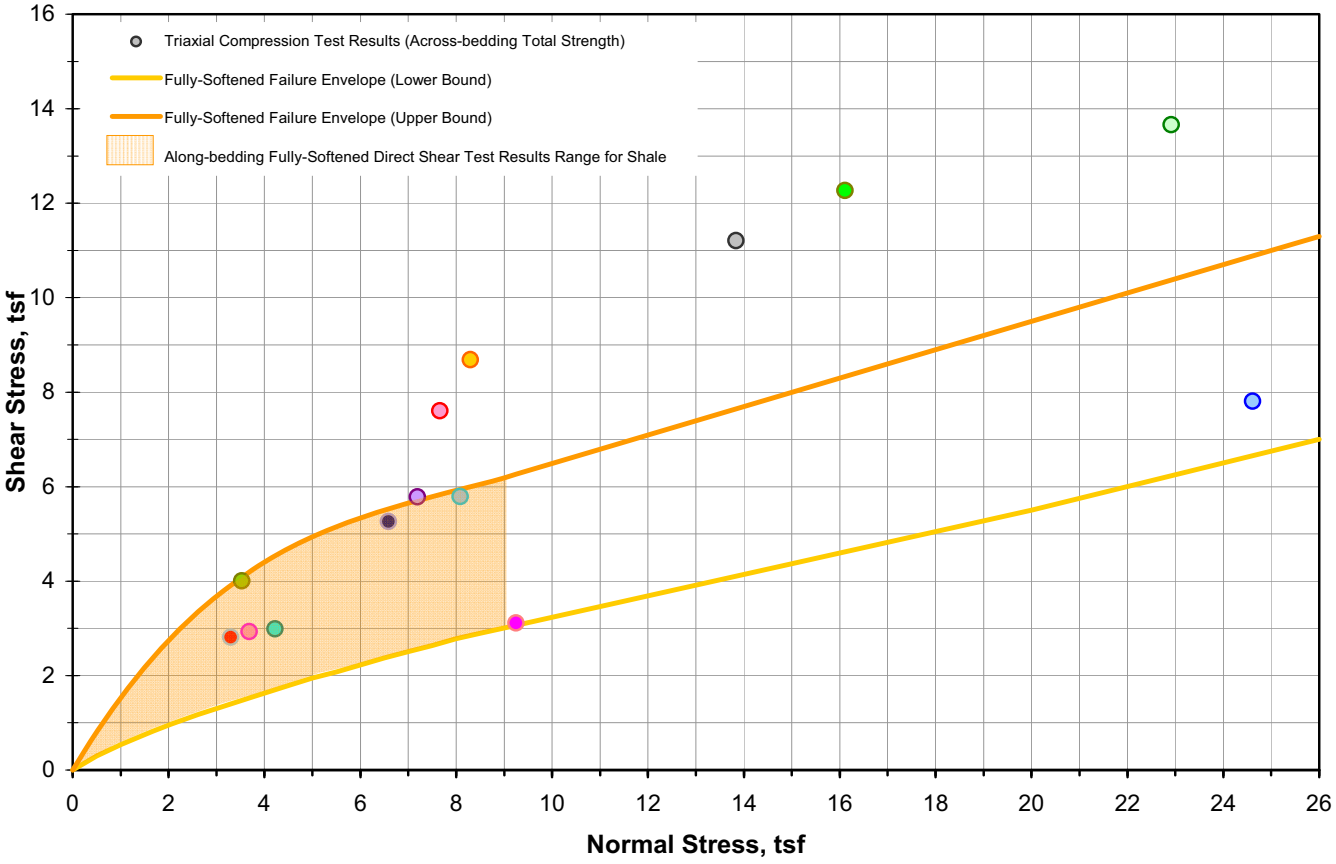
Ultimate Strength of Shale from CU and UU Triaxial Tests

FIGURE 14



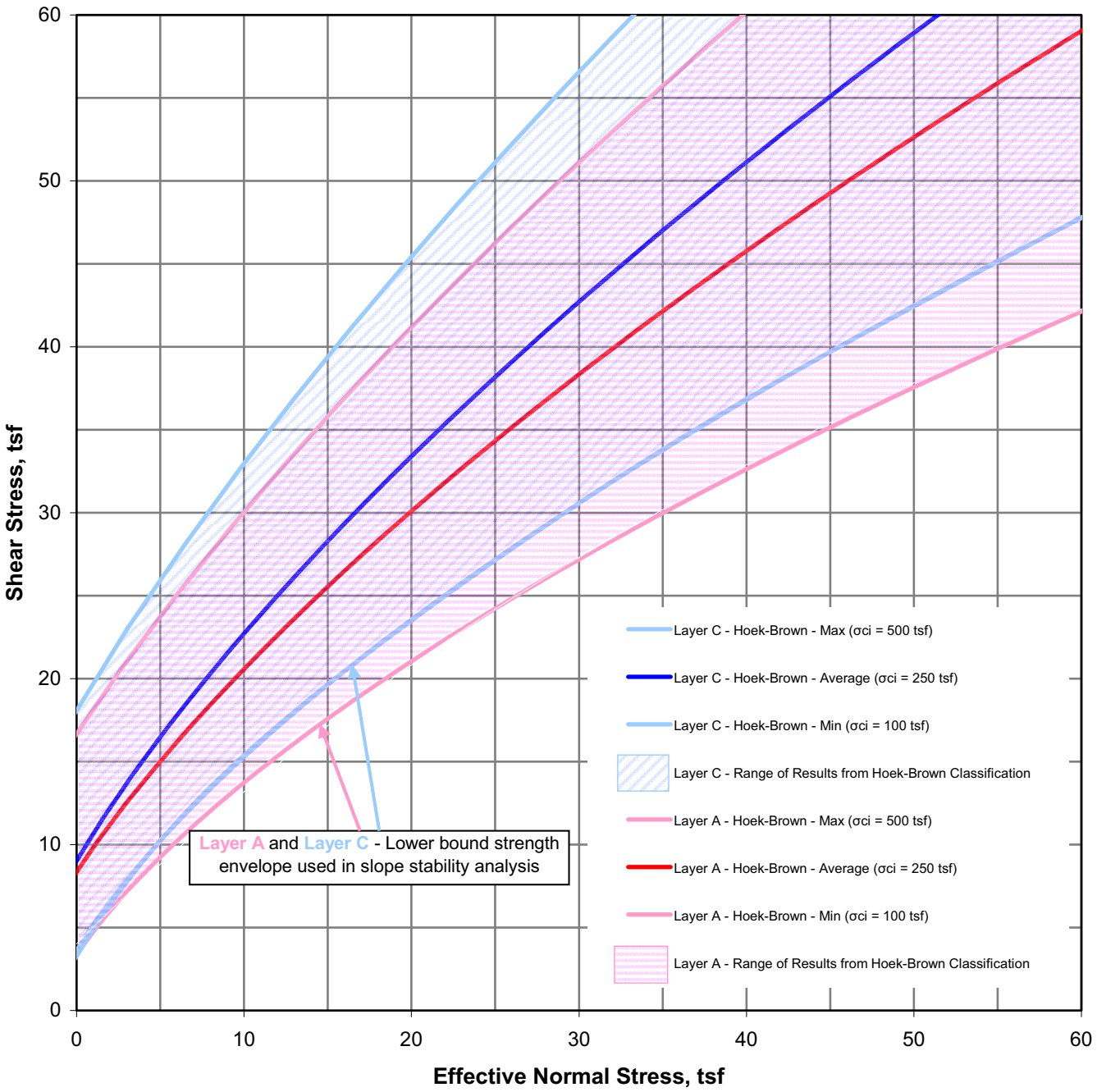
Fully-Softened Drained Shear Strength of Shale from Direct Shear Tests

FIGURE 15



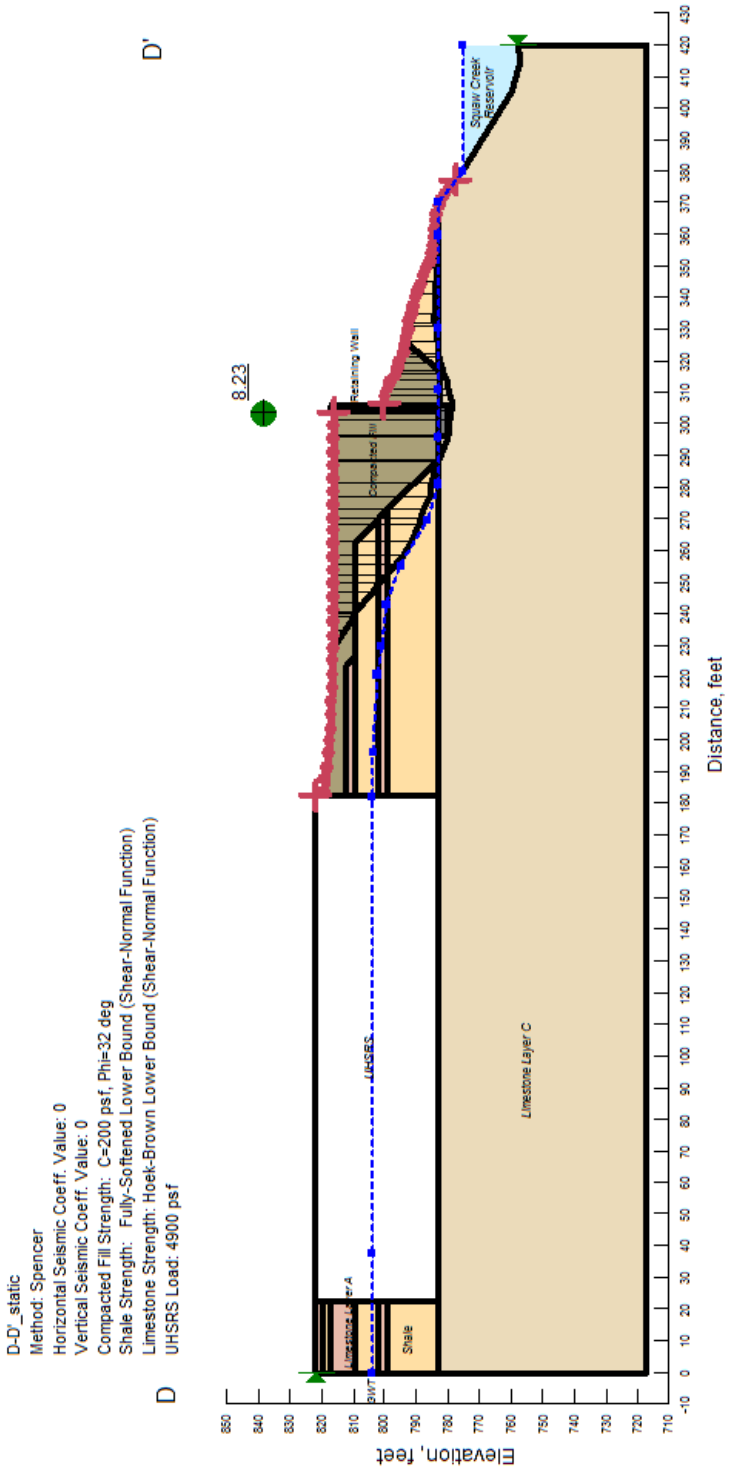
Fully-Softened Direct Shear Test Range with Triaxial Test Data

FIGURE 16



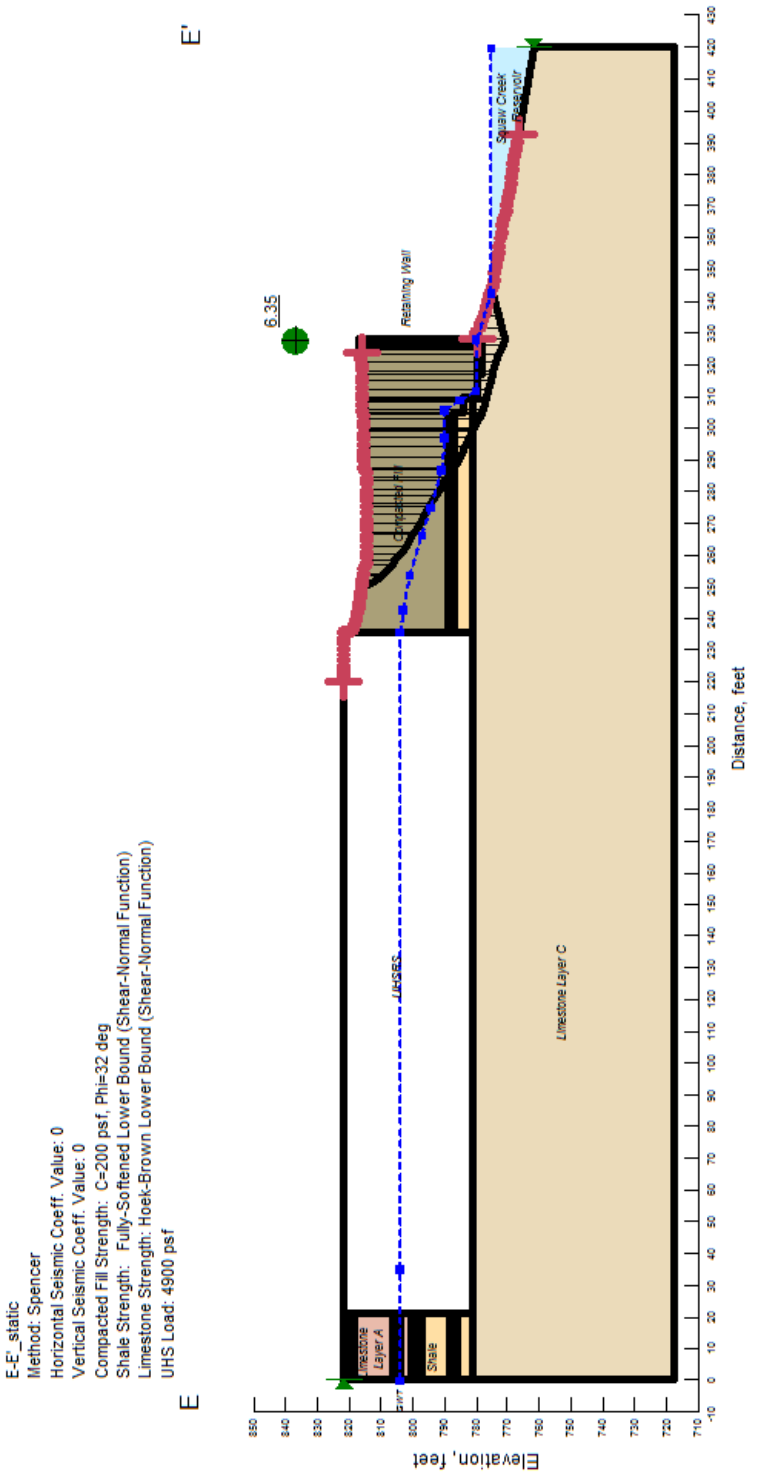
Peak Shear Strength Parameters for Limestone

FIGURE 17



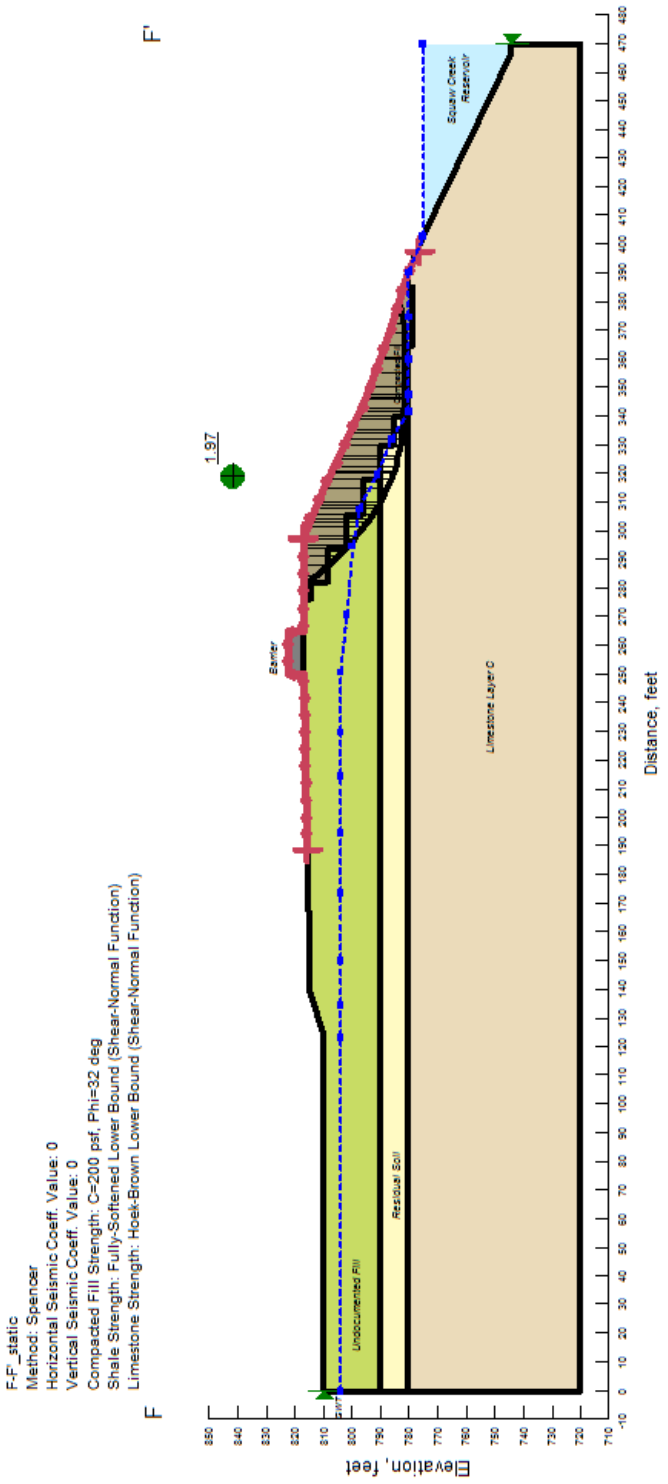
Static Stability Analysis for Cross Section D-D'

FIGURE 18



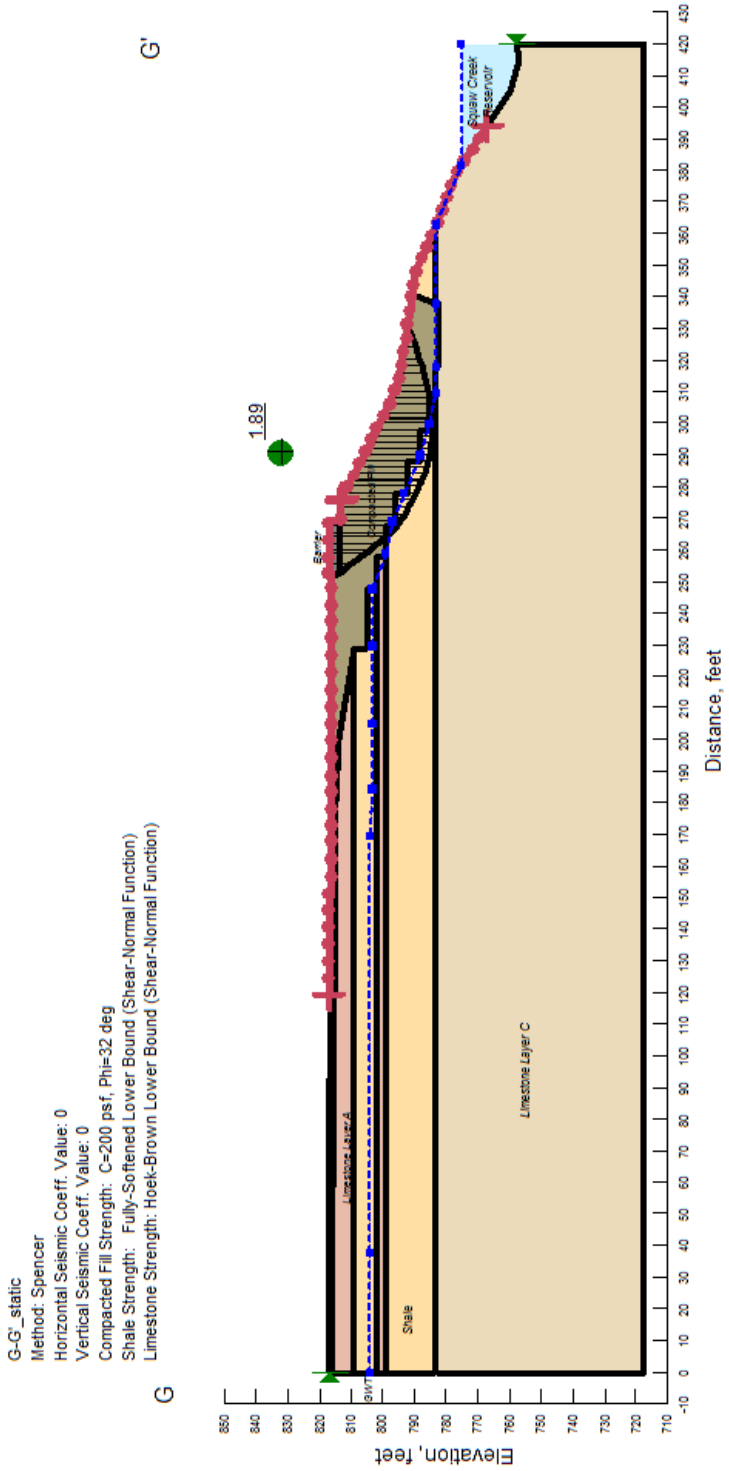
Static Stability Analysis for Cross Section E-E'

FIGURE 19



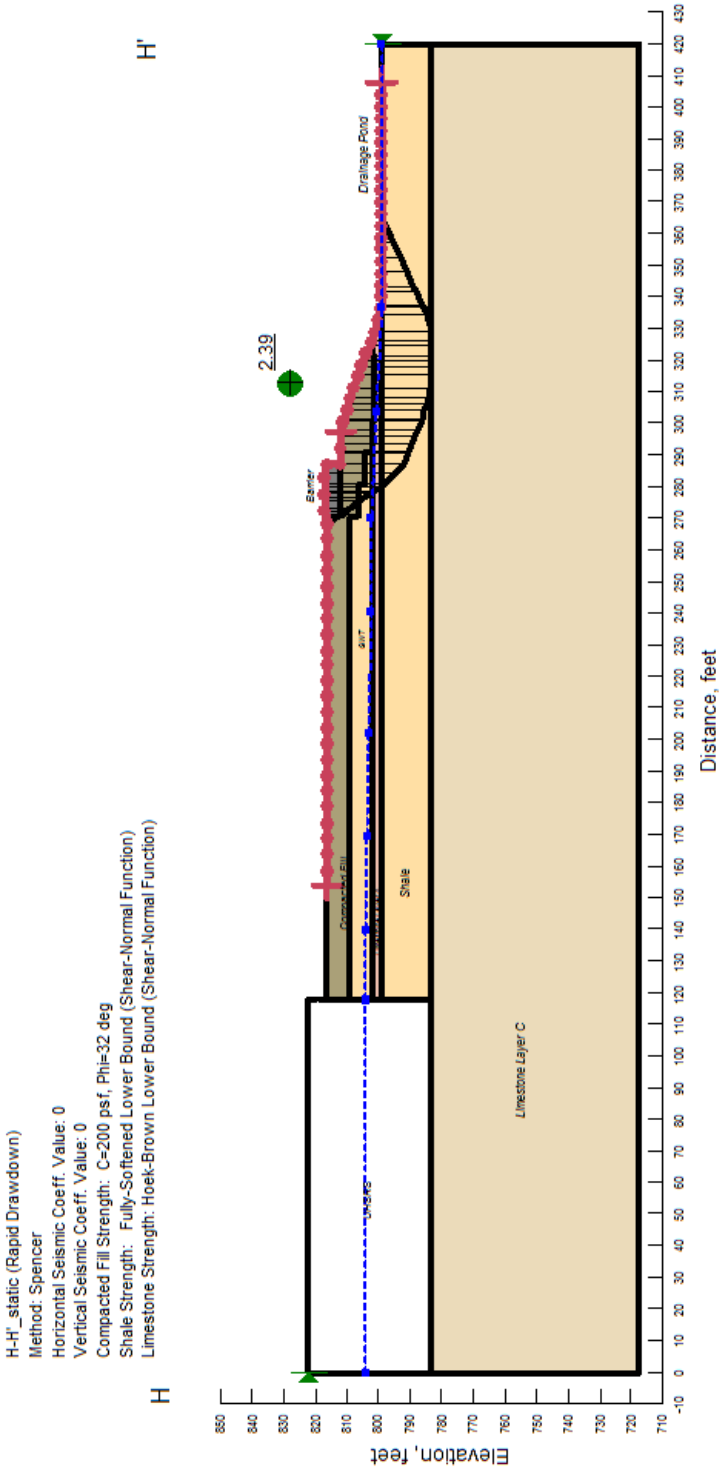
Static Stability Analysis for Cross Section F-F'

FIGURE 20



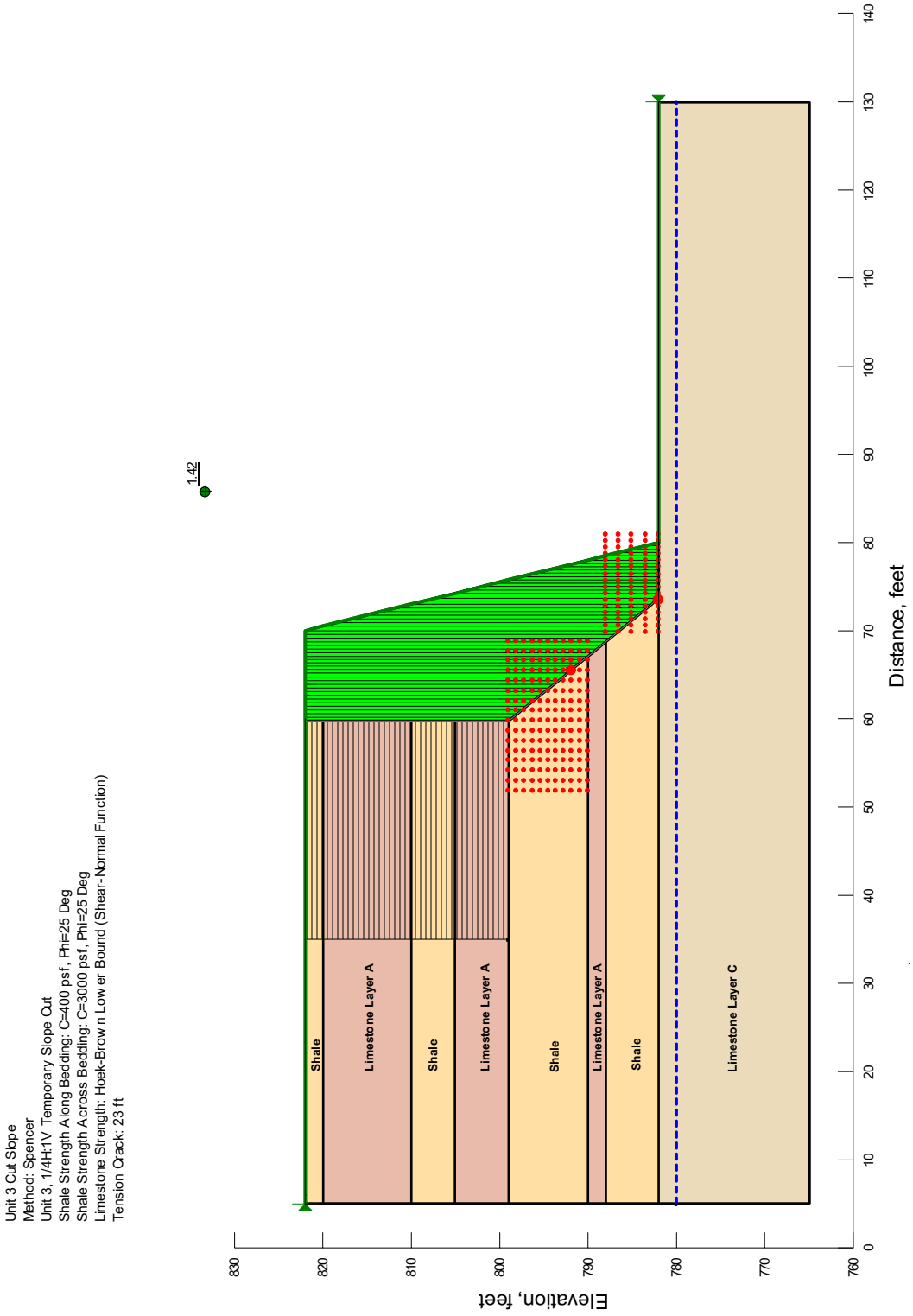
Static Stability Analysis for Cross Section G-G'

FIGURE 21



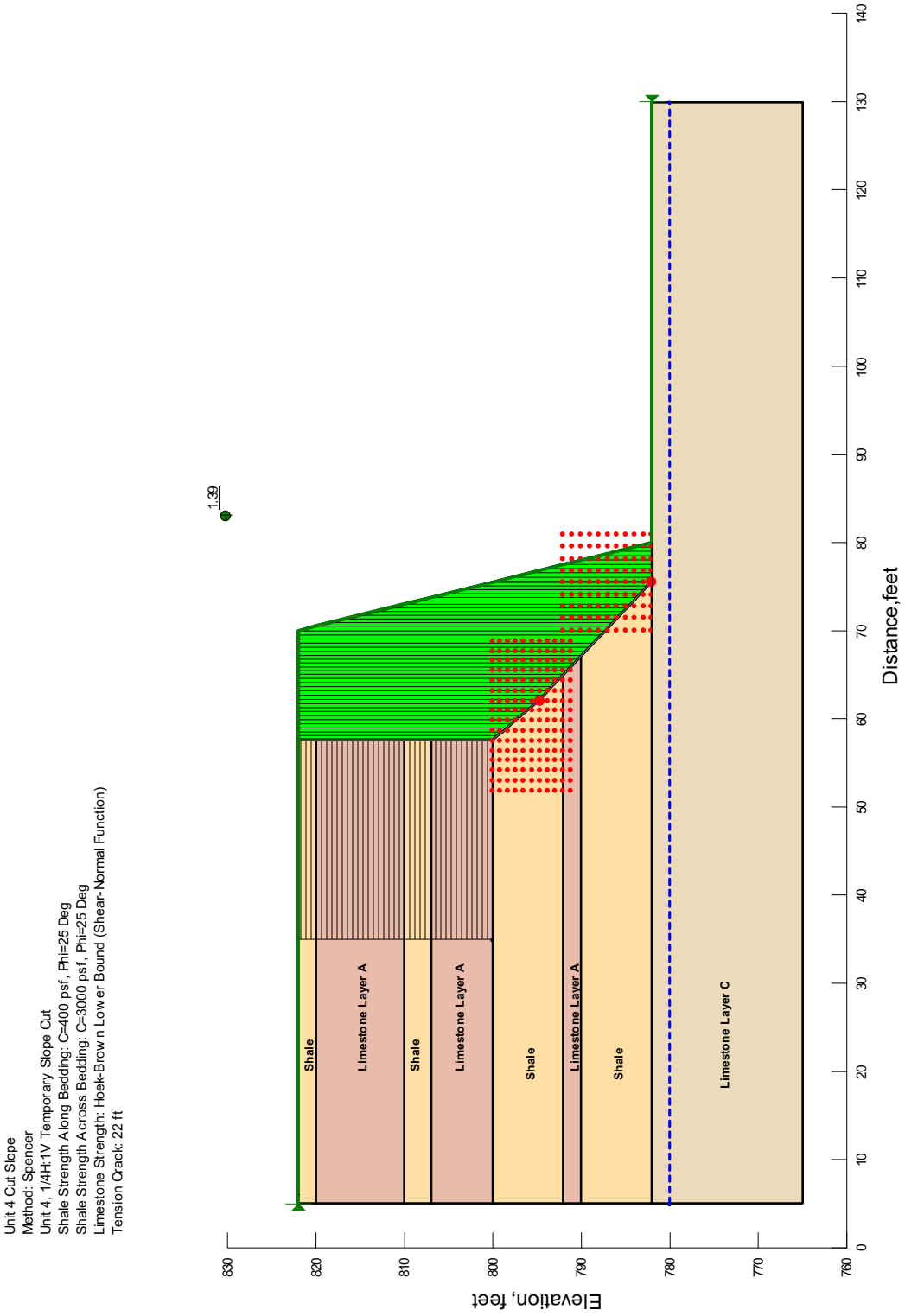
Static Stability Analysis for Cross Section H-H'

FIGURE 22



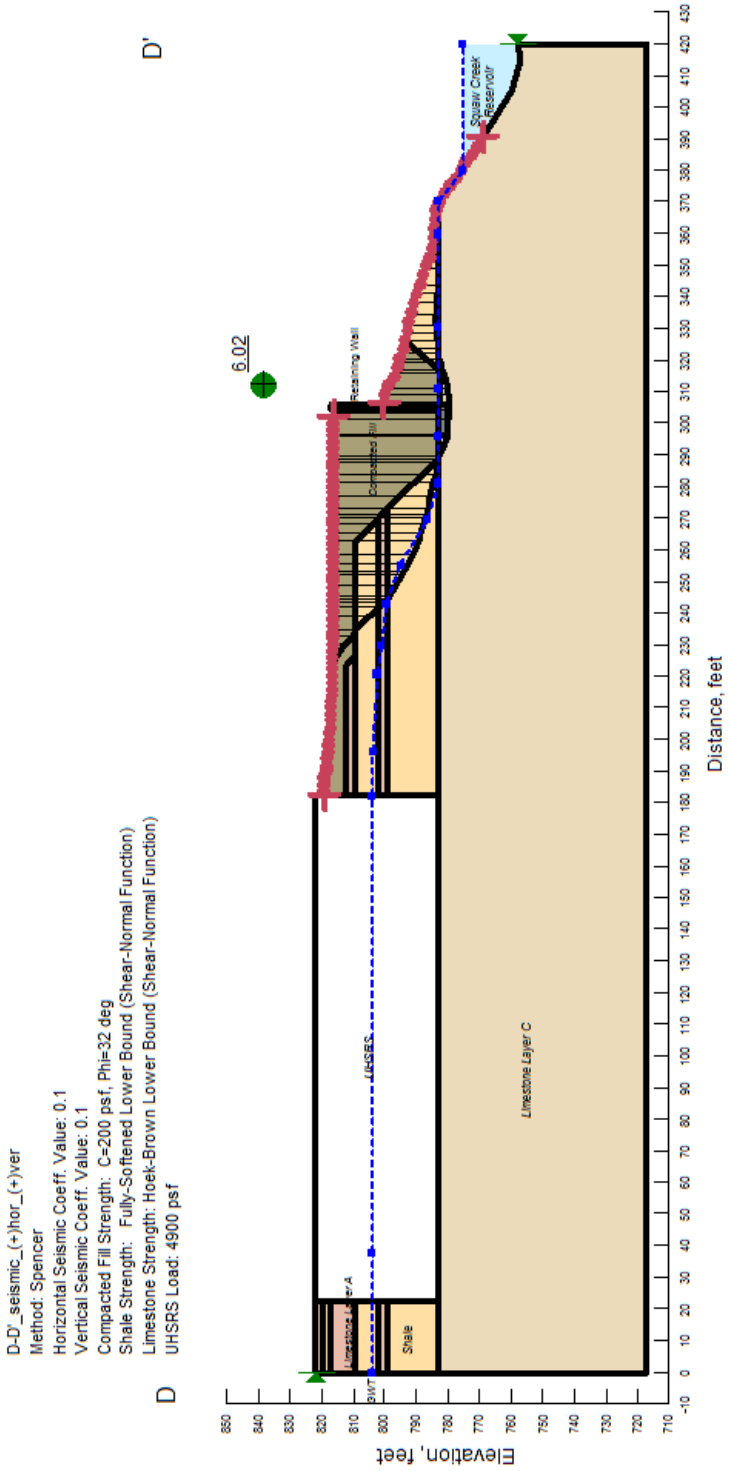
Static Stability Analysis for Temporary Cut at Unit 3

FIGURE 23



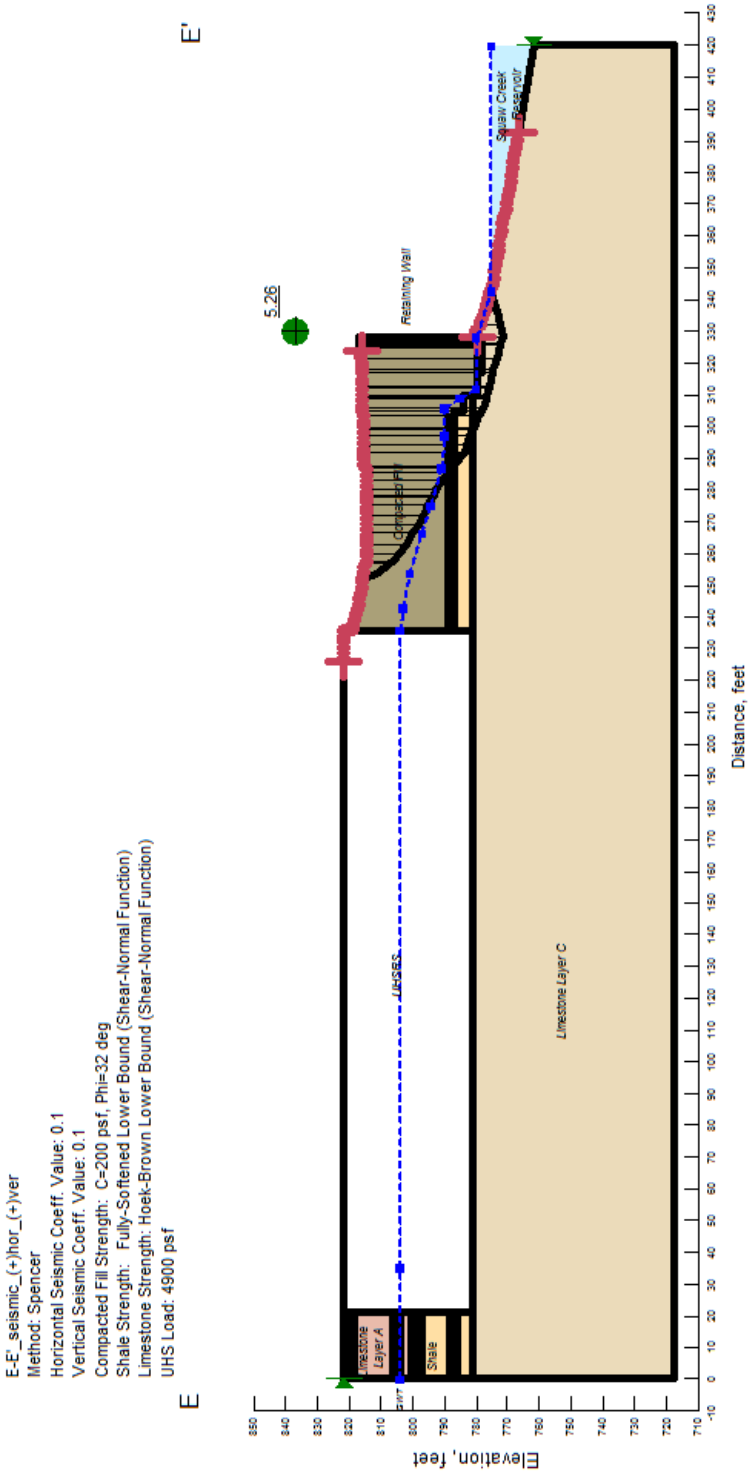
Static Stability Analysis for Temporary Cut at Unit 4

FIGURE 24



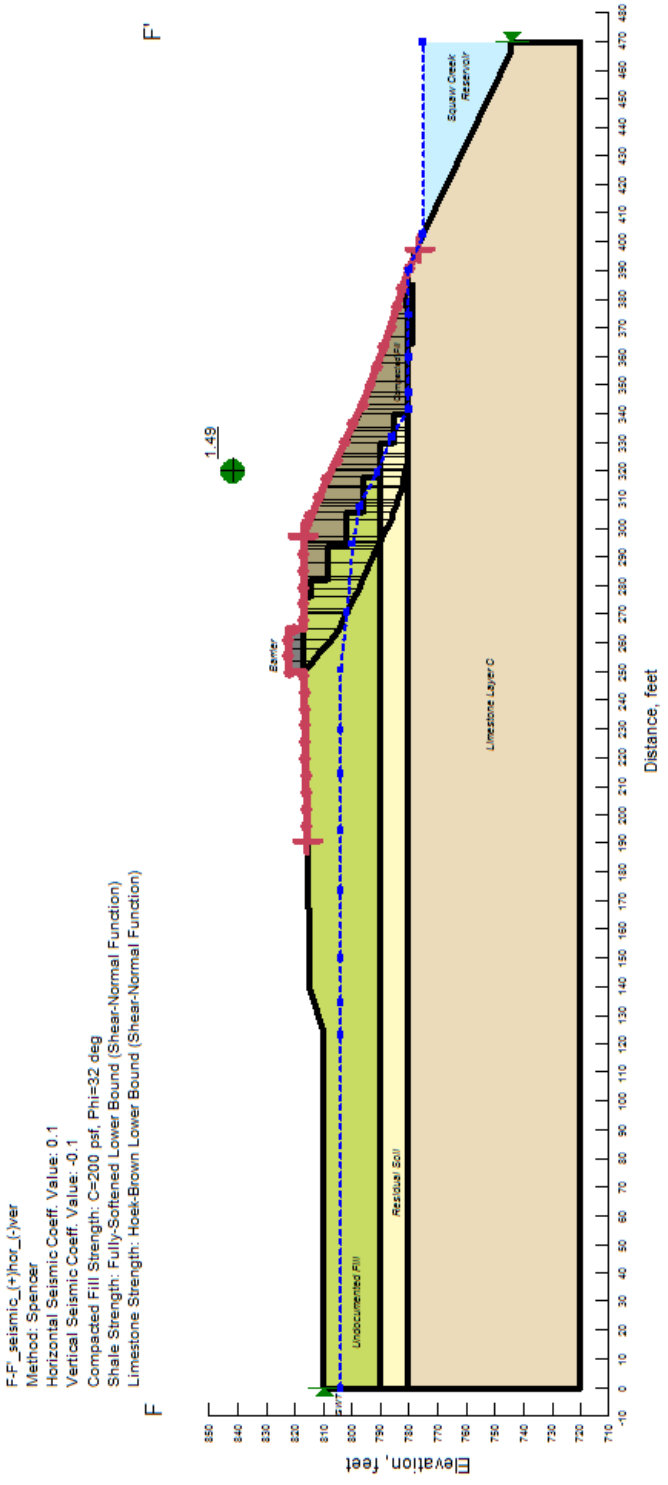
Seismic Stability Analysis for Cross Section D-D'

FIGURE 25



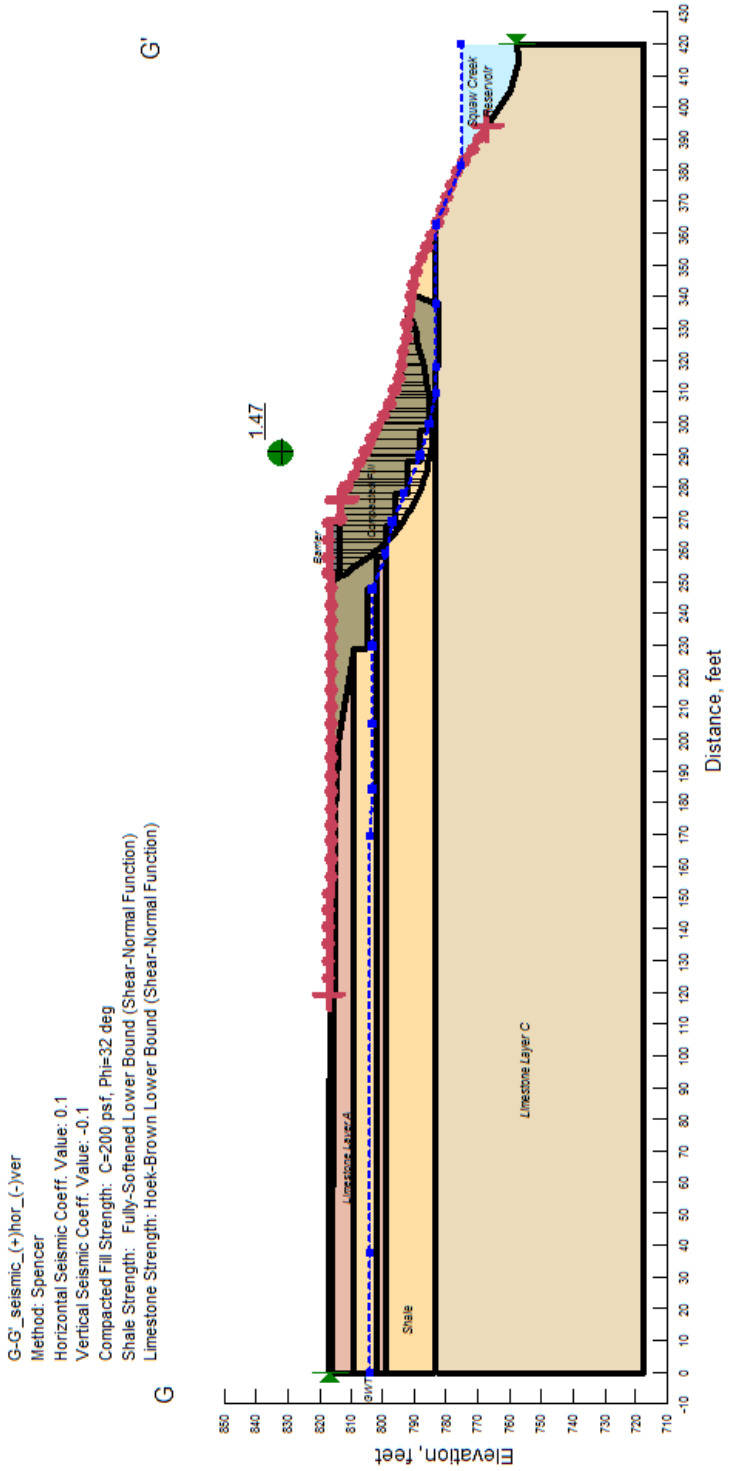
Seismic Stability Analysis for Cross Section E-E'

FIGURE 26



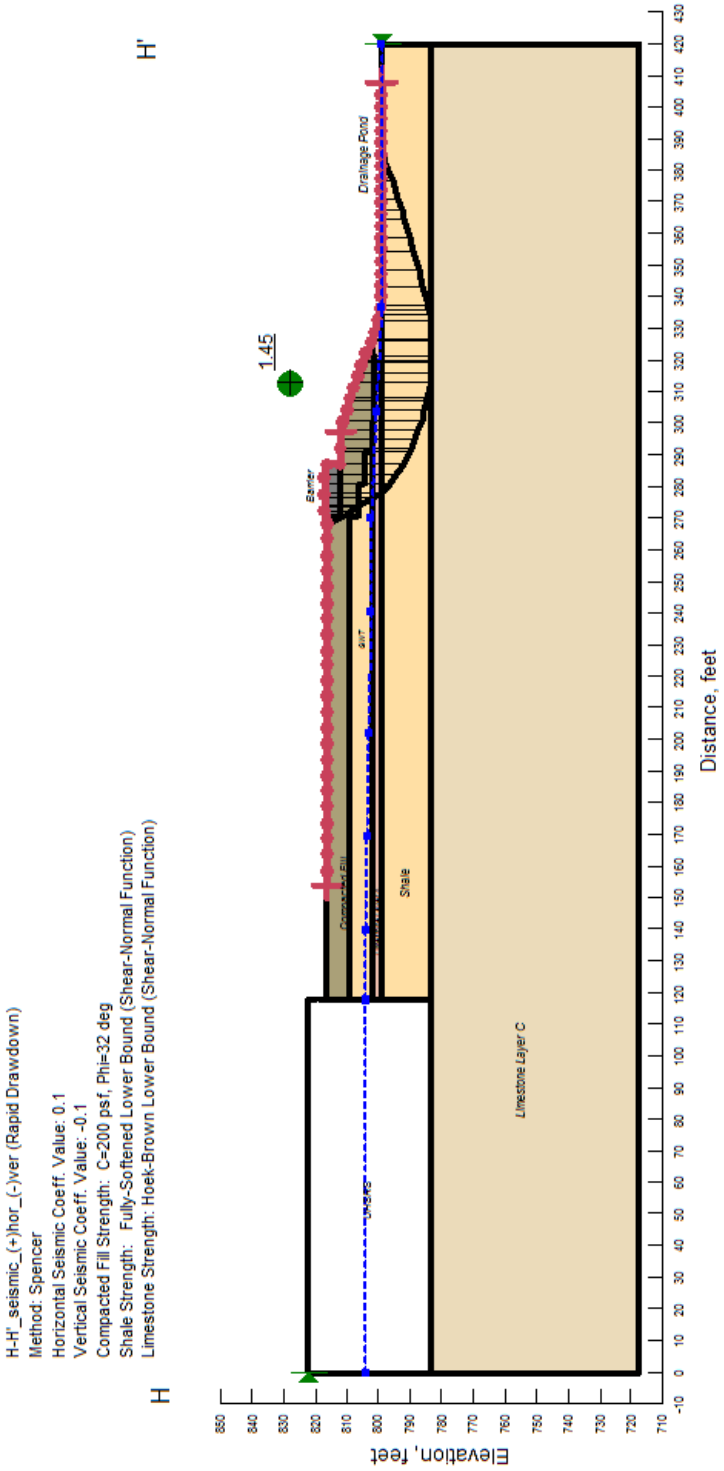
Seismic Stability Analysis for Cross Section F-F'

FIGURE 27



Seismic Stability Analysis for Cross Section G-G'

FIGURE 28



Seismic Stability Analysis for Cross Section H-H'

FIGURE 29

APPENDIX A

Slope Stability Calculations
For
Permanent Slopes

D-D'_static

File Information

Created By: Graf, Thomas [FWI]
Revision Number: 668
Last Edited By: Osman El Menchawi
Date: 8/2/2013
Time: 10:53:37 PM
File Name: profile_DD'_07_31_2013.gsz
Directory: C:\Users\Osman\Desktop\Comanche\Slope Stability\
Last Solved Date: 8/2/2013
Last Solved Time: 10:56:40 PM

Project Settings

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

Analysis Settings

D-D'_static

Kind: SLOPE/W
Method: Spencer
Settings
- Apply Phreatic Correction: No
- PWP Conditions Source: Piezometric Line
- Use Staged Rapid Drawdown: No

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: Yes
- Tension Crack
  - Tension Crack Option: (none)

FOS Distribution

FOS Calculation Option: Constant

Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 4 ft
Optimization Maximum Iterations: 4000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 24
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 5 °

Materials

Compacted Fill

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 200 psf
Phi: 32 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Limestone Layer C

Model: Shear/Normal Fn.
Unit Weight: 155 pcf
Strength Function: Unit C Limestone, Lower Bound
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Shale

Model: Shear/Normal Fn.
Unit Weight: 135 pcf
Strength Function: Shale-Fully Softened Lower Bound
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Limestone Layer A

Model: Shear/Normal Fn.
Unit Weight: 145 pcf
Strength Function: Unit A Limestone, Lower Bound
Phi-B: 0 °

Pore Water Pressure
Piezometric Line: 1

UHSRS

Model: Mohr-Coulomb
Unit Weight: 122.5 pcf
Cohesion: 5000 psf
Phi: 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Retaining Wall

Model: Mohr-Coulomb
Unit Weight: 155 pcf
Cohesion: 3.6e+005 psf
Phi: 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (182.29748, 821.7496) ft
Left-Zone Right Coordinate: (303.8533, 816) ft
Left-Zone Increment: 30
Right Projection: Range
Right-Zone Left Coordinate: (306.52206, 800) ft
Right-Zone Right Coordinate: (377.23428, 777.5993) ft
Right-Zone Increment: 30
Radius Increments: 0

Slip Surface Limits

Left Coordinate: (0, 822) ft
Right Coordinate: (420, 758) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	0	804
	38	804
	182.29748	804
	196.1	803.5
	220.9	802.5
	230.1	801
	243.3	799.5
	255.4	794.6
	270.2	786.5
	281.2	783
	295.8	783
	311	783
	330.7	783
	360.1	783
	370.7	783
	380	775
	420	775

Maximum Suction: 0 psf

Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

Shear/Normal Strength Functions

Shale-Fully Softened Lower Bound

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 100 %

Y-Intercept: 3.8193582e-007
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (1000, 449.95299)
Data Point: (2000, 892.95299)
Data Point: (3000, 1302.953)
Data Point: (4000, 1680.953)
Data Point: (5000, 2031.953)
Data Point: (6000, 2356.953)
Data Point: (7000, 2660.953)
Data Point: (8000, 2944.953)
Data Point: (9000, 3213.953)
Data Point: (10000, 3468.953)
Data Point: (11000, 3714.953)
Data Point: (12000, 3952.953)
Data Point: (13000, 4187.953)
Data Point: (14000, 4420.953)
Data Point: (15000, 4656.953)
Data Point: (16000, 4896.953)
Data Point: (17000, 5145.953)
Data Point: (18000, 5404.953)
Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Unit A Limestone, Lower Bound

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Y-Intercept: 6697.4707
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (-1710, 3833)
Data Point: (-299, 6231)
Data Point: (1063, 8237)
Data Point: (2388, 10014)
Data Point: (3684, 11635)
Data Point: (4956, 13137)
Data Point: (6207, 14546)
Data Point: (7440, 15878)
Data Point: (8656, 17146)
Data Point: (9857, 18358)
Data Point: (11045, 19522)

Data Point: (12220, 20643)
Data Point: (13383, 21726)
Data Point: (14536, 22775)
Data Point: (15679, 23793)
Data Point: (16813, 24783)
Data Point: (17938, 25747)
Data Point: (19054, 26689)
Data Point: (20163, 27603)
Data Point: (21264, 28500)
Data Point: (22358, 29377)
Data Point: (23445, 30236)
Data Point: (24526, 31078)
Data Point: (25600, 31904)
Data Point: (26669, 32715)
Data Point: (27732, 33512)
Data Point: (28789, 34295)
Data Point: (29841, 35065)
Data Point: (30888, 35823)
Data Point: (31931, 36569)
Data Point: (32968, 37304)
Data Point: (34001, 38028)
Data Point: (35029, 38742)
Data Point: (36053, 39447)
Data Point: (37073, 40141)
Data Point: (38089, 40827)
Data Point: (39101, 41504)
Data Point: (40109, 42173)

Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Unit C Limestone, Lower Bound

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Y-Intercept: 7248.7668
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (-1613, 4254)
Data Point: (-174, 6947)
Data Point: (1222, 9215)
Data Point: (2584, 11234)

Data Point: (3920, 13080)
Data Point: (5233, 14797)
Data Point: (6527, 16411)
Data Point: (7804, 17941)
Data Point: (9065, 19400)
Data Point: (10312, 20797)
Data Point: (11546, 22141)
Data Point: (12768, 23437)
Data Point: (13980, 24691)
Data Point: (15181, 25906)
Data Point: (16372, 27087)
Data Point: (17555, 28237)
Data Point: (18728, 29357)
Data Point: (19894, 30450)
Data Point: (21052, 31518)
Data Point: (22203, 32563)
Data Point: (23346, 33586)
Data Point: (24483, 34589)
Data Point: (25614, 35573)
Data Point: (26738, 36538)
Data Point: (27857, 37486)
Data Point: (28970, 38419)
Data Point: (30077, 39336)
Data Point: (31179, 40238)
Data Point: (32276, 41126)
Data Point: (33369, 42001)
Data Point: (34456, 42863)
Data Point: (35539, 43714)
Data Point: (36617, 44552)
Data Point: (37692, 45380)
Data Point: (38761, 46196)
Data Point: (39827, 47003)
Data Point: (40889, 47799)
Data Point: (41947, 48586)

Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Regions

	Material	Points	Area (ft²)

Region 1	Limestone Layer C	17,18,22,39,38,52,53,54,55,40,41,19,23,3,2,1,12,20,21	26805.55
Region 2	UHSRS	5,16,15,26,8,9,36,18,22,37,10,27,28,29,11,4	6240
Region 3	Limestone Layer A	29,34,30,35,28	130.27645
Region 4	Shale	28,35,33,32,27	592.85868
Region 5	Limestone Layer A	27,32,31,10	239.19051
Region 6	Limestone Layer A	6,5,16,14	55.7437
Region 7	Shale	14,16,15,13	55.7437
Region 8	Limestone Layer A	13,15,26,25	178.37984
Region 9	Shale	25,26,8,24	156.08236
Region 10	Limestone Layer A	24,8,9,7	66.89244
Region 11	Shale	7,9,36,18,17	356.75968
Region 12	Shale	10,31,39,22,37	1605.2117
Region 13	Compacted Fill	55,47,48,49,57,41,40	234
Region 14	Shale	41,57,50,51,19	254.32
Region 15	Retaining Wall	54,55,47,46,45,44,56,58,52,53	98
Region 16	Compacted Fill	11,59,60,61,42,43,44,56,58,52,38,39,31,32,33,35,30,34,29	1520.1929

Points

	X (ft)	Y (ft)
Point 1	415	757
Point 2	405	760
Point 3	380.7	775
Point 4	182.29748	822
Point 5	22.29748	822

Point 6	0	822
Point 7	0	799
Point 8	22.29748	802
Point 9	22.29748	799
Point 10	182.29748	799
Point 11	182.29748	819
Point 12	420	758
Point 13	0	817
Point 14	0	819.5
Point 15	22.29748	817
Point 16	22.29748	819.5
Point 17	0	783
Point 18	22.29748	783
Point 19	370.7	783
Point 20	420	717.2
Point 21	0	717.2
Point 22	182.29748	783
Point 23	376.7	778
Point 24	0	802
Point 25	0	809
Point 26	22.29748	809
Point 27	182.29748	802
Point 28	182.29748	809
Point 29	182.29748	812
Point 30	224	812
Point 31	273	799.4868
Point 32	270	801.8441
Point 33	263	808.9258
Point 34	188.21156	812
Point 35	227.01361	808.9689
Point 36	22.29748	787
Point 37	182.29748	787
Point 38	295.8	783
Point 39	289	783
Point 40	316	782

Point 41	317	783
Point 42	252.1	816
Point 43	301.6	816
Point 44	304.2	816
Point 45	304.2	817
Point 46	306.2	817
Point 47	306.2	800
Point 48	308.8	800
Point 49	319	795
Point 50	341.1	790
Point 51	354.4	785
Point 52	296.2	783
Point 53	296.2	780
Point 54	306.2	780
Point 55	306.2	782
Point 56	304.2	800
Point 57	326	793.4
Point 58	304.2	783
Point 59	195.55262	818
Point 60	205.55262	817
Point 61	239.17114	816
Point 62		

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	8.23	(306.137, 860.997)	66.85924	(228.388, 816.321)	(370.466, 783.029)
2	451	11.09	(306.137, 860.997)	82.042	(237.503, 816.05)	(344.769, 788.621)

Slices of Slip Surface: Optimized

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)

1	Optimized	229.2439	815.79185	0	45.660063	28.531574	200
2	Optimized	232.3678	813.86185	0	238.64585	149.12248	200
3	Optimized	236.90335	811.0598	0	518.83854	324.2063	200
4	Optimized	239.52275	809.44155	0	681.74507	426.0016	200
5	Optimized	240.0586	809.0887	0	692.95952	433.00917	200
6	Optimized	241.7714	807.8277	0	846.44796	380.87058	-8.98e-005
7	Optimized	245.2299	805.28155	0	1128.1415	507.21992	0.37247
8	Optimized	248.2848	802.87075	0	1344.3684	601.56215	3.0462
9	Optimized	250.7549	800.697	0	1123.3202	1555.0607	6765.6
10	Optimized	253.75	798.06125	0	1876.5758	814.28429	25.418
11	Optimized	257.01135	795.19115	0	2183.3746	920.54267	50.423
12	Optimized	260.81135	792.76215	0	2729.3261	1095.799	99.715
13	Optimized	265.5939	790.5531	0	2969.3183	1168.8075	122.09
14	Optimized	269.0939	789.0346	0	3216.4841	1241.7184	145.49
15	Optimized	270.1	788.67885	0	3250.3738	1251.5434	148.77
16	Optimized	271.6	788.14845	0	3294.0862	1264.0854	153.01
17	Optimized	275.10255	786.9099	0	3406.4981	1296.0487	164.03
18	Optimized	279.20255	785.64315	0	3619.1841	1355.1018	185.23
19	Optimize	284.5493	784.2425	0	3744.619	1389.1902	197.91

	d						
20	Optimized	288.29575	783.2275	0	3743.3982	1388.8116	197.79
21	Optimized	288.8031	783.04495	0	3695.6061	1375.9257	192.94
22	Optimized	292.35665	781.5951	87.664894	3720.0171	4927.3428	7764.7
23	Optimized	295.99975	780.1087	180.41563	3925.6054	5056.3485	7788.4
24	Optimized	298.89975	779.59835	212.26635	4633.5767	5814.7396	7930.9
25	Optimized	302.9	778.96305	251.90459	4728.814	5875.5071	7943.3
26	Optimized	305.2	778.5978	274.69736	5900.0575	7075.595	8218.3
27	Optimized	306.22485	778.43505	284.84767	2826.8296	3641.5426	7532.3
28	Optimized	307.52485	778.7787	263.40947	3849.3011	4874.1074	7755
29	Optimized	309.9	779.4262	223.00283	3653.6661	4695.3118	7721.9
30	Optimized	312.4763	780.12855	179.18008	3340.1638	4382.0059	7664
31	Optimized	314.9763	780.84285	134.60755	3115.9709	4170.4724	7625.3
32	Optimized	316.5	781.307	105.64751	2936.6832	3991.4685	7593.1
33	Optimized	318	781.7639	77.135922	2774.3964	3830.5612	7564.8
34	Optimized	319.9994	782.3729	39.132393	2582.7111	3643.4237	7532.7
35	Optimized	321.7456	782.83865	10.067931	2256.6459	3271.1145	7476.1
36	Optimized	322.50905	783.0036	0	1595.6746	706.17294	10.34
37	Optimized	324.26285	783.2274	0	1484.159	660.54188	6.4674

38	Optimized	328.35	783.74545	0	1303.3379	583.93962	2.3076
39	Optimized	331.4017	784.13225	0	1149.9754	516.8918	0.516
40	Optimized	333.48075	784.27915	0	1032.6579	464.61489	0.022689
41	Optimized	337.97905	784.2005	0	878.22239	395.16791	-9.3175e-005
42	Optimized	342.99795	783.9808	0	716.61023	322.44836	-2.1646e-005
43	Optimized	347.03895	783.6788	0	542.13242	243.93973	-3.6827e-005
44	Optimized	351.325	783.24095	0	386.52786	173.92338	-4.0795e-005
45	Optimized	353.934	783.02065	0	294.84412	132.66905	-8.6812e-006
46	Optimized	357.25	783.01095	0	224.34993	100.94925	-6.5141e-006
47	Optimized	360.5252	783.00135	0	170.65613	76.789007	-1.6304e-006
48	Optimized	363.32925	783.00725	0	123.00453	55.347532	-1.0684e-006
49	Optimized	368.08695	783.02155	0	41.000809	18.448862	5.0305e-006

Slices of Slip Surface: 451

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	451	238.33715	814.825	0	90.195557	56.360439	200
2	451	240.9445	811.27525	0	416.77332	260.42887	200
3	451	243.00895	808.59945	0	701.24942	315.53655	-7.4295e-005
4	451	244.78745	806.5721	0	922.88549	415.26467	-9.7903e-005
5	451	247.76235	803.3882	0	1283.9284	575.56644	1.9951
6	451	250.6749	800.57295	0	1236.0783	1701.1909	6775.1

7	451	253.75	797.8951	0	1965.4922	846.19002	31.939
8	451	257.3	795.11685	0	2319.7638	965.71947	62.353
9	451	261.1	792.45985	0	2671.8763	1077.9895	94.369
10	451	264.75	790.18845	0	2969.1685	1168.7486	122.05
11	451	268.25	788.25415	0	3214.1817	1241.0874	145.26
12	451	270.1	787.2938	0	3337.337	1276.4745	157.22
13	451	271.6	786.59505	0	3420.8445	1300.0719	165.44
14	451	274.7504	785.2202	0	3595.2351	1348.5678	182.82
15	451	278.5979	783.7476	5.0132782	3794.0385	1401.0768	202.42
16	451	280.9475	782.91855	10.096341	3827.9178	5139.2017	7803.6
17	451	283.15	782.26775	45.692255	3959.7985	5248.6906	7823.3
18	451	287.05	781.2318	110.33643	4179.1986	5423.7487	7855.2
19	451	290.7	780.43945	159.78116	4377.9933	5590.8508	7886.8
20	451	294.1	779.8615	195.84483	4560.0925	5752.1852	7918.4
21	451	296	779.5844	213.13671	4656.2953	5838.6074	7935.9
22	451	297.55	779.4174	223.55764	4726.4831	5903.6638	7949.2
23	451	300.25	779.17815	238.48356	4842.6678	6013.3178	7972
24	451	302.9	779.02965	247.74925	4944.9929	6113.3888	7993.3
25	451	305.2	778.9669	251.66364	6197.0972	7396.2139	8298.1
26	451	307.5	778.9771	251.03072	2991.8177	3883.1545	7574
27	451	309.9	779.0492	246.53115	2963.0598	3853.7801	7568.9
28	451	313.5	779.3251	229.30996	2764.3882	3633.0035	7531
29	451	316.5	779.61415	211.27396	2600.6994	3452.0556	7502.3
30	451	318	779.82395	198.18468	2527.4509	3376.2114	7491.1
31	451	320.75	780.28695	169.29039	2422.6392	3279.7465	7477.3
32	451	324.25	781.00005	124.79529	2312.6865	3195.6935	7465.9
33	451	328.35	782.0576	58.805518	2107.307	3014.3915	7442.8
34	451	331.1393	782.85945	8.7710103	1931.166	2847.6013	7423.4
35	451	333.1655	783.55385	0	1243.6198	558.01809	1.4394
36	451	336.3393	784.7362	0	971.24722	437.02567	-0.00010309
37	451	339.5131	786.0716	0	667.35454	300.2851	-2.0133e-005
38	451	342.93465	787.69955	0	255.44707	114.94182	-2.6302e-

							006

D-D'_seismic_(+)hor_(+)ver

File Information

Created By: Graf, Thomas [FWI]
Revision Number: 668
Last Edited By: Osman El Menchawi
Date: 8/2/2013
Time: 10:53:37 PM
File Name: profile_DD'_07_31_2013.gsz
Directory: C:\Users\Osman\Desktop\Comanche\Slope Stability\
Last Solved Date: 8/2/2013
Last Solved Time: 10:55:58 PM

Project Settings

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

Analysis Settings

D-D'_seismic_(+)hor_(+)ver

Kind: SLOPE/W
Method: Spencer
Settings
- Apply Phreatic Correction: No
- PWP Conditions Source: Piezometric Line
- Use Staged Rapid Drawdown: No

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: Yes
- Tension Crack
  - Tension Crack Option: (none)

FOS Distribution

FOS Calculation Option: Constant

Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 4 ft
Optimization Maximum Iterations: 4000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 24
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 5 °

Materials

Compacted Fill

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 200 psf
Phi: 32 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Limestone Layer C

Model: Shear/Normal Fn.
Unit Weight: 155 pcf
Strength Function: Unit C Limestone, Lower Bound
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Shale

Model: Shear/Normal Fn.
Unit Weight: 135 pcf
Strength Function: Shale-Fully Softened Lower Bound
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Limestone Layer A

Model: Shear/Normal Fn.
Unit Weight: 145 pcf
Strength Function: Unit A Limestone, Lower Bound
Phi-B: 0 °

Pore Water Pressure
Piezometric Line: 1

UHSRS

Model: Mohr-Coulomb
Unit Weight: 122.5 pcf
Cohesion: 5000 psf
Phi: 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Retaining Wall

Model: Mohr-Coulomb
Unit Weight: 155 pcf
Cohesion: 3.6e+005 psf
Phi: 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (182.29748, 819) ft
Left-Zone Right Coordinate: (302.19486, 816) ft
Left-Zone Increment: 60
Right Projection: Range
Right-Zone Left Coordinate: (306.52206, 800) ft
Right-Zone Right Coordinate: (390.49985, 768.9507) ft
Right-Zone Increment: 30
Radius Increments: 0

Slip Surface Limits

Left Coordinate: (0, 822) ft
Right Coordinate: (420, 758) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	0	804
	38	804
	182.29748	804
	196.1	803.5
	220.9	802.5
	230.1	801
	243.3	799.5
	255.4	794.6
	270.2	786.5
	281.2	783
	295.8	783
	311	783
	330.7	783
	360.1	783
	370.7	783
	380	775
	420	775

Seismic Loads

Horz Seismic Load: 0.1
Vert Seismic Load: 0.1
Ignore seismic load in strength: No

Shear/Normal Strength Functions

Shale-Fully Softened Lower Bound

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 100 %

Y-Intercept: 3.8193582e-007
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (1000, 449.95299)
Data Point: (2000, 892.95299)
Data Point: (3000, 1302.953)
Data Point: (4000, 1680.953)
Data Point: (5000, 2031.953)
Data Point: (6000, 2356.953)
Data Point: (7000, 2660.953)
Data Point: (8000, 2944.953)
Data Point: (9000, 3213.953)
Data Point: (10000, 3468.953)
Data Point: (11000, 3714.953)
Data Point: (12000, 3952.953)
Data Point: (13000, 4187.953)
Data Point: (14000, 4420.953)
Data Point: (15000, 4656.953)
Data Point: (16000, 4896.953)
Data Point: (17000, 5145.953)
Data Point: (18000, 5404.953)
Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Unit A Limestone, Lower Bound

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Y-Intercept: 6697.4707
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (-1710, 3833)
Data Point: (-299, 6231)
Data Point: (1063, 8237)
Data Point: (2388, 10014)
Data Point: (3684, 11635)
Data Point: (4956, 13137)
Data Point: (6207, 14546)
Data Point: (7440, 15878)
Data Point: (8656, 17146)
Data Point: (9857, 18358)
Data Point: (11045, 19522)

Data Point: (12220, 20643)
Data Point: (13383, 21726)
Data Point: (14536, 22775)
Data Point: (15679, 23793)
Data Point: (16813, 24783)
Data Point: (17938, 25747)
Data Point: (19054, 26689)
Data Point: (20163, 27603)
Data Point: (21264, 28500)
Data Point: (22358, 29377)
Data Point: (23445, 30236)
Data Point: (24526, 31078)
Data Point: (25600, 31904)
Data Point: (26669, 32715)
Data Point: (27732, 33512)
Data Point: (28789, 34295)
Data Point: (29841, 35065)
Data Point: (30888, 35823)
Data Point: (31931, 36569)
Data Point: (32968, 37304)
Data Point: (34001, 38028)
Data Point: (35029, 38742)
Data Point: (36053, 39447)
Data Point: (37073, 40141)
Data Point: (38089, 40827)
Data Point: (39101, 41504)
Data Point: (40109, 42173)

Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Unit C Limestone, Lower Bound

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Y-Intercept: 7248.7668
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (-1613, 4254)
Data Point: (-174, 6947)
Data Point: (1222, 9215)
Data Point: (2584, 11234)

Data Point: (3920, 13080)
Data Point: (5233, 14797)
Data Point: (6527, 16411)
Data Point: (7804, 17941)
Data Point: (9065, 19400)
Data Point: (10312, 20797)
Data Point: (11546, 22141)
Data Point: (12768, 23437)
Data Point: (13980, 24691)
Data Point: (15181, 25906)
Data Point: (16372, 27087)
Data Point: (17555, 28237)
Data Point: (18728, 29357)
Data Point: (19894, 30450)
Data Point: (21052, 31518)
Data Point: (22203, 32563)
Data Point: (23346, 33586)
Data Point: (24483, 34589)
Data Point: (25614, 35573)
Data Point: (26738, 36538)
Data Point: (27857, 37486)
Data Point: (28970, 38419)
Data Point: (30077, 39336)
Data Point: (31179, 40238)
Data Point: (32276, 41126)
Data Point: (33369, 42001)
Data Point: (34456, 42863)
Data Point: (35539, 43714)
Data Point: (36617, 44552)
Data Point: (37692, 45380)
Data Point: (38761, 46196)
Data Point: (39827, 47003)
Data Point: (40889, 47799)
Data Point: (41947, 48586)

Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Regions

	Material	Points	Area (ft²)

Region 1	Limestone Layer C	17,18,22,39,38,52,53,54,55,40,41,19,23,3,2,1,12,20,21	26805.55
Region 2	UHSRS	5,16,15,26,8,9,36,18,22,37,10,27,28,29,11,4	6240
Region 3	Limestone Layer A	29,34,30,35,28	130.27645
Region 4	Shale	28,35,33,32,27	592.85868
Region 5	Limestone Layer A	27,32,31,10	239.19051
Region 6	Limestone Layer A	6,5,16,14	55.7437
Region 7	Shale	14,16,15,13	55.7437
Region 8	Limestone Layer A	13,15,26,25	178.37984
Region 9	Shale	25,26,8,24	156.08236
Region 10	Limestone Layer A	24,8,9,7	66.89244
Region 11	Shale	7,9,36,18,17	356.75968
Region 12	Shale	10,31,39,22,37	1605.2117
Region 13	Compacted Fill	55,47,48,49,57,41,40	234
Region 14	Shale	41,57,50,51,19	254.32
Region 15	Retaining Wall	54,55,47,46,45,44,56,58,52,53	98
Region 16	Compacted Fill	11,59,60,61,42,43,44,56,58,52,38,39,31,32,33,35,30,34,29	1520.1929

Points

	X (ft)	Y (ft)
Point 1	415	757
Point 2	405	760
Point 3	380.7	775
Point 4	182.29748	822
Point 5	22.29748	822

Point 6	0	822
Point 7	0	799
Point 8	22.29748	802
Point 9	22.29748	799
Point 10	182.29748	799
Point 11	182.29748	819
Point 12	420	758
Point 13	0	817
Point 14	0	819.5
Point 15	22.29748	817
Point 16	22.29748	819.5
Point 17	0	783
Point 18	22.29748	783
Point 19	370.7	783
Point 20	420	717.2
Point 21	0	717.2
Point 22	182.29748	783
Point 23	376.7	778
Point 24	0	802
Point 25	0	809
Point 26	22.29748	809
Point 27	182.29748	802
Point 28	182.29748	809
Point 29	182.29748	812
Point 30	224	812
Point 31	273	799.4868
Point 32	270	801.8441
Point 33	263	808.9258
Point 34	188.21156	812
Point 35	227.01361	808.9689
Point 36	22.29748	787
Point 37	182.29748	787
Point 38	295.8	783
Point 39	289	783
Point 40	316	782

Point 41	317	783
Point 42	252.1	816
Point 43	301.6	816
Point 44	304.2	816
Point 45	304.2	817
Point 46	306.2	817
Point 47	306.2	800
Point 48	308.8	800
Point 49	319	795
Point 50	341.1	790
Point 51	354.4	785
Point 52	296.2	783
Point 53	296.2	780
Point 54	306.2	780
Point 55	306.2	782
Point 56	304.2	800
Point 57	326	793.4
Point 58	304.2	783
Point 59	195.55262	818
Point 60	205.55262	817
Point 61	239.17114	816
Point 62		

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	6.02	(306.042, 860.44)	67.98296	(224.364, 816.44)	(370.625, 783.009)
2	882	7.84	(306.042, 860.44)	81.09	(238.195, 816.029)	(344.14, 788.857)

Slices of Slip Surface: Optimized

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)

1	Optimized	227.23215	814.33495	-802.92579	195.95313	122.44511	200
2	Optimized	231.50185	811.20035	-646.4436	501.53719	313.39522	200
3	Optimized	233.6014	809.5657	-559.30173	627.55018	392.13688	200
4	Optimized	236.56375	806.99485	-419.90799	905.03163	407.23108	-2.7481e-005
5	Optimized	238.99975	804.85235	-303.50371	1066.5536	479.79812	0.10539
6	Optimized	240.51665	803.28465	-216.4291	1223.3747	549.13923	1.2343
7	Optimized	242.5811	801.15115	-97.937082	858.70266	1207.0623	6744.6
8	Optimized	243.8043	799.88705	-36.894749	985.6802	1374.5522	6754.9
9	Optimized	244.82825	799.0183	-8.5588475	1883.8741	816.86521	25.98
10	Optimized	246.9384	797.6068	26.194947	2044.1204	864.25868	36.375
11	Optimized	250.31445	795.47035	74.198774	2342.1224	948.55346	57.882
12	Optimized	252.62	794.08545	102.36179	2502.9922	991.92019	69.718
13	Optimized	254.27	793.21685	114.86491	2707.8902	1053.2874	87.171
14	Optimized	257.04365	791.85145	115.37745	2872.4958	1104.2761	102.34
15	Optimized	260.84365	790.1985	88.743955	3190.1873	1208.1423	134.5
16	Optimized	264.1888	788.88955	56.182394	3342.6644	1261.8913	152.29
17	Optimized	266.84175	787.98055	22.305043	3551.1069	1330.1865	176.17
18	Optimized	269.15295	787.2799	-12.904702	3619.4737	1355.2102	185.25
19	Optimize	270.1	786.99275	-27.332113	3646.8975	1362.7211	188.01

	d						
20	Optimized	270.71595	786.806	-29.3394	3661.7678	1366.7484	189.51
21	Optimized	272.11595	786.44745	-34.760809	3798.95	1403.7669	203.43
22	Optimized	274.94445	785.80065	-50.560097	3851.792	1417.8705	208.81
23	Optimized	279.04445	784.94665	-78.673872	3986.6777	1453.3964	222.68
24	Optimized	282.49365	784.29165	-80.599105	4039.8279	1467.2638	228.18
25	Optimized	285.6519	783.523	-32.635003	3962.9324	1447.1694	220.25
26	Optimized	288.25825	782.79195	12.982107	4191.049	5546.4958	7877.7
27	Optimized	289.3139	782.49585	31.458303	4228.2303	5567.2826	7881.7
28	Optimized	292.7139	781.26225	108.43638	4105.0015	5342.7077	7839.7
29	Optimized	295.917	780.07325	182.62817	4277.5064	5453.4692	7860.1
30	Optimized	296.117	780.0239	185.71212	5465.0346	6723.781	8132.2
31	Optimized	298.9	779.8257	198.07229	5498.1085	6745.0709	8137.3
32	Optimized	302.85905	779.5437	215.67448	5545.2587	6775.3696	8144.6
33	Optimized	304.15905	779.44775	221.6596	5194.713	6406.1412	8057.6
34	Optimized	305.1877	779.29025	231.49045	6423.5071	7640.776	8359
35	Optimized	306.1877	779.1417	240.75573	8797.2183	9867.406	8950.2
36	Optimized	307.5	779.43245	222.61258	4510.9812	5668.5944	7901.7
37	Optimized	309.8903	779.9621	189.56565	4315.5511	5488.1116	7867

38	Optimized	310.9903	780.20625	174.33041	4387.8938	5585.703	7885.7
39	Optimized	313.5	780.8712	132.83426	4037.2846	5237.8404	7821.2
40	Optimized	316.5	781.6661	83.23385	3638.4481	4838.9526	7748.4
41	Optimized	318	782.06355	58.433631	3465.3221	4668.0729	7716.8
42	Optimized	319.54325	782.47245	32.918127	3298.5747	4504.2069	7686.4
43	Optimized	321.19125	782.8082	11.968128	2832.2638	3978.6802	7590.8
44	Optimized	322.9204	783.1084	-6.7641944	1711.128	751.88081	15.548
45	Optimized	324.7724	783.32115	-20.040608	1571.0739	696.23694	9.3903
46	Optimized	327.27665	783.53405	-33.325776	1470.5268	654.8745	6.0657
47	Optimized	329.62665	783.65315	-40.756227	1323.9462	592.81219	2.6609
48	Optimized	332.60485	783.6824	-42.581125	1220.2145	547.79748	1.1596
49	Optimized	336.44485	783.61595	-38.435378	1075.442	483.7741	0.12446
50	Optimized	339.74	783.3921	-24.466552	975.23865	438.82167	-2.9595e-005
51	Optimized	342.32405	783.12855	-8.0209688	904.34005	406.9199	-2.7415e-005
52	Optimized	346.24615	783.011	-0.68640187	746.90842	336.08143	-2.2577e-005
53	Optimized	351.64225	783.0256	-1.597447	444.96869	200.21961	-1.3296e-005
54	Optimized	354.37015	783.03285	-2.0502324	291.79475	131.29695	-8.5875e-006
55	Optimized	357.25	783.02865	-1.7884192	239.19273	107.62797	1.1157e-005
56	Optimize	362.7313	783.02065	-1.2900589	141.16521	63.519175	-1.2825e-

	d						006
57	Optimized	367.9939	783.013	-0.81159071	47.054437	21.172773	-4.151e-006

Slices of Slip Surface: 882

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	882	238.68325	815.301	-953.24871	40.966074	25.598444	200
2	882	241.23555	811.82125	-754.19933	344.57128	215.31203	200
3	882	244.98745	807.13665	-519.16229	830.70644	373.78747	-8.786e-005
4	882	248.313	803.54175	-378.89176	1233.0694	553.46509	1.2809
5	882	251.02555	800.88715	-281.7793	1132.8052	1567.4994	6766.2
6	882	252.39285	799.6362	-238.26983	1313.7358	1800.8551	6782.1
7	882	254.04285	798.24315	-193.03852	1898.1909	822.28603	26.763
8	882	257.3	795.6785	-132.18829	2234.8523	937.83939	54.741
9	882	261.1	792.9827	-93.742896	2607.4734	1057.9901	88.334
10	882	264.75	790.681	-74.769011	2927.5719	1156.3307	118.09
11	882	268.25	788.72295	-72.116873	3196.2352	1235.953	143.48
12	882	270.1	787.75135	-74.665899	3332.782	1275.1991	156.72
13	882	271.6	787.0449	-61.798207	3427.1267	1301.9117	166
14	882	275.05	785.53965	-36.370414	3642.4503	1361.4941	187.53
15	882	279.15	783.9705	-19.858546	3884.5973	1426.5599	212.18
16	882	281.59465	783.1248	-7.7873639	4020.0912	1462.1606	226.13
17	882	283.742	782.49855	31.292007	4220.5399	5558.3105	7880.8
18	882	287.24735	781.5794	88.64705	4468.9835	5769.6255	7922.2
19	882	290.7	780.83405	135.15691	4712.3984	5983.969	7966.2
20	882	294.1	780.2532	171.39787	4952.4378	6202.4825	8013
21	882	296	779.97505	188.75573	5082.5719	6322.0467	8039.5
22	882	297.55	779.80795	199.18355	5180.2383	6413.9058	8060.2
23	882	300.25	779.5691	214.08865	5345.5667	6570.5921	8096.5
24	882	302.9	779.42195	223.27058	5497.7892	6718.3868	8131.6
25	882	305.2	779.36115	227.06274	6906.1271	8116.1967	8480
26	882	307.5	779.37415	226.25191	3417.6402	4417.3269	7670.7
27	882	309.9	779.4499	221.52614	3414.5382	4419.2495	7671.1

28	882	313.5	779.7333	203.8316	3237.009	4231.5462	7636.6
29	882	316.5	780.02935	185.36882	3090.2737	4079.601	7609.1
30	882	318	780.2435	172.0035	3026.4427	4019.4082	7598.3
31	882	320.75	780.71545	142.55445	2943.192	3954.8968	7586.8
32	882	324.25	781.44165	97.241994	2865.1684	3915.6552	7579.9
33	882	328.0475	782.4225	36.037345	2705.68	3796.9675	7559.1
34	882	330.3975	783.09525	-5.9441436	1571.9882	696.57648	9.4317
35	882	332.43335	783.7873	-49.127477	1397.5093	624.19964	4.173
36	882	335.9	785.07075	-129.21384	1071.1278	481.83341	0.11106
37	882	339.36665	786.539	-220.83325	695.16759	312.79995	-7.3692e-005
38	882	342.6198	788.08895	-317.56275	248.76532	111.93528	-2.5522e-006

E-E'_static

File Information

Created By: Graf, Thomas [FWI]
Revision Number: 544
Last Edited By: Osman El Menchawi
Date: 8/2/2013
Time: 11:23:39 PM
File Name: profile_EE'_07-31-2013.gsz
Directory: C:\Users\Osman\Desktop\Comanche\Slope Stability\
Last Solved Date: 8/2/2013
Last Solved Time: 11:28:16 PM

Project Settings

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

Analysis Settings

E-E'_static

Kind: SLOPE/W
Method: Spencer
Settings
- Apply Phreatic Correction: No
- PWP Conditions Source: Piezometric Line
- Use Staged Rapid Drawdown: No

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: Yes
- Tension Crack
  - Tension Crack Option: (none)

FOS Distribution

FOS Calculation Option: Constant

Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 4 ft
Optimization Maximum Iterations: 4000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 24
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 5 °

Materials

Compacted Fill

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 200 psf
Phi: 32 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Limestone Layer C

Model: Shear/Normal Fn.
Unit Weight: 155 pcf
Strength Function: Unit C Limestone, Lower Bound
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Shale

Model: Shear/Normal Fn.
Unit Weight: 135 pcf
Strength Function: Shale-Fully Softened Lower Bound
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Limestone Layer A

Model: Shear/Normal Fn.
Unit Weight: 145 pcf
Strength Function: Unit A Limestone, Lower Bound
Phi-B: 0 °

Pore Water Pressure
Piezometric Line: 1

UHSRS

Model: Mohr-Coulomb
Unit Weight: 122.5 pcf
Cohesion: 5000 psf
Phi: 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Retaining Wall

Model: Mohr-Coulomb
Unit Weight: 155 pcf
Cohesion: 3.6e+005 psf
Phi: 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (220, 822) ft
Left-Zone Right Coordinate: (323.74163, 815.9414) ft
Left-Zone Increment: 60
Right Projection: Range
Right-Zone Left Coordinate: (328.1467, 779.9841) ft
Right-Zone Right Coordinate: (392.35613, 766.4625) ft
Right-Zone Increment: 30
Radius Increments: 0

Slip Surface Limits

Left Coordinate: (0, 822) ft
Right Coordinate: (420, 761.7) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	0	804
	35	804
	235.81614	804
	243.1	803
	253.8	801
	266.4	796.7
	275.3	794.3
	287.3	790.9
	297.2	790
	306	789.8
	309	785
	312	780
	328	780
	342.8	775
	420	775

Maximum Suction: 0 psf

Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

Reinforcements

Reinforcement 1

Type: Pile
Outside Point: (305, 795) ft
Inside Point: (305, 778) ft
Slip Surface Intersection: (305, 778) ft
Total Length: 17 ft
Reinforcement Direction: 90 °
Applied Load Option: Variable

F of S Dependent: No
Pile Spacing: 1 ft
Shear Capacity: 1e+008 lbs
Shear Safety Factor: 1
Shear Load Used: 1e+008 lbs
Shear Option: Parallel to Slip
Resisting Force Used: 0 lbs/ft

Shear/Normal Strength Functions

Shale-Fully Softened Lower Bound

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Y-Intercept: 3.8193582e-007
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (1000, 449.95299)
Data Point: (2000, 892.95299)
Data Point: (3000, 1302.953)
Data Point: (4000, 1680.953)
Data Point: (5000, 2031.953)
Data Point: (6000, 2356.953)
Data Point: (7000, 2660.953)
Data Point: (8000, 2944.953)
Data Point: (9000, 3213.953)
Data Point: (10000, 3468.953)
Data Point: (11000, 3714.953)
Data Point: (12000, 3952.953)
Data Point: (13000, 4187.953)
Data Point: (14000, 4420.953)
Data Point: (15000, 4656.953)
Data Point: (16000, 4896.953)
Data Point: (17000, 5145.953)
Data Point: (18000, 5404.953)
Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Unit A Limestone, Lower Bound

Model: Spline Data Point Function

Function: Shear Stress vs. Normal Stress
- Curve Fit to Data: 100 %
- Segment Curvature: 100 %

Y-Intercept: 6697.4707

Data Points: Normal Stress (psf), Shear Stress (psf)
- Data Point: (-1710, 3833)
- Data Point: (-299, 6231)
- Data Point: (1063, 8237)
- Data Point: (2388, 10014)
- Data Point: (3684, 11635)
- Data Point: (4956, 13137)
- Data Point: (6207, 14546)
- Data Point: (7440, 15878)
- Data Point: (8656, 17146)
- Data Point: (9857, 18358)
- Data Point: (11045, 19522)
- Data Point: (12220, 20643)
- Data Point: (13383, 21726)
- Data Point: (14536, 22775)
- Data Point: (15679, 23793)
- Data Point: (16813, 24783)
- Data Point: (17938, 25747)
- Data Point: (19054, 26689)
- Data Point: (20163, 27603)
- Data Point: (21264, 28500)
- Data Point: (22358, 29377)
- Data Point: (23445, 30236)
- Data Point: (24526, 31078)
- Data Point: (25600, 31904)
- Data Point: (26669, 32715)
- Data Point: (27732, 33512)
- Data Point: (28789, 34295)
- Data Point: (29841, 35065)
- Data Point: (30888, 35823)
- Data Point: (31931, 36569)
- Data Point: (32968, 37304)
- Data Point: (34001, 38028)
- Data Point: (35029, 38742)
- Data Point: (36053, 39447)
- Data Point: (37073, 40141)
- Data Point: (38089, 40827)
- Data Point: (39101, 41504)
- Data Point: (40109, 42173)

Estimation Properties
- Intact Rock Param.: 10
- Geological Strength: 100

Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Unit C Limestone, Lower Bound

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Y-Intercept: 7248.7668
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (-1613, 4254)
Data Point: (-174, 6947)
Data Point: (1222, 9215)
Data Point: (2584, 11234)
Data Point: (3920, 13080)
Data Point: (5233, 14797)
Data Point: (6527, 16411)
Data Point: (7804, 17941)
Data Point: (9065, 19400)
Data Point: (10312, 20797)
Data Point: (11546, 22141)
Data Point: (12768, 23437)
Data Point: (13980, 24691)
Data Point: (15181, 25906)
Data Point: (16372, 27087)
Data Point: (17555, 28237)
Data Point: (18728, 29357)
Data Point: (19894, 30450)
Data Point: (21052, 31518)
Data Point: (22203, 32563)
Data Point: (23346, 33586)
Data Point: (24483, 34589)
Data Point: (25614, 35573)
Data Point: (26738, 36538)
Data Point: (27857, 37486)
Data Point: (28970, 38419)
Data Point: (30077, 39336)
Data Point: (31179, 40238)
Data Point: (32276, 41126)
Data Point: (33369, 42001)
Data Point: (34456, 42863)
Data Point: (35539, 43714)
Data Point: (36617, 44552)
Data Point: (37692, 45380)

Data Point: (38761, 46196)
Data Point: (39827, 47003)
Data Point: (40889, 47799)
Data Point: (41947, 48586)
Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Regions

	Material	Points	Area (ft²)
Region 1	Limestone Layer A	15,26,27,14	31.5
Region 2	UHSRS	26,27,16,17,18,19,20,21,22,32,24,23,28,25,3,47,40	8807.4617
Region 3	Shale	14,27,16,13	42
Region 4	Limestone Layer A	13,16,17,12	252
Region 5	Shale	12,17,18,11	52.5
Region 6	Limestone Layer A	11,18,19,10	73.5
Region 7	Shale	10,19,20,9	42
Region 8	Limestone Layer A	9,20,21,8	31.5
Region 9	Shale	8,21,22,6	178.5
Region 10	Limestone Layer A	6,22,32,24,5	52.5
Region 11	Shale	5,24,23,4	105
Region 12	Limestone Layer C	4,23,28,38,35,33,39,34,41,2,1,30,7	25727.67
Region 13	Retaining Wall	31,41,34,39,33,43,42,29	99.9
Region 14	Compacted Fill	47,48,49,50,51,42,43,33,35,38,44,45,37,46,36,3	2581.3742
Region 15	Limestone Layer A	25,3,36,46	124.91831
Region 16	Shale	28,25,46,37,45,44,38	430.10316

Points

	X (ft)	Y (ft)
Point 1	420	761.7
Point 2	342.8	775
Point 3	235.81614	788.9187

Point 4	0	781
Point 5	0	786
Point 6	0	788.5
Point 7	0	717.2
Point 8	0	797
Point 9	0	798.5
Point 10	0	800.5
Point 11	0	804
Point 12	0	806.5
Point 13	0	818.5
Point 14	0	820.5
Point 15	0	822
Point 16	21	818.5
Point 17	21	806.5
Point 18	21	804
Point 19	21	800.5
Point 20	21	798.5
Point 21	21	797
Point 22	21	788.5
Point 23	21	781
Point 24	21	786
Point 25	235.81614	787
Point 26	21	822
Point 27	21	820.5
Point 28	235.81614	781
Point 29	326	817
Point 30	420	717.2
Point 31	328.1	817
Point 32	21	787
Point 33	317	780
Point 34	328.1	778
Point 35	310	780
Point 36	303	788.8
Point 37	305	787
Point 38	310	781

Point 39	317	778
Point 40	235.81614	822
Point 41	328.1	780
Point 42	326	816
Point 43	326	780
Point 44	310	784
Point 45	305	784
Point 46	303	787
Point 47	235.81614	819
Point 48	239.87277	818
Point 49	247.98603	816
Point 50	256.86359	815
Point 51	287.43806	815

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	6.35	(329.673, 854.615)	55.64977	(250.441, 815.723)	(342.756, 775.015)
2	752	7.40	(329.673, 854.615)	80.627	(259.449, 815)	(342.674, 775.043)

Slices of Slip Surface: Optimized

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimized	250.971	813.95685	0	39.075876	24.417317	200
2	Optimized	252.6503	810.8472	0	363.80595	227.33119	200
3	Optimized	254.0615	809.19865	0	486.18335	303.80108	200
4	Optimized	255.5933	807.7897	0	655.83153	409.80902	200
5	Optimized	257.4369	806.1882	0	788.12272	492.47373	200

6	Optimized	259.2631	804.78755	0	968.39537	605.12059	200
7	Optimized	261.7689	802.98225	0	1141.041	713.00152	200
8	Optimized	264.7109	800.96445	0	1365.5693	853.30241	200
9	Optimized	266.6403	799.69065	0	1490.1269	931.13462	200
10	Optimized	268.3908	798.60875	0	1626.8543	1016.5714	200
11	Optimized	271.4112	796.7622	0	1810.8015	1131.5144	200
12	Optimized	274.1107	795.1864	0	2017.5686	1260.7168	200
13	Optimized	275.7409	794.29205	0	2108.7943	1317.7209	200
14	Optimized	277.46485	793.34625	21.240577	2205.6103	1364.9457	200
15	Optimized	279.90235	791.91545	67.427475	2278.5773	1381.6798	200
16	Optimized	282.21125	790.46175	117.31728	2423.3501	1440.9693	200
17	Optimized	283.96125	789.28375	159.88441	2421.7894	1413.3951	200
18	Optimized	285.7574	787.92305	213.0342	2203.4713	2631.6387	6862.4
19	Optimized	286.96885	787.00675	248.79486	2555.3448	2997.0633	6911.4
20	Optimized	287.10245	786.92375	251.61224	2834.8165	1050.2437	86.237
21	Optimized	287.2626	786.829	254.68672	2979.1936	1094.3058	99.269
22	Optimized	287.36905	786.7764	256.91843	2985.1735	1095.4242	99.615
23	Optimized	289.24465	785.84965	304.11028	3094.9474	1114.6735	105.44
24	Optimize	292.85775	784.06435	395.02575	3307.1	1151.561	116.72

	d						
25	Optimized	295.93215	782.62485	467.41781	3560.494	1205.6913	133.7
26	Optimized	298.1897	781.6511	519.56559	3679.4985	1225.2765	140.06
27	Optimized	299.39235	781.1121	551.48701	3616.4002	1197.3637	131.04
28	Optimized	300.0088	780.7876	570.87519	3458.7598	4059.5956	7605.1
29	Optimized	301.70615	779.81025	629.45009	3423.6869	3947.6108	7585.1
30	Optimized	303.79915	778.5728	703.70877	3554.1979	4015.0334	7597.1
31	Optimized	304.79915	778.0496	734.93136	4640.9604	5239.7673	7821.4
32	Optimized	305.5	777.87275	744.97112	4640.3618	5227.7811	7819.3
33	Optimized	307.3471	777.4067	638.83242	4716.297	5433.8326	7856.7
34	Optimized	308.8471	777.02525	512.89027	4708.2266	5565.5802	7881.6
35	Optimized	309.3	776.90215	474.10378	4728.0103	5630.594	7894.2
36	Optimized	309.8	776.76625	430.58235	4749.9641	5702.9665	7908.4
37	Optimized	311	776.44015	326.13573	4746.8761	5814.2005	7930.6
38	Optimized	313.6391	775.72295	266.88945	4858.9045	6000.4612	7969
39	Optimized	316.1391	775.01945	310.78444	4861.9317	5956.3153	7959.7
40	Optimized	317.511	774.60825	336.44217	4923.7131	5995.3459	7967.9
41	Optimized	319.35225	774.02775	372.67525	4930.5931	5963.4502	7961.3
42	Optimized	322.01275	773.17305	425.99637	5057.2755	6042.8036	7977.9

43	Optimized	324.6715	772.21485	485.79708	4913.5404	5821.9344	7932.2
44	Optimized	327	771.28445	543.84239	6111.2042	7017.4667	8203.6
45	Optimized	328.04115	770.86845	568.93789	6166.8322	7048.1163	8211.2
46	Optimized	328.09115	770.8542	568.79085	10050.612	10673.627	9197.9
47	Optimized	329.907	771.3012	502.61585	2513.2404	2964.6619	7436.8
48	Optimized	333.47765	772.2149	370.32176	2167.3522	2679.2101	7405.5
49	Optimized	336.9455	773.1876	236.5126	1837.129	2410.2164	7380.2
50	Optimized	340.7028	774.35315	84.575064	1423.739	2042.7199	7351.5
51	Optimized	342.756	775.0149	0	1146.2565	1765.0802	7333.5

Slices of Slip Surface: 752

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	752	260.60775	813.07395	0	117.97285	73.717615	200
2	752	262.92465	809.43635	0	402.17753	251.30841	200
3	752	265.24155	806.1836	0	679.01143	424.29343	200
4	752	267.88335	802.8711	0	982.32482	613.82467	200
5	752	270.85	799.5162	0	1311.3115	819.39834	200
6	752	273.81665	796.5067	0	1625.6049	1015.7907	200
7	752	275.93935	794.50925	0	1844.4472	1152.5386	200
8	752	278.19635	792.59505	55.183115	2064.7646	1255.7259	200
9	752	281.43165	790.0438	157.17852	2371.7794	1383.8362	200
10	752	284.4012	787.9176	237.35155	2395.059	2826.7626	6887.5
11	752	286.52655	786.51	287.61307	2875.9123	1051.7888	86.725
12	752	287.36905	785.97745	306.7765	2950.9171	1069.3223	91.861
13	752	288.996	785.02425	357.01837	3092.7738	1097.7704	100.33
14	752	292.1118	783.29315	447.36593	3359.078	1151.4765	116.7

15	752	295.2276	781.73635	526.85305	3611.1066	1203.0584	132.86
16	752	296.99275	780.9081	568.51051	3671.488	4314.1176	7651.2
17	752	298.65	780.2116	608.75336	3837.0526	4460.8678	7678.2
18	752	301.55	779.06725	676.02373	4121.9383	4713.2488	7724.9
19	752	304	778.19155	727.21292	4322.8478	4885.5643	7756.8
20	752	305.5	777.69845	755.84108	4434.2664	4980.3717	7774.2
21	752	307.5	777.11215	641.94475	4612.9263	5313.7257	7834.6
22	752	309.3	776.6047	492.65953	4775.6578	5662.9334	7900.4
23	752	309.8	776.4755	448.73927	4819.8101	5759.9256	7919.6
24	752	311	776.1865	341.96099	4867.4381	5928.5084	7953.9
25	752	313.25	775.6883	269.04908	5056.492	6210.1166	8013.8
26	752	315.75	775.20905	298.95514	5256.9992	6390.2597	8054.1
27	752	318.5	774.77995	325.73208	5468.3719	6582.9893	8098.5
28	752	321.5	774.41715	348.36227	5689.1985	6786.9922	8147.3
29	752	324.5	774.16785	363.91506	5899.4823	6985.1494	8195.6
30	752	327	774.0382	372.01539	7357.4534	8411.6107	8555.1
31	752	328.05	774.004	373.09426	7432.7911	8482.6396	8573.5
32	752	329.55735	774.0009	341.5128	1300.5633	1493.76	7315
33	752	332.4721	774.04945	277.03821	1195.2712	1434.201	7310.9
34	752	335.38685	774.20365	205.96951	1068.3133	1352.4102	7305.2
35	752	338.30155	774.4641	128.27235	918.27772	1245.9064	7298
36	752	341.2163	774.83185	43.879918	743.57836	1111.7907	7289.1
37	752	342.67395	775.04275	0	648.72936	1035.4073	7284.3

E-E'_seismic_(+)hor_(+)ver

File Information

Created By: Graf, Thomas [FWI]
Revision Number: 544
Last Edited By: Osman El Menchawi
Date: 8/2/2013
Time: 11:23:39 PM
File Name: profile_EE'_07-31-2013.gsz
Directory: C:\Users\Osman\Desktop\Comanche\Slope Stability\
Last Solved Date: 8/2/2013
Last Solved Time: 11:26:58 PM

Project Settings

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

Analysis Settings

E-E'_seismic_(+)hor_(+)ver

Kind: SLOPE/W
Method: Spencer
Settings
- Apply Phreatic Correction: No
- PWP Conditions Source: Piezometric Line
- Use Staged Rapid Drawdown: No

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: Yes
- Tension Crack
  - Tension Crack Option: (none)

FOS Distribution

FOS Calculation Option: Constant

Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 4 ft
Optimization Maximum Iterations: 4000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 24
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 5 °

Materials

Compacted Fill

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 200 psf
Phi: 32 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Limestone Layer C

Model: Shear/Normal Fn.
Unit Weight: 155 pcf
Strength Function: Unit C Limestone, Lower Bound
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Shale

Model: Shear/Normal Fn.
Unit Weight: 135 pcf
Strength Function: Shale-Fully Softened Lower Bound
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Limestone Layer A

Model: Shear/Normal Fn.
Unit Weight: 145 pcf
Strength Function: Unit A Limestone, Lower Bound
Phi-B: 0 °

Pore Water Pressure
Piezometric Line: 1

UHSRS

Model: Mohr-Coulomb
Unit Weight: 122.5 pcf
Cohesion: 5000 psf
Phi: 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Retaining Wall

Model: Mohr-Coulomb
Unit Weight: 155 pcf
Cohesion: 3.6e+005 psf
Phi: 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (225.63439, 822) ft
Left-Zone Right Coordinate: (323.73816, 815.9413) ft
Left-Zone Increment: 60
Right Projection: Range
Right-Zone Left Coordinate: (328.1467, 779.9841) ft
Right-Zone Right Coordinate: (392.35613, 766.4625) ft
Right-Zone Increment: 30
Radius Increments: 0

Slip Surface Limits

Left Coordinate: (0, 822) ft
Right Coordinate: (420, 761.7) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	0	804
	35	804
	235.81614	804
	243.1	803
	253.8	801
	266.4	796.7
	275.3	794.3
	287.3	790.9
	297.2	790
	306	789.8
	309	785
	312	780
	328	780
	342.8	775
	420	775

Seismic Loads

Horz Seismic Load: 0.1
Vert Seismic Load: 0.1
Ignore seismic load in strength: No

Reinforcements

Reinforcement 1

Type: Pile
Outside Point: (305, 795) ft
Inside Point: (305, 778) ft
Slip Surface Intersection: (305, 778) ft
Total Length: 17 ft
Reinforcement Direction: 90 °
Applied Load Option: Variable

F of S Dependent: No
Pile Spacing: 1 ft
Shear Capacity: 1e+008 lbs
Shear Safety Factor: 1
Shear Load Used: 1e+008 lbs
Shear Option: Parallel to Slip
Resisting Force Used: 0 lbs/ft

Shear/Normal Strength Functions

Shale-Fully Softened Lower Bound

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Y-Intercept: 3.8193582e-007
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (1000, 449.95299)
Data Point: (2000, 892.95299)
Data Point: (3000, 1302.953)
Data Point: (4000, 1680.953)
Data Point: (5000, 2031.953)
Data Point: (6000, 2356.953)
Data Point: (7000, 2660.953)
Data Point: (8000, 2944.953)
Data Point: (9000, 3213.953)
Data Point: (10000, 3468.953)
Data Point: (11000, 3714.953)
Data Point: (12000, 3952.953)
Data Point: (13000, 4187.953)
Data Point: (14000, 4420.953)
Data Point: (15000, 4656.953)
Data Point: (16000, 4896.953)
Data Point: (17000, 5145.953)
Data Point: (18000, 5404.953)
Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Unit A Limestone, Lower Bound

Model: Spline Data Point Function

Function: Shear Stress vs. Normal Stress
- Curve Fit to Data: 100 %
- Segment Curvature: 100 %

Y-Intercept: 6697.4707

Data Points: Normal Stress (psf), Shear Stress (psf)
- Data Point: (-1710, 3833)
- Data Point: (-299, 6231)
- Data Point: (1063, 8237)
- Data Point: (2388, 10014)
- Data Point: (3684, 11635)
- Data Point: (4956, 13137)
- Data Point: (6207, 14546)
- Data Point: (7440, 15878)
- Data Point: (8656, 17146)
- Data Point: (9857, 18358)
- Data Point: (11045, 19522)
- Data Point: (12220, 20643)
- Data Point: (13383, 21726)
- Data Point: (14536, 22775)
- Data Point: (15679, 23793)
- Data Point: (16813, 24783)
- Data Point: (17938, 25747)
- Data Point: (19054, 26689)
- Data Point: (20163, 27603)
- Data Point: (21264, 28500)
- Data Point: (22358, 29377)
- Data Point: (23445, 30236)
- Data Point: (24526, 31078)
- Data Point: (25600, 31904)
- Data Point: (26669, 32715)
- Data Point: (27732, 33512)
- Data Point: (28789, 34295)
- Data Point: (29841, 35065)
- Data Point: (30888, 35823)
- Data Point: (31931, 36569)
- Data Point: (32968, 37304)
- Data Point: (34001, 38028)
- Data Point: (35029, 38742)
- Data Point: (36053, 39447)
- Data Point: (37073, 40141)
- Data Point: (38089, 40827)
- Data Point: (39101, 41504)
- Data Point: (40109, 42173)

Estimation Properties
- Intact Rock Param.: 10
- Geological Strength: 100

Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Unit C Limestone, Lower Bound

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Y-Intercept: 7248.7668
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (-1613, 4254)
Data Point: (-174, 6947)
Data Point: (1222, 9215)
Data Point: (2584, 11234)
Data Point: (3920, 13080)
Data Point: (5233, 14797)
Data Point: (6527, 16411)
Data Point: (7804, 17941)
Data Point: (9065, 19400)
Data Point: (10312, 20797)
Data Point: (11546, 22141)
Data Point: (12768, 23437)
Data Point: (13980, 24691)
Data Point: (15181, 25906)
Data Point: (16372, 27087)
Data Point: (17555, 28237)
Data Point: (18728, 29357)
Data Point: (19894, 30450)
Data Point: (21052, 31518)
Data Point: (22203, 32563)
Data Point: (23346, 33586)
Data Point: (24483, 34589)
Data Point: (25614, 35573)
Data Point: (26738, 36538)
Data Point: (27857, 37486)
Data Point: (28970, 38419)
Data Point: (30077, 39336)
Data Point: (31179, 40238)
Data Point: (32276, 41126)
Data Point: (33369, 42001)
Data Point: (34456, 42863)
Data Point: (35539, 43714)
Data Point: (36617, 44552)
Data Point: (37692, 45380)

Data Point: (38761, 46196)
Data Point: (39827, 47003)
Data Point: (40889, 47799)
Data Point: (41947, 48586)
Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Regions

	Material	Points	Area (ft²)
Region 1	Limestone Layer A	15,26,27,14	31.5
Region 2	UHSRS	26,27,16,17,18,19,20,21,22,32,24,23,28,25,3,47,40	8807.4617
Region 3	Shale	14,27,16,13	42
Region 4	Limestone Layer A	13,16,17,12	252
Region 5	Shale	12,17,18,11	52.5
Region 6	Limestone Layer A	11,18,19,10	73.5
Region 7	Shale	10,19,20,9	42
Region 8	Limestone Layer A	9,20,21,8	31.5
Region 9	Shale	8,21,22,6	178.5
Region 10	Limestone Layer A	6,22,32,24,5	52.5
Region 11	Shale	5,24,23,4	105
Region 12	Limestone Layer C	4,23,28,38,35,33,39,34,41,2,1,30,7	25727.67
Region 13	Retaining Wall	31,41,34,39,33,43,42,29	99.9
Region 14	Compacted Fill	47,48,49,50,51,42,43,33,35,38,44,45,37,46,36,3	2581.3742
Region 15	Limestone Layer A	25,3,36,46	124.91831
Region 16	Shale	28,25,46,37,45,44,38	430.10316

Points

	X (ft)	Y (ft)
Point 1	420	761.7
Point 2	342.8	775
Point 3	235.81614	788.9187

Point 4	0	781
Point 5	0	786
Point 6	0	788.5
Point 7	0	717.2
Point 8	0	797
Point 9	0	798.5
Point 10	0	800.5
Point 11	0	804
Point 12	0	806.5
Point 13	0	818.5
Point 14	0	820.5
Point 15	0	822
Point 16	21	818.5
Point 17	21	806.5
Point 18	21	804
Point 19	21	800.5
Point 20	21	798.5
Point 21	21	797
Point 22	21	788.5
Point 23	21	781
Point 24	21	786
Point 25	235.81614	787
Point 26	21	822
Point 27	21	820.5
Point 28	235.81614	781
Point 29	326	817
Point 30	420	717.2
Point 31	328.1	817
Point 32	21	787
Point 33	317	780
Point 34	328.1	778
Point 35	310	780
Point 36	303	788.8
Point 37	305	787
Point 38	310	781

Point 39	317	778
Point 40	235.81614	822
Point 41	328.1	780
Point 42	326	816
Point 43	326	780
Point 44	310	784
Point 45	305	784
Point 46	303	787
Point 47	235.81614	819
Point 48	239.87277	818
Point 49	247.98603	816
Point 50	256.86359	815
Point 51	287.43806	815

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	5.26	(333.036, 855.723)	55.36036	(251.961, 815.552)	(342.837, 774.994)
2	723	5.91	(333.036, 855.723)	82.632	(261.136, 815)	(346.99, 774.278)

Slices of Slip Surface: Optimized

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimized	252.8806	813.61165	-776.23691	71.241397	44.516566	200
2	Optimized	253.9948	811.25995	-644.36403	185.87973	116.15055	200
3	Optimized	255.5266	809.0597	-539.69747	420.93627	263.03017	200
4	Optimized	257.108	806.94355	-441.32961	562.18094	351.28964	200
5	Optimized	258.6712	805.51975	-385.77995	828.84097	517.91732	200

6	Optimized	261.30875	803.32625	-305.06175	1022.3723	638.84909	200
7	Optimized	264.51375	801.0401	-230.6556	1349.6727	843.36912	200
8	Optimized	267.6791	799.0441	-167.79423	1543.0046	964.17632	200
9	Optimized	270.62815	797.32945	-110.42604	1787.0548	1116.6758	200
10	Optimized	273.79905	795.68125	-60.935075	2006.8688	1254.0308	200
11	Optimized	276.63745	794.2816	-22.499671	2152.1629	1344.8206	200
12	Optimized	278.1349	793.53675	-2.4960763	2182.4569	1363.7504	200
13	Optimized	279.20525	792.96585	14.204847	2240.4909	1391.1379	200
14	Optimized	281.6049	791.5107	62.581751	2250.3883	1367.0933	200
15	Optimized	284.18675	789.6862	130.78428	2279.381	1342.5923	200
16	Optimized	286.2358	788.0829	194.60253	2178.0184	2623.4975	6861.2
17	Optimized	287.24615	787.2955	225.87116	2382.4705	2825.7199	6887
18	Optimized	287.36905	787.2065	230.08396	2392.0543	2831.9374	6887.9
19	Optimized	289.7259	785.4992	323.25309	2792.1817	1013.7394	76.012
20	Optimized	293.3103	783.3386	437.72329	3537.017	1207.4918	134.3
21	Optimized	295.90345	782.33195	485.85991	3662.5533	1230.1812	141.68
22	Optimized	297.9921	781.5211	527.96124	3763.6281	1247.3074	147.36
23	Optimized	299.01925	781.1068	552.34677	3691.2203	1219.0647	138.1
24	Optimize	299.56455	780.85905	567.0389	3861.2118	4537.8696	7692

	d						
25	Optimized	301.46525	779.85755	626.83799	3696.7156	4275.4927	7643.7
26	Optimized	304.02785	778.4978	708.0757	3939.3002	4464.5818	7678.5
27	Optimized	305.10065	777.9469	740.92441	3987.6177	4482.6596	7681.8
28	Optimized	305.60065	777.78535	750.27737	4995.7732	5621.705	7892
29	Optimized	307.5	777.26285	632.56884	5087.0337	5851.5571	7937.7
30	Optimized	309.00655	776.8484	507.97946	5161.4641	6067.1698	7982.6
31	Optimized	309.30655	776.766	481.91853	5178.0363	6112.8067	7992.3
32	Optimized	309.8	776.6304	439.05367	5202.4473	6184.7228	8007.9
33	Optimized	311	776.30065	334.83598	5203.6526	6296.5595	8032.6
34	Optimized	312.47555	775.89525	256.13413	5273.7434	6453.0671	8068
35	Optimized	314.97555	775.20655	299.10158	5377.4949	6516.6761	8082.6
36	Optimized	317.5644	774.4929	343.64607	5489.6431	6586.8128	8099
37	Optimized	319.98595	773.82875	385.09128	5603.6884	6661.7471	8116.8
38	Optimized	323.70025	772.8116	448.55474	5763.905	6761.159	8140.7
39	Optimized	325.7787	772.22505	485.15347	5445.4045	6393.1041	8054.2
40	Optimized	327	771.7948	512.00599	6634.3376	7572.6029	8341.2
41	Optimized	328.05	771.42485	534.03846	6686.0207	7601.9473	8348.6
42	Optimized	328.109	771.40405	534.10255	1429.1815	1400.4574	7308.4

43	Optimized	330.05245	771.77985	469.68077	3136.3627	3793.8823	7558.1
44	Optimized	334.166	772.658	328.15352	2818.7833	3578.48	7521.7
45	Optimized	338.5806	773.76855	165.79269	2459.0486	3330.9758	7484.2
46	Optimized	341.80805	774.68115	40.807557	2135.8966	3075.6655	7450.1
47	Optimized	342.81845	774.988	0.74694249	1977.4065	2919.953	7431.4

Slices of Slip Surface: 723

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	723	262.45215	812.8343	-922.71315	118.26615	73.900895	200
2	723	265.08405	808.76435	-724.80188	411.54335	257.16082	200
3	723	267.88335	804.95645	-540.16224	721.44559	450.80924	200
4	723	270.85	801.3561	-365.42885	1044.1046	652.42897	200
5	723	273.81665	798.1341	-214.28781	1357.8815	848.49854	200
6	723	277.11305	794.9407	-72.033409	1694.1134	1058.5996	200
7	723	280.32505	792.11335	47.603951	2015.1183	1229.4394	200
8	723	283.12295	789.89335	136.6637	2284.6299	1342.1983	200
9	723	285.83835	787.9163	212.02344	2400.1683	2862.0782	6892
10	723	287.2274	786.95165	247.65932	2704.1138	1009.9705	74.687
11	723	287.36905	786.8575	251.86318	2717.4156	1012.856	75.512
12	723	289.06505	785.78875	308.919	2876.1155	1045.1977	84.764
13	723	292.319	783.84415	411.81424	3177.716	1107.0658	103.1
14	723	295.573	782.09465	502.52316	3467.292	1167.4351	121.64
15	723	297.4799	781.1334	552.88471	3634.3482	1202.2799	132.56
16	723	299.06985	780.40915	595.80636	3913.7085	4565.5274	7697.1
17	723	301.68995	779.2811	662.49884	4217.0253	4838.7244	7747.7
18	723	304	778.36855	716.15915	4448.2944	5042.0347	7785.1
19	723	305.5	777.81645	748.4825	4589.648	5166.48	7807.7
20	723	307.5	777.1522	639.47371	4814.1224	5542.9646	7876.7
21	723	309.3	776.57475	494.53999	5022.0282	5931.1431	7953.9

22	723	309.8	776.4262	451.80239	5079.1782	6039.2387	7976.4
23	723	311	776.09085	347.93395	5157.1828	6233.6761	8018.5
24	723	313.25	775.5058	280.43902	5404.0367	6563.8073	8093.4
25	723	315.75	774.93005	316.36771	5668.1147	6798.6596	8149.5
26	723	318.5	774.3945	349.79009	5953.9786	7055.2827	8212.1
27	723	321.5	773.91485	379.70994	6261.3853	7333.6583	8281.2
28	723	324.5	773.5475	402.63343	6564.3439	7611.5231	8350.9
29	723	327	773.31845	416.92784	8179.0841	9144.4051	8747.3
30	723	328.05	773.24215	420.63193	8293.9552	9247.8529	8774.8
31	723	329.57	773.1774	392.64716	1788.9336	2124.1077	7357.1
32	723	332.51	773.10635	335.0884	1730.1348	2122.3018	7357
33	723	335.45	773.13995	271.01347	1649.3974	2098.7083	7355.3
34	723	338.39	773.27835	200.39767	1545.0113	2050.6425	7351.9
35	723	341.33	773.5221	123.20778	1414.8234	1974.8486	7346.8
36	723	344.89485	773.9743	64.002827	1315.1098	1916.6339	7343

F-F'_static

File Information

Created By: Graf, Thomas [FWI]
Revision Number: 522
Last Edited By: Osman El Menchawi
Date: 8/3/2013
Time: 7:03:57 PM
File Name: profile_FF'_07-31-2013.gsz
Directory: C:\Users\Osman\Desktop\Comanche\Slope Stability\
Last Solved Date: 8/3/2013
Last Solved Time: 7:12:48 PM

Project Settings

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

Analysis Settings

F-F'_static

Kind: SLOPE/W
Method: Spencer
Settings
- Apply Phreatic Correction: No
- PWP Conditions Source: Piezometric Line
- Use Staged Rapid Drawdown: No

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: Yes
- Tension Crack
  - Tension Crack Option: (none)

FOS Distribution

FOS Calculation Option: Constant

Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 3 ft
Optimization Maximum Iterations: 4000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 24
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 5 °

Materials

Compacted Fill

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 200 psf
Phi: 32 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Limestone Layer C

Model: Shear/Normal Fn.
Unit Weight: 155 pcf
Strength Function: Unit C Limestone, Lower Bound
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Existing Fill

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 200 psf
Phi: 25 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Residual Soil

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 200 psf

Phi: 25 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Concrete

Model: Mohr-Coulomb
Unit Weight: 155 pcf
Cohesion: 5000 psf
Phi: 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (188.51783, 815.5793) ft
Left-Zone Right Coordinate: (297, 817) ft
Left-Zone Increment: 20
Right Projection: Range
Right-Zone Left Coordinate: (297.60627, 816.7979) ft
Right-Zone Right Coordinate: (397.71478, 776.8994) ft
Right-Zone Increment: 15
Radius Increments: 50

Slip Surface Limits

Left Coordinate: (0, 810) ft
Right Coordinate: (470, 744) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	0	804
	123.4	804
	135	804
	150.6	804
	174	804

	195	804
	214.8	804
	230.2	804
	250.9	803.9
	271.1	802
	295.1	799.7
	308	797.1
	320	791
	332	786
	342	780
	347.8	780
	360.2	780
	375.1	780
	390.5	780
	403	775
	470	775

Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

Shear/Normal Strength Functions

Unit C Limestone, Lower Bound

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Y-Intercept: 7248.7668
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (-1613, 4254)
Data Point: (-174, 6947)
Data Point: (1222, 9215)
Data Point: (2584, 11234)
Data Point: (3920, 13080)
Data Point: (5233, 14797)
Data Point: (6527, 16411)
Data Point: (7804, 17941)

Data Point: (9065, 19400)
Data Point: (10312, 20797)
Data Point: (11546, 22141)
Data Point: (12768, 23437)
Data Point: (13980, 24691)
Data Point: (15181, 25906)
Data Point: (16372, 27087)
Data Point: (17555, 28237)
Data Point: (18728, 29357)
Data Point: (19894, 30450)
Data Point: (21052, 31518)
Data Point: (22203, 32563)
Data Point: (23346, 33586)
Data Point: (24483, 34589)
Data Point: (25614, 35573)
Data Point: (26738, 36538)
Data Point: (27857, 37486)
Data Point: (28970, 38419)
Data Point: (30077, 39336)
Data Point: (31179, 40238)
Data Point: (32276, 41126)
Data Point: (33369, 42001)
Data Point: (34456, 42863)
Data Point: (35539, 43714)
Data Point: (36617, 44552)
Data Point: (37692, 45380)
Data Point: (38761, 46196)
Data Point: (39827, 47003)
Data Point: (40889, 47799)
Data Point: (41947, 48586)

Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Regions

	Material	Points	Area (ft²)
Region 1	Residual Soil	15,14,33,34,35,36,37	3350
Region 2	Existing Fill	14,1,2,3,4,5,6,24,25,26,27,28,29,30,31,32,33	6953.6

Region 3	Concrete	5,22,23,6	74
Region 4	Limestone Layer C	15,37,42,41,40,39,16,38,21,20,19,18	26725.319
Region 5	Compacted Fill	24,7,8,9,10,11,12,13,17,16,39,40,41,42,37,36,35,34,33,32,31,30,29,28,27,26,25	1254.75

Points

	X (ft)	Y (ft)
Point 1	0	810
Point 2	123.4	810
Point 3	138.7	815
Point 4	224.7	816
Point 5	250.2	817
Point 6	265	817
Point 7	297	817
Point 8	303	815
Point 9	314.5	810
Point 10	324.9	805
Point 11	335.3	800
Point 12	345.8	795
Point 13	360.2	790
Point 14	0	790
Point 15	0	780
Point 16	390.5	780
Point 17	375.1	785
Point 18	0	720
Point 19	470	720
Point 20	470	744
Point 21	465.5	745
Point 22	250.2	822
Point 23	265	822
Point 24	276	817
Point 25	276	814

Point 26	282	814
Point 27	282	808
Point 28	294	808
Point 29	294	802
Point 30	306	802
Point 31	306	796
Point 32	318	796
Point 33	318	790
Point 34	330	790
Point 35	330	785
Point 36	340	785
Point 37	340	780
Point 38	403.19342	774.5449
Point 39	385	780
Point 40	385	779
Point 41	365	779
Point 42	365	780

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	1.97	(352.358, 872.657)	53.59915	(281.171, 817)	(380.129, 783.367)
2	14506	1.98	(352.358, 872.657)	91.903	(279.224, 817)	(377.437, 784.241)

Slices of Slip Surface: Optimized

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimized	282.7615	814.81585	-869.43567	93.413717	58.371369	200
2	Optimized	286.2269	810.3901	-613.99286	451.48295	282.11786	200
3	Optimize	289.65545	806.53955	-394.23315	822.87478	383.71281	200

	d						
4	Optimized	292.66325	803.47895	-221.23579	1069.9503	498.92602	200
5	Optimized	294.6089	801.58915	-114.9462	1333.2391	621.69962	200
6	Optimized	296.05	800.30345	-49.601675	1434.8747	669.09307	200
7	Optimized	297.1005	799.3662	-4.3304204	1505.8635	702.19568	200
8	Optimized	297.6721	798.8562	20.302804	1531.1246	704.50776	200
9	Optimized	299.59015	797.2429	96.851797	1654.4204	726.30619	200
10	Optimized	302.01855	795.3359	185.30405	1813.6561	759.31305	200
11	Optimized	303.63945	794.15675	238.49993	1859.2852	755.78457	200
12	Optimized	305.13945	793.14365	282.8532	1958.1579	781.20743	200
13	Optimized	307	791.959	333.372	2056.0231	803.28542	200
14	Optimized	308.592	790.9454	365.27101	2077.9602	798.64009	200
15	Optimized	309.67395	790.3132	370.39886	2191.4972	849.19209	200
16	Optimized	312.33195	788.92835	372.50701	2198.2679	851.36628	200
17	Optimized	314.5225	787.78705	374.24085	2203.5257	853.00954	200
18	Optimized	316.2725	787.08205	362.71116	2299.4539	903.11796	200
19	Optimized	319	785.9875	344.50053	2339.7322	930.39179	200
20	Optimized	320.50265	785.3845	337.34119	2318.5802	923.86693	200
21	Optimized	321.70265	784.9764	331.60403	2411.2157	969.73883	200

22	Optimized	323.65	784.4	316.94295	2361.7877	953.52674	200
23	Optimized	325.49015	783.8553	303.08766	2315.077	938.20602	200
24	Optimized	328.04015	783.2978	271.57318	2345.6551	967.16029	200
25	Optimized	330.85255	782.74845	232.73417	2313.9301	970.4776	200
26	Optimized	331.85255	782.562	218.36485	2349.5484	993.78722	200
27	Optimized	332.83335	782.42975	191.5802	2306.2286	986.07676	200
28	Optimized	334.35155	782.22505	147.51762	2239.2088	975.3716	200
29	Optimized	335.1682	782.1246	123.20842	2293.6198	1012.0795	200
30	Optimized	337.06765	782.00765	59.389773	2193.1528	994.99006	200
31	Optimized	339.41765	781.86295	-19.565061	2067.9147	964.28445	200
32	Optimized	341	781.76555	-72.727291	2069.182	1292.9684	200
33	Optimized	342.3935	781.67975	-104.81549	1993.0492	1245.3954	200
34	Optimized	344.2935	781.56805	-97.843824	1893.0278	1182.8951	200
35	Optimized	346.1526	781.4601	-91.109211	1796.3362	1122.4755	200
36	Optimized	347.1526	781.41675	-88.4022	1784.1761	1114.8769	200
37	Optimized	349.09515	781.3482	-84.126435	1702.9768	1064.138	200
38	Optimized	352.73495	781.2508	-78.05008	1561.2574	975.58193	200
39	Optimized	357.5337	781.20125	-74.95805	1365.3852	853.18736	200
40	Optimize	360.0939	781.2062	-75.266476	1266.4878	791.38941	200

	d						
41	Optimized	362.5747	781.2711	-79.315683	1141.1246	713.05378	200
42	Optimized	366.9661	781.44245	-90.009665	932.15631	582.47591	200
43	Optimized	370.42165	781.67005	-104.20945	752.52186	470.22784	200
44	Optimized	373.48025	782.00975	-125.40799	582.84562	364.20236	200
45	Optimized	375.4249	782.2755	-141.991	445.11218	278.13696	200
46	Optimized	377.9392	782.8436	-177.44272	268.99597	168.08733	200

Slices of Slip Surface: 14506

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	14506	280.4161	815.5	-898.12029	53.450842	33.399793	200
2	14506	281.8039	813.7651	-798.15024	198.14871	92.398259	200
3	14506	283.2614	812.0911	-702.3986	330.36223	206.43323	200
4	14506	285.7842	809.326	-544.95861	572.03305	357.44592	200
5	14506	288.7842	806.3335	-376.15371	866.121	403.87886	200
6	14506	292.2614	803.16345	-199.14424	1155.7362	538.92862	200
7	14506	294.55	801.2149	-91.243494	1409.3943	657.21136	200
8	14506	296.0316	800.0472	-33.379486	1526.3822	711.7637	200
9	14506	296.9816	799.3106	0.6349896	1601.5697	746.52811	200
10	14506	298.5	798.2115	50.121895	1672.6113	756.57924	200
11	14506	301.5	796.12945	142.30972	1804.6275	775.15151	200
12	14506	304.5	794.2174	223.89096	1906.4963	784.61176	200
13	14506	307	792.7347	284.97044	2041.3612	819.01847	200
14	14506	309.08195	791.5896	309.53153	2083.6416	827.28113	200
15	14506	311.1732	790.506	310.80926	2118.6206	842.99628	200
16	14506	313.34125	789.4566	307.52113	2147.5378	858.01386	200
17	14506	316.25	788.16535	295.83195	2165.8524	872.00487	200

18	14506	319	787.0279	279.57937	2247.9469	917.86486	200
19	14506	321.2	786.20585	267.95692	2241.8006	920.4184	200
20	14506	323.65	785.3623	256.89293	2226.7575	918.56293	200
21	14506	326.175	784.5722	240.54316	2201.9561	914.62188	200
22	14506	328.725	783.8539	219.06526	2167.3083	908.48066	200
23	14506	331	783.27565	196.00196	2199.5754	934.28162	200
24	14506	332.83335	782.8555	165.01476	2163.5725	931.94276	200
25	14506	334.48335	782.51235	124.65063	2126.976	933.69964	200
26	14506	337.2277	782.0286	52.091235	2056.7096	934.76891	200
27	14506	339.5777	781.6475	-12.111219	1991.6096	928.70281	200
28	14506	341	781.46365	-53.88863	2024.2596	1264.8978	200
29	14506	343.9	781.16345	-72.598339	1928.1207	1204.8235	200
30	14506	346.8	780.9272	-57.858887	1836.2823	1147.4365	200
31	14506	349.35	780.81585	-50.908191	1768.2455	1104.9224	200
32	14506	352.45	780.76665	-47.838679	1670.2247	1043.6722	200
33	14506	355.55	780.82205	-51.294831	1552.9977	970.42065	200
34	14506	358.65	780.9823	-61.297728	1415.3799	884.42751	200
35	14506	361.69	781.2408	-77.426475	1261.8983	788.52158	200
36	14506	364.67	781.59435	-99.487416	1092.077	682.40544	200
37	14506	367.65	782.04725	-127.75045	898.96504	561.7357	200
38	14506	370.63	782.60105	-162.3069	680.36495	425.13921	200
39	14506	373.61	783.2576	-203.27485	433.71873	271.01754	200
40	14506	376.26825	783.9266	-245.01873	190.53109	119.05704	200

F-F'_seismic_(+)hor_(-)ver

File Information

Created By: Graf, Thomas [FWI]
Revision Number: 522
Last Edited By: Osman El Menchawi
Date: 8/3/2013
Time: 7:03:57 PM
File Name: profile_FF'_07-31-2013.gsz
Directory: C:\Users\Osman\Desktop\Comanche\Slope Stability\
Last Solved Date: 8/3/2013
Last Solved Time: 7:07:46 PM

Project Settings

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

Analysis Settings

F-F'_seismic_(+)hor_(-)ver

Kind: SLOPE/W
Method: Spencer
Settings
- Apply Phreatic Correction: No
- PWP Conditions Source: Piezometric Line
- Use Staged Rapid Drawdown: No

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: Yes
- Tension Crack
  - Tension Crack Option: (none)

FOS Distribution

FOS Calculation Option: Constant

Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 3 ft
Optimization Maximum Iterations: 4000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 24
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 5 °

Materials

Compacted Fill

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 200 psf
Phi: 32 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Limestone Layer C

Model: Shear/Normal Fn.
Unit Weight: 155 pcf
Strength Function: Unit C Limestone, Lower Bound
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Existing Fill

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 200 psf
Phi: 25 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Residual Soil

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 200 psf

Phi: 25 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Concrete

Model: Mohr-Coulomb
Unit Weight: 155 pcf
Cohesion: 5000 psf
Phi: 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (190.85066, 815.6064) ft
Left-Zone Right Coordinate: (297, 817) ft
Left-Zone Increment: 20
Right Projection: Range
Right-Zone Left Coordinate: (297.60627, 816.7979) ft
Right-Zone Right Coordinate: (397.71478, 776.8994) ft
Right-Zone Increment: 15
Radius Increments: 50

Slip Surface Limits

Left Coordinate: (0, 810) ft
Right Coordinate: (470, 744) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	0	804
	123.4	804
	135	804
	150.6	804
	174	804

	195	804
	214.8	804
	230.2	804
	250.9	803.9
	271.1	802
	295.1	799.7
	308	797.1
	320	791
	332	786
	342	780
	347.8	780
	360.2	780
	375.1	780
	390.5	780
	403	775
	470	775

Maximum Suction: 0 psf

Seismic Loads

Horz Seismic Load: 0.1
Vert Seismic Load: -0.1
Ignore seismic load in strength: No

Shear/Normal Strength Functions

Unit C Limestone, Lower Bound

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Y-Intercept: 7248.7668
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (-1613, 4254)
Data Point: (-174, 6947)
Data Point: (1222, 9215)
Data Point: (2584, 11234)
Data Point: (3920, 13080)
Data Point: (5233, 14797)

Data Point: (6527, 16411)
Data Point: (7804, 17941)
Data Point: (9065, 19400)
Data Point: (10312, 20797)
Data Point: (11546, 22141)
Data Point: (12768, 23437)
Data Point: (13980, 24691)
Data Point: (15181, 25906)
Data Point: (16372, 27087)
Data Point: (17555, 28237)
Data Point: (18728, 29357)
Data Point: (19894, 30450)
Data Point: (21052, 31518)
Data Point: (22203, 32563)
Data Point: (23346, 33586)
Data Point: (24483, 34589)
Data Point: (25614, 35573)
Data Point: (26738, 36538)
Data Point: (27857, 37486)
Data Point: (28970, 38419)
Data Point: (30077, 39336)
Data Point: (31179, 40238)
Data Point: (32276, 41126)
Data Point: (33369, 42001)
Data Point: (34456, 42863)
Data Point: (35539, 43714)
Data Point: (36617, 44552)
Data Point: (37692, 45380)
Data Point: (38761, 46196)
Data Point: (39827, 47003)
Data Point: (40889, 47799)
Data Point: (41947, 48586)

Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Regions

	Material	Points	Area (ft²)
Region 1	Residual Soil	15,14,33,34,35,36,37	3350

Region 2	Existing Fill	14,1,2,3,4,5,6,24,25,26,27,28,29,30,31,32,33	6953.6
Region 3	Concrete	5,22,23,6	74
Region 4	Limestone Layer C	15,37,42,41,40,39,16,38,21,20,19,18	26725.319
Region 5	Compacted Fill	24,7,8,9,10,11,12,13,17,16,39,40,41,42,37,36,35,34,33,32,31,30,29,28,27,26,25	1254.75

Points

	X (ft)	Y (ft)
Point 1	0	810
Point 2	123.4	810
Point 3	138.7	815
Point 4	224.7	816
Point 5	250.2	817
Point 6	265	817
Point 7	297	817
Point 8	303	815
Point 9	314.5	810
Point 10	324.9	805
Point 11	335.3	800
Point 12	345.8	795
Point 13	360.2	790
Point 14	0	790
Point 15	0	780
Point 16	390.5	780
Point 17	375.1	785
Point 18	0	720
Point 19	470	720
Point 20	470	744
Point 21	465.5	745
Point 22	250.2	822
Point 23	265	822
Point 24	276	817

Point 25	276	814
Point 26	282	814
Point 27	282	808
Point 28	294	808
Point 29	294	802
Point 30	306	802
Point 31	306	796
Point 32	318	796
Point 33	318	790
Point 34	330	790
Point 35	330	785
Point 36	340	785
Point 37	340	780
Point 38	403.19342	774.5449
Point 39	385	780
Point 40	385	779
Point 41	365	779
Point 42	365	780

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	1.49	(344.013, 921.764)	64.25666	(250.2, 822)	(384.008, 782.108)
2	8788	1.52	(344.013, 921.764)	141.526	(248.915, 816.95)	(377.437, 784.241)

Slices of Slip Surface: Optimized

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimized	250.55	816.70895	0	422.49732	197.01373	200
2	Optimized	252.4475	815.01455	0	531.69389	247.93293	200

3	Optimized	255.9976	811.9454	0	750.46302	349.94666	200
4	Optimized	259.72065	808.8358	0	963.40879	449.2449	200
5	Optimized	263.1615	805.9912	0	1151.8526	537.1177	200
6	Optimized	264.94095	804.5407	0	1525.0391	711.13743	200
7	Optimized	267.5254	803.3056	0	1066.5471	497.3391	200
8	Optimized	270.5754	801.848	12.5651	1181.9501	545.2932	200
9	Optimized	271.4353	801.43705	33.123208	1215.0603	551.14631	200
10	Optimized	273.8853	800.27115	91.224585	1310.8556	568.72329	200
11	Optimized	277.46105	798.5707	175.94935	1480.2295	608.1958	200
12	Optimized	280.46105	797.163	245.84862	1605.1281	633.84243	200
13	Optimized	282.579	796.1819	294.40157	1749.6572	678.59685	200
14	Optimized	285.6753	794.7232	366.90869	1857.7064	695.17041	200
15	Optimized	290.42765	792.5124	476.45087	2054.4044	735.8118	200
16	Optimized	293.33135	791.1777	542.36476	2146.8972	748.20575	200
17	Optimized	294.55	790.6047	570.83153	2258.0367	786.75667	200
18	Optimized	295.4681	790.17305	589.84619	2292.7809	794.0915	200
19	Optimized	296.4181	789.7264	605.77244	2328.7097	803.41885	200
20	Optimized	297.0774	789.4164	616.83137	2351.2676	808.78091	200
21	Optimize	300.0333	787.97655	669.49474	2356.8151	786.8104	200

	d						
22	Optimized	302.9559	786.55565	721.40615	2501.7447	830.18551	200
23	Optimized	304.5	785.945	740.09095	2489.8561	815.92891	200
24	Optimized	307	784.9563	770.34417	2537.4676	824.02317	200
25	Optimized	308.3512	784.4219	779.96691	2526.549	814.44458	200
26	Optimized	309.43315	784.0531	768.67347	2627.0788	866.58865	200
27	Optimized	312.1056	783.2123	736.36498	2585.801	862.40616	200
28	Optimized	314.27365	782.55055	708.8918	2688.7364	923.2167	200
29	Optimized	316.25	782.1065	673.91249	2633.0116	913.54294	200
30	Optimized	319	781.4886	625.21221	2628.8085	934.29232	200
31	Optimized	320.41505	781.17065	602.55897	2587.9369	925.79693	200
32	Optimized	321.61505	780.9671	584.06629	2687.0102	980.61886	200
33	Optimized	323.65	780.6811	549.00482	2609.4762	960.81356	200
34	Optimized	325.4433	780.42905	518.09911	2541.1025	943.34195	200
35	Optimized	327.9933	780.2437	463.36692	2576.0852	985.17671	200
36	Optimized	331	780.08035	395.387	2500.9623	981.8459	200
37	Optimized	332.1706	780.01675	366.96673	2444.6206	968.82592	200
38	Optimized	333.00395	780.0139	335.94661	2518.0719	1017.5417	200
39	Optimized	334.48335	780.0282	279.66664	2436.683	1005.8333	200

40	Optimized	337.73985	780.05965	155.78021	2258.8633	980.68376	200
41	Optimized	341.06095	780.05895	31.480915	2171.303	1337.1092	200
42	Optimized	341.9711	780.0339	0	2125.6719	1328.2672	200
43	Optimized	342.60065	780.01655	0	2090.7582	1306.4507	200
44	Optimized	344.50065	780.00135	0	2036.0251	1272.2497	200
45	Optimized	346.8	780.00375	0	1913.199	1195.4994	200
46	Optimized	349.4484	780.0065	0	1796.217	1122.401	200
47	Optimized	354.43925	780.0085	0	1574.7219	983.99544	200
48	Optimized	358.99085	780.0185	0	1384.2208	864.95718	200
49	Optimized	363.49845	780.0547	0	1184.7491	740.3134	200
50	Optimized	370.03725	780.2079	0	915.72341	572.20749	200
51	Optimized	374.1888	780.4452	0	774.1208	483.72436	200
52	Optimized	377.60815	780.8603	0	555.81843	347.3139	200
53	Optimized	382.0623	781.63625	0	296.95968	185.56101	200

Slices of Slip Surface: 8788

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	8788	249.5577	816.37395	0	-7.9005673	-3.684095	200
2	8788	250.55	815.4905	0	501.02151	233.63017	200
3	8788	253.25	813.2177	0	663.16073	309.23693	200

4	8788	257.95	809.4519	0	945.86607	441.06459	200
5	8788	262.65	805.99945	0	1222.008	569.8317	200
6	8788	266.5851	803.3117	0	947.38015	441.77062	200
7	8788	269.6351	801.3706	47.874246	1112.4294	496.41023	200
8	8788	273.55	799.0587	168.88767	1319.9144	536.7326	200
9	8788	279	796.0997	320.94263	1628.4719	609.7109	200
10	8788	284.5904	793.34895	459.14791	1965.6246	702.48162	200
11	8788	289.77125	791.07515	570.04985	2205.7877	762.75709	200
12	8788	293.18085	789.68475	636.40134	2359.4471	803.46945	200
13	8788	294.55	789.1643	660.71911	2486.885	851.55515	200
14	8788	296.05	788.6169	679.61862	2551.1571	872.71272	200
15	8788	300	787.2928	712.58542	2616.261	887.69851	200
16	8788	304.5	785.87475	744.46667	2632.6318	880.46587	200
17	8788	307	785.1676	757.14654	2689.4652	901.05499	200
18	8788	309.08195	784.62105	744.37176	2673.3703	899.50678	200
19	8788	312.33195	783.84745	689.54883	2641.4948	910.20737	200
20	8788	316.25	782.9993	618.20555	2585.6995	917.45748	200
21	8788	319	782.4696	564.02864	2609.1185	953.64104	200
22	8788	321.2	782.094	524.54907	2561.3917	949.79531	200
23	8788	323.65	781.71625	484.38658	2503.0004	941.29511	200
24	8788	327.45	781.234	415.69139	2400.2493	925.41453	200
25	8788	331	780.84115	347.9148	2364.1915	940.20529	200
26	8788	332.83335	780.68275	300.59974	2306.4303	935.33413	200
27	8788	334.48335	780.5616	246.38236	2252.8342	935.62386	200
28	8788	337.65	780.4007	137.86041	2142.724	934.88324	200
29	8788	340.78405	780.277	28.238758	2183.9724	1347.0519	200
30	8788	341.78405	780.2557	0	2146.8277	1341.4869	200
31	8788	343.9	780.2508	0	2051.2889	1281.7876	200
32	8788	346.8	780.269	0	1929.4257	1205.639	200
33	8788	349.86665	780.37425	0	1818.3053	1136.2033	200
34	8788	354	780.60605	0	1648.8057	1030.2881	200
35	8788	358.13335	780.95955	0	1452.288	907.49023	200
36	8788	362.68335	781.49735	0	1204.7767	752.82805	200
37	8788	367.65	782.2486	0	893.88569	558.56177	200
38	8788	372.61665	783.1819	0	529.06923	330.59915	200

39	8788	376.26825	783.96795	0	226.63513	141.61735	200

G-G'_static

File Information

Created By: Graf, Thomas [FWI]
Revision Number: 666
Last Edited By: Osman El Menchawi
Date: 8/3/2013
Time: 7:23:37 PM
File Name: profile_GG'_Buttress_07-31-2013.gsz
Directory: C:\Users\Osman\Desktop\Comanche\Slope Stability\
Last Solved Date: 8/3/2013
Last Solved Time: 7:25:06 PM

Project Settings

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

Analysis Settings

G-G'_static

Kind: SLOPE/W
Method: Spencer
Settings
- Apply Phreatic Correction: No
- PWP Conditions Source: Piezometric Line
- Use Staged Rapid Drawdown: No

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: Yes
- Tension Crack
  - Tension Crack Option: (none)

FOS Distribution

FOS Calculation Option: Constant

Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 4 ft
Optimization Maximum Iterations: 4000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 24
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 5 °

Materials

Compacted Fill

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 200 psf
Phi: 32 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Limestone Layer C

Model: Shear/Normal Fn.
Unit Weight: 155 pcf
Strength Function: Unit C Limestone, Lower Bound
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Shale

Model: Shear/Normal Fn.
Unit Weight: 135 pcf
Strength Function: Shale-Fully Softened Lower Bound
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Limestone Layer A

Model: Shear/Normal Fn.
Unit Weight: 145 pcf
Strength Function: Unit A Limestone, Lower Bound
Phi-B: 0 °

Pore Water Pressure
Piezometric Line: 1

Concrete

Model: Mohr-Coulomb
Unit Weight: 155 pcf
Cohesion: 5000 psf
Phi: 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (119.42333, 816.6997) ft
Left-Zone Right Coordinate: (275.45004, 813) ft
Left-Zone Increment: 30
Right Projection: Range
Right-Zone Left Coordinate: (276.23642, 812.8818) ft
Right-Zone Right Coordinate: (393.86004, 767.2652) ft
Right-Zone Increment: 30
Radius Increments: 0

Slip Surface Limits

Left Coordinate: (0, 817) ft
Right Coordinate: (420, 758) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	0	804
	38	804
	170	804
	184.4	803
	205	803
	230	803

	248	803
	259	799
	269	797
	278	793
	290	788
	300	785
	310	783
	318	783
	338	783
	363	783
	382	775
	420	775

Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

Shear/Normal Strength Functions

Shale-Fully Softened Lower Bound

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Y-Intercept: 3.8193582e-007
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (1000, 449.95299)
Data Point: (2000, 892.95299)
Data Point: (3000, 1302.953)
Data Point: (4000, 1680.953)
Data Point: (5000, 2031.953)
Data Point: (6000, 2356.953)
Data Point: (7000, 2660.953)
Data Point: (8000, 2944.953)
Data Point: (9000, 3213.953)
Data Point: (10000, 3468.953)
Data Point: (11000, 3714.953)
Data Point: (12000, 3952.953)
Data Point: (13000, 4187.953)
Data Point: (14000, 4420.953)

Data Point: (15000, 4656.953)
Data Point: (16000, 4896.953)
Data Point: (17000, 5145.953)
Data Point: (18000, 5404.953)
Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Unit A Limestone, Lower Bound

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Y-Intercept: 6697.4707
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (-1710, 3833)
Data Point: (-299, 6231)
Data Point: (1063, 8237)
Data Point: (2388, 10014)
Data Point: (3684, 11635)
Data Point: (4956, 13137)
Data Point: (6207, 14546)
Data Point: (7440, 15878)
Data Point: (8656, 17146)
Data Point: (9857, 18358)
Data Point: (11045, 19522)
Data Point: (12220, 20643)
Data Point: (13383, 21726)
Data Point: (14536, 22775)
Data Point: (15679, 23793)
Data Point: (16813, 24783)
Data Point: (17938, 25747)
Data Point: (19054, 26689)
Data Point: (20163, 27603)
Data Point: (21264, 28500)
Data Point: (22358, 29377)
Data Point: (23445, 30236)
Data Point: (24526, 31078)
Data Point: (25600, 31904)
Data Point: (26669, 32715)
Data Point: (27732, 33512)
Data Point: (28789, 34295)

Data Point: (29841, 35065)
Data Point: (30888, 35823)
Data Point: (31931, 36569)
Data Point: (32968, 37304)
Data Point: (34001, 38028)
Data Point: (35029, 38742)
Data Point: (36053, 39447)
Data Point: (37073, 40141)
Data Point: (38089, 40827)
Data Point: (39101, 41504)
Data Point: (40109, 42173)

Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Unit C Limestone, Lower Bound

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Y-Intercept: 7248.7668
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (-1613, 4254)
Data Point: (-174, 6947)
Data Point: (1222, 9215)
Data Point: (2584, 11234)
Data Point: (3920, 13080)
Data Point: (5233, 14797)
Data Point: (6527, 16411)
Data Point: (7804, 17941)
Data Point: (9065, 19400)
Data Point: (10312, 20797)
Data Point: (11546, 22141)
Data Point: (12768, 23437)
Data Point: (13980, 24691)
Data Point: (15181, 25906)
Data Point: (16372, 27087)
Data Point: (17555, 28237)
Data Point: (18728, 29357)
Data Point: (19894, 30450)
Data Point: (21052, 31518)
Data Point: (22203, 32563)

Data Point: (23346, 33586)
Data Point: (24483, 34589)
Data Point: (25614, 35573)
Data Point: (26738, 36538)
Data Point: (27857, 37486)
Data Point: (28970, 38419)
Data Point: (30077, 39336)
Data Point: (31179, 40238)
Data Point: (32276, 41126)
Data Point: (33369, 42001)
Data Point: (34456, 42863)
Data Point: (35539, 43714)
Data Point: (36617, 44552)
Data Point: (37692, 45380)
Data Point: (38761, 46196)
Data Point: (39827, 47003)
Data Point: (40889, 47799)
Data Point: (41947, 48586)

Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Regions

	Material	Points	Area (ft^2)
Region 1	Concrete	24,23,36,26,25	64
Region 2	Limestone Layer A	13,37,59,38,39,17,15	1353.4957
Region 3	Limestone Layer C	7,10,19,18,46,44,54,43,34,11,35,2,1,5,8,9	26814.5
Region 4	Shale	54,45,32,33,43	109.65
Region 5	Shale	7,10,19,47,48,49,50,51,52,53,55,16,56,4,3	4578

Region 6	Limestone Layer A	3,12,14,57,41,56,4	774
Region 7	Shale	13,15,17,58,40,57,14,12	1660
Region 8	Compacted Fill	6,20,21,22,23,36,26,27,28,29,30,31,42,45,54,44,46,18,19,47,48,49,50,51,52,53,55,16,56,41,57,40,58,17,39,38,59,37	1860.9043

Points

	X (ft)	Y (ft)
Point 1	415	757
Point 2	405	760
Point 3	0	799
Point 4	181	799
Point 5	420	758
Point 6	0	817
Point 7	0	783
Point 8	420	717.2
Point 9	0	717.2
Point 10	181	783
Point 11	376.7	778
Point 12	0	802
Point 13	0	809
Point 14	181	802
Point 15	181	809
Point 16	268	799
Point 17	229	809
Point 18	318	783
Point 19	308	783
Point 20	57	817
Point 21	93	817
Point 22	181	816
Point 23	253	816
Point 24	253	817

Point 25	269	817
Point 26	269	813
Point 27	276	813
Point 28	282	810
Point 29	292	805
Point 30	302	800
Point 31	312	795
Point 32	347	790
Point 33	358	785
Point 34	370	780
Point 35	382	775
Point 36	253	813
Point 37	0	816
Point 38	181	815
Point 39	200	814
Point 40	248	805
Point 41	258	802
Point 42	329	792.5
Point 43	362.5	783
Point 44	338	782
Point 45	341	790.7
Point 46	318	782
Point 47	308	785
Point 48	298	785
Point 49	298	788
Point 50	288	788
Point 51	288	792
Point 52	278	792
Point 53	278	796
Point 54	338	783
Point 55	268	796
Point 56	258	799
Point 57	248	802
Point 58	229	805
Point 59	58.56299	815.6764

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	1.89	(305.747, 853.08)	42.81073	(251.069, 816)	(330.813, 792.228)
2	760	1.98	(305.747, 853.08)	68.422	(248.244, 816)	(335.593, 791.511)

Slices of Slip Surface: Optimized

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimized	252.0344	814.5787	-814.04908	26.087399	16.301216	200
2	Optimized	254.1381	811.48225	-668.57281	386.3304	241.40603	200
3	Optimized	257.1381	807.50055	-488.18502	742.06079	463.69105	200
4	Optimized	259.438	804.6514	-358.11209	962.28373	601.30161	200
5	Optimized	260.92895	802.84535	-264.02319	1119.472	699.52371	200
6	Optimized	263.03485	800.3184	-132.62265	1317.4407	823.22832	200
7	Optimized	264.81355	798.3735	-33.46089	1775.2288	776.42717	19.09
8	Optimized	266.76965	796.53705	56.723371	1961.6894	824.51033	27.494
9	Optimized	268.5	794.91255	136.49994	2108.6298	848.35419	32.614
10	Optimized	269.0106	794.43315	159.87582	1708.751	687.14334	8.626
11	Optimized	270.1356	793.79645	168.40667	2017.2587	804.09561	23.539
12	Optimized	272.4652	792.48625	185.55703	2165.1727	851.124	33.094
13	Optimize	274.8402	791.1639	202.20672	2324.3766	899.97724	45.108

	d						
14	Optimized	277	789.9741	216.55045	2407.1623	922.96367	51.02
15	Optimized	278.0628	789.3886	223.7167	2384.7637	913.08425	48.453
16	Optimized	279.2628	788.84535	226.41564	2478.162	943.35771	56.343
17	Optimized	280.976	788.07905	229.6926	2475.1365	941.27022	55.791
18	Optimized	281.776	787.7411	229.97833	2558.4433	968.57894	63.127
19	Optimized	283.07945	787.27385	225.24787	2541.8707	964.69655	62.064
20	Optimized	285.23835	786.49995	217.40372	2514.2265	958.2393	60.308
21	Optimized	287.1589	785.9025	204.7554	2590.3237	987.15928	68.215
22	Optimized	289	785.4417	185.63879	2502.7987	964.92019	62.105
23	Optimized	290.0759	785.1724	175.02403	2473.6601	958.80741	60.461
24	Optimized	291.0759	785.0137	166.20568	2540.8867	983.67364	67.232
25	Optimized	293.0344	784.7176	148.01478	2460.174	963.26401	61.655
26	Optimized	295.1032	784.40485	128.80617	2374.9087	941.5002	55.822
27	Optimized	297.0688	784.2347	102.6288	2424.0928	966.33217	62.483
28	Optimized	299	784.20605	68.262491	2272.2501	927.51231	52.137
29	Optimized	300.6496	784.18155	42.964238	2169.1064	901.35538	45.402
30	Optimized	301.6496	784.203	29.145041	2211.606	920.29207	50.268
31	Optimized	302.6335	784.29035	11.415656	2132.4266	899.61681	44.961

32	Optimized	304.69765	784.4736	-25.779188	1964.0308	845.68274	31.807
33	Optimized	307.06415	784.80025	-75.696695	1871.7519	812.57935	25.033
34	Optimized	309	785.21325	-125.62775	1809.0376	1130.4122	200
35	Optimized	311	785.63995	-164.73269	1587.6695	992.08601	200
36	Optimized	312.02905	785.8595	-178.43447	1475.3825	921.92129	200
37	Optimized	313.9015	786.4381	-214.53778	1453.4616	908.22363	200
38	Optimized	316.87245	787.35955	-272.03591	1226.5105	766.40881	200
39	Optimized	319.1972	788.07925	-316.94484	1050.0863	656.16672	200
40	Optimized	322.32225	789.0841	-379.6554	821.17418	513.12658	200
41	Optimized	326.12925	790.3867	-460.9181	521.38446	325.79717	200
42	Optimized	328.5042	791.26245	-515.57403	335.78278	209.82037	200
43	Optimized	329.9064	791.84895	-552.16454	191.98023	119.96256	200

Slices of Slip Surface: 760

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	760	249.43295	814.2745	-736.05397	53.28565	33.29657	200
2	760	251.811	811.0241	-587.17134	317.99512	198.7054	200
3	760	254.5	807.8015	-447.10744	766.18298	478.76426	200
4	760	257.5	804.61065	-316.07031	1086.3898	678.85169	200
5	760	260.20795	802.03975	-204.75608	1364.639	852.72111	200
6	760	262.62385	799.981	-106.44102	1601.9009	1000.9788	200
7	760	264.71085	798.341	-30.150139	1914.4498	827.98042	28.107
8	760	266.79495	796.84725	37.047699	2116.9578	885.56975	41.523

9	760	268.5	795.688	88.102216	2256.3663	915.46468	49.094
10	760	270.125	794.67735	113.73161	1892.8076	777.96184	19.242
11	760	272.4375	793.3292	133.72719	2082.0354	840.08206	30.619
12	760	274.8125	792.06515	146.73613	2266.7433	899.23472	44.915
13	760	277	791	152.53478	2374.6133	933.4826	53.751
14	760	279.2	790.03165	154.02416	2371.2094	931.88225	53.319
15	760	281.2	789.2189	152.7423	2390.8936	938.81032	55.151
16	760	283.5	788.3955	144.32265	2398.8211	944.23319	56.584
17	760	286.5	787.43975	125.96008	2392.8544	948.35543	57.676
18	760	289	786.74745	104.15672	2335.612	936.59708	54.559
19	760	291	786.27425	88.968137	2307.9864	932.47039	53.471
20	760	293.5	785.78055	72.974843	2259.0325	921.49415	50.599
21	760	296.5	785.30295	46.61813	2182.3494	904.58516	46.25
22	760	298.45855	785.04915	25.791136	2125.9147	1312.3028	200
23	760	299.45855	784.95	13.254941	2057.4353	873.4353	38.454
24	760	300.41045	784.8679	3.1186551	2021.7396	864.63996	36.302
25	760	301.41045	784.79835	-5.0212275	1981.1525	851.66186	33.196
26	760	303.5	784.7116	-25.686129	1886.0815	817.78324	26.039
27	760	306.5	784.67885	-61.079628	1731.6616	759.8219	16.605
28	760	309	784.743	-96.280962	1653.2277	1033.0513	200
29	760	311	784.8676	-116.535	1527.777	954.66103	200
30	760	313.5	785.1157	-132.01716	1427.6744	892.10997	200
31	760	316.5	785.52555	-157.59602	1347.9967	842.32185	200
32	760	319.375	786.04385	-189.93675	1249.0334	780.4827	200
33	760	322.125	786.66245	-228.53612	1130.6412	706.50306	200
34	760	324.875	787.40195	-274.68244	986.78434	616.61129	200
35	760	327.625	788.26655	-328.62994	814.17592	508.75358	200
36	760	330.6483	789.375	-397.79203	583.94627	364.89013	200
37	760	333.94495	790.76515	-484.54502	278.84899	174.24419	200

G-G'_seismic_(+)hor_(-)ver

File Information

Created By: Graf, Thomas [FWI]
Revision Number: 666
Last Edited By: Osman El Menchawi
Date: 8/3/2013
Time: 7:23:37 PM
File Name: profile_GG'_Buttress_07-31-2013.gsz
Directory: C:\Users\Osman\Desktop\Comanche\Slope Stability\
Last Solved Date: 8/3/2013
Last Solved Time: 7:24:06 PM

Project Settings

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

Analysis Settings

G-G'_seismic_(+)hor_(-)ver

Kind: SLOPE/W
Method: Spencer
Settings
- Apply Phreatic Correction: No
- PWP Conditions Source: Piezometric Line
- Use Staged Rapid Drawdown: No

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: Yes
- Tension Crack
  - Tension Crack Option: (none)

FOS Distribution

FOS Calculation Option: Constant

Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 4 ft
Optimization Maximum Iterations: 4000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 24
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 5 °

Materials

Compacted Fill

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 200 psf
Phi: 32 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Limestone Layer C

Model: Shear/Normal Fn.
Unit Weight: 155 pcf
Strength Function: Unit C Limestone, Lower Bound
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Shale

Model: Shear/Normal Fn.
Unit Weight: 135 pcf
Strength Function: Shale-Fully Softened Lower Bound
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Limestone Layer A

Model: Shear/Normal Fn.
Unit Weight: 145 pcf
Strength Function: Unit A Limestone, Lower Bound
Phi-B: 0 °

Pore Water Pressure
Piezometric Line: 1

Concrete

Model: Mohr-Coulomb
Unit Weight: 155 pcf
Cohesion: 5000 psf
Phi: 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (119.42333, 816.6997) ft
Left-Zone Right Coordinate: (275.45004, 813) ft
Left-Zone Increment: 30
Right Projection: Range
Right-Zone Left Coordinate: (276.23642, 812.8818) ft
Right-Zone Right Coordinate: (393.86004, 767.2652) ft
Right-Zone Increment: 30
Radius Increments: 0

Slip Surface Limits

Left Coordinate: (0, 817) ft
Right Coordinate: (420, 758) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	0	804
	38	804
	170	804
	184.4	803
	205	803
	230	803

	248	803
	259	799
	269	797
	278	793
	290	788
	300	785
	310	783
	318	783
	338	783
	363	783
	382	775
	420	775

Seismic Loads

Horz Seismic Load: 0.1
Vert Seismic Load: -0.1
Ignore seismic load in strength: No

Shear/Normal Strength Functions

Shale-Fully Softened Lower Bound

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Y-Intercept: 3.8193582e-007
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (1000, 449.95299)
Data Point: (2000, 892.95299)
Data Point: (3000, 1302.953)
Data Point: (4000, 1680.953)
Data Point: (5000, 2031.953)
Data Point: (6000, 2356.953)
Data Point: (7000, 2660.953)
Data Point: (8000, 2944.953)
Data Point: (9000, 3213.953)
Data Point: (10000, 3468.953)
Data Point: (11000, 3714.953)
Data Point: (12000, 3952.953)
Data Point: (13000, 4187.953)

Data Point: (14000, 4420.953)
Data Point: (15000, 4656.953)
Data Point: (16000, 4896.953)
Data Point: (17000, 5145.953)
Data Point: (18000, 5404.953)
Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Unit A Limestone, Lower Bound

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Y-Intercept: 6697.4707
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (-1710, 3833)
Data Point: (-299, 6231)
Data Point: (1063, 8237)
Data Point: (2388, 10014)
Data Point: (3684, 11635)
Data Point: (4956, 13137)
Data Point: (6207, 14546)
Data Point: (7440, 15878)
Data Point: (8656, 17146)
Data Point: (9857, 18358)
Data Point: (11045, 19522)
Data Point: (12220, 20643)
Data Point: (13383, 21726)
Data Point: (14536, 22775)
Data Point: (15679, 23793)
Data Point: (16813, 24783)
Data Point: (17938, 25747)
Data Point: (19054, 26689)
Data Point: (20163, 27603)
Data Point: (21264, 28500)
Data Point: (22358, 29377)
Data Point: (23445, 30236)
Data Point: (24526, 31078)
Data Point: (25600, 31904)
Data Point: (26669, 32715)
Data Point: (27732, 33512)

Data Point: (28789, 34295)
Data Point: (29841, 35065)
Data Point: (30888, 35823)
Data Point: (31931, 36569)
Data Point: (32968, 37304)
Data Point: (34001, 38028)
Data Point: (35029, 38742)
Data Point: (36053, 39447)
Data Point: (37073, 40141)
Data Point: (38089, 40827)
Data Point: (39101, 41504)
Data Point: (40109, 42173)

Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Unit C Limestone, Lower Bound

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Y-Intercept: 7248.7668
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (-1613, 4254)
Data Point: (-174, 6947)
Data Point: (1222, 9215)
Data Point: (2584, 11234)
Data Point: (3920, 13080)
Data Point: (5233, 14797)
Data Point: (6527, 16411)
Data Point: (7804, 17941)
Data Point: (9065, 19400)
Data Point: (10312, 20797)
Data Point: (11546, 22141)
Data Point: (12768, 23437)
Data Point: (13980, 24691)
Data Point: (15181, 25906)
Data Point: (16372, 27087)
Data Point: (17555, 28237)
Data Point: (18728, 29357)
Data Point: (19894, 30450)
Data Point: (21052, 31518)

Data Point: (22203, 32563)
Data Point: (23346, 33586)
Data Point: (24483, 34589)
Data Point: (25614, 35573)
Data Point: (26738, 36538)
Data Point: (27857, 37486)
Data Point: (28970, 38419)
Data Point: (30077, 39336)
Data Point: (31179, 40238)
Data Point: (32276, 41126)
Data Point: (33369, 42001)
Data Point: (34456, 42863)
Data Point: (35539, 43714)
Data Point: (36617, 44552)
Data Point: (37692, 45380)
Data Point: (38761, 46196)
Data Point: (39827, 47003)
Data Point: (40889, 47799)
Data Point: (41947, 48586)

Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Regions

	Material	Points	Area (ft^2)
Region 1	Concrete	24,23,36,26,25	64
Region 2	Limestone Layer A	13,37,59,38,39,17,15	1353.4957
Region 3	Limestone Layer C	7,10,19,18,46,44,54,43,34,11,35,2,1,5,8,9	26814.5
Region 4	Shale	54,45,32,33,43	109.65
Region 5	Shale	7,10,19,47,48,49,50,51,52,53,55,16,56,4,3	4578

Region 6	Limestone Layer A	3,12,14,57,41,56,4	774
Region 7	Shale	13,15,17,58,40,57,14,12	1660
Region 8	Compacted Fill	6,20,21,22,23,36,26,27,28,29,30,31,42,45,54,44,46,18,19,47,48,49,50,51,52,53,55,16,56,41,57,40,58,17,39,38,59,37	1860.9043

Points

	X (ft)	Y (ft)
Point 1	415	757
Point 2	405	760
Point 3	0	799
Point 4	181	799
Point 5	420	758
Point 6	0	817
Point 7	0	783
Point 8	420	717.2
Point 9	0	717.2
Point 10	181	783
Point 11	376.7	778
Point 12	0	802
Point 13	0	809
Point 14	181	802
Point 15	181	809
Point 16	268	799
Point 17	229	809
Point 18	318	783
Point 19	308	783
Point 20	57	817
Point 21	93	817
Point 22	181	816
Point 23	253	816
Point 24	253	817

Point 25	269	817
Point 26	269	813
Point 27	276	813
Point 28	282	810
Point 29	292	805
Point 30	302	800
Point 31	312	795
Point 32	347	790
Point 33	358	785
Point 34	370	780
Point 35	382	775
Point 36	253	813
Point 37	0	816
Point 38	181	815
Point 39	200	814
Point 40	248	805
Point 41	258	802
Point 42	329	792.5
Point 43	362.5	783
Point 44	338	782
Point 45	341	790.7
Point 46	318	782
Point 47	308	785
Point 48	298	785
Point 49	298	788
Point 50	288	788
Point 51	288	792
Point 52	278	792
Point 53	278	796
Point 54	338	783
Point 55	268	796
Point 56	258	799
Point 57	248	802
Point 58	229	805
Point 59	58.56299	815.6764

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	1.47	(305.747, 853.08)	44.68628	(249.934, 816)	(334.731, 791.64)
2	760	1.53	(305.747, 853.08)	68.422	(248.244, 816)	(335.593, 791.511)

Slices of Slip Surface: Optimized

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimized	250.84105	814.5738	-786.66498	-8.8453214	-5.5271702	200
2	Optimized	252.3739	812.21195	-674.08315	127.00903	79.364048	200
3	Optimized	253.3357	810.77465	-606.2057	314.92378	196.78622	200
4	Optimized	254.6562	808.83685	-515.24946	430.46085	268.98179	200
5	Optimized	256.6121	806.0908	-388.29563	617.8448	386.07228	200
6	Optimized	258.2916	803.8941	-289.31636	783.64223	489.67401	200
7	Optimized	259.5158	802.3616	-216.19784	876.91595	547.9579	200
8	Optimized	261.1562	800.3748	-112.69537	1027.3939	641.98698	200
9	Optimized	262.78495	798.58795	-21.523376	1456.9087	649.08414	5.7979
10	Optimized	264.4793	797.08985	50.810961	1584.597	680.86574	8.2134
11	Optimized	266.83475	795.08455	146.54676	1807.8606	732.17262	13.328
12	Optimized	268.5	793.7227	210.7464	1910.1481	747.11749	15.172
13	Optimize	269.00065	793.31325	230.03714	1562.8844	596.57436	2.8846

	d						
14	Optimized	270.12565	792.6987	237.18287	1815.8521	699.27326	9.7021
15	Optimized	272.20005	791.5659	250.33915	1923.9306	737.165	13.744
16	Optimized	274.57505	790.3416	260.8679	2089.7607	796.70592	22.268
17	Optimized	277	789.141	268.53472	2161.8458	820.36838	26.578
18	Optimized	278.0818	788.6054	272.09562	2136.56	809.84106	24.591
19	Optimized	279.2818	788.1142	271.54763	2227.4653	842.79643	31.183
20	Optimized	280.8033	787.50095	270.25193	2218.1771	839.99752	30.561
21	Optimized	281.6033	787.2029	268.049	2280.5753	862.56987	35.753
22	Optimized	283.36395	786.6015	259.80446	2257.943	857.60066	34.557
23	Optimized	286.36395	785.73565	235.83129	2319.3035	886.91461	41.719
24	Optimized	288.74785	785.1529	210.21021	2229.0024	864.75498	36.26
25	Optimized	289.74785	784.9334	197.91484	2329.0563	903.07989	45.782
26	Optimized	291	784.75115	184.0064	2282.8985	892.13762	43.027
27	Optimized	293.3674	784.4066	161.18942	2195.6164	870.14982	37.567
28	Optimized	296.3674	784.1431	121.47322	2203.5269	886.4395	41.594
29	Optimized	298.8003	784.047	81.923616	2049.5575	846.98993	32.054
30	Optimized	299.8003	784.0293	64.3102	2144.9638	885.97214	41.469
31	Optimized	301	784.1128	42.88075	2061.4623	864.70646	36.231

32	Optimized	302.77445	784.2363	13.028351	1937.6355	831.73545	28.75
33	Optimized	304.1808	784.3342	-10.631362	1838.0914	800.1787	22.774
34	Optimized	306.40635	784.68895	-60.542493	1809.9311	789.72394	20.984
35	Optimized	308.5203	785.10115	-112.64452	1828.7403	1142.7238	200
36	Optimized	309.5203	785.2957	-137.27005	1723.4733	1076.9457	200
37	Optimized	311	785.58295	-161.17593	1570.4799	981.34477	200
38	Optimized	312.42855	785.8603	-178.48804	1445.2904	903.11771	200
39	Optimized	314.14285	786.229	-201.49032	1396.7728	872.80049	200
40	Optimized	316.7143	786.79995	-237.11577	1251.2946	781.89563	200
41	Optimized	318.353	787.1638	-259.82312	1158.612	723.98112	200
42	Optimized	320.22005	787.6127	-287.8323	1077.0576	673.02026	200
43	Optimized	323.24815	788.3537	-334.08544	890.91589	556.70604	200
44	Optimized	326.83585	789.2712	-391.3116	681.50794	425.85342	200
45	Optimized	328.95475	789.83235	-426.34188	582.18475	363.78941	200
46	Optimized	330.43275	790.29495	-455.20716	466.56402	291.54156	200
47	Optimized	333.29825	791.1919	-511.15887	242.35418	151.4397	200

Slices of Slip Surface: 760

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	760	249.43295	814.2745	-736.05397	19.245063	12.02565	200

2	760	251.811	811.0241	-587.17134	231.09852	144.40638	200
3	760	254.5	807.8015	-447.10744	593.5242	370.87508	200
4	760	257.5	804.61065	-316.07031	860.44642	537.6666	200
5	760	260.20795	802.03975	-204.75608	1096.3627	685.08343	200
6	760	262.62385	799.981	-106.44102	1300.5102	812.64899	200
7	760	264.71085	798.341	-30.150139	1578.3459	699.19594	9.6562
8	760	266.79495	796.84725	37.047699	1754.7689	754.45602	15.876
9	760	268.5	795.688	88.102216	1878.5577	782.30519	19.891
10	760	270.125	794.67735	113.73161	1582.658	654.22323	6.019
11	760	272.4375	793.3292	133.72719	1749.6482	714.29008	11.162
12	760	274.8125	792.06515	146.73613	1914.4084	773.63679	18.586
13	760	277	791	152.53478	2014.6804	808.98846	24.422
14	760	279.2	790.03165	154.02416	2021.0655	810.80545	24.754
15	760	281.2	789.2189	152.7423	2046.3454	820.49489	26.589
16	760	283.5	788.3955	144.32265	2062.995	829.52836	28.397
17	760	286.5	787.43975	125.96008	2071.0052	838.9166	30.381
18	760	289	786.74745	104.15672	2032.5225	833.00032	29.117
19	760	291	786.27425	88.968137	2017.4313	833.04241	29.122
20	760	293.5	785.78055	72.974843	1985.7868	827.43056	27.967
21	760	296.5	785.30295	46.61813	1932.068	817.50936	26.014
22	760	298.45855	785.04915	25.791136	1930.8657	1190.4227	200
23	760	299.45855	784.95	13.254941	1835.1863	794.08956	21.817
24	760	300.41045	784.8679	3.1186551	1807.7488	787.63597	20.756
25	760	301.41045	784.79835	-5.0212275	1775.9868	776.79564	19.06
26	760	303.5	784.7116	-25.686129	1699.5822	747.37384	14.972
27	760	306.5	784.67885	-61.079628	1572.6046	696.8496	9.4504
28	760	309	784.743	-96.280962	1567.8244	979.68544	200
29	760	311	784.8676	-116.535	1463.5671	914.53823	200
30	760	313.5	785.1157	-132.01716	1385.6138	865.82762	200
31	760	316.5	785.52555	-157.59602	1330.1218	831.15232	200
32	760	319.375	786.04385	-189.93675	1255.0913	784.2681	200
33	760	322.125	786.66245	-228.53612	1159.6628	724.63776	200
34	760	324.875	787.40195	-274.68244	1037.7575	648.46285	200
35	760	327.625	788.26655	-328.62994	884.56487	552.73748	200
36	760	330.6483	789.375	-397.79203	670.08745	418.71711	200

37	760	333.94495	790.76515	-484.54502	369.66145	230.99011	200

H-H'_static (Rapid Drawdown)

File Information

Created By: Graf, Thomas [FWI]
Revision Number: 690
Last Edited By: Osman El Menchawi
Date: 8/3/2013
Time: 8:50:10 PM
File Name: profile_HH'_Buttress_07-31-2013.gsz
Directory: C:\Users\Osman\Desktop\Comanche\Slope Stability\
Last Solved Date: 8/3/2013
Last Solved Time: 8:51:18 PM

Project Settings

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

Analysis Settings

H-H'_static (Rapid Drawdown)

Kind: SLOPE/W
Method: Spencer
Settings
- Apply Phreatic Correction: No
- PWP Conditions Source: Piezometric Line
- Use Staged Rapid Drawdown: No

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: Yes
- Tension Crack
  - Tension Crack Option: (none)

FOS Distribution

FOS Calculation Option: Constant

Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 4 ft
Optimization Maximum Iterations: 4000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 24
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 5 °

Materials

Compacted Fill

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 200 psf
Phi: 32 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Limestone Layer C

Model: Shear/Normal Fn.
Unit Weight: 155 pcf
Strength Function: Unit C Limestone, Lower Bound
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Shale

Model: Shear/Normal Fn.
Unit Weight: 135 pcf
Strength Function: Shale-Fully Softened Lower Bound
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Limestone Layer A

Model: Shear/Normal Fn.
Unit Weight: 145 pcf
Strength Function: Unit A Limestone, Lower Bound
Phi-B: 0 °

Pore Water Pressure
Piezometric Line: 1

UHSRS

Model: Mohr-Coulomb
Unit Weight: 122.5 pcf
Cohesion: 5000 psf
Phi: 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Concrete

Model: Mohr-Coulomb
Unit Weight: 155 pcf
Cohesion: 5000 psf
Phi: 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (154.20463, 816) ft
Left-Zone Right Coordinate: (297.27671, 812) ft
Left-Zone Increment: 30
Right Projection: Range
Right-Zone Left Coordinate: (297.27671, 812) ft
Right-Zone Right Coordinate: (407.83974, 799) ft
Right-Zone Increment: 30
Radius Increments: 0

Slip Surface Limits

Left Coordinate: (0, 822) ft
Right Coordinate: (420, 799) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	0	804
	118	804
	140.3	804
	170	803.5
	202.3	803
	240.8	802.2
	270.5	802.1
	304	800.5
	337	799
	420	799

Maximum Suction: 0 psf

Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

Shear/Normal Strength Functions

Shale-Fully Softened Lower Bound

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Y-Intercept: 3.8193582e-007
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (1000, 449.95299)
Data Point: (2000, 892.95299)
Data Point: (3000, 1302.953)
Data Point: (4000, 1680.953)
Data Point: (5000, 2031.953)
Data Point: (6000, 2356.953)
Data Point: (7000, 2660.953)
Data Point: (8000, 2944.953)

Data Point: (9000, 3213.953)
Data Point: (10000, 3468.953)
Data Point: (11000, 3714.953)
Data Point: (12000, 3952.953)
Data Point: (13000, 4187.953)
Data Point: (14000, 4420.953)
Data Point: (15000, 4656.953)
Data Point: (16000, 4896.953)
Data Point: (17000, 5145.953)
Data Point: (18000, 5404.953)

Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Unit A Limestone, Lower Bound

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Y-Intercept: 6697.4707
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (-1710, 3833)
Data Point: (-299, 6231)
Data Point: (1063, 8237)
Data Point: (2388, 10014)
Data Point: (3684, 11635)
Data Point: (4956, 13137)
Data Point: (6207, 14546)
Data Point: (7440, 15878)
Data Point: (8656, 17146)
Data Point: (9857, 18358)
Data Point: (11045, 19522)
Data Point: (12220, 20643)
Data Point: (13383, 21726)
Data Point: (14536, 22775)
Data Point: (15679, 23793)
Data Point: (16813, 24783)
Data Point: (17938, 25747)
Data Point: (19054, 26689)
Data Point: (20163, 27603)
Data Point: (21264, 28500)
Data Point: (22358, 29377)

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Data Point: (24526, 31078)
Data Point: (25600, 31904)
Data Point: (26669, 32715)
Data Point: (27732, 33512)
Data Point: (28789, 34295)
Data Point: (29841, 35065)
Data Point: (30888, 35823)
Data Point: (31931, 36569)
Data Point: (32968, 37304)
Data Point: (34001, 38028)
Data Point: (35029, 38742)
Data Point: (36053, 39447)
Data Point: (37073, 40141)
Data Point: (38089, 40827)
Data Point: (39101, 41504)
Data Point: (40109, 42173)

Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Unit C Limestone, Lower Bound

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Y-Intercept: 7248.7668
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (-1613, 4254)
Data Point: (-174, 6947)
Data Point: (1222, 9215)
Data Point: (2584, 11234)
Data Point: (3920, 13080)
Data Point: (5233, 14797)
Data Point: (6527, 16411)
Data Point: (7804, 17941)
Data Point: (9065, 19400)
Data Point: (10312, 20797)
Data Point: (11546, 22141)
Data Point: (12768, 23437)
Data Point: (13980, 24691)
Data Point: (15181, 25906)

Data Point: (16372, 27087)
Data Point: (17555, 28237)
Data Point: (18728, 29357)
Data Point: (19894, 30450)
Data Point: (21052, 31518)
Data Point: (22203, 32563)
Data Point: (23346, 33586)
Data Point: (24483, 34589)
Data Point: (25614, 35573)
Data Point: (26738, 36538)
Data Point: (27857, 37486)
Data Point: (28970, 38419)
Data Point: (30077, 39336)
Data Point: (31179, 40238)
Data Point: (32276, 41126)
Data Point: (33369, 42001)
Data Point: (34456, 42863)
Data Point: (35539, 43714)
Data Point: (36617, 44552)
Data Point: (37692, 45380)
Data Point: (38761, 46196)
Data Point: (39827, 47003)
Data Point: (40889, 47799)
Data Point: (41947, 48586)

Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Regions

	Material	Points	Area (ft²)
Region 1	Limestone Layer C	4,39,7,14,3,5,6	27636
Region 2	Shale	39,17,35,2,12,32,33,34,3,14,7	4832
Region 3	Limestone Layer A	35,36,10,16,46,45,44,43,42,40,31,32,12,2	621.5
Region 4	Compacted Fill	37,38,52,53,22,26,25,27,28,29,51,13,11,41	1166
Region 5	Concrete	23,22,26,25,24	80
Region 6	UHSRS	18,21,38,37,36,35,17,39,4,19,1,8,9,15,20	4602
Region 7	Compacted Fill	51,50,49,48,47,46,45,44,43,42,40,30,29	288
Region 8	Shale	36,37,41,11,13,51,50,49,48,47,46,16,10	1131

Points

	X (ft)	Y (ft)
Point 1	0	799
Point 2	181	799
Point 3	420	783
Point 4	0	783
Point 5	420	717.2
Point 6	0	717.2
Point 7	181	783
Point 8	0	802
Point 9	0	809
Point 10	181	802
Point 11	181	809
Point 12	276	799
Point 13	227.01361	809
Point 14	289	783
Point 15	0	816
Point 16	269	802
Point 17	118	787
Point 18	118	822
Point 19	0	787
Point 20	0	822
Point 21	118	819
Point 22	271	816
Point 23	271	817
Point 24	287	817
Point 25	287	812
Point 26	271	812
Point 27	298	812
Point 28	304	810
Point 29	308	809
Point 30	320	805
Point 31	334	800
Point 32	337	799

Point 33	371	799
Point 34	420	799
Point 35	118	799
Point 36	118	802
Point 37	118	809
Point 38	118	816
Point 39	118	783
Point 40	326	802
Point 41	125.42744	809
Point 42	321	802
Point 43	321	801
Point 44	301	801
Point 45	301	802
Point 46	291	802
Point 47	291	804
Point 48	281	804
Point 49	281	806
Point 50	271	806
Point 51	271	809
Point 52	165.24682	816
Point 53	246.21278	816

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	2.39	(325.034, 858.651)	46.08801	(268.499, 816)	(364.188, 799)
2	703	2.64	(325.034, 858.651)	74.85	(263.524, 816)	(370.248, 799)

Slices of Slip Surface: Optimized

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimize	269.4996	814.4319	0	47.730965	29.825617	200

	d						
2	Optimized	270.75	812.47195	0	204.47586	127.7707	200
3	Optimized	271.54295	811.22905	0	479.04337	299.33952	200
4	Optimized	272.6074	809.689	0	655.31065	409.48354	200
5	Optimized	274.26415	807.5	0	841.46161	525.80357	200
6	Optimized	275.84195	805.4153	0	1160.9346	521.7447	0.60265
7	Optimized	277.17375	803.4153	0	1279.817	573.75017	1.9527
8	Optimized	278.1476	801.86535	0	-935.01404	-1593.5654	6772.6
9	Optimized	279.0592	800.41455	79.664666	-803.53039	-1499.3078	6766.5
10	Optimized	279.9327	799.0492	162.25856	-24.801811	-293.19667	6701.1
11	Optimized	280.4896	798.46015	197.35266	2005.4944	788.90566	20.995
12	Optimized	282.60045	796.2274	330.38986	2240.4441	826.39599	27.793
13	Optimized	285.60045	793.2276	508.63125	2644.8616	904.66463	46.352
14	Optimized	287.00375	791.9172	586.22152	2178.3843	704.75167	10.218
15	Optimized	288.82915	791.22335	624.08851	2547.4823	831.25094	28.731
16	Optimized	290.8254	790.4648	665.46838	2635.9216	847.91822	32.352
17	Optimized	292.29175	789.8922	696.81411	2689.6895	855.71245	34.168
18	Optimized	294.87525	788.88335	752.08763	2816.5698	880.36334	40.183
19	Optimized	297.0835	788.011	799.92467	2918.9656	898.91214	44.832

20	Optimized	299.5	787.041	853.26096	2983.7685	902.76737	45.819
21	Optimized	301.1534	786.37735	889.73187	2986.1013	891.23817	42.893
22	Optimized	302.6534	785.91385	914.17227	3058.3179	907.39884	46.985
23	Optimized	305.08355	785.1885	952.35021	3066.9497	897.42002	44.445
24	Optimized	307.08355	784.6624	979.54348	3131.3642	909.98276	47.644
25	Optimized	309.43365	784.14265	1005.2899	3114.3519	895.54785	43.971
26	Optimized	312.9957	783.53175	1033.3084	3111.5842	885.08815	41.34
27	Optimized	316.54335	783.13875	1047.762	3067.9715	865.19518	36.437
28	Optimized	318.9813	783.03325	1047.4167	3026.7157	851.0288	33.046
29	Optimized	320.5	783.0238	1043.6802	2952.9439	826.17263	27.682
30	Optimized	322.7504	783.00985	1038.2089	2831.9513	783.55497	20.084
31	Optimized	325.2504	783.0951	1025.8063	2749.5313	756.77002	16.188
32	Optimized	327.62535	783.3995	1000.0482	2594.511	705.70322	10.285
33	Optimized	331.62535	784.1973	938.93586	2399.5527	650.73621	5.7785
34	Optimized	334.01245	784.7899	895.18328	2218.1533	592.40281	2.6416
35	Optimized	335.27385	785.23285	863.9768	2143.3089	573.55962	1.929
36	Optimized	336.7614	785.78135	825.52325	2034.8183	543.02217	1.0401
37	Optimized	339.34065	786.95595	751.55549	1841.5724	490.26183	0.17876
38	Optimize	342.4124	788.3663	663.5464	1632.9119	436.17897	-

	d						0.00010287
39	Optimized	345.4972	789.7577	576.72607	1409.13	374.55129	-8.8286e-005
40	Optimized	350.1871	791.90885	442.47856	1089.3908	291.08683	-6.8525e-005
41	Optimized	354.90815	794.17895	300.83781	743.95767	199.38771	3.5528e-006
42	Optimized	358.37015	795.86255	195.77885	483.04611	129.25975	1.3323e-005
43	Optimized	361.81775	797.6901	81.737908	205.77556	55.812401	-2.2557e-006

Slices of Slip Surface: 703

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	703	264.89865	814.14295	0	95.931103	59.944406	200
2	703	267.64755	810.64295	0	426.13116	266.2763	200
3	703	269.761	808.1905	0	771.2909	347.05265	-8.1774e-005
4	703	270.75	807.11765	0	892.6051	401.6396	-2.7054e-005
5	703	271.41605	806.42715	0	1061.7826	663.47542	200
6	703	274.07615	803.911	0	1466.6265	653.26023	5.9522
7	703	278.07	800.411	82.830979	354.4084	402.25137	6703.8
8	703	280.4099	798.5618	191.24819	2184.4497	855.85247	34.197
9	703	282.5	797.08725	277.04318	2369.9231	890.01344	42.599
10	703	285.5	795.1175	391.01381	2645.6545	944.29275	56.618
11	703	289	793.08495	507.39701	2249.8639	763.98288	17.194
12	703	292.75	791.14885	617.03352	2506.7712	819.09423	26.308
13	703	296.25	789.5826	704.34143	2736.1899	869.17279	37.433
14	703	299.5	788.3088	774.14232	2870.8156	891.32414	42.926
15	703	302.5	787.29065	828.73069	2893.5326	880.45712	40.215
16	703	306	786.2909	880.98165	2935.8802	877.08201	39.374
17	703	310	785.3546	928.05476	2953.0239	866.77359	36.866

18	703	314	784.6462	960.90365	2918.2432	843.28759	31.328
19	703	318	784.15915	979.96611	2851.5662	812.47463	25.055
20	703	320.5	783.93995	986.54476	2786.4729	785.84557	20.469
21	703	323.5	783.85835	983.13335	2651.6426	735.20467	13.482
22	703	328	783.88645	968.61294	2446.5252	657.94711	6.2831
23	703	332	784.15285	940.64643	2286.1517	602.07086	3.0637
24	703	335.5	784.55175	905.84195	2100.1209	536.42961	0.88966
25	703	338.8471	785.11055	866.69102	1963.9622	493.50159	0.21018
26	703	342.5413	785.902	817.31298	1872.4639	474.69069	0.065786
27	703	346.23545	786.89225	755.52077	1751.1218	447.984	-0.00010568
28	703	349.9296	788.0897	680.81374	1597.6276	412.53265	-9.7289e-005
29	703	353.6238	789.50515	592.4697	1409.1543	367.47816	-2.4722e-005
30	703	357.318	791.15235	489.69666	1181.9338	311.48136	-7.3364e-005
31	703	361.01215	793.0488	371.35034	911.07339	242.8556	-5.7115e-005
32	703	364.7063	795.217	236.07099	589.94796	159.23167	1.6325e-005
33	703	368.4005	797.6861	81.987915	209.30973	57.290152	-1.1194e-006

H-H'_seismic_(+)hor_(-)ver (Rapid Drawdown)

File Information

Created By: Graf, Thomas [FWI]
Revision Number: 690
Last Edited By: Osman El Menchawi
Date: 8/3/2013
Time: 8:50:10 PM
File Name: profile_HH'_Buttress_07-31-2013.gsz
Directory: C:\Users\Osman\Desktop\Comanche\Slope Stability\
Last Solved Date: 8/3/2013
Last Solved Time: 8:50:48 PM

Project Settings

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

Analysis Settings

H-H'_seismic_(+)hor_(-)ver (Rapid Drawdown)

Kind: SLOPE/W
Method: Spencer
Settings
- Apply Phreatic Correction: No
- PWP Conditions Source: Piezometric Line
- Use Staged Rapid Drawdown: No

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: Yes

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 4 ft
Optimization Maximum Iterations: 4000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 24
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 5 °

Materials

Compacted Fill

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 200 psf
Phi: 32 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Limestone Layer C

Model: Shear/Normal Fn.
Unit Weight: 155 pcf
Strength Function: Unit C Limestone, Lower Bound
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Shale

Model: Shear/Normal Fn.
Unit Weight: 135 pcf
Strength Function: Shale-Fully Softened Lower Bound
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Limestone Layer A

Model: Shear/Normal Fn.

Unit Weight: 145 pcf
Strength Function: Unit A Limestone, Lower Bound
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

UHSRS

Model: Mohr-Coulomb
Unit Weight: 122.5 pcf
Cohesion: 5000 psf
Phi: 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Concrete

Model: Mohr-Coulomb
Unit Weight: 155 pcf
Cohesion: 5000 psf
Phi: 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (154.20463, 816) ft
Left-Zone Right Coordinate: (297.27671, 812) ft
Left-Zone Increment: 30
Right Projection: Range
Right-Zone Left Coordinate: (297.27671, 812) ft
Right-Zone Right Coordinate: (407.83974, 799) ft
Right-Zone Increment: 30
Radius Increments: 0

Slip Surface Limits

Left Coordinate: (0, 822) ft
Right Coordinate: (420, 799) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	0	804
	118	804
	140.3	804
	170	803.5
	202.3	803
	240.8	802.2
	270.5	802.1
	304	800.5
	337	799
	420	799

Seismic Loads

Horz Seismic Load: 0.1
Vert Seismic Load: -0.1
Ignore seismic load in strength: No

Shear/Normal Strength Functions

Shale-Fully Softened Lower Bound

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Y-Intercept: 3.8193582e-007
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (1000, 449.95299)
Data Point: (2000, 892.95299)
Data Point: (3000, 1302.953)
Data Point: (4000, 1680.953)
Data Point: (5000, 2031.953)
Data Point: (6000, 2356.953)
Data Point: (7000, 2660.953)
Data Point: (8000, 2944.953)

Data Point: (9000, 3213.953)
Data Point: (10000, 3468.953)
Data Point: (11000, 3714.953)
Data Point: (12000, 3952.953)
Data Point: (13000, 4187.953)
Data Point: (14000, 4420.953)
Data Point: (15000, 4656.953)
Data Point: (16000, 4896.953)
Data Point: (17000, 5145.953)
Data Point: (18000, 5404.953)

Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Unit A Limestone, Lower Bound

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Y-Intercept: 6697.4707
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (-1710, 3833)
Data Point: (-299, 6231)
Data Point: (1063, 8237)
Data Point: (2388, 10014)
Data Point: (3684, 11635)
Data Point: (4956, 13137)
Data Point: (6207, 14546)
Data Point: (7440, 15878)
Data Point: (8656, 17146)
Data Point: (9857, 18358)
Data Point: (11045, 19522)
Data Point: (12220, 20643)
Data Point: (13383, 21726)
Data Point: (14536, 22775)
Data Point: (15679, 23793)
Data Point: (16813, 24783)
Data Point: (17938, 25747)
Data Point: (19054, 26689)
Data Point: (20163, 27603)
Data Point: (21264, 28500)
Data Point: (22358, 29377)

Data Point: (23445, 30236)
Data Point: (24526, 31078)
Data Point: (25600, 31904)
Data Point: (26669, 32715)
Data Point: (27732, 33512)
Data Point: (28789, 34295)
Data Point: (29841, 35065)
Data Point: (30888, 35823)
Data Point: (31931, 36569)
Data Point: (32968, 37304)
Data Point: (34001, 38028)
Data Point: (35029, 38742)
Data Point: (36053, 39447)
Data Point: (37073, 40141)
Data Point: (38089, 40827)
Data Point: (39101, 41504)
Data Point: (40109, 42173)

Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Unit C Limestone, Lower Bound

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Y-Intercept: 7248.7668
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (-1613, 4254)
Data Point: (-174, 6947)
Data Point: (1222, 9215)
Data Point: (2584, 11234)
Data Point: (3920, 13080)
Data Point: (5233, 14797)
Data Point: (6527, 16411)
Data Point: (7804, 17941)
Data Point: (9065, 19400)
Data Point: (10312, 20797)
Data Point: (11546, 22141)
Data Point: (12768, 23437)
Data Point: (13980, 24691)
Data Point: (15181, 25906)

Data Point: (16372, 27087)
Data Point: (17555, 28237)
Data Point: (18728, 29357)
Data Point: (19894, 30450)
Data Point: (21052, 31518)
Data Point: (22203, 32563)
Data Point: (23346, 33586)
Data Point: (24483, 34589)
Data Point: (25614, 35573)
Data Point: (26738, 36538)
Data Point: (27857, 37486)
Data Point: (28970, 38419)
Data Point: (30077, 39336)
Data Point: (31179, 40238)
Data Point: (32276, 41126)
Data Point: (33369, 42001)
Data Point: (34456, 42863)
Data Point: (35539, 43714)
Data Point: (36617, 44552)
Data Point: (37692, 45380)
Data Point: (38761, 46196)
Data Point: (39827, 47003)
Data Point: (40889, 47799)
Data Point: (41947, 48586)

Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Regions

	Material	Points	Area (ft²)
Region 1	Limestone Layer C	4,39,7,14,3,5,6	27636
Region 2	Shale	39,17,35,2,12,32,33,34,3,14,7	4832
Region 3	Limestone Layer A	35,36,10,16,46,45,44,43,42,40,31,32,12,2	621.5
Region 4	Compacted Fill	37,38,52,53,22,26,25,27,28,29,51,13,11,41	1166
Region 5	Concrete	23,22,26,25,24	80
Region 6	UHSRS	18,21,38,37,36,35,17,39,4,19,1,8,9,15,20	4602
Region 7	Compacted Fill	51,50,49,48,47,46,45,44,43,42,40,30,29	288
Region 8	Shale	36,37,41,11,13,51,50,49,48,47,46,16,10	1131

Points

	X (ft)	Y (ft)
Point 1	0	799
Point 2	181	799
Point 3	420	783
Point 4	0	783
Point 5	420	717.2
Point 6	0	717.2
Point 7	181	783
Point 8	0	802
Point 9	0	809
Point 10	181	802
Point 11	181	809
Point 12	276	799
Point 13	227.01361	809
Point 14	289	783
Point 15	0	816
Point 16	269	802
Point 17	118	787
Point 18	118	822
Point 19	0	787
Point 20	0	822
Point 21	118	819
Point 22	271	816
Point 23	271	817
Point 24	287	817
Point 25	287	812
Point 26	271	812
Point 27	298	812
Point 28	304	810
Point 29	308	809
Point 30	320	805
Point 31	334	800
Point 32	337	799

Point 33	371	799
Point 34	420	799
Point 35	118	799
Point 36	118	802
Point 37	118	809
Point 38	118	816
Point 39	118	783
Point 40	326	802
Point 41	125.42744	809
Point 42	321	802
Point 43	321	801
Point 44	301	801
Point 45	301	802
Point 46	291	802
Point 47	291	804
Point 48	281	804
Point 49	281	806
Point 50	271	806
Point 51	271	809
Point 52	165.24682	816
Point 53	246.21278	816

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	1.45	(325.034, 858.651)	53.83443	(267.416, 816)	(385.987, 799)
2	703	1.66	(325.034, 858.651)	74.85	(263.524, 816)	(370.248, 799)

Slices of Slip Surface: Optimized

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimiz	268.5226	814.3589	-764.54685	3.5552565	2.2215708	200

	ed						
2	Optimized	270.06485	812.0767	-622.45518	139.08337	86.908934	200
3	Optimized	270.75	811.0673	-560.30404	198.72299	124.17591	200
4	Optimized	271.5766	809.8495	-486.77564	400.65862	250.3593	200
5	Optimized	272.92275	807.8663	-367.02631	517.84354	323.58456	200
6	Optimized	273.899	806.3663	-276.34621	529.10682	330.62264	200
7	Optimized	275.28645	803.9075	-127.05259	850.38852	382.64368	-2.6155e-005
8	Optimized	277.23235	800.4591	82.328118	-1572.4076	-2899.8845	6829.8
9	Optimized	279.52825	797.8083	240.89559	1730.7684	662.71106	6.8487
10	Optimized	282.5438	795.33455	386.25852	1986.9132	707.90922	10.808
11	Optimized	285.5134	792.97685	524.53201	2212.4285	742.48125	14.745
12	Optimized	286.9991	791.79765	593.69883	2680.6607	887.79783	42.332
13	Optimized	289	790.99215	637.99441	2170.5493	680.44729	8.0849
14	Optimized	291.5093	789.982	693.55291	2262.6924	695.34689	9.3964
15	Optimized	293.43085	789.21265	735.84553	2347.1309	712.34181	11.058
16	Optimized	296.42155	788.0691	798.26881	2499.3926	747.87458	15.141
17	Optimized	299.5333	786.92725	860.25778	2572.3854	752.17743	15.698
18	Optimized	302.5333	785.9655	911.33969	2656.3225	764.90441	17.39
19	Optimized	305.6286	785.1232	954.8956	2658.3862	748.84416	15.22

20	Optimized	307.6286	784.61015	981.24191	2753.4417	775.32351	18.872
21	Optimized	310.57105	784.05665	1007.4259	2715.8509	750.79983	15.433
22	Optimized	314.64515	783.43055	1034.9333	2744.2902	751.2094	15.451
23	Optimized	317.65125	783.1456	1044.206	2666.4326	716.84047	11.42
24	Optimized	319.57715	783.0033	1047.6077	2718.7046	736.24039	13.558
25	Optimized	320.5	783.0038	1045	2672.9	719.10973	11.632
26	Optimized	323.5	783.0054	1036.3598	2515.5995	658.50714	6.3024
27	Optimized	326.37225	783.0069	1028.1112	2356.2196	594.62024	2.7261
28	Optimized	329.56615	783.27295	1002.4605	2305.8251	583.97889	2.2877
29	Optimized	333.1939	783.67805	966.88308	2200.8066	553.82256	1.2976
30	Optimized	334.82795	783.96035	944.61668	2092.0338	515.76597	0.48585
31	Optimized	336.32795	784.2688	921.12364	2045.1112	505.39944	0.33359
32	Optimized	339.9067	785.1497	864.2529	1889.7911	461.43312	0.011574
33	Optimized	345.6521	786.62995	771.8949	1706.8561	420.69831	-2.829e-005
34	Optimized	351.3857	788.1996	673.94191	1496.5338	370.13621	-2.4842e-005
35	Optimized	356.49635	789.63515	584.37064	1301.828	322.82955	-2.1617e-005
36	Optimized	361.4272	791.06325	495.25095	1108.285	275.84287	-1.8413e-005
37	Optimized	365.8339	792.33485	415.89822	924.57878	228.88762	4.0131e-006
38	Optimiz	369.26275	793.3606	351.88907	796.93493	200.25434	-4.689e-

	ed						005
39	Optimized	373.94775	794.8482	259.07071	586.72038	147.43035	-3.442e-005
40	Optimized	377.2605	795.9169	192.37905	446.18086	114.20152	-7.3919e-006
41	Optimized	379.7159	796.7872	138.07853	318.44497	81.158291	1.1886e-005
42	Optimized	383.8967	798.2624	46.025426	106.14607	27.052087	-5.3901e-006

Slices of Slip Surface: 703

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	703	264.89865	814.14295	-750.29563	38.472426	24.04024	200
2	703	267.64755	810.64295	-532.47721	290.00074	181.21257	200
3	703	269.761	808.1905	-379.89316	590.41981	265.66729	-1.776e-005
4	703	270.75	807.11765	-313.84317	686.67651	308.97928	-2.0718e-005
5	703	271.41605	806.42715	-272.74473	786.05286	491.18034	200
6	703	274.07615	803.911	-123.66435	1145.1363	514.76479	0.48003
7	703	278.07	800.411	82.830979	-212.01332	-469.18488	6706.8
8	703	280.4099	798.5618	191.24819	1755.682	693.523	9.1389
9	703	282.5	797.08725	277.04318	1920.1873	725.1583	12.323
10	703	285.5	795.1175	391.01381	2165.7456	776.32051	18.983
11	703	289	793.08495	507.39701	1864.9179	607.19157	3.3014
12	703	292.75	791.14885	617.03352	2098.6975	659.49341	6.3939
13	703	296.25	789.5826	704.34143	2310.6893	710.46062	10.77
14	703	299.5	788.3088	774.14232	2443.3094	735.45971	13.509
15	703	302.5	787.29065	828.73069	2479.8348	728.32696	12.683
16	703	306	786.2909	880.98165	2535.9835	729.87376	12.856
17	703	310	785.3546	928.05476	2573.1815	725.93036	12.423
18	703	314	784.6462	960.90365	2564.8989	709.52051	10.678
19	703	318	784.15915	979.96611	2527.7565	686.7591	8.5467
20	703	320.5	783.93995	986.54476	2483.2309	665.74168	6.85
21	703	323.5	783.85835	983.13335	2377.7002	622.973	4.1023

22	703	328	783.88645	968.61294	2214.1081	558.85956	1.4627
23	703	332	784.15285	940.64643	2087.1448	515.35302	0.49123
24	703	335.5	784.55175	905.84195	1931.6927	461.57373	0.014103
25	703	338.8471	785.11055	866.69102	1821.0967	429.44759	-0.00010129
26	703	342.5413	785.902	817.31298	1755.3214	422.06944	-2.8451e-005
27	703	346.23545	786.89225	755.52077	1661.3513	407.59056	-9.6118e-005
28	703	349.9296	788.0897	680.81374	1536.1067	384.85052	-9.0741e-005
29	703	353.6238	789.50515	592.4697	1375.4833	352.32744	-8.3044e-005
30	703	357.318	791.15235	489.69666	1173.8752	307.85526	-2.0654e-005
31	703	361.01215	793.0488	371.35034	923.43908	248.41971	-3.7525e-005
32	703	364.7063	795.217	236.07099	612.71506	169.47604	-1.1204e-005
33	703	368.4005	797.6861	81.987915	224.06663	63.930216	-1.295e-006

APPENDIX B

Slope Stability Calculations
For
Temporary Cut Slopes

Unit 3 Temporary Cut

File Information

Created By: Shu, Shanzhi [FWI]
Revision Number: 239
Last Edited By: Shu, Shanzhi [FWI]
Date: 5/20/2008
Time: 2:39:34 PM
File Name: Unit 3 Cut Slope-400_3000.gsz
Directory: M:\S Shu\TXU\Slope Stability\Latest_04-20-08\
Last Solved Date: 5/20/2008
Last Solved Time: 3:17:10 PM

Project Settings

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

Analysis Settings

23' TC_block

Description: Construction Cuts
Kind: SLOPE/W
Method: Spencer
Settings
    Apply Phreatic Correction: No
    PWP Conditions Source: Piezometric Line
    Use Staged Rapid Drawdown: No
SlipSurface
    Direction of movement: Left to Right
    Allow Passive Mode: No
    Slip Surface Option: Block
    Critical slip surfaces saved: 30
    Optimize Critical Slip Surface Location: Yes

Tension Crack
Tension Crack Option: Tension Crack Line
Percentage Wet: 0
Tension Crack Fluid Unit Weight: 62.4 pcf
FOS Distribution
FOS Calculation Option: Constant
Restrict Block Crossing: No
Advanced
Number of Slices: 50
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Minimum Slice Width: 0.001 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 5
Ending Optimization Points: 30
Complete Passes per Insertion: 1

Materials

Shale

Model: Anisotropic Strength
Unit Weight: 135 pcf
C-Horizontal: 400 psf
C-Vertical: 3000 psf
Phi-Horizontal: 25 °
Phi-Vertical: 25 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Unit A Limestone, Lower Bound

Model: Shear/Normal Fn.
Unit Weight: 145 pcf
Strength Function: Unit A Limestone, Lower Bound
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Unit C Limestone, Lower Bound

Model: Shear/Normal Fn.
Unit Weight: 155 pcf
Strength Function: Unit C Limestone, Lower Bound

Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Limits

Left Coordinate: (5, 822) ft
Right Coordinate: (130, 782) ft

Slip Surface Block

Left Grid
Upper Left: (52, 799) ft
Lower Left: (52, 790) ft
Lower Right: (69, 790) ft
X Increments: 15
Y Increments: 10
Starting Angle: 115 °
Ending Angle: 135 °
Angle Increments: 10
Right Grid
Upper Left: (70, 788) ft
Lower Left: (70, 782) ft
Lower Right: (81, 782) ft
X Increments: 15
Y Increments: 4
Starting Angle: 0 °
Ending Angle: 0 °
Angle Increments: 0

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	5	780
	130	780

Tension Crack Line

	X (ft)	Y (ft)
	35	799
	75.5	799

Shear/Normal Strength Functions

Unit A Limestone, Lower Bound

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Y-Intercept: 6697.4707
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (-1710, 3833)
Data Point: (-299, 6231)
Data Point: (1063, 8237)
Data Point: (2388, 10014)
Data Point: (3684, 11635)
Data Point: (4956, 13137)
Data Point: (6207, 14546)
Data Point: (7440, 15878)
Data Point: (8656, 17146)
Data Point: (9857, 18358)
Data Point: (11045, 19522)
Data Point: (12220, 20643)
Data Point: (13383, 21726)
Data Point: (14536, 22775)
Data Point: (15679, 23793)
Data Point: (16813, 24783)
Data Point: (17938, 25747)
Data Point: (19054, 26689)
Data Point: (20163, 27603)
Data Point: (21264, 28500)
Data Point: (22358, 29377)
Data Point: (23445, 30236)
Data Point: (24526, 31078)
Data Point: (25600, 31904)
Data Point: (26669, 32715)
Data Point: (27732, 33512)
Data Point: (28789, 34295)

Data Point: (29841, 35065)
Data Point: (30888, 35823)
Data Point: (31931, 36569)
Data Point: (32968, 37304)
Data Point: (34001, 38028)
Data Point: (35029, 38742)
Data Point: (36053, 39447)
Data Point: (37073, 40141)
Data Point: (38089, 40827)
Data Point: (39101, 41504)
Data Point: (40109, 42173)

Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Unit C Limestone, Lower Bound

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Y-Intercept: 7248.7668
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (-1613, 4254)
Data Point: (-174, 6947)
Data Point: (1222, 9215)
Data Point: (2584, 11234)
Data Point: (3920, 13080)
Data Point: (5233, 14797)
Data Point: (6527, 16411)
Data Point: (7804, 17941)
Data Point: (9065, 19400)
Data Point: (10312, 20797)
Data Point: (11546, 22141)
Data Point: (12768, 23437)
Data Point: (13980, 24691)
Data Point: (15181, 25906)
Data Point: (16372, 27087)
Data Point: (17555, 28237)
Data Point: (18728, 29357)
Data Point: (19894, 30450)
Data Point: (21052, 31518)

Data Point: (22203, 32563)
Data Point: (23346, 33586)
Data Point: (24483, 34589)
Data Point: (25614, 35573)
Data Point: (26738, 36538)
Data Point: (27857, 37486)
Data Point: (28970, 38419)
Data Point: (30077, 39336)
Data Point: (31179, 40238)
Data Point: (32276, 41126)
Data Point: (33369, 42001)
Data Point: (34456, 42863)
Data Point: (35539, 43714)
Data Point: (36617, 44552)
Data Point: (37692, 45380)
Data Point: (38761, 46196)
Data Point: (39827, 47003)
Data Point: (40889, 47799)
Data Point: (41947, 48586)

Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Regions

	Material	Points	Area (ft²)
Region 1	Shale	1,2,3,4	130.5
Region 2	Unit A Limestone, Lower Bound	4,3,5,6	667.5
Region 3	Shale	6,5,7,8	343.125
Region 4	Shale	10,9,11,12	646.875
Region 5	Unit C Limestone, Lower Bound	14,17,16,15,13	2125
Region 6	Unit A Limestone, Lower Bound	8,7,9,10	420
Region 7	Unit A Limestone, Lower Bound	12,11,19,18	146.5
Region 8	Shale	18,19,13,14	445.5

Points

	X (ft)	Y (ft)
Point 1	5	822
Point 2	70	822
Point 3	70.5	820
Point 4	5	820
Point 5	73	810
Point 6	5	810
Point 7	74.25	805
Point 8	5	805
Point 9	75.75	799
Point 10	5	799
Point 11	78	790
Point 12	5	790
Point 13	80	782
Point 14	5	782
Point 15	130	782
Point 16	130	765
Point 17	5	765
Point 18	5	788
Point 19	78.5	788

Critical Slip Surfaces

	Number	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	1.42	(85.792, 833.234)	20.87923	(59.7696, 822)	(80, 782)
2	39286	1.42	(85.792, 833.234)	20.879	(59.7696, 822)	(80, 782)
3	25048	1.50	(85.792, 833.234)	20.773	(59.9283, 822)	(80, 782)
4	26728	1.52	(85.792, 833.234)	21.33	(62.6065, 822)	(80, 782)
5	11769	1.54	(85.792, 833.234)	20.915	(60.8887, 822)	(80, 782)
6	51367	1.55	(85.792, 833.234)	20.751	(59.2421, 822)	(80, 782)
7	134484	1.56	(85.792, 833.234)	21.373	(60.2274, 822)	(80, 782)
8	10885	1.56	(85.792, 833.234)	21.223	(59.7553, 822)	(80, 782)
9	106724	1.56	(85.792, 833.234)	21.457	(60.5777, 822)	(80, 782)
10	38247	1.57	(85.792, 833.234)	20.758	(59.4252, 822)	(80, 782)
11	12648	1.58	(85.792, 833.234)	21.204	(62.022, 822)	(80, 782)
12	65383	1.58	(85.792, 833.234)	18.869	(60.0887, 822)	(79.625, 783.5)

13	147603	1.59	(85.792, 833.234)	21.618	(59.9333, 822)	(80, 782)
14	147443	1.59	(85.792, 833.234)	21.618	(59.9333, 822)	(80, 782)
15	147683	1.59	(85.792, 833.234)	21.618	(59.9333, 822)	(80, 782)
16	147043	1.59	(85.792, 833.234)	21.618	(59.9333, 822)	(80, 782)
17	147123	1.59	(85.792, 833.234)	21.618	(59.9333, 822)	(80, 782)
18	147763	1.59	(85.792, 833.234)	21.618	(59.9333, 822)	(80, 782)
19	147523	1.59	(85.792, 833.234)	21.618	(59.9333, 822)	(80, 782)
20	147363	1.59	(85.792, 833.234)	21.618	(59.9333, 822)	(80, 782)
21	147283	1.59	(85.792, 833.234)	21.618	(59.9333, 822)	(80, 782)
22	146963	1.59	(85.792, 833.234)	21.618	(59.9333, 822)	(80, 782)
23	147203	1.59	(85.792, 833.234)	21.618	(59.9333, 822)	(80, 782)
24	134164	1.60	(85.792, 833.234)	21.417	(60.4365, 822)	(80, 782)
25	37204	1.62	(85.792, 833.234)	21.244	(59.0071, 822)	(80, 782)
26	40006	1.62	(85.792, 833.234)	21.333	(61.6918, 822)	(80, 782)
27	22324	1.63	(85.792, 833.234)	21.058	(56.9398, 822)	(80, 782)
28	53929	1.63	(85.792, 833.234)	21.302	(62.9479, 822)	(80, 782)
29	53126	1.64	(85.792, 833.234)	21.339	(61.5087, 822)	(80, 782)
30	24004	1.65	(85.792, 833.234)	21.402	(59.5997, 822)	(80, 782)
31	92566	1.65	(85.792, 833.234)	21.01	(60.2045, 822)	(80, 782)

Slices of Slip Surface: Optimized

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimized	59.977785	798.74285	-1169.5593	-265.03482	-123.58777	1970.3
2	Optimized	60.39425	798.22855	-1137.4631	-12.193959	-5.6861365	1970.3
3	Optimized	60.81071	797.71425	-1105.367	240.64539	112.21479	1970.3
4	Optimized	61.22717	797.2	-1073.286	493.4855	230.11607	1970.3
5	Optimized	61.64363	796.68575	-1041.1899	746.31049	348.0103	1970.3
6	Optimized	62.06009	796.17145	-1009.0938	999.1506	465.91158	1970.3
7	Optimized	62.47655	795.65715	-977.01274	1251.9907	583.81286	1970.3
8	Optimized	62.89301	795.14285	-944.91661	1504.8157	701.70709	1970.3
9	Optimized	63.30947	794.62855	-912.82048	1757.7314	819.6436	1970.3
10	Optimized	63.72593	794.11425	-880.72436	2010.5413	937.53078	1970.3
11	Optimized	64.14239	793.6	-848.64334	2263.3511	1055.418	1970.3
12	Optimized	64.55885	793.08575	-816.54722	2516.161	1173.3052	1970.3
13	Optimized	64.97531	792.57145	-784.45109	2768.9709	1291.1923	1970.3
14	Optimized	65.39177	792.05715	-752.37007	3021.7808	1409.0795	1970.3
15	Optimized	65.785205	791.575	-722.27394	3279.8035	1529.3975	1949.9
16	Optimized	66.155615	791.125	-694.20448	3490.496	1627.645	1949.9
17	Optimized	66.52602	790.675	-666.11786	3701.1886	1725.8926	1949.9
18	Optimized	66.896425	790.225	-638.0484	3911.8811	1824.1401	1949.9
19	Optimized	67.287415	789.75	-608.40043	-3072.5766	-5386.3634	6830.7
20	Optimized	67.69898	789.25	-577.19289	-3043.8552	-5336.0134	6830.7
21	Optimized	68.110545	788.75	-546.00079	-3015.2881	-5285.9341	6830.7
22	Optimized	68.52211	788.25	-514.79324	-2986.5667	-5235.5842	6830.7
23	Optimized	68.93991	787.7424	-483.12111	5143.9996	2398.6864	1949.9

24	Optimized	69.363945	787.22725	-450.98797	5385.2979	2511.2056	1949.9
25	Optimized	69.78798	786.7121	-418.83985	5626.4463	2623.655	1949.9
26	Optimized	70.25	786.1508	-383.81785	5421.0125	2527.8596	1949.9
27	Optimized	70.708335	785.594	-349.06995	4794.3353	2235.6353	1949.9
28	Optimized	71.125	785.0878	-317.48191	4193.0796	1955.2651	1949.9
29	Optimized	71.541665	784.5816	-285.89387	3591.6714	1674.8239	1949.9
30	Optimized	71.958335	784.0754	-254.30583	2990.4158	1394.4538	1949.9
31	Optimized	72.375	783.5692	-222.71779	2389.1601	1114.0836	1949.9
32	Optimized	72.791665	783.063	-191.12976	1787.9044	833.71351	1949.9
33	Optimized	73.166665	782.60745	-162.70472	1269.8514	592.14145	1949.9
34	Optimized	73.5	782.2025	-137.43505	835.0583	389.39408	1949.9
35	Optimized	73.958335	782	-124.80001	2076.8573	968.45445	400
36	Optimized	74.4375	782	-124.8	1890.9067	881.74426	400
37	Optimized	74.8125	782	-124.8	1738.9333	810.87793	400
38	Optimized	75.1875	782	-124.8	1586.96	740.0116	400
39	Optimized	75.5625	782	-124.8	1435.0133	669.15771	400
40	Optimized	75.9375	782	-124.8	1288.2667	600.72861	400
41	Optimized	76.3125	782	-124.8	1146.8	534.76162	400
42	Optimized	76.6875	782	-124.8	1005.3067	468.7822	400
43	Optimized	77.0625	782	-124.8	863.81333	402.80277	400
44	Optimized	77.4375	782	-124.8	722.32	336.82335	400
45	Optimized	77.8125	782	-124.8	580.85333	270.85636	400
46	Optimized	78.25	782	-124.8	408.8	190.62657	400
47	Optimized	78.6875	782	-124.8	236.73867	110.39305	400
48	Optimized	79.0625	782	-124.8	95.253333	44.417359	400
49	Optimized	79.4375	782	-124.8	-46.232	-21.558336	400
50	Optimized	79.8125	782	-124.8	-187.71733	-87.53403	400

Slices of Slip Surface: 39286

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	39286	59.977785	798.74285	-1169.5593	-265.03482	-123.58777	1970.3
2	39286	60.39425	798.22855	-1137.4631	-12.193959	-5.6861365	1970.3
3	39286	60.81071	797.71425	-1105.367	240.64539	112.21479	1970.3
4	39286	61.22717	797.2	-1073.286	493.4855	230.11607	1970.3
5	39286	61.64363	796.68575	-1041.1899	746.31049	348.0103	1970.3
6	39286	62.06009	796.17145	-1009.0938	999.1506	465.91158	1970.3
7	39286	62.47655	795.65715	-977.01274	1251.9907	583.81286	1970.3
8	39286	62.89301	795.14285	-944.91661	1504.8157	701.70709	1970.3
9	39286	63.30947	794.62855	-912.82048	1757.7314	819.6436	1970.3
10	39286	63.72593	794.11425	-880.72436	2010.5413	937.53078	1970.3
11	39286	64.14239	793.6	-848.64334	2263.3511	1055.418	1970.3
12	39286	64.55885	793.08575	-816.54722	2516.161	1173.3052	1970.3
13	39286	64.97531	792.57145	-784.45109	2768.9709	1291.1923	1970.3
14	39286	65.39177	792.05715	-752.37007	3021.7808	1409.0795	1970.3
15	39286	65.785205	791.575	-722.27394	3279.8035	1529.3975	1949.9

16	39286	66.155615	791.125	-694.20448	3490.496	1627.645	1949.9
17	39286	66.52602	790.675	-666.11786	3701.1886	1725.8926	1949.9
18	39286	66.896425	790.225	-638.0484	3911.8811	1824.1401	1949.9
19	39286	67.287415	789.75	-608.40043	-3072.5766	-5386.3634	6830.7
20	39286	67.69898	789.25	-577.19289	-3043.8552	-5336.0134	6830.7
21	39286	68.110545	788.75	-546.00079	-3015.2881	-5285.9341	6830.7
22	39286	68.52211	788.25	-514.79324	-2986.5667	-5235.5842	6830.7
23	39286	68.93991	787.7424	-483.12111	5143.9996	2398.6864	1949.9
24	39286	69.363945	787.22725	-450.98797	5385.2979	2511.2056	1949.9
25	39286	69.78798	786.7121	-418.83985	5626.4463	2623.655	1949.9
26	39286	70.25	786.1508	-383.81785	5421.0125	2527.8596	1949.9
27	39286	70.708335	785.594	-349.06995	4794.3353	2235.6353	1949.9
28	39286	71.125	785.0878	-317.48191	4193.0796	1955.2651	1949.9
29	39286	71.541665	784.5816	-285.89387	3591.6714	1674.8239	1949.9
30	39286	71.958335	784.0754	-254.30583	2990.4158	1394.4538	1949.9
31	39286	72.375	783.5692	-222.71779	2389.1601	1114.0836	1949.9
32	39286	72.791665	783.063	-191.12976	1787.9044	833.71351	1949.9
33	39286	73.166665	782.60745	-162.70472	1269.8514	592.14145	1949.9
34	39286	73.5	782.2025	-137.43505	835.0583	389.39408	1949.9
35	39286	73.958335	782	-124.80001	2076.8573	968.45445	400
36	39286	74.4375	782	-124.8	1890.9067	881.74426	400
37	39286	74.8125	782	-124.8	1738.9333	810.87793	400
38	39286	75.1875	782	-124.8	1586.96	740.0116	400
39	39286	75.5625	782	-124.8	1435.0133	669.15771	400
40	39286	75.9375	782	-124.8	1288.2667	600.72861	400
41	39286	76.3125	782	-124.8	1146.8	534.76162	400
42	39286	76.6875	782	-124.8	1005.3067	468.7822	400
43	39286	77.0625	782	-124.8	863.81333	402.80277	400
44	39286	77.4375	782	-124.8	722.32	336.82335	400
45	39286	77.8125	782	-124.8	580.85333	270.85636	400
46	39286	78.25	782	-124.8	408.8	190.62657	400
47	39286	78.6875	782	-124.8	236.73867	110.39305	400
48	39286	79.0625	782	-124.8	95.253333	44.417359	400
49	39286	79.4375	782	-124.8	-46.232	-21.558336	400
50	39286	79.8125	782	-124.8	-187.71733	-87.53403	400

Slices of Slip Surface: 25048

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	25048	60.13088	798.7107	-1167.5546	-1071.5904	-499.69082	2144.6
2	25048	60.536	798.13215	-1131.4512	-643.1638	-299.9122	2144.6
3	25048	60.94112	797.5536	-1095.3479	-214.72301	-100.12698	2144.6
4	25048	61.34624	796.975	-1059.2445	213.71778	99.658237	2144.6
5	25048	61.75136	796.3964	-1023.1411	642.14441	299.43686	2144.6
6	25048	62.15648	795.81785	-987.03776	1070.5852	499.22208	2144.6
7	25048	62.5616	795.2393	-950.93439	1499.0685	699.0271	2144.6

8	25048	62.96672	794.6607	-914.83102	1927.4951	898.80572	2144.6
9	25048	63.37184	794.08215	-878.72766	2355.9217	1098.5843	2144.6
10	25048	63.77696	793.5036	-842.62429	2784.3484	1298.363	2144.6
11	25048	64.18208	792.925	-806.52092	3212.775	1498.1416	2144.6
12	25048	64.5872	792.3464	-770.41755	3641.2016	1697.9202	2144.6
13	25048	64.99232	791.76785	-734.31418	4069.6282	1897.6988	2144.6
14	25048	65.39744	791.1893	-698.21082	4498.0549	2097.4774	2144.6
15	25048	65.84101	790.675	-666.12246	4183.4723	1950.7852	1610.8
16	25048	66.32303	790.225	-638.03752	4311.4619	2010.4677	1610.8
17	25048	66.778275	789.8	-611.52402	-2449.3375	-4293.7975	6830.7
18	25048	67.20674	789.4	-586.5649	-2425.2826	-4251.6282	6830.7
19	25048	67.635205	789	-561.60578	-2401.0571	-4209.1597	6830.7
20	25048	68.06367	788.6	-536.64666	-2377.0021	-4166.9904	6830.7
21	25048	68.492135	788.2	-511.68754	-2352.9472	-4124.821	6830.7
22	25048	68.921975	787.7987	-486.64564	5044.1088	2352.1066	1610.8
23	25048	69.353185	787.39615	-461.52341	5158.7014	2405.542	1610.8
24	25048	69.784395	786.9936	-436.40119	5273.294	2458.9774	1610.8
25	25048	70.25	786.5589	-409.27028	5112.4064	2383.9543	1610.8
26	25048	70.708335	786.131	-382.58401	4694.9345	2189.2839	1610.8
27	25048	71.125	785.74205	-358.3041	4296.1756	2003.3396	1610.8
28	25048	71.541665	785.3531	-334.02419	3897.4167	1817.3952	1610.8
29	25048	71.958335	784.9641	-309.76182	3498.6578	1631.4509	1610.8
30	25048	72.375	784.5751	-285.48191	3100.0743	1445.5884	1610.8
31	25048	72.791665	784.1861	-261.21955	2701.3154	1259.644	1610.8
32	25048	73.208335	783.7971	-236.93964	2320.0997	1081.8803	1610.8
33	25048	73.625	783.4081	-212.65973	1956.6028	912.37888	1610.8
34	25048	74.041665	783.01915	-188.39736	1592.948	742.80386	1610.8
35	25048	74.470835	782.6185	-163.39421	1199.845	559.49692	1610.8
36	25048	74.9125	782.20615	-137.66516	777.20074	362.41466	1610.8
37	25048	75.2875	782	-124.80001	1569.1137	731.68973	400
38	25048	75.595835	782	-124.80001	1442.9839	672.87446	400
39	25048	75.9375	782	-124.8	1308.5067	610.16668	400
40	25048	76.3125	782	-124.8	1165.68	543.56551	400
41	25048	76.6875	782	-124.8	1022.8533	476.96434	400
42	25048	77.0625	782	-124.8	880.05333	410.37561	400
43	25048	77.4375	782	-124.8	737.22667	343.77444	400
44	25048	77.8125	782	-124.8	594.4	277.17327	400
45	25048	78.25	782	-124.8	420.74	196.19428	400
46	25048	78.6875	782	-124.8	247.056	115.2041	400
47	25048	79.0625	782	-124.8	104.23733	48.606667	400
48	25048	79.4375	782	-124.8	-38.581333	-17.990771	400
49	25048	79.8125	782	-124.8	-181.4	-84.588209	400

Slices of Slip Surface: 26728

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)

1	26728	62.78181	798.73	-1168.7495	-3518.0676	-1640.5019	2228.8
2	26728	63.13249	798.19	-1135.0629	-2794.9472	-1303.3053	2228.8
3	26728	63.48317	797.65	-1101.3608	-2071.6715	-966.03631	2228.8
4	26728	63.83385	797.11	-1067.6587	-1348.3959	-628.76731	2228.8
5	26728	64.18453	796.57	-1033.9721	-625.16676	-291.52005	2228.8
6	26728	64.53521	796.03	-1000.2699	98.074754	45.733009	2228.8
7	26728	64.88589	795.49	-966.58333	821.30695	382.98172	2228.8
8	26728	65.23657	794.95	-932.8812	1544.5516	720.23623	2228.8
9	26728	65.58725	794.41	-899.17907	2267.8273	1057.5052	2228.8
10	26728	65.93793	793.87	-865.49247	2991.1029	1394.7742	2228.8
11	26728	66.28861	793.33	-831.79033	3714.2233	1731.9708	2228.8
12	26728	66.63929	792.79	-798.10373	4437.499	2069.2398	2228.8
13	26728	66.98997	792.25	-764.4016	5160.7747	2406.5088	2228.8
14	26728	67.34065	791.71	-730.69947	5884.0504	2743.7778	2228.8
15	26728	67.69133	791.17	-697.01287	6607.1708	3080.9743	2228.8
16	26728	68.050375	790.675	-666.12433	5802.4665	2705.7346	1960
17	26728	68.41779	790.225	-638.03205	6081.1516	2835.6875	1960
18	26728	68.77631	789.7859	-610.64005	-3150.0684	-5522.2098	6830.7
19	26728	69.125935	789.3577	-583.92217	-3123.2962	-5475.2771	6830.7
20	26728	69.47556	788.9295	-557.20429	-3096.3432	-5428.0272	6830.7
21	26728	69.825185	788.5013	-530.48642	-3069.3901	-5380.7773	6830.7
22	26728	70.11723	788.1436	-508.15508	-3074.3409	-5389.4563	6830.7
23	26728	70.36723	787.8374	-489.06103	6741.6779	3143.6961	1960
24	26728	70.67857	787.4561	-465.25622	6173.902	2878.9378	1960
25	26728	71.035715	787.01865	-437.96737	5494.7799	2562.2579	1960
26	26728	71.39286	786.5812	-410.66082	4815.6577	2245.5781	1960
27	26728	71.75	786.1438	-383.37197	4136.5356	1928.8982	1960
28	26728	72.10714	785.7064	-356.08313	3457.4135	1612.2184	1960
29	26728	72.464285	785.269	-328.77657	2778.2913	1295.5385	1960
30	26728	72.82143	784.83155	-301.48773	2099.1692	978.85867	1960
31	26728	73.15625	784.42145	-275.90905	1491.0786	695.30139	1960
32	26728	73.46875	784.03875	-252.00759	954.15595	444.93023	1960
33	26728	73.78125	783.656	-228.12637	417.23326	194.55906	1960
34	26728	74.09375	783.27325	-204.24515	-119.67932	-55.807383	1960
35	26728	74.39722	782.9016	-181.05805	-668.09375	-311.53723	1960
36	26728	74.691665	782.54095	-158.55413	-1227.996	-572.62395	1960
37	26728	74.98611	782.1803	-136.05236	-1787.9198	-833.72067	1960
38	26728	75.2875	782	-124.80001	1568.3029	731.31164	400
39	26728	75.595835	782	-124.80001	1442.2056	672.5115	400
40	26728	75.9375	782	-124.8	1307.7867	609.83094	400
41	26728	76.3125	782	-124.8	1165.0133	543.25464	400
42	26728	76.6875	782	-124.8	1022.24	476.67834	400
43	26728	77.0625	782	-124.8	879.46667	410.10204	400
44	26728	77.4375	782	-124.8	736.69333	343.52574	400
45	26728	77.8125	782	-124.8	593.92	276.94944	400
46	26728	78.25	782	-124.8	420.3	195.98911	400

47	26728	78.6875	782	-124.8	246.68533	115.03126	400
48	26728	79.0625	782	-124.8	103.912	48.454961	400
49	26728	79.4375	782	-124.8	-38.858667	-18.120094	400
50	26728	79.8125	782	-124.8	-181.62933	-84.695149	400

Slices of Slip Surface: 11769

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	11769	61.083485	798.7	-1166.8843	-1450.2011	-676.2399	2228.8
2	11769	61.47313	798.1	-1129.4376	-958.53054	-446.97013	2228.8
3	11769	61.862775	797.5	-1092.005	-466.818	-217.68081	2228.8
4	11769	62.25242	796.9	-1054.5583	24.881957	11.602647	2228.8
5	11769	62.642065	796.3	-1017.1257	516.5931	240.89132	2228.8
6	11769	63.03171	795.7	-979.67901	1008.2917	470.17412	2228.8
7	11769	63.421355	795.1	-942.24635	1499.9623	699.44389	2228.8
8	11769	63.811	794.5	-904.79971	1991.7028	928.74625	2228.8
9	11769	64.200645	793.9	-867.35307	2483.4432	1158.0486	2228.8
10	11769	64.59029	793.3	-829.92041	2975.1837	1387.351	2228.8
11	11769	64.979935	792.7	-792.47377	3466.7845	1616.5881	2228.8
12	11769	65.36958	792.1	-755.04111	3958.5249	1845.8905	2228.8
13	11769	65.75922	791.5	-717.59447	4450.2654	2075.1929	2228.8
14	11769	66.148865	790.9	-680.16181	4942.0059	2304.4952	2228.8
15	11769	66.53851	790.3	-642.71517	5433.6066	2533.7324	2228.8
16	11769	66.92361	789.83335	-613.60098	-2177.7083	-3817.6194	6830.7
17	11769	67.304165	789.5	-592.80631	-2157.1508	-3781.5812	6830.7
18	11769	67.68472	789.16665	-571.99187	-2136.3957	-3745.1965	6830.7
19	11769	68.06528	788.83335	-551.1972	-2115.6405	-3708.8119	6830.7
20	11769	68.445835	788.5	-530.40252	-2094.8854	-3672.4272	6830.7
21	11769	68.82639	788.16665	-509.60785	-2074.3279	-3636.389	6830.7
22	11769	69.180555	787.85645	-490.24906	4908.687	2288.9584	1528.8
23	11769	69.50833	787.56935	-472.32544	4980.0603	2322.2402	1528.8
24	11769	69.83611	787.28225	-454.40181	5051.4335	2355.5221	1528.8
25	11769	70.25	786.9197	-431.78374	4893.1478	2281.7123	1528.8
26	11769	70.67857	786.5443	-408.36211	4547.4201	2120.4968	1528.8
27	11769	71.035715	786.2315	-388.83706	4243.9077	1978.9667	1528.8
28	11769	71.39286	785.9187	-369.33308	3940.6059	1837.5347	1528.8
29	11769	71.75	785.60585	-349.80802	3637.0936	1696.0046	1528.8
30	11769	72.10714	785.293	-330.28297	3333.7918	1554.5726	1528.8
31	11769	72.464285	784.9802	-310.75792	3030.2794	1413.0425	1528.8
32	11769	72.82143	784.66735	-291.23287	2726.767	1271.5123	1528.8
33	11769	73.208335	784.32845	-270.10105	2413.4155	1125.3941	1528.8
34	11769	73.625	783.9635	-247.31731	2090.2547	974.70176	1528.8
35	11769	74.041665	783.59855	-224.55163	1766.8592	823.89995	1528.8
36	11769	74.4375	783.25185	-202.92329	1445.8987	674.23362	1528.8
37	11769	74.8125	782.92335	-182.41833	1127.3115	525.67398	1528.8
38	11769	75.1875	782.5949	-161.92139	808.72434	377.11435	1528.8

39	11769	75.5625	782.26645	-141.42445	490.13718	228.55472	1528.8
40	11769	75.808335	782.0511	-127.98764	285.5833	133.16968	1528.8
41	11769	76.044445	782	-124.79905	1314.3373	612.88557	400
42	11769	76.4	782	-124.79905	1175.9624	548.36025	400
43	11769	76.755555	782	-124.79905	1037.5874	483.83494	400
44	11769	77.11111	782	-124.79905	899.21239	419.30962	400
45	11769	77.466665	782	-124.79905	760.80928	354.77119	400
46	11769	77.82222	782	-124.79905	622.4343	290.24588	400
47	11769	78.25	782	-124.8	448.74	209.2509	400
48	11769	78.6875	782	-124.8	271.25333	126.48751	400
49	11769	79.0625	782	-124.8	125.312	58.433945	400
50	11769	79.4375	782	-124.8	-20.634933	-9.6222274	400
51	11769	79.8125	782	-124.8	-166.584	-77.679395	400

Slices of Slip Surface: 51367

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	51367	59.44663	798.685	-1165.9384	-259.49531	-121.00465	2228.8
2	51367	59.855755	798.055	-1126.6274	5.2719096	2.4583318	2228.8
3	51367	60.264885	797.425	-1087.3164	270.0386	125.92107	2228.8
4	51367	60.67401	796.795	-1048.0054	534.80556	249.38393	2228.8
5	51367	61.083135	796.165	-1008.6944	799.57252	372.84679	2228.8
6	51367	61.492265	795.535	-969.38333	1064.3395	496.30965	2228.8
7	51367	61.90139	794.905	-930.07232	1329.1064	619.77251	2228.8
8	51367	62.310515	794.275	-890.7613	1593.8734	743.23537	2228.8
9	51367	62.719645	793.645	-851.45028	1858.6537	866.70444	2228.8
10	51367	63.12877	793.015	-812.13926	2123.4339	990.1735	2228.8
11	51367	63.5328	792.50715	-780.45454	3429.5812	1599.24	1656.2
12	51367	63.931735	792.12145	-756.37845	3519.8666	1641.3407	1656.2
13	51367	64.330665	791.73575	-732.30236	3610.3321	1683.5255	1656.2
14	51367	64.729595	791.35	-708.24429	3700.6174	1725.6263	1656.2
15	51367	65.128525	790.96425	-684.16821	3790.9028	1767.727	1656.2
16	51367	65.527455	790.57855	-660.11014	3881.3683	1809.9118	1656.2
17	51367	65.92639	790.19285	-636.03405	3971.6536	1852.0125	1656.2
18	51367	66.33271	789.8	-611.51132	-2093.4575	-3669.924	6830.7
19	51367	66.746415	789.4	-586.55735	-2067.9127	-3625.1428	6830.7
20	51367	67.160125	789	-561.60338	-2042.3679	-3580.3617	6830.7
21	51367	67.573835	788.6	-536.63203	-2016.9969	-3535.8851	6830.7
22	51367	67.98754	788.2	-511.67806	-1991.452	-3491.1039	6830.7
23	51367	68.42009	787.7818	-485.57698	4571.1668	2131.5701	1656.2
24	51367	68.871495	787.34535	-458.34301	4673.4137	2179.2486	1656.2
25	51367	69.3229	786.9089	-431.10903	4775.6605	2226.9271	1656.2
26	51367	69.7743	786.47245	-403.87506	4877.9074	2274.6056	1656.2
27	51367	70.25	786.0125	-375.17364	4751.3175	2215.5757	1656.2
28	51367	70.708335	785.56935	-347.52986	4411.3275	2057.0358	1656.2

29	51367	71.125	785.1665	-322.3908	4086.2624	1905.4554	1656.2
30	51367	71.541665	784.76365	-297.25173	3761.3697	1753.9555	1656.2
31	51367	71.958335	784.36075	-272.11267	3436.3046	1602.3751	1656.2
32	51367	72.375	783.9579	-246.97361	3111.4119	1450.8752	1656.2
33	51367	72.791665	783.55505	-221.83454	2786.5193	1299.3753	1656.2
34	51367	73.208335	783.1522	-196.69548	2475.9475	1154.5533	1656.2
35	51367	73.625	782.74935	-171.55814	2179.869	1016.4896	1656.2
36	51367	74.041665	782.34645	-146.41908	1883.9631	878.50643	1656.2
37	51367	74.325	782.0725	-129.32344	1677.3753	782.17296	1656.2
38	51367	74.625	782	-124.8	1992.1333	928.94703	400
39	51367	75.075	782	-124.8	1797.6667	838.26573	400
40	51367	75.525	782	-124.8	1603.2222	747.5948	400
41	51367	75.975	782	-124.8	1415.4889	660.05331	400
42	51367	76.425	782	-124.8	1234.4444	575.6309	400
43	51367	76.875	782	-124.8	1053.4	491.20849	400
44	51367	77.325	782	-124.8	872.35556	406.78608	400
45	51367	77.775	782	-124.8	691.31111	322.36367	400
46	51367	78.25	782	-124.8	492.78	229.78709	400
47	51367	78.6875	782	-124.8	309.30667	144.23207	400
48	51367	79.0625	782	-124.8	158.44533	73.884272	400
49	51367	79.4375	782	-124.8	7.5784	3.533866	400
50	51367	79.8125	782	-124.8	-143.288	-66.816292	400

Slices of Slip Surface: 134484

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	134484	60.437215	798.775	-1171.5635	1609.8069	750.66529	1790.7
2	134484	60.85685	798.325	-1143.4796	1698.3657	791.96093	1790.7
3	134484	61.266715	797.8107	-1111.3946	463.79783	216.27248	2158.9
4	134484	61.6668	797.23215	-1075.2859	629.4856	293.53396	2158.9
5	134484	62.066885	796.6536	-1039.1772	795.18759	370.80206	2158.9
6	134484	62.466975	796.075	-1003.0827	960.87537	448.06354	2158.9
7	134484	62.867065	795.4964	-966.97404	1126.5774	525.33165	2158.9
8	134484	63.267155	794.91785	-930.87955	1292.2651	602.59313	2158.9
9	134484	63.667245	794.3393	-894.77085	1457.9956	679.87449	2158.9
10	134484	64.067335	793.7607	-858.66214	1623.6122	757.10283	2158.9
11	134484	64.467425	793.18215	-822.56766	1789.3711	834.39745	2158.9
12	134484	64.86751	792.6036	-786.45895	1954.9878	911.62578	2158.9
13	134484	65.267595	792.025	-750.36446	2120.7467	988.92041	2158.9
14	134484	65.667685	791.4464	-714.25576	2286.5055	1066.215	2158.9
15	134484	66.067775	790.86785	-678.16127	2452.1222	1143.4434	2158.9
16	134484	66.467865	790.2893	-642.05257	2617.8811	1220.738	2158.9
17	134484	66.898415	789.66665	-603.20399	-2297.732	-4028.0263	6830.7
18	134484	67.35942	789	-561.60202	-2256.8949	-3956.4371	6830.7
19	134484	67.820425	788.33335	-520.00004	-2216.0579	-3884.8479	6830.7
20	134484	68.24584	787.71815	-481.61129	3396.5793	1583.851	2158.9

21	134484	68.635655	787.15445	-446.433	3558.0989	1659.1688	2158.9
22	134484	69.025465	786.59075	-411.25472	3719.4725	1734.4185	2158.9
23	134484	69.41528	786.027	-376.09102	3880.8461	1809.6683	2158.9
24	134484	69.805095	785.46325	-340.91274	4042.3657	1884.9861	2158.9
25	134484	70.25	784.8199	-300.76406	3940.1912	1837.3413	2158.9
26	134484	70.7125	784.1511	-259.02326	3583.9023	1671.2011	2158.9
27	134484	71.1375	783.5365	-220.68166	3237.0212	1509.4478	2158.9
28	134484	71.5625	782.9219	-182.32668	2890.1401	1347.6945	2158.9
29	134484	71.9875	782.3073	-143.9717	2543.2591	1185.9412	2158.9
30	134484	72.4	782	-124.8	3197.5	1491.0187	400
31	134484	72.8	782	-124.8	3011.75	1404.4021	400
32	134484	73.208335	782	-124.79999	2828.8798	1319.1283	400
33	134484	73.625	782	-124.79999	2648.6398	1235.081	400
34	134484	74.041665	782	-124.79999	2468.6398	1151.1456	400
35	134484	74.4375	782	-124.8	2291.4933	1068.5409	400
36	134484	74.8125	782	-124.8	2117.3867	987.35362	400
37	134484	75.1875	782	-124.8	1943.28	906.16635	400
38	134484	75.5625	782	-124.8	1769.1733	824.97907	400
39	134484	75.9375	782	-124.8	1601.04	746.57721	400
40	134484	76.3125	782	-124.8	1438.9333	670.98563	400
41	134484	76.6875	782	-124.8	1276.8267	595.39405	400
42	134484	77.0625	782	-124.8	1114.72	519.80247	400
43	134484	77.4375	782	-124.8	952.61333	444.21089	400
44	134484	77.8125	782	-124.8	790.50667	368.61931	400
45	134484	78.25	782	-124.8	593.4	276.70696	400
46	134484	78.6875	782	-124.8	396.26667	184.78218	400
47	134484	79.0625	782	-124.8	234.15467	109.18811	400
48	134484	79.4375	782	-124.8	72.048	33.596534	400
49	134484	79.8125	782	-124.8	-90.058667	-41.995046	400

Slices of Slip Surface: 10885

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	10885	59.96407	798.67855	-1165.5414	-50.76715	-23.673111	2228.8
2	10885	60.381545	798.0357	-1125.425	160.11339	74.662098	2228.8
3	10885	60.79902	797.39285	-1085.3086	370.97566	172.98879	2228.8
4	10885	61.2165	796.75	-1045.2053	581.85097	271.32156	2228.8
5	10885	61.633975	796.10715	-1005.0888	792.72629	369.65434	2228.8
6	10885	62.05145	795.4643	-964.97244	1003.6016	467.98711	2228.8
7	10885	62.46893	794.82145	-924.85603	1214.4769	566.31989	2228.8
8	10885	62.886405	794.17855	-884.73963	1425.4044	664.677	2228.8
9	10885	63.30388	793.5357	-844.62322	1636.2276	762.98544	2228.8
10	10885	63.721355	792.89285	-804.51986	1847.0507	861.29388	2228.8
11	10885	64.13883	792.25	-764.40345	2058.0043	959.66316	2228.8
12	10885	64.55631	791.60715	-724.28705	2268.8274	1057.9716	2228.8
13	10885	64.973785	790.9643	-684.17064	2479.781	1156.3409	2228.8

14	10885	65.39126	790.32145	-644.05423	2690.6041	1254.6493	2228.8
15	10885	65.783335	789.8	-611.52459	-1926.9208	-3377.9777	6830.7
16	10885	66.15	789.4	-586.5535	-1901.1204	-3332.7485	6830.7
17	10885	66.516665	789	-561.60083	-1875.5043	-3287.8423	6830.7
18	10885	66.883335	788.6	-536.64817	-1849.7039	-3242.6131	6830.7
19	10885	67.25	788.2	-511.67707	-1823.9588	-3197.4808	6830.7
20	10885	67.64722	787.76665	-484.64202	4090.8898	1907.6133	1812.8
21	10885	68.075	787.3	-455.5139	4194.3547	1955.8597	1812.8
22	10885	68.50278	786.83335	-426.40158	4297.8196	2004.1062	1812.8
23	10885	68.930555	786.36665	-397.27346	4401.1265	2052.279	1812.8
24	10885	69.35833	785.9	-368.16113	4504.5913	2100.5254	1812.8
25	10885	69.78611	785.43335	-339.03301	4608.0562	2148.7719	1812.8
26	10885	70.25	784.92725	-307.46822	4498.5691	2097.7172	1812.8
27	10885	70.70278	784.4333	-276.63428	4193.4177	1955.4228	1812.8
28	10885	71.108335	783.9909	-249.02583	3905.1702	1821.0108	1812.8
29	10885	71.51389	783.5485	-221.41739	3617.0894	1686.6765	1812.8
30	10885	71.919445	783.10605	-193.82561	3329.0085	1552.3422	1812.8
31	10885	72.325	782.6636	-166.2105	3040.9276	1418.0078	1812.8
32	10885	72.730555	782.2212	-138.60372	2752.8468	1283.6735	1812.8
33	10885	72.966665	782	-124.79999	2863.3499	1335.202	400
34	10885	73.208335	782	-124.79999	2759.7598	1286.8971	400
35	10885	73.625	782	-124.79999	2583.1198	1204.5285	400
36	10885	74.041665	782	-124.79999	2406.2398	1122.048	400
37	10885	74.4375	782	-124.8	2232.5333	1041.0474	400
38	10885	74.8125	782	-124.8	2061.68	961.37717	400
39	10885	75.1875	782	-124.8	1890.8267	881.70695	400
40	10885	75.5625	782	-124.8	1719.9733	802.03674	400
41	10885	75.9375	782	-124.8	1555.0133	725.11463	400
42	10885	76.3125	782	-124.8	1395.92	650.92819	400
43	10885	76.6875	782	-124.8	1236.8533	576.75418	400
44	10885	77.0625	782	-124.8	1077.7867	502.58018	400
45	10885	77.4375	782	-124.8	918.72	428.40617	400
46	10885	77.8125	782	-124.8	759.65333	354.23217	400
47	10885	78.25	782	-124.8	566.22	264.03272	400
48	10885	78.6875	782	-124.8	372.77333	173.82706	400
49	10885	79.0625	782	-124.8	213.704	99.651812	400
50	10885	79.4375	782	-124.8	54.634667	25.476563	400
51	10885	79.8125	782	-124.8	-104.43467	-48.698685	400

Slices of Slip Surface: 106724

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	106724	60.78047	798.6625	-1164.5412	-792.44169	-369.52163	2310.3
2	106724	61.18605	797.9875	-1122.4194	-554.54283	-258.58757	2310.3
3	106724	61.59163	797.3125	-1080.2975	-316.64397	-147.65351	2310.3
4	106724	61.99721	796.6375	-1038.1757	-78.748917	-36.721223	2310.3

5	106724	62.400255	796.01365	-999.25151	1219.8924	568.84518	2146.1
6	106724	62.800765	795.4409	-963.50825	1378.4906	642.80072	2146.1
7	106724	63.201275	794.86815	-927.77931	1537.0459	716.73625	2146.1
8	106724	63.60178	794.29545	-892.03605	1695.7299	790.73183	2146.1
9	106724	64.002285	793.72275	-856.29279	1854.2708	864.66069	2146.1
10	106724	64.402795	793.15	-820.56385	2012.9549	938.65626	2146.1
11	106724	64.803305	792.57725	-784.82059	2171.4958	1012.5851	2146.1
12	106724	65.203815	792.00455	-749.07734	2330.0367	1086.514	2146.1
13	106724	65.604325	791.43185	-713.34839	2488.7208	1160.5096	2146.1
14	106724	66.004835	790.8591	-677.60513	2647.2617	1234.4384	2146.1
15	106724	66.40534	790.28635	-641.87619	2805.9457	1308.434	2146.1
16	106724	66.780415	789.75	-608.39762	-2298.7006	-4029.7243	6830.7
17	106724	67.13007	789.25	-577.20741	-2267.5596	-3975.1327	6830.7
18	106724	67.479725	788.75	-546.00081	-2236.5824	-3920.8284	6830.7
19	106724	67.829375	788.25	-514.79421	-2205.6053	-3866.5241	6830.7
20	106724	68.20378	787.7146	-481.39224	3559.1153	1659.6427	2146.1
21	106724	68.60294	787.1438	-445.77238	3717.1866	1733.3526	2146.1
22	106724	69.0021	786.573	-410.15251	3875.2578	1807.0624	2146.1
23	106724	69.40126	786.0022	-374.53264	4033.3291	1880.7722	2146.1
24	106724	69.80042	785.4314	-338.91277	4191.4003	1954.4821	2146.1
25	106724	70.25	784.7885	-298.80269	4092.4622	1908.3465	2146.1
26	106724	70.7125	784.12715	-257.53435	3745.9052	1746.7443	2146.1
27	106724	71.1375	783.5194	-219.60335	3408.531	1589.4241	2146.1
28	106724	71.5625	782.91165	-181.68584	3071.1568	1432.1039	2146.1
29	106724	71.9875	782.3039	-143.76833	2733.9175	1274.8467	2146.1
30	106724	72.4	782	-124.8	3207.75	1495.7984	400
31	106724	72.8	782	-124.8	3021.5	1408.9486	400
32	106724	73.208335	782	-124.79999	2837.9998	1323.381	400
33	106724	73.625	782	-124.79999	2657.5198	1239.2218	400
34	106724	74.041665	782	-124.79999	2477.0398	1155.0626	400
35	106724	74.4375	782	-124.8	2299.3867	1072.2216	400
36	106724	74.8125	782	-124.8	2124.8267	990.82295	400
37	106724	75.1875	782	-124.8	1950.2667	909.42428	400
38	106724	75.5625	782	-124.8	1775.7333	828.03805	400
39	106724	75.9375	782	-124.8	1607.2	749.44967	400
40	106724	76.3125	782	-124.8	1444.6933	673.67157	400
41	106724	76.6875	782	-124.8	1282.1867	597.89346	400
42	106724	77.0625	782	-124.8	1119.6533	522.10292	400
43	106724	77.4375	782	-124.8	957.14667	446.32482	400
44	106724	77.8125	782	-124.8	794.64	370.54672	400
45	106724	78.25	782	-124.8	597.02	278.395	400
46	106724	78.6875	782	-124.8	399.38667	186.23706	400
47	106724	79.0625	782	-124.8	236.88533	110.46145	400
48	106724	79.4375	782	-124.8	74.373333	34.680855	400
49	106724	79.8125	782	-124.8	-88.138667	-41.099735	400

Slices of Slip Surface: 38247

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	38247	59.635235	798.7	-1166.882	-328.64378	-153.24911	2144.6
2	38247	60.05536	798.1	-1129.4331	-25.101548	-11.705044	2144.6
3	38247	60.475485	797.5	-1091.9979	278.44341	129.8403	2144.6
4	38247	60.89561	796.9	-1054.5626	581.98019	271.38182	2144.6
5	38247	61.315735	796.3	-1017.1137	885.51696	412.92334	2144.6
6	38247	61.73586	795.7	-979.67848	1189.0674	554.47122	2144.6
7	38247	62.15598	795.1	-942.24323	1492.6315	696.02548	2144.6
8	38247	62.576105	794.5	-904.79433	1796.1273	837.5479	2144.6
9	38247	62.99623	793.9	-867.35909	2099.6231	979.07032	2144.6
10	38247	63.416355	793.3	-829.92384	2403.2554	1120.6564	2144.6
11	38247	63.83648	792.7	-792.47494	2706.7512	1262.1788	2144.6
12	38247	64.256605	792.1	-755.0397	3010.247	1403.7013	2144.6
13	38247	64.69473	791.575	-722.27425	3470.8306	1618.4749	1682.4
14	38247	65.15085	791.125	-694.19733	3567.9059	1663.7418	1682.4
15	38247	65.60697	790.675	-666.12042	3665.1372	1709.0815	1682.4
16	38247	66.063095	790.225	-638.04351	3762.2124	1754.3485	1682.4
17	38247	66.49388	789.8	-611.52152	-1762.279	-3089.3534	6830.7
18	38247	66.89932	789.4	-586.55429	-1736.2407	-3043.7072	6830.7
19	38247	67.30476	789	-561.60462	-1710.2025	-2998.0609	6830.7
20	38247	67.710205	788.6	-536.63739	-1684.1467	-2952.2642	6830.6
21	38247	68.11565	788.2	-511.68772	-1658.1084	-2906.2663	6830.3
22	38247	68.528575	787.7926	-486.25887	4319.3849	2014.1623	1682.4
23	38247	68.94898	787.37785	-460.38557	4408.9593	2055.9315	1682.4
24	38247	69.369385	786.9631	-434.49534	4498.5338	2097.7008	1682.4
25	38247	69.789795	786.5483	-408.62204	4588.1082	2139.47	1682.4
26	38247	70.25	786.0943	-380.28005	4470.1059	2084.4446	1682.4
27	38247	70.708335	785.64215	-352.06726	4158.6204	1939.1965	1682.4
28	38247	71.125	785.23105	-326.42292	3861.0025	1800.4151	1682.4
29	38247	71.541665	784.81995	-300.76149	3563.2138	1661.5539	1682.4
30	38247	71.958335	784.4089	-275.11715	3265.4251	1522.6927	1682.4
31	38247	72.375	783.99785	-249.45572	2967.8072	1383.9112	1682.4
32	38247	72.791665	783.58675	-223.81138	2670.0185	1245.0501	1682.4
33	38247	73.208335	783.17565	-198.16704	2385.5559	1112.403	1682.4
34	38247	73.625	782.7646	-172.50561	2114.5904	986.0497	1682.4
35	38247	74.041665	782.35355	-146.85956	1843.454	859.61673	1682.4
36	38247	74.325	782.074	-129.41768	1654.2873	771.40683	1682.4
37	38247	74.625	782	-124.8	2123.4	990.15768	400
38	38247	75.075	782	-124.8	1920	895.3107	400
39	38247	75.525	782	-124.8	1716.5778	800.45336	400
40	38247	75.975	782	-124.8	1520.2	708.8809	400
41	38247	76.425	782	-124.8	1330.8222	620.57259	400
42	38247	76.875	782	-124.8	1141.4222	532.25392	400
43	38247	77.325	782	-124.8	952.04444	443.94562	400

44	38247	77.775	782	-124.8	762.66667	355.63731	400
45	38247	78.25	782	-124.8	554.98	258.79142	400
46	38247	78.6875	782	-124.8	363.06667	169.30077	400
47	38247	79.0625	782	-124.8	205.25333	95.711201	400
48	38247	79.4375	782	-124.8	47.437333	22.120392	400
49	38247	79.8125	782	-124.8	-110.37867	-51.470418	400

Unit 4 Temporary Cut

File Information

Created By: Shu, Shanzhi [FWI]
Revision Number: 316
Last Edited By: Shu, Shanzhi [FWI]
Date: 5/20/2008
Time: 3:55:04 PM
File Name: Unit 4 Cut Slope-400-3000.gsz
Directory: M:\S Shu\TXU\Slope Stability\Latest_04-20-08\
Last Solved Date: 5/20/2008
Last Solved Time: 4:13:28 PM

Project Settings

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

Analysis Settings

Unit 4 Temporary Cut

Description: Construction Cuts
Kind: SLOPE/W
Method: Spencer
Settings
- Apply Phreatic Correction: No
- PWP Conditions Source: Piezometric Line
- Use Staged Rapid Drawdown: No

SlipSurface
- Direction of movement: Left to Right
- Allow Passive Mode: No
- Slip Surface Option: Block
- Critical slip surfaces saved: 30
- Optimize Critical Slip Surface Location: Yes

Tension Crack
Tension Crack Option: Tension Crack Line
Percentage Wet: 0
Tension Crack Fluid Unit Weight: 62.4 pcf
FOS Distribution
FOS Calculation Option: Constant
Restrict Block Crossing: No
Advanced
Number of Slices: 50
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Minimum Slice Width: 0.001 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 5
Ending Optimization Points: 30
Complete Passes per Insertion: 1

Materials

Shale

Model: Anisotropic Strength
Unit Weight: 135 pcf
C-Horizontal: 400 psf
C-Vertical: 3000 psf
Phi-Horizontal: 25 °
Phi-Vertical: 25 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Unit A Limestone, Lower Bound

Model: Shear/Normal Fn.
Unit Weight: 145 pcf
Strength Function: Unit A Limestone, Lower Bound
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Unit C Limestone, Lower Bound

Model: Shear/Normal Fn.
Unit Weight: 155 pcf
Strength Function: Unit C Limestone, Lower Bound

Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Limits

Left Coordinate: (5, 822) ft
Right Coordinate: (130, 782) ft

Slip Surface Block

Left Grid
Upper Left: (52, 800) ft
Lower Left: (52, 791.191) ft
Lower Right: (69, 791.191) ft
X Increments: 15
Y Increments: 10
Starting Angle: 115 °
Ending Angle: 135 °
Angle Increments: 5
Right Grid
Upper Left: (70.1811, 792) ft
Lower Left: (70.1811, 782) ft
Lower Right: (81, 782) ft
X Increments: 8
Y Increments: 10
Starting Angle: 0 °
Ending Angle: 0 °
Angle Increments: 0

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	5	780
	130	780

Tension Crack Line

	X (ft)	Y (ft)
	35	800
	75	800

Shear/Normal Strength Functions

Unit A Limestone, Lower Bound

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Y-Intercept: 6697.4707
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (-1710, 3833)
Data Point: (-299, 6231)
Data Point: (1063, 8237)
Data Point: (2388, 10014)
Data Point: (3684, 11635)
Data Point: (4956, 13137)
Data Point: (6207, 14546)
Data Point: (7440, 15878)
Data Point: (8656, 17146)
Data Point: (9857, 18358)
Data Point: (11045, 19522)
Data Point: (12220, 20643)
Data Point: (13383, 21726)
Data Point: (14536, 22775)
Data Point: (15679, 23793)
Data Point: (16813, 24783)
Data Point: (17938, 25747)
Data Point: (19054, 26689)
Data Point: (20163, 27603)
Data Point: (21264, 28500)
Data Point: (22358, 29377)
Data Point: (23445, 30236)
Data Point: (24526, 31078)
Data Point: (25600, 31904)
Data Point: (26669, 32715)
Data Point: (27732, 33512)
Data Point: (28789, 34295)

Data Point: (29841, 35065)
Data Point: (30888, 35823)
Data Point: (31931, 36569)
Data Point: (32968, 37304)
Data Point: (34001, 38028)
Data Point: (35029, 38742)
Data Point: (36053, 39447)
Data Point: (37073, 40141)
Data Point: (38089, 40827)
Data Point: (39101, 41504)
Data Point: (40109, 42173)

Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Unit C Limestone, Lower Bound

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Y-Intercept: 7248.7668
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (-1613, 4254)
Data Point: (-174, 6947)
Data Point: (1222, 9215)
Data Point: (2584, 11234)
Data Point: (3920, 13080)
Data Point: (5233, 14797)
Data Point: (6527, 16411)
Data Point: (7804, 17941)
Data Point: (9065, 19400)
Data Point: (10312, 20797)
Data Point: (11546, 22141)
Data Point: (12768, 23437)
Data Point: (13980, 24691)
Data Point: (15181, 25906)
Data Point: (16372, 27087)
Data Point: (17555, 28237)
Data Point: (18728, 29357)
Data Point: (19894, 30450)
Data Point: (21052, 31518)

Data Point: (22203, 32563)
Data Point: (23346, 33586)
Data Point: (24483, 34589)
Data Point: (25614, 35573)
Data Point: (26738, 36538)
Data Point: (27857, 37486)
Data Point: (28970, 38419)
Data Point: (30077, 39336)
Data Point: (31179, 40238)
Data Point: (32276, 41126)
Data Point: (33369, 42001)
Data Point: (34456, 42863)
Data Point: (35539, 43714)
Data Point: (36617, 44552)
Data Point: (37692, 45380)
Data Point: (38761, 46196)
Data Point: (39827, 47003)
Data Point: (40889, 47799)
Data Point: (41947, 48586)

Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Regions

	Material	Points	Area (ft²)
Region 1	Shale	1,2,3,4	130.5
Region 2	Unit A Limestone, Lower Bound	4,3,5,6	667.5
Region 3	Shale	6,5,7,8	205.125
Region 4	Unit A Limestone, Lower Bound	8,7,19,9	487.375
Region 5	Shale	9,19,10,11	572
Region 6	Unit A Limestone, Lower Bound	11,10,12,13	145.5
Region 7	Shale	13,12,14,15	592
Region 8	Unit C Limestone, Lower Bound	15,14,16,17,18	2125

Points

	X (ft)	Y (ft)
Point 1	5	822
Point 2	70	822
Point 3	70.5	820
Point 4	5	820
Point 5	73	810
Point 6	5	810
Point 7	73.75	807
Point 8	5	807
Point 9	5	800
Point 10	77.5	792
Point 11	5	792
Point 12	78	790
Point 13	5	790
Point 14	80	782
Point 15	5	782
Point 16	130	782
Point 17	130	765
Point 18	5	765
Point 19	75.5	800

Critical Slip Surfaces

	Number	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	1.39	(83.11, 830.167)	21.5241	(57.6055, 822)	(80, 782)
2	43763	1.39	(83.11, 830.167)	21.524	(57.6055, 822)	(80, 782)

Slices of Slip Surface: Optimized

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimized	57.835195	799.73575	-1231.5042	-744.55708	-347.19267	1880.9
2	Optimized	58.29465	799.2072	-1198.5337	-338.5298	-157.85904	1880.9
3	Optimized	58.754105	798.67865	-1165.5489	67.4932	31.472596	1880.9
4	Optimized	59.213555	798.1501	-1132.5641	473.52477	220.80822	1880.9
5	Optimized	59.67301	797.62155	-1099.5793	879.55205	410.14185	1880.9

6	Optimized	60.132465	797.09305	-1066.6088	1285.5793	599.47549	1880.9
7	Optimized	60.591915	796.5645	-1033.6239	1691.6494	788.82909	1880.9
8	Optimized	61.051365	796.03595	-1000.6391	2097.6053	978.12943	1880.9
9	Optimized	61.51082	795.5074	-967.66861	2503.704	1167.4964	1880.9
10	Optimized	61.970275	794.97885	-934.6838	2909.6599	1356.7967	1880.9
11	Optimized	62.438245	794.4884	-904.08048	3209.574	1496.6489	1632.7
12	Optimized	62.91473	794.03595	-875.84889	3415.9461	1592.8818	1632.7
13	Optimized	63.391215	793.5835	-847.6173	3622.4705	1689.1857	1632.7
14	Optimized	63.8677	793.1311	-819.38571	3828.8426	1785.4186	1632.7
15	Optimized	64.344185	792.67865	-791.15412	4035.367	1881.7225	1632.7
16	Optimized	64.820675	792.2262	-762.92253	4241.7391	1977.9554	1632.7
17	Optimized	65.26955	791.8	-736.31874	-3456.2603	-6058.9779	6830.7
18	Optimized	65.690815	791.4	-711.3582	-3435.259	-6022.1617	6830.7
19	Optimized	66.11208	791	-686.39766	-3414.2577	-5985.3455	6830.7
20	Optimized	66.533345	790.6	-661.43712	-3393.4286	-5948.8311	6830.7
21	Optimized	66.95461	790.2	-636.47658	-3372.4273	-5912.0149	6830.7
22	Optimized	67.40147	789.7757	-609.99588	5427.6771	2530.9674	1632.7
23	Optimized	67.87393	789.3271	-582.01484	5632.2779	2626.3743	1632.7
24	Optimized	68.34639	788.8785	-554.01845	5837.0322	2721.8528	1632.7
25	Optimized	68.81885	788.4299	-526.02206	6041.7865	2817.3313	1632.7
26	Optimized	69.29131	787.9813	-498.02567	6246.5407	2912.8098	1632.7
27	Optimized	69.76377	787.53265	-470.04463	6451.1415	3008.2167	1632.7
28	Optimized	70.25	787.07095	-441.22429	6205.5958	2893.7169	1632.7
29	Optimized	70.708335	786.63575	-414.07961	5539.3939	2583.0618	1632.7
30	Optimized	71.125	786.2401	-389.38312	4903.098	2286.3522	1632.7
31	Optimized	71.541665	785.8445	-364.70403	4266.6281	1989.5614	1632.7
32	Optimized	71.958335	785.44885	-340.00754	3630.3323	1692.8518	1632.7
33	Optimized	72.375	785.0532	-315.32845	2994.0365	1396.1421	1632.7
34	Optimized	72.791665	784.6576	-290.63195	2357.7406	1099.4325	1632.7
35	Optimized	73.1875	784.28175	-267.17311	1778.5306	829.34243	1632.7
36	Optimized	73.5625	783.92565	-244.95381	1256.5413	585.93483	1632.7
37	Optimized	73.96875	783.5399	-220.88359	661.45735	308.44263	1632.7
38	Optimized	74.40625	783.1245	-194.97627	-6.6936381	-3.1212947	1632.7
39	Optimized	74.84375	782.7091	-169.05236	-674.85027	-314.68785	1632.7
40	Optimized	75.28125	782.2937	-143.1268	-1343.0041	-626.25309	1632.7
41	Optimized	75.545275	782.043	-127.47994	-1740.0956	-811.41992	1632.7
42	Optimized	75.82923	782	-124.80034	994.67386	463.82404	400
43	Optimized	76.306595	782	-124.80034	842.10637	392.68065	400
44	Optimized	76.78396	782	-124.80034	689.55982	321.54703	400
45	Optimized	77.26132	782	-124.80034	536.99233	250.40363	400
46	Optimized	77.75	782	-124.8	374.9	174.81874	400
47	Optimized	78.25	782	-124.8	209.18	97.542236	400
48	Optimized	78.75	782	-124.8	49.376	23.024407	400
49	Optimized	79.25	782	-124.8	-110.422	-51.490624	400
50	Optimized	79.75	782	-124.8	-270.22	-126.00566	400

APPENDIX B

Slices of Slip Surface: 43763

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	43763	57.835195	799.73575	-1231.5042	-744.55708	-347.19267	1880.9
2	43763	58.29465	799.2072	-1198.5337	-338.5298	-157.85904	1880.9
3	43763	58.754105	798.67865	-1165.5489	67.4932	31.472596	1880.9
4	43763	59.213555	798.1501	-1132.5641	473.52477	220.80822	1880.9
5	43763	59.67301	797.62155	-1099.5793	879.55205	410.14185	1880.9
6	43763	60.132465	797.09305	-1066.6088	1285.5793	599.47549	1880.9
7	43763	60.591915	796.5645	-1033.6239	1691.6494	788.82909	1880.9
8	43763	61.051365	796.03595	-1000.6391	2097.6053	978.12943	1880.9
9	43763	61.51082	795.5074	-967.66861	2503.704	1167.4964	1880.9
10	43763	61.970275	794.97885	-934.6838	2909.6599	1356.7967	1880.9
11	43763	62.438245	794.4884	-904.08048	3209.574	1496.6489	1632.7
12	43763	62.91473	794.03595	-875.84889	3415.9461	1592.8818	1632.7
13	43763	63.391215	793.5835	-847.6173	3622.4705	1689.1857	1632.7
14	43763	63.8677	793.1311	-819.38571	3828.8426	1785.4186	1632.7
15	43763	64.344185	792.67865	-791.15412	4035.367	1881.7225	1632.7
16	43763	64.820675	792.2262	-762.92253	4241.7391	1977.9554	1632.7
17	43763	65.26955	791.8	-736.31874	-3456.2603	-6058.9779	6830.7
18	43763	65.690815	791.4	-711.3582	-3435.259	-6022.1617	6830.7
19	43763	66.11208	791	-686.39766	-3414.2577	-5985.3455	6830.7
20	43763	66.533345	790.6	-661.43712	-3393.4286	-5948.8311	6830.7
21	43763	66.95461	790.2	-636.47658	-3372.4273	-5912.0149	6830.7
22	43763	67.40147	789.7757	-609.99588	5427.6771	2530.9674	1632.7
23	43763	67.87393	789.3271	-582.01484	5632.2779	2626.3743	1632.7
24	43763	68.34639	788.8785	-554.01845	5837.0322	2721.8528	1632.7
25	43763	68.81885	788.4299	-526.02206	6041.7865	2817.3313	1632.7
26	43763	69.29131	787.9813	-498.02567	6246.5407	2912.8098	1632.7
27	43763	69.76377	787.53265	-470.04463	6451.1415	3008.2167	1632.7
28	43763	70.25	787.07095	-441.22429	6205.5958	2893.7169	1632.7
29	43763	70.708335	786.63575	-414.07961	5539.3939	2583.0618	1632.7
30	43763	71.125	786.2401	-389.38312	4903.098	2286.3522	1632.7
31	43763	71.541665	785.8445	-364.70403	4266.6281	1989.5614	1632.7
32	43763	71.958335	785.44885	-340.00754	3630.3323	1692.8518	1632.7
33	43763	72.375	785.0532	-315.32845	2994.0365	1396.1421	1632.7
34	43763	72.791665	784.6576	-290.63195	2357.7406	1099.4325	1632.7
35	43763	73.1875	784.28175	-267.17311	1778.5306	829.34243	1632.7
36	43763	73.5625	783.92565	-244.95381	1256.5413	585.93483	1632.7
37	43763	73.96875	783.5399	-220.88359	661.45735	308.44263	1632.7
38	43763	74.40625	783.1245	-194.97627	-6.6936381	-3.1212947	1632.7
39	43763	74.84375	782.7091	-169.05236	-674.85027	-314.68785	1632.7
40	43763	75.28125	782.2937	-143.1268	-1343.0041	-626.25309	1632.7
41	43763	75.545275	782.043	-127.47994	-1740.0956	-811.41992	1632.7
42	43763	75.82923	782	-124.80034	994.67386	463.82404	400
43	43763	76.306595	782	-124.80034	842.10637	392.68065	400

44	43763	76.78396	782	-124.80034	689.55982	321.54703	400
45	43763	77.26132	782	-124.80034	536.99233	250.40363	400
46	43763	77.75	782	-124.8	374.9	174.81874	400
47	43763	78.25	782	-124.8	209.18	97.542236	400
48	43763	78.75	782	-124.8	49.376	23.024407	400
49	43763	79.25	782	-124.8	-110.422	-51.490624	400
50	43763	79.75	782	-124.8	-270.22	-126.00566	400

APPENDIX C

Slope Stability Calculations
For
Infinite Slope
(Surficial Stability)

Procedure for estimating the infinite slope factor of safety.

References: Campbell, R.H. (1975) "Soil Slips , Debris Flows, and Rainstorms in the Santa Monica Mountains and Vicinity, Southern California," USGS Professional Paper 851, pp. 19-20.

INPUT PARAMETERS:

$z := 4.0 \cdot ft$ Vertical depth of slip surface (ft)

$z_w := 4.0 \cdot ft$ Height of water table above slip surface (ft)

$\gamma := 125 \cdot pcf$ Soil unit weight (pcf)

$\gamma_w := 62.4 \cdot pcf$ Unit weight of water (pcf)

$\phi := 32 \cdot deg$ Soil friction angle (deg)

$c := 200 \cdot psf$ Soil cohesion (psf)

$\beta := 26.6 \cdot deg$ Slope surface inclination (deg)

RESULTS:

$$FS_{Campbell} := \frac{c + \left[\gamma - \left(\frac{z_w \cdot \gamma_w}{z}\right)\right] \cdot z \cdot \cos(\beta)^2 \cdot \tan(\phi)}{\gamma \cdot z \cdot \sin(\beta) \cdot \cos(\beta)} = 1.624$$